

East Anglia THREE
Offshore Windfarm

East Anglia THREE

In Principle Monitoring Plan (Track Changes)

Document Reference – Deadline 5/ Action Points/
8.12 In principle monitoring plan (Track Changes)

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1 Purpose of the In Principle Monitoring Plan

1. This In Principle Monitoring Plan (IPMP) has been produced following consultation with the MMO and other relevant Statutory Nature Conservation Bodies (SNCBs), and sets out the basis for delivering the monitoring measures as required by the conditions contained within the Deemed Marine Licences (DMLs).
2. The IPMP provides a framework for further discussions post consent with the MMO and the relevant authorities to agree the exact detail (timings, methodologies etc.) of the monitoring that is required. Due to the long lead in time for the development of offshore wind farms and the associated offshore developments it is not desirable to provide final detailed method statements prior to being granted consent. However agreeing guiding principles will allow refinements to be made based on the best available knowledge and technology. Final detailed plans for monitoring work will be produced closer to the time that the actual work will be undertaken, and as set out in the DMLs.
3. The relevant topics and/or receptor groups that will be discussed in this plan are as follows. This is cross referenced against the relevant conditions within the respective DMLs in *Appendix 1*:
 - Marine Geology, Oceanography and Physical Processes;
 - Offshore Ornithology;
 - Benthic Ecology;
 - Fish and Shellfish Ecology;
 - Marine Mammal Ecology;
 - Underwater Noise;
 - Commercial Fishing;
 - Shipping and Navigation; and
 - Offshore Archaeology and Cultural Heritage.

2 Description of project

4. The proposed East Anglia THREE project would consist of up to 172 wind turbines, with a maximum rated capacity of 12MW, with a total installed capacity of up to 1,200MW.
5. East Anglia THREE Limited (EATL) are currently considering both a High Voltage Direct Current (HVDC) and a Low Frequency Alternating Current (LFAC) electrical solution for the proposed East Anglia THREE project. A decision on the final electrical solution for the project will be made post-consent during the final design stage of the project. Unless specified the range of values presented in this document will therefore cover both the HVDC and the LFAC solution.
6. The East Anglia THREE offshore cable corridor would follow a similar offshore cable corridor to that proposed within the East Anglia ONE Development Consent Order (DCO). An additional section joins East Anglia THREE cable corridor with that of East Anglia ONE.
7. EATL is currently considering constructing the project in either a Single Phase or in a Two Phased approach ([offshore windfarm and onshore substation only](#)). [Offshore and Onshore export cable laying would be completed in a single activity](#). Under the Single Phased approach the project would be constructed in one single build period and under a Two Phased approach the project would be constructed in two phases each consisting of up to 600MW.
8. Under the Single Phase approach it is expected that the construction period for the proposed East Anglia THREE project (offshore and onshore) would span approximately 41 months. Under a Two Phased approach the proposed East Anglia THREE project would be built in a staggered way, with the construction of Phase 2 commencing a maximum of 18 months after the start of onshore construction of Phase 1. The total construction period would span 45 months.

2.1 Key Project Characteristics

9. Project key characteristics are displayed in Table 1.

Table 1 project Key characteristics

Parameter	Characteristic
Capacity	Up to 1,200MW
Number of wind turbines	Up to 172 units
East Anglia THREE area (offshore)	305km ²
Water depth	Generally <45m but up to 49m

Parameter	Characteristic
Distance from East Anglia THREE to shore (closest point of site to Lowestoft)	69km
Maximum offshore cable corridor length	166km
Maximum export cable corridor area	454km ²
Number of export cables	Up to four
Maximum interconnector cable corridor area	238km ²
Offshore cable corridor (taking account of overlap between the interconnector cable corridor and the export cable corridor).	571km ²
Number of interconnector cables	Up to four
Proposed turbine capacity	7 - 12MW
Turbine rotor diameter	154 – 220m
Hub height	99 - 150m (MSL)
Tip height	178 - 247m (LAT)
Minimum clearance above sea level	22m (MHWS)
Indicative minimum separation between turbines	In row spacing 675m
	Inter-row spacing 900m
Number of wind turbine models	Up to three
Wind turbine foundation type options	Jackets (on piles or on caissons), gravity base structures, suction caissons, monopiles
Number of met masts	Up to two
Height of met masts (maximum)	160m (LAT)
Met mast foundation type options	Jacket (on piles or on caissons), gravity base, suction caisson or monopile
Offshore electrical platforms	Up to two HVDC converter stations and four* HVAC collector stations
Accommodation platform	One
Offshore platform foundation type options	Jacket and gravity base
Buoys	Up to 12 which could include LiDAR, wave monitoring or guard.
*Under a Single Phase approach a maximum of three collector stations would be required	

3 General guiding principles for the proposed monitoring

10. Throughout the Environmental Statement (ES) and supporting documentation the Applicant has taken steps to avoid or reduce significant impacts either through the iterative process of project design ('embedded mitigation' e.g. the location of project boundaries) or by 'additional' mitigation measures which will be applied during the construction, operation or decommissioning phases of the Project.
11. The guiding principles for such monitoring and which apply in general to the in principle monitoring outlined in this document are as follows:
 - a. All consent conditions, which would include those for monitoring, should be "necessary, relevant to planning, relevant to the permitted development, enforceable, precise and reasonable in all other respects" as set out in Paragraph 206 of the National Planning Policy Framework and referred to as the 'six tests' (Department for Communities and Local Government 2014).
 - b. In line with good practice, monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified (e.g. Cefas 2012, Glasson et al. 2011, OSPAR 2008). As such, monitoring proposals should have an identified end date and confirmed outputs, which provide statistically robust data sets, as applicable to the hypothesis being tested.
 - c. Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to the project and can be realistically filled, as well as those species or features considered to be the most sensitive to the project impacts including those of conservation, ecological and/or economic importance. The presence of a significant impact should not, on its own, necessarily lead to the requirement for monitoring.
 - d. Proposals for monitoring should be based, where relevant, on the best practice and outcomes of the latest review of environmental data associated with post-consent monitoring of licence conditions of offshore wind farms (MMO 2014).
 - e. The scope and design of all monitoring work should be finalised and agreed following review of the results of any preceding survey and/or monitoring work (i.e. an adaptive approach), including those surveys conducted in support of the environmental impact assessment. This

includes the potential for survey requirements to be adapted based on the results of the monitoring outlined in this document. Where it has been agreed that there are no significant impacts, monitoring need not be conditioned through the DMLs.

4 East Anglia THREE residual impacts

12. The Environmental Impact Assessment (EIA) predicts the residual impact to a species or features taking into account:
 - Linkages using the source > pathway > receptor model;
 - Embedded / Additional Mitigation;
 - Sensitivity to the effect;
 - Magnitude of the effect; and
 - Ecological / economic importance.
13. The significance of the residual impact should not in its own right necessarily lead to the requirement for monitoring. Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to the project and can be realistically filled.
14. For each receptor the residual impacts and major areas of uncertainty as predicted within the East Anglia THREE ES are detailed. Only where moderate or major adverse impacts are predicted or significant uncertainty remains in the assessment has monitoring been deemed necessary and required as part of the DML.

5 In principle proposals for monitoring

15. The following sections set out the in principle proposals for monitoring in relation to those topics and/or receptor groups with Appendix 1 cross referenced against the relevant conditions within the respective DMLs with the relevant topics and/or receptor groups that will be discussed in this plan are as follows.
16. While accepting that this IPMP represents the best approach to monitoring available at the time of writing, it is recognised that the outcomes of the survey work discussed could influence future monitoring requirements, methodologies, focus and effort for the Project, as knowledge and understanding develops. For example where appropriate, and in consultation with the MMO and its advisors, these scopes may be refined to consider other relevant studies carried out by neighbouring projects such as East Anglia ONE. This is a key principle for an adaptive approach to monitoring and will be the subject of ongoing consultation between the Applicant, the MMO and its advisors. It is recognised that the MMO has the ability to vary the DML conditions in this regard.
17. This document has been submitted and will be used as a basis for further discussions post consent.

5.1 Engineering and design related monitoring

18. In addition to the environmental survey and monitoring required as conditions of the DMLs within the DCO, additional studies will be undertaken for engineering and design purposes. Some of these will overlap with the conditioned monitoring and wherever possible the Applicant will look to combine surveys for monitoring purposes with those already being carried out for engineering purposes. These are:
 - Geophysical;
 - Geotechnical;
 - pre-lay grapnel;
 - UXO survey and clearance;
 - ROV survey; and
 - Cable burial survey.

19. Other relevant Plans required under the DML with commitments to monitoring (linked to those listed above) are:

- A scour protection management and cable ~~armouring-protection~~ plan (monitoring of scour and protection measures);
- A cable specification and installation plan (cable burial monitoring); and
- An offshore operations and maintenance plan.

5.2 Marine Geology Oceanography and Physical Processes

5.2.1 Conclusions of the Environmental Statement

20. No residual impacts greater than minor were predicted within the ES. The Applicant would wish to survey areas using appropriate high resolution bathymetric and side-scan surveys of the area(s) within the Order limits for engineering purposes. This information would also help inform the interpretation of the benthic monitoring campaign (see section [5.55.4](#)).

5.2.2 In-principle Monitoring

21. ~~Table~~ [the following table 2](#) provides information on the monitoring requirements for marine physical processes. The proposed monitoring will be discussed and agreed with Natural England and the MMO.

Table 2 In principle monitoring proposed – marine geological and physical processes

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Changes in seabed topography, including scour processes	Physical environment and lined receptor groups e.g. marine ecology	Pre-construction	<ul style="list-style-type: none"> Engineering and design purposes Input in to benthic and other related ecological surveys and monitoring requirements as agreed with the MMO and SNCBs 	A single survey within the agreed array and cable corridor survey areas using full sea floor coverage swath-bathymetric and side-scan surveys of the area(s) within the Order limits in which it is proposed to carry out construction works, including a 500m buffer area around the site of each works. (The “site of each works” being the area within the order limits which is actually taken forwards to construction noting that it is possible that certain areas within the order limits may not be developed.)	Scope of surveys and programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works.
		Post-construction	<ul style="list-style-type: none"> Structural integrity / engineering (scour) 	A single survey within the agreed array and cable corridor survey areas using full sea floor coverage swath-bathymetric surveys undertaken to IHO Order 1A standard and side scan sonar surveys around appropriate samples of adjacent infrastructure to assess any changes in seabed topography. For this purpose the undertaker will, prior to the first such survey, submit a desk based assessment (which takes account of all factors which influence scour) to identify the sample of adjacent turbines with greatest potential for scour. The survey will be used to validate the desk based assessment: further surveys may be required if there are significant differences between the modelled scour and recorded scour. The quantity of turbines subject to monitoring will be confirmed following the completion of detailed design studies and in consultation with the MMO and relevant SNCBs.	

5.3 Marine Water and Sediment quality

5.3.1 Conclusions of the Environmental Statement

22. The ES concluded that provided embedded mitigation measures are implemented impacts on marine water and sediment quality would be of negligible impact. As stated in the ES chapter elevated levels of Arsenic (exceeding Cefas Action level 2) were recorded in one sample point (site 30) located within the offshore cable corridor. EATL committed to the following as part of the DCO application:
23. “If dredging of the sea bed for cable installation was required in the vicinity of site 30 (Figure 8.1) EATL would make use of any opportunity to further analyse the levels of arsenic within that area.”
24. During post application consultation with the MMO and Natural England this mitigation measure has been developed further.

5.3.2 In-principle Monitoring

25. Table 3 provides information on the monitoring requirements for marine water and sediment quality. The final proposed monitoring has been discussed and will be agreed with Natural England and the MMO post consent.

Table 3 In principle monitoring proposed – marine water and sediment quality

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details				
Change in Water Quality due to Re-suspension of Contaminants within Sediment.	Marine water and sediment quality	Construction	Elevated levels of Arsenic at site 30	EATL propose to collect and analyse further sediment samples should works be required within 250m of site 30.	<p>Condition 1 has been added to Schedule 12 and 13 of the DCO (Transmission DMLs):</p> <p><i>“No licensed activities may take place within the restricted area until the MMO has confirmed in writing that it is satisfied with the results of a sediment sample survey or that sufficient mitigation has been secured in the approved method statement required to be submitted under condition 13(1)(g), to prevent impacts from contaminated sediment.”</i></p> <p><i>“restricted area” means the area hatched black on the works plan being 250 metres from site 30;</i></p> <p><i>“site 30” means site 30 shown on the works plan (offshore) which has the following grid coordinates:</i></p> <table border="1"> <thead> <tr> <th><i>Latitude (DMS)</i></th> <th><i>Longitude (DMS)</i></th> </tr> </thead> <tbody> <tr> <td>52° 27' 32.889" N</td> <td>02° 36' 9.019" E</td> </tr> </tbody> </table> <p><i>“sediment sample survey” means a survey to be carried out in the event that works are proposed in the restricted area which:</i></p> <p><i>___ (i) samples sediment for arsenic contamination in the area of those works; and</i></p> <p><i>___ (ii) must be carried out in accordance with details which have first been approved by the MMO;</i></p> <p>The Applicant will update the IPMP so that the final monitoring plan can include a monitoring method for recording elevated levels of arsenic if required.</p>	<i>Latitude (DMS)</i>	<i>Longitude (DMS)</i>	52° 27' 32.889" N	02° 36' 9.019" E
<i>Latitude (DMS)</i>	<i>Longitude (DMS)</i>								
52° 27' 32.889" N	02° 36' 9.019" E								

5.35.4 Marine and Coastal Ornithology

5.3.15.4.1 Conclusions of the Environmental Statement

~~22-26.~~ The impacts that could potentially arise during the construction, operation and decommissioning of the proposed East Anglia THREE project have been discussed with Natural England and the RSPB as part of the Evidence Plan process (EATL Environmental Statement Chapter 13).

~~23-27.~~ During the construction phase of the proposed project no impacts have been assessed to be greater than of minor adverse significance for any bird species. Similarly, no species is subject to an impact of greater than minor adverse significance from the potential effects of the proposed project during the 25 year operational lifetime.

~~24-28.~~ Displacement effects during operation from the project alone on red-throated divers, gannets, guillemots, razorbills and puffins would not create impacts of more than minor adverse significance during any biological season.

~~25-29.~~ The risk to birds from collisions with wind turbines from the proposed East Anglia THREE project alone is assessed as no greater than minor adverse significance for all species when considered for all biological seasons against the most appropriate population scale.

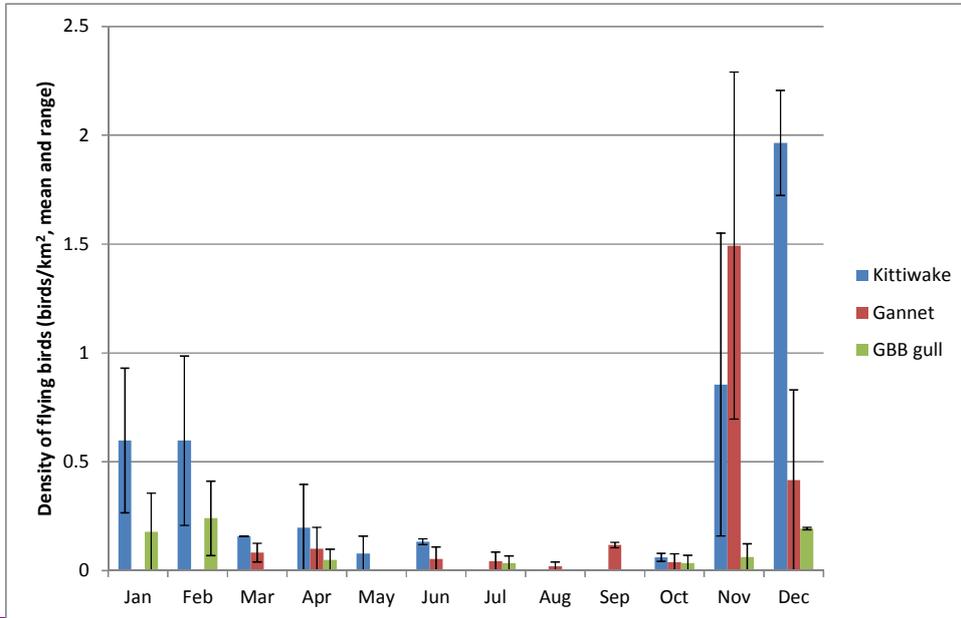
30. On the basis of this assessment, it is therefore reasonable to focus monitoring efforts on the operational period when there is the potential for impacts to contribute to cumulative collision and displacement impacts.

31. It is EATL's position that the development of ornithological monitoring proposals should be driven by a requirement to monitor predicted impacts and/or address evidence gaps or uncertainty present in the assessment which are of most relevance to the project. In terms of predicted impact magnitude and significance the potential monitoring targets for consideration are gannet, kittiwake and great black-backed gull (for cumulative collision risk) and guillemot and razorbill (for cumulative displacement risk).

32. Offshore wind farm monitoring studies should be designed to address specific questions and not simply to replicate baseline surveys. They should also be developed with an awareness of the inherent variability of marine environments. This means that traditional Before-After style comparisons are unlikely to yield meaningful results due to the presence of large amounts of noise in the data. Much of the early offshore wind farm monitoring undertaken failed to take this into account, with the result that the monitoring could be considered data-rich, information-poor (DRIPy; Bennet et al. 2016). Bennet et al. (2016) present strong arguments in favour of applying an adaptive management approach to monitoring studies. A key objective of this approach is to reduce the uncertainties inherent in impact assessments, to the benefit of both current and existing developments. Thus proposed monitoring studies should be subject to rigorous review to ensure they are sufficiently robust to achieve their objectives. An

example for how this can be done is to undertake power analysis, simulating the expected survey data to see if it would generate statistically robust outputs.

33. With this type of informed approach to monitoring in mind, this document does not seek to propose specific monitoring projects which could be undertaken for the East Anglia THREE wind farm, but rather to highlight areas of current uncertainty in offshore wind farm impact assessment which should be the focus of discussions on monitoring and to provide background to the options for their study. However, it is important to remember that there is ongoing work in this field and that this document reflects current priorities. These may be superseded by the time that monitoring plans for East Anglia THREE are being developed.
34. The species of greatest concern for collision risk were gannet, kittiwake and great black-backed gull. It is clear from a review of the survey data (Figure 1) that the peak abundance of these species occurred outside the breeding season, with marked migratory movements in the autumn.
35. This temporal pattern, combined with the wind farm's location in the southern North Sea, indicates that the birds recorded in the wind farm pass through the area on migration and are drawn from breeding colonies distributed across a large area to the north. The challenge for assessing impacts is to be able to attribute the birds to their breeding colonies, in order that population level effects can be estimated and assigned appropriately. The difficulty in colony attribution represents one of the areas of uncertainty in the impact assessment. Although there is uncertainty in other parameters used in the collision risk modelling (e.g. flight heights, avoidance rates, flight speeds), it could be argued that in fact at least some of the uncertainty represents natural variations (i.e. these are inherently imprecise values) and that these aspects are not the key areas of the assessment which need refinement.
36. Surveys conducted at the site (e.g. by boat or aerial methods) cannot provide information on population linkage as it is not possible to determine colony origins visually.
37. One option which could be used to improve understanding of bird movements and hence colony linkages, is to attach GPS tags to birds and record migration routes. Given the wide distribution of colonies with potential connectivity to the wind farm this would likely require a large scale programme of tag attachments, with considerable cost and logistical implications. There are also technical considerations, in terms of the types of tags available, their size, weight and attachment methods. Most seabird tag studies use short-term deployments (days or weeks), with tags attached to tail feathers and birds re-caught at their nests. Such approaches are largely unsuitable for use outside the breeding season.



26. ~~Potential plans and projects have been considered for how they might act cumulatively with the proposed project and a screening process carried out. The cumulative assessment identified that most impacts would be temporary, small scale and localised. Given the distances to other activities in the region (e.g. other offshore windfarms and aggregate extraction) and the highly localised nature of the impacts the assessment concluded that there is no pathway for interaction between most impacts cumulatively.~~
27. ~~The risk to birds from cumulative collisions with wind turbines across all windfarms considered is assessed as no greater than minor adverse significance for all species with the exception of kittiwake, for which a minor to moderate adverse significant impact is predicted. Therefore it is reasonable to focus the monitoring period during the operational period when there is a pathway to the risk (collision with turbines).~~
28. ~~It is EATL position that any ornithological monitoring proposal should be targeted to address impacts, evidence gaps or uncertainty of most relevance to the project. As the highest predicted ornithological impact is the cumulative collision mortality of kittiwake, during operation, it is reasonable to consider it only necessary that monitoring should focus on substantiating this assessment.~~
29. ~~Any monitoring proposal should be enforceable, precise and reasonable and the text below outlines a monitoring plan that meets these objectives.~~

30. Kittiwakes were observed in 22 of the 24 months baseline surveys were commissioned. However a review of the data highlights a key period between November and February when a higher, and more variable, abundance of kittiwake were observed (Figure 1). It is therefore appropriate and reasonable to focus kittiwake monitoring on these key months as a) it is the most relevant biological period b) the period when project alone has the greatest predicted impact and therefore the greatest contribution to the in-combination assessment and c) most practicable period to gather a robust data.

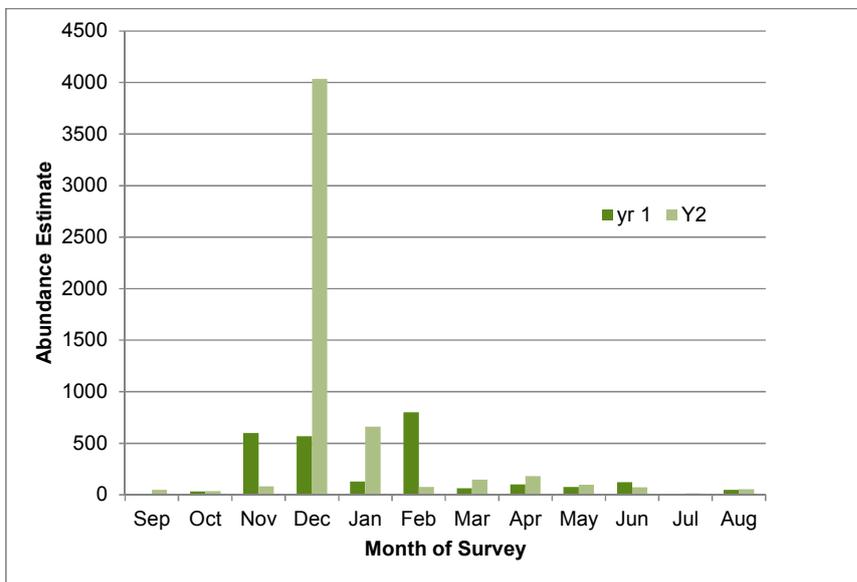
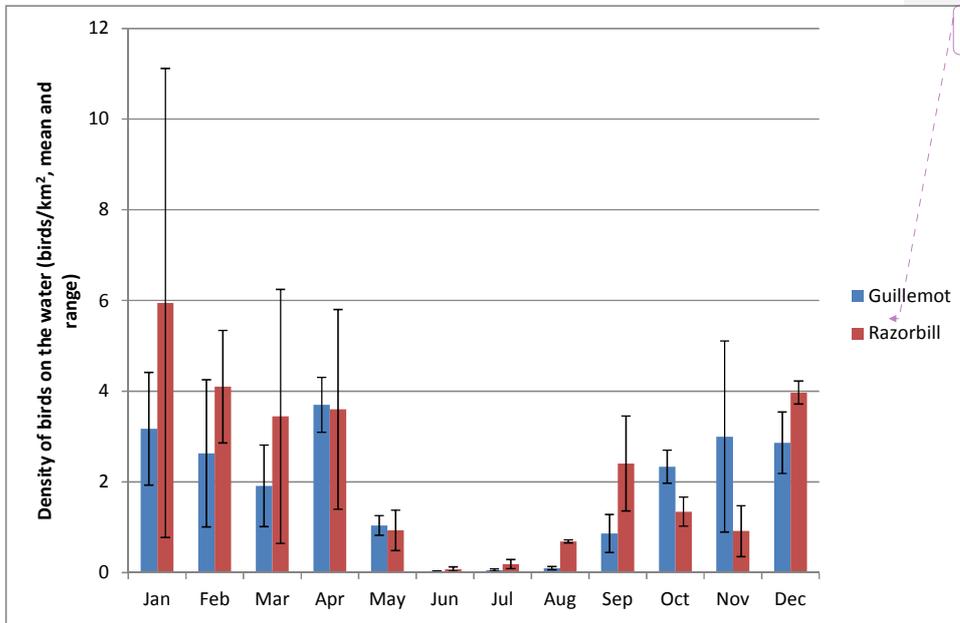


Figure 1: Gannet, kittiwake and great black-backed gull densities of birds in flight from aerial survey data within the East Anglia THREE Site only. The columns provide the average values across the two years of survey and the error bars indicate the upper and lower individual values.

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Figure 1: Kittiwake monthly abundance estimates (estimates including positively identified and proportioned out individuals are in bold) aerial survey data within the East Anglia THREE Site only

38. Therefore, the key uncertainty for collision risk relates to the identification of the breeding populations of birds present in the nonbreeding season.
39. The species of greatest concern for displacement risk were guillemot and razorbill. It is clear from a review of the survey data (Figure 2) that the peak abundance of these species occurred outside the breeding season.



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Figure 2: Guillemot and razorbill densities of birds on the water from aerial survey data within the East Anglia THREE Site and 2km buffer. The columns provide the average values across the two years of survey and the error bars indicate the upper and lower individual values.

40. Displacement impacts are estimated by combining the percentage of birds expected to be displaced (e.g. between 30% and 70% of the on-site population) and the percentage of those displaced birds expected to die as a consequence (e.g. between 1% and 10%). As can be seen by the wide range for each of these parameters, there is considerable uncertainty in the assessment of displacement impacts.
41. Of the two key displacement parameters (percentage displaced and percentage mortality), the first has been estimated from monitoring conducted elsewhere. However, if it is assumed that displacement occurs as a response to the wind turbines, there is an argument that the magnitude will reflect their characteristics, for example the turbine dimensions and inter-turbine spacing. Existing studies have been conducted in wind farms with comparatively small turbines which do not need to be spaced as far apart as the larger models on which current wind farms are based. Consequently, displacement responses may not be constant, but vary depending on the wind farm. This suggests that further study of auk locations in relation to operational wind turbines at sites with varying designs would enable this assumption to be tested (of variable responses dependent on wind farm design). This could be studies using aerial surveys of operational sites and analysis of bird locations in relation to turbines.

42. The second parameter, the consequence of displacement, is much harder to estimate. Modelling work has generated mortality estimates using energetic costs to adults in the breeding season; however nothing similar has been attempted for the nonbreeding season.
43. In addition, the timing of auk presence indicates that, as with the collision risk species, birds at risk of displacement are predominantly present outside the breeding season. Thus the same colony attribution challenge applies to these species.
44. Consequently the key uncertainties with regards displacement relate to estimating the parameters used to estimate impact magnitude and identifying the breeding populations of birds present in the nonbreeding season.
31. ~~Kittiwake collisions modelling predictions vary throughout the year at the East Anglia THREE site with an annual total of between 147 (Option 1) and 170 (Option 2) birds. On the basis of the values presented above and in Chapter 13 Table 13.46 the cumulative kittiwake annual mortality is 4,041, of which the proposed East Anglia THREE project contributes 3.6% and 4.2% of this total.~~
32. ~~The cumulative estimate is based on a worst case scenario and includes the application of precaution at many stages of the assessment. However the contribution of the East Anglia THREE project is very small and there is some uncertainty around the magnitude and significance of the EATL contribution to the collision mortality prediction.~~
33. ~~There is continued scrutiny of collision risk modelling methods, with the most significant recent update following a review of avoidance rates conducted by the BTO on behalf of Marine Scotland (Cook et al. 2014). This review led to recommend increases in the avoidance rates for use with Option 1 or 2 for kittiwake from 98% to 98.9% however no recommendations were agreed for Option 3 avoidance rates for this species. The appropriate avoidance rate is the key parameter in the collision modelling. Therefore it is EATL position that a monitoring study developed to substantiate the macro and meso-avoidance rates of kittiwake used in the Environmental Statement is a reasonable and proportionate proposal to the predicted risk.~~

5.3.25.4.2 In-principle Monitoring

45. In line with good practice, monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified or there are large uncertainties in the methods used.
34. Monitoring should seek to address both project specific aspects and also to address wider evidence gaps or uncertainties. However, irrespective of which of these is the primary motivation, it is also critical that the objectives are realistic and that consideration is given to the likelihood of obtaining robust outputs. Table 4 summarises the above discussions in relation to marine ornithology.In line with good practice,

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~~monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified. Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to the project and can be realistically filled, as well as those species or features considered to be the most sensitive to the project impacts including those of conservation, ecological and/or economic importance. Table 4 provides information on the monitoring requirements for marine and coastal ornithology.~~

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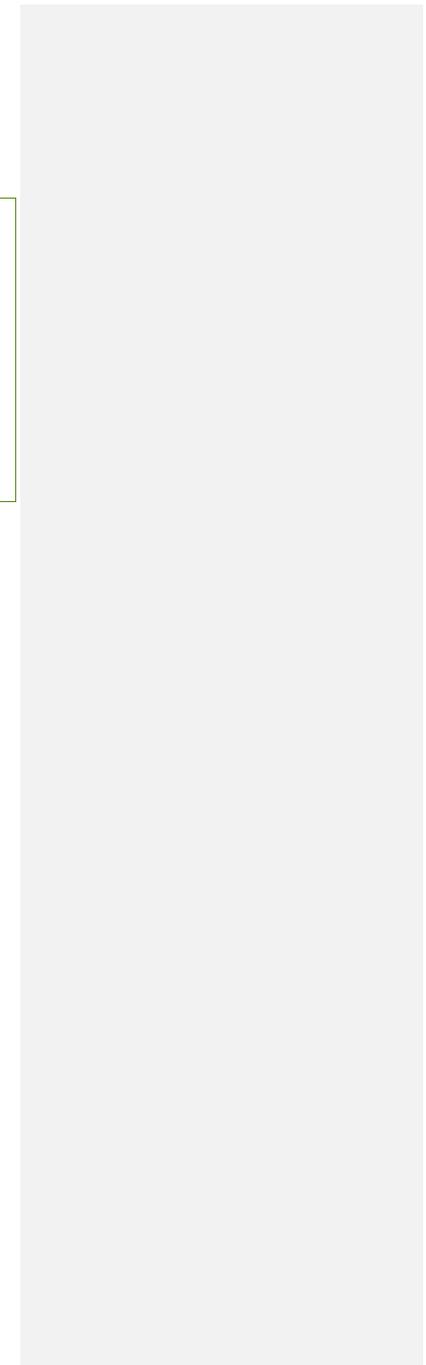
Table 43 In principle monitoring proposed – marine and coastal ornithology

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Behavioural response to operational wind-farm	Primary: Kittiwake Secondary: Gannet	Post-construction	<p>The proposed monitoring would aim to substantiate, within reason, macro (and where possible meso) industry standard avoidance rates used in the East Anglia THREE environmental statement</p> <p>The proposed surveys are appropriate as they are:</p> <ul style="list-style-type: none"> • Relevant to the permitted development as focused on the area(s) within the Order limits in which construction works were carried out where the impacts are predicted • Focused on key ornithological interests of relevance to the authorised scheme. • Enforceable and precise to facilitate timely and efficient discharge of the condition • Reasonable in all other respects. 	EATL propose to commission monthly surveys during the key biologically defined periods for kittiwake (November to February inclusive) in the first, second and third year after the project has been commissioned.	Each survey of the project area would involve a flights starting at least 10km away from the site boundary. It is estimated that a sample size of 100 observations would be sufficient per survey. The exact survey effort would be agreed with Natural England prior to the surveys being commissioned using baseline data collected as part of the Environmental Statement. Seabird counts would be modelled using distance to the nearest turbine as the main explanatory variable and

					include flight altitude for kittiwake and gannet to estimate macro (and where possible meso) avoidance rates.
Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Example projects
Collision risk	<u>Gannet, kittiwake and great black-backed gull</u>	<u>Operation</u>	<u>Uncertainty in impact assessment methods:</u> <ul style="list-style-type: none"> <u>Collision modelling parameters; and,</u> <u>Population attribution in nonbreeding season.</u> 	<u>Deployment of tags at breeding colonies with potential connectivity to the wind farm. Dependent on availability of suitable tags for long term (e.g. 12 months) deployment.</u>	<u>Example study would be attachment of geolocator tags (low spatial resolution but lightweight) on breeding great black-backed gull at breeding colonies in Norway, Russia and northern Scotland. This would permit identification of origins of birds in southern North Sea in winter.</u>
Displacement	<u>Guillemot and Razorbill</u>	<u>Operation</u>	<u>Uncertainty in impact assessment methods for nonbreeding season effects:</u> <ul style="list-style-type: none"> <u>Percentage displaced;</u> <u>Percentage mortality; and,</u> <u>Population attribution in nonbreeding season.</u> 	<u>Percentage displaced could be estimated from aerial surveys of the wind farm and buffer to record bird locations with</u>	<u>Nonbreeding season digital aerial surveys.</u> <u>Geolocator study (details as described above)</u>

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				<u>respect to turbine locations. Analysis based on methods which do not require before-after comparisons but consider how observed distributions compare with randomised ones.</u>	<u>for guillemot and/or razorbill.</u>
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5.45.5 Benthic Ecology

5.4.15.5.1 Conclusions of the Environmental Statement

~~35.47.~~ No impact was greater than minor adverse for the project alone or cumulatively. The project has no direct impact on any designated site and therefore no Annex 1 habitat features will be impacted.

5.4.25.5.2 In-principle Monitoring

~~36.48.~~ The following table provides information on the monitoring requirements for marine physical processes. The proposed monitoring has been discussed and agreed with Natural England and the MMO. Where it is possible synergies with monitoring commitments made in section 5.2 would be explored in interpreting geophysical data.

~~37.49.~~ No Annex 1 surveys are proposed. In line with NE advice, consideration has been given to habitats/species "of principal importance pursuant to section 41 of the NERC Act 2006". The specific habitats of relevance identified within the project area are the focus for monitoring outlined within *Table 45* below. These shall be referred to specifically as surveys for the main feature of concern: *Sabellaria spinulosa* reef. Initial geophysical surveys will be reviewed with drop down surveys to confirm presence as appropriate. This shall then be used to inform detailed layout design in the construction method statement and this will constitute the outline mitigation scheme requirements pursuant to sub-paragraph 13(i) of the DML.

Table 45 In principle monitoring proposed –Benthic Ecology

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Effects on Sabellaria spinulosa reef	<i>Sabellaria spinulosa</i>	Pre-construction	Determine the location and extent of any <i>S. spinulosa</i> reef within areas of the Order limits in which it is proposed to carry out construction works to inform the appropriate mitigation if found	<ul style="list-style-type: none"> A single survey geophysical (sidescan or Multi-Beam Echo Sounder) survey of those areas within which it is proposed that seabed works will be carried out at a resolution sufficient to identify potential <i>S. spinulosa</i> reef; and In areas where potential <i>S. spinulosa</i> reef is identified from the review of the geophysical data, drop down video and/or stills will be deployed to confirm presence, extent and elevation. Where underwater visibility prevents the use of drop down video, grab sampling using a Hamon grab may be employed as an alternative. 	<ul style="list-style-type: none"> Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works. Surveys may occur up to 18 months prior to the proposed construction works
		Post-construction	The requirement for post-construction monitoring will be dependent on the findings of the pre-construction surveys.	<ul style="list-style-type: none"> Where no <i>S. spinulosa</i> reef is identified by the pre-construction survey of the proposed works (and associated buffers), no post-construction surveys will be undertaken; Where <i>S. spinulosa</i> reef is identified during the baseline survey, a single post-construction survey, specifically targeting those reefs identified in the baseline survey will be undertaken as a check on their condition using the same methodology set out for pre-construction monitoring. 	<ul style="list-style-type: none"> If required, survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works and conducted within the first year post commissioning of the proposed wind farm. If significant impacts are observed the potential requirement for further surveys will be agreed with the MMO following review of the post-construction survey

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5.55.6 Fish Ecology

5.5.15.6.1 Conclusions of the Environmental Statements

~~38-50~~. Alone and cumulatively no moderate or major residual impacts are predicted for the proposed East Anglia THREE project.

5.5.25.6.2 In-principle Monitoring

~~39-51~~. In line with good practice, monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental impacts have been identified. Monitoring should be targeted to address significant evidence gaps or uncertainty, which are relevant to the project and can be realistically filled, as well as those species or features considered to be the most sensitive to the project impacts including those of conservation, ecological and/or economic importance.

~~40-52~~. In this instance it is agreed that no further monitoring or independent surveys are required.

5.65.7 Marine Mammals

5.6.15.7.1 Conclusions of the Environmental Statements

~~41-53~~. At a project level the impacts from the proposed East Anglia THREE project are assessed as minor adverse at worst for underwater noise from piling with the potential for auditory injury (PTS) in grey and harbour seal and the potential for possible avoidance of harbour porpoise. All the other potential impacts were determined to be negligible or no impact for construction, operations and decommissioning. No significant impacts were identified. The conclusions of the assessment are based on varying levels of confidence in the data used in the assessment. However the conclusions of the assessment are of a precautionary nature where there is high uncertainty or low confidence in the data.

~~42-54~~. Significant (moderate adverse) impacts are predicted from the cumulative impact of underwater noise from piling and the possible avoidance of harbour porpoise, based on worst-case scenarios. All other potential cumulative impacts were determined to be minor adverse (not significant) or negligible. However, it should be noted that the contribution of the proposed East Anglia THREE project to this cumulative assessment is very small with a worst-case of up to 1.3% of the reference population (North Sea Management Unit) assessed as being potentially disturbed during piling operations.

5.6.25.7.2 In-principle Monitoring

~~43-55~~. Given the small contribution that the proposed East Anglia THREE project has to impacts on marine mammals it is not clear what purpose or contribution any site based monitoring would have in providing answers to specific questions where significant environmental impacts have been identified. As recognised in the recent Marine Management Organisation report (MMO 2014) monitoring should be targeted to address significant risk, evidence gaps or uncertainty, which are relevant to the project

and can be realistically filled, as well as those species or features considered to be the most sensitive to the project impacts including those of conservation, ecological and/or economic importance.

44-56. The monitoring proposal outlined will collect further data on the habitat use of the East Anglia THREE site by harbour porpoise prior to and throughout the construction stage by the deployment of passive acoustic monitoring. This would seek to address the objective of determining their use of the site in the pre-construction phase, and monitoring the effects of construction and one year post construction to establish a basis for evaluating the monitoring results. It is recognised that there may be external variables that may account for changes in behaviours which shall be given due consideration.

45-57. East Anglia Offshore Wind are supportive of industry initiatives such as the Disturbance Effects on Harbour Porpoise of the North Sea (DEPONS) project and financially contributes to this project that will finish in 2017. It is recognised that the output from that project will be important to establish data gaps and future workstreams for focus on a better understanding of the impacts. EATL are supportive in principal of joint industry projects or alternative site based monitoring of existing marine mammal activity inside the area(s) within the Order limits in which it is proposed to carry out construction works as detailed below.

46-58. The outline monitoring could be fed into further modelling to support results as appropriate to better understand disturbance impacts particularly refining site contribution to cumulative impacts. In addition, at time of finalisation of the monitoring plan consideration may be given to any wider benefits from combined cluster surveys as appropriate within the wider Southern North Sea.

59. EATL will follow the relevant guidelines at the time in relation to a strategic approach to construction and monitoring in development of the Marine Mammal Mitigation Protocol (MMMP) to minimise the risk of injury or death to marine mammals. A draft proposal is presented which shall be finalised prior to construction with input from the contractor (see document 8.15).

Table 6 provides information on the monitoring requirements for Marine Mammals

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Table 56 In principle monitoring proposed – Marine Mammals

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Disturbance effects on harbour porpoise	Harbour porpoise	Pre-construction/ Construction	Validate, within reason, predictions in the Environmental Statement.	Appropriate surveys (i.e. such as those included within the Disturbance Effects on Harbour Porpoise of the North Sea (DEPONS) project). OR Deploy four measurement stations; three within and one outwith the site boundary. Each monitoring station will contain underwater hydrophones (see section 5.7) and marine mammal detection device (e.g c-pod or equivalent) and be installed during the pre-construction phase and operated throughout construction. Information on harbour porpoise activity and underwater noise levels recorded will be used to validate the values used in the analysis within the Environmental Statement.	The Applicant considers its contribution to the DEPONS project to provide the necessary monitoring measures for harbour porpoise. Where they are an alternative surveys are proposed programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works.
Disturbance effects on harbour porpoise	Harbour porpoise	Construction	Ensure best practice is followed to minimise risk of injury or death to Marine Mammals	The Applicant will follow the relevant guidelines at the time in relation to a strategic approach to construction and monitoring in development of the MMMP. The particulars of deployment shall be determined subsequent to appointment of the contractor in the pre-construction stage and consideration of best available techniques at that time.	The Applicant will submit and agree a draft MMMP as part of the ES submission A final MMMP will be submitted at least 6 months prior to construction.
Disturbance effects on harbour porpoise	Harbour porpoise	Post construction	Validate, within reason, the predictions made in the Environmental Statement and HRA with respect to disturbance	Appropriate surveys (i.e. such as those included within the Disturbance Effects on Harbour Porpoise of the North Sea (DEPONS) project	Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
			effects on harbour porpoise during construction	OR Continue monitoring through CPODS and hydrophones during the operational phase for one year. Information on harbour porpoise activity and underwater noise levels recorded will be used to validate the assessment within the Environmental Statement.	commencement of any survey works.

5.75.8 Underwater Noise

5.7.15.8.1 Conclusions of the Environmental Statements

47-60. There is considerable variability in the extent of the level of underwater noise resulting from piling within the East Anglia THREE site due to variable bathymetry, with the greatest ranges observed to the west (south-west to north-west) of the East Anglia THREE site. The noise levels present in the water will also depend on the depth of the receptor and hearing sensitive receptors near the surface will be exposed to lower noise levels with correspondingly smaller impact ranges. This study would be conducted in conjunction with marine mammal monitoring as detailed in section 5.6

5.7.25.8.2 In-principle Monitoring

48-61. Construction noise monitoring is proposed to validate the assumptions made within the ES

49-62. Noise measurements shall be made in line with Good Practice Guide (2014) – Deployment for noise measurement and full specifications should be provided in the final monitoring plan. Underwater data shall be recorded in a format that allows analysis using un-weighted metrics, such as peak sound pressure level, sound exposure level and peak to peak pressure level, and all conclusions and discussions should be made in relation to the un-weighted metrics. Construction noise monitoring should include measurements of noise generated by the installation of the first four piled foundations of each piled foundation type to be installed.

50-63. Ambient noise monitoring shall be undertaken prior to the commencement of construction through to post-construction in line with the stationary acoustic devices described in section 5.6.

51-64. In addition the requirements of the UK Marine Noise Register shall be adhered to (yet to be implemented but outlined in Information Document Version 1 out for consultation July 2015). This would cover geophysical survey activities as well as impact pile driving (see section 5.1).

Table 7 provides information on the monitoring requirements for Underwater noise.

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Table 67 In principle monitoring proposed – Underwater Noise

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Injury / disturbance to marine ecology	Marine Ecology	Construction	Reduce uncertainty in impact assessment	Compare the measured data, from the first four foundations, with predictions for received levels, source levels that were made in the original ES.	Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works. Information will also be gathered and processed in accordance with UK Noise Registry requirements if appropriate at the time of construction.

5.85.9 Commercial Fisheries

5.8.15.9.1 Conclusions of the Environmental Statement

~~52-65~~ The impacts on commercial fisheries during the construction, operation and decommissioning phases of the proposed East Anglia THREE project found that the only receptors which experience potentially sustained significant impacts are UK vessels operating static gear during the construction phase and in relation to installation of the offshore export cable.

5.8.25.9.2 In-principle Monitoring

~~53-66~~ For EA3 it is agreed that no further monitoring or independent surveys are required.

~~54-67~~ The deemed Marine Licence includes the requirement for a Fisheries Liaison and co-existence Plan.

~~55-68~~ In order to aid and maintain regular communication between East Anglia Offshore Wind Limited and local fishermen potentially affected by the projects in the East Anglia Zone, a Commercial Fisheries Working Group (CFWG) has been established with a representative from each local port which could potentially be impacted by the proposed East Anglia THREE project (Orford, Aldeburgh, Harwich, Felixstowe, Lowestoft and Southwold). The CFWG aims to identify and develop co-existence strategies during a project's lifecycle.

5.95.10 Shipping and Navigation

5.9.15.10.1 Conclusions of the Environmental Statement

~~56-69~~ The effects of the project have been assessed in Chapter 15 of the ES with impacts ranging from broadly tolerable to tolerable/as low as reasonably possible (ALARP).

5.9.25.10.2 In-principle Monitoring

~~57-70~~ *Table 78* provides information on the vessel traffic monitoring requirements for shipping and navigation.

Table 87 In principle monitoring proposed – Shipping and Navigation

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Effects on the levels of marine traffic across the project	Marine traffic	Construction	Validate the predictions made in the Environmental Statement and Navigational Risk Assessment with respect to potential effects on the levels of shipping traffic.	Construction monitoring shall include vessel traffic monitoring by Automatic Identification System (AIS), including the provision of reports on the results of that monitoring periodically as requested by the MCA.	Post-construction vessel traffic monitoring using AIS will be undertaken for a maximum of but not consecutively, 28 days, and will take account of seasonal variation of traffic patterns over a year. This will be done at a suitable time as agreed with the MMO and MCA following the commencement of commercial operation.
		Post-construction		Vessel traffic monitoring by Automatic Identification System, totalling a maximum of 28 days taking account of seasonal variations in traffic patterns over one year, following the commencement of commercial operation. A report will be submitted to the MMO and the MCA following the end of the monitoring.	

5.105.11 Offshore Archaeology and Cultural Heritage

5.10.15.11.1 Conclusions of the Environmental Statement

~~58-71.~~ The construction, operation and decommissioning phases of the proposed East Anglia THREE site and offshore cable corridor will result in a range of effects upon the marine archaeological and cultural heritage environment. For the project alone the effects that have been assessed are anticipated to be reduced to a minor residual significance or are considered to be negligible on the basis of embedded mitigation. Furthermore known archaeological receptors are not considered to be subject to significant cumulative impacts on the basis that they should be avoided due to appropriate mitigation (embedded and project).

5.10.25.11.2 In-principle Monitoring

~~72.~~ ~~The following table 9~~ provides information on the monitoring requirements for marine archaeological and cultural heritage. The principal mechanism for delivery of monitoring is through agreement on the Written Scheme of Investigation and has been discussed and agreed with Historic England and the MMO.

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Table 98 In principle monitoring proposed – Offshore Archaeology and Cultural Heritage

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
<p>All direct and indirect effects on the archaeological resource</p> <p>All direct and indirect effects on the archaeological resource</p>	All Archaeology receptors	Pre-construction	Validate the predictions made were reasonable in the Environmental Statement with respect to potential effects on the archaeological resource and to inform selection of appropriate mitigation.	<ul style="list-style-type: none"> An outline project specific WSI has been compiled which makes provision for all archaeological mitigation that might be required in the light of preconstruction investigations, including field investigation, post-fieldwork activities, archiving and dissemination of results. The WSI includes provision to update the document as the project design is refined and as the results of further archaeological assessment become available. Full sea floor coverage swath-bathymetric surveys undertaken to IHO Order 1A standard and side-scan surveys of the area(s) within the Order limits in which it is proposed to carry out construction works, including a 500m buffer area around the site of each works. This should include the identification of sites of historic or archaeological interest (A1 around the whole feature and A3 receptors 100m around centre point) and any unidentified anomalies larger than 5m in diameter (A2 receptors), which may require the refinement, removal or introduction of archaeological exclusion zones and to confirm project specific micro-siting requirements (for A2 receptors). 	EATL has submitted to the MMO for approval an outline WSI with the DCO application. This will be updated at least four months prior to the intended start of construction.

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
All direct and indirect effects on the archaeological resource	All Archaeology receptors	Construction	Validate the predictions made in the Environmental Statement, where reasonable, with respect to potential effects on the archaeological resource and to inform selection of appropriate mitigation (Historic England requirement)	Specific requirements relating to monitoring during post-construction (including a conservation programme for finds) as detailed in the written scheme of archaeological investigation (WSI). Notably the ORPAD shall be followed during all intrusive works.	EATL has submitted to the MMO for approval an outline WSI with the DCO application. This will be updated at least four months prior to the intended start of construction.

6 Strategic Monitoring

59-73. EATOL are supportive of appropriate strategic monitoring studies. Where the project is made aware of new strategic monitoring studies, and they are aligned with EATOL's business goals, EATOL will discuss with the relevant authorities if they are appropriate to discharging their specific East Anglia THREEEA3 DML conditions.

60-74. Key current strategic groups that the project parent companies are engaging in to support the growing evidence base are:

- ORJIP: The Offshore Renewables Joint Industry Programme (ORJIP) is a joint industry project involving the Carbon Trust, the Department of Energy and Climate Change, Marine Scotland, The Crown Estate and offshore wind developers.
- DEPONS: The project will lead to fundamental new insights into harbour porpoise responses to underwater piling noise, as well as their small and large-scale general movement patterns. This information will be fed into a model, which will provide an evidence based framework for the assessment of wind farm underwater noise impacts.
<http://www.depons.au.dk>

64-75. EATL are aware of the MMO and NE's encouragement for industry to engage in strategic studies for key ecological receptors to improve the robustness of impact monitoring particularly for mobile species and habitats. Appropriate studies may be considered for relevance to the proposed East Anglia THREE project as and when a suitable framework for regional type studies develops.

7 References

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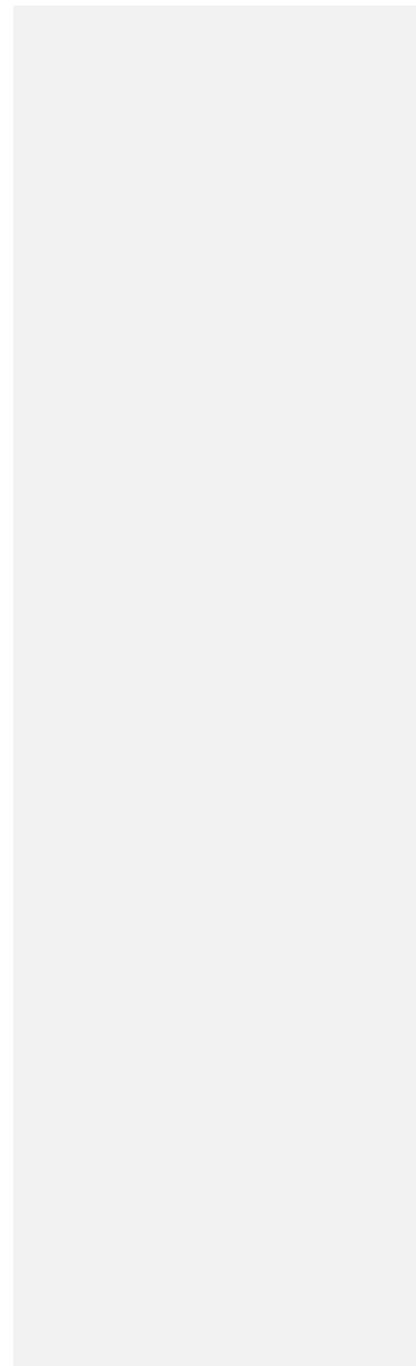
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Appendix 1: Relevant DML conditions

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Subject	Relevant DML Condition					
	Schedule 10. GENERATION (LICENCE 1 – PHASE 1)	Schedule 11. GENERATION (LICENCE 2 – PHASE 2)	Schedule 12. TRANSMISSION (LICENCE 1 – PHASE 1)	Schedule 13. TRANSMISSION (LICENCE 2 – PHASE 2)	Schedule 14. INTERCONNECTION (LICENCE 1 – PHASE 1)	Schedule 15. INTERCONNECTION (LICENCE 2 – PHASE 2)
Contaminated sediment			Condition 1 (Schedules 12 & 13)			
Bathymetric (Pre-construction)	Condition 17(2)(b)					
Bathymetric (Post-construction)	Condition 19(2)(b)					
Marine and coastal ornithology (Pre- construction)	Condition 17(2)(c)		Not applicable			
Marine and coastal ornithology (Post- construction)	Condition 19(2)(c)		Not applicable			
Benthic (Pre- construction)	Condition 17(2)(a) and 13 (i)					
Benthic (Post- construction)	Condition 19(2)(a)					
Fish	Not required					
Marine mammals/ MMMP (Pre-construction)	Condition 17(2)(d)		Condition 17(2)(d)		Not applicable	
Marine mammals/ MMMP (Construction)	Condition 13(f)		Condition 13(f)		Not applicable	
Marine mammals/ MMMP (Post-construction)	Condition 19(2)(d)		Condition 19(2)(d)		Not applicable	
Underwater noise	Condition 18(1) to 18(3)		Condition 18(1) to 18(3)		Not applicable	
Commercial fisheries	Not applicable (but note 13(d)(v))					

Subject	Relevant DML Condition					
	Schedule 10. GENERATION (LICENCE 1 – PHASE 1)	Schedule 11. GENERATION (LICENCE 2 – PHASE 2)	Schedule 12. TRANSMISSION (LICENCE 1 – PHASE 1)	Schedule 13. TRANSMISSION (LICENCE 2 – PHASE 2)	Schedule 14. INTERCONNECTION (LICENCE 1 – PHASE 1)	Schedule 15. INTERCONNECTION (LICENCE 2 – PHASE 2)
Shipping and navigation (Construction)	Condition 18(4)		Not applicable		Not applicable	
Shipping and navigation (Post-construction)	Condition 19(2)(e)		Not applicable		Not applicable	
Archaeology and cultural heritage (Construction) and (Post-construction)	Condition 13(h)(v)					



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