Norfolk Boreas Offshore Wind Farm

Addendum to REP11-012

In principle Habitats Regulations Derogation Provision of Evidence Appendix 1 Flamborough and Filey Coast Special Protection Area (kittiwake) In Principle compensation

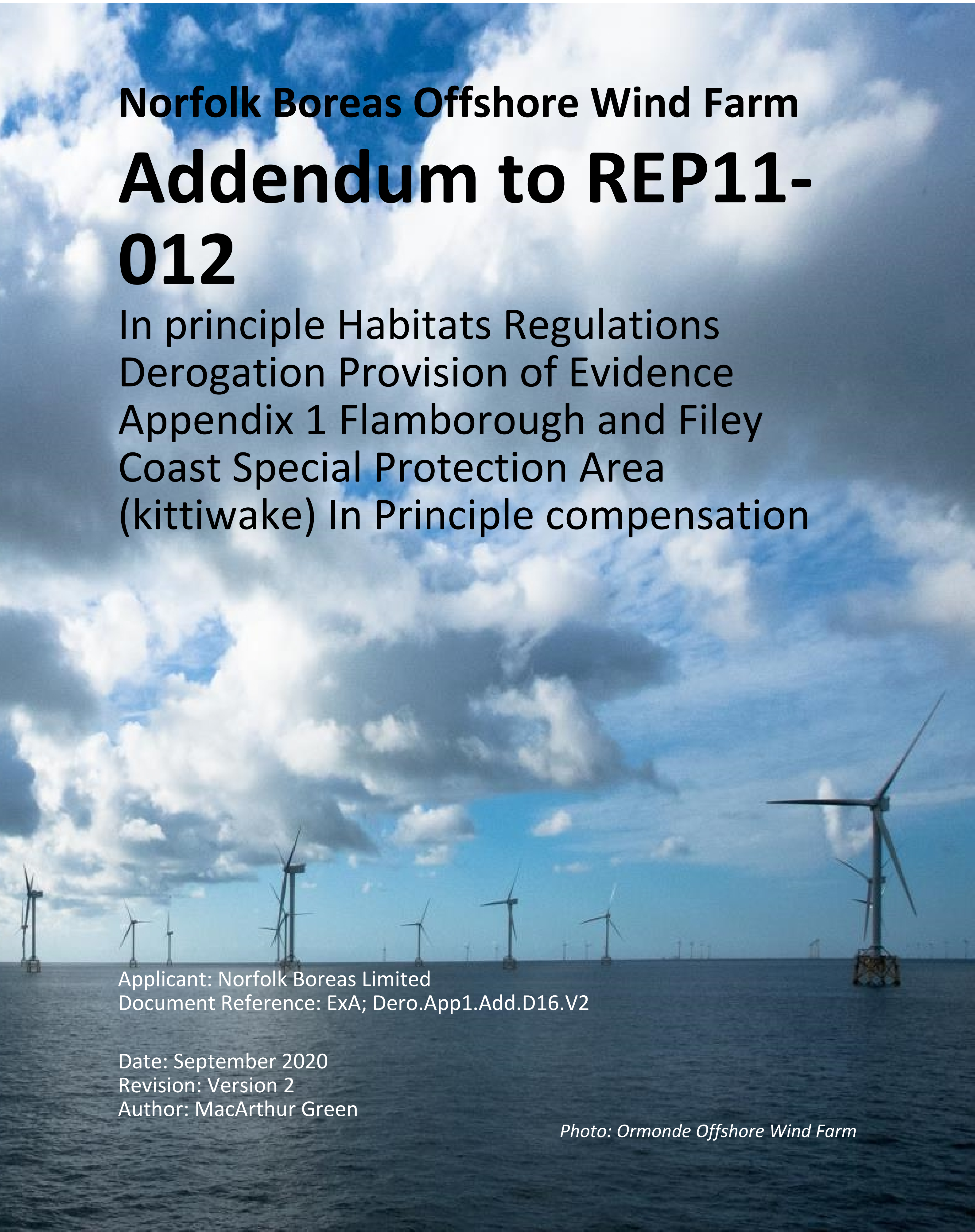

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Table of Contents

Table of Tables, Photos and Figures

Glossary of Acronyms

FFC	Flamborough and Filey Coast
ICES	International Council for the Exploration of the Sea
JNCC	Joint Nature Conservation Council
RAG	Red-Amber-Green
SMP	Seabird Monitoring Programme
SoS	Secretary of State
SPA	Special Protection Area

1 Introduction

1. This addendum provides responses to the issues raised by Natural England in their advice provided to the Applicant on the 28th August 2020 as referenced in [REP15-009] with respect to compensation measures for the Kittiwake feature of the Flamborough and Filey Coast (FFC) Special Protection Area (SPA). The information in this addendum should be read in conjunction with the previous submission on this topic [REP11-012] and to which this is appended. The specific points raised by Natural England are provided in Section 1.1 to 1.5 below, followed by the Applicant's response.

2. Natural England reviewed an earlier draft of this addendum, following which the Applicant revised the information provided in the current version to address the additional comments received.

1.1 Spatial analysis to identify sustainable locations for nest site provision.

3. *Natural England's advice states: "One aspect of particular concern with the proposals is the location of the artificial nest structure within the existing offshore Order limits for the project. It has not to date been demonstrated that this will not expose the colonising kittiwakes to an elevated collision risk from Norfolk Boreas, its sister project Vanguard, and other existing/consented proposals in the area. This has the potential to significantly impair the effectiveness of the compensation provided. Natural England considers that a suitable location, either within or outwith the project Order limits, should be identified through a spatial analysis of ecological requirements and constraints. This should include: location of existing, consented and proposed windfarms, and their likely impingement on kittiwake foraging ranges; current predicted distribution of foraging kittiwake from e.g. Cleasby et al. (2018; 2020); locations of prey species e.g. maps of sandeel/sandeel fisheries distribution; presence of other kittiwake colonies, particularly large colonies where density dependence may be operating. A matrix or RAG status approach could then be used to compare the merits of different locations and identify an appropriate site(s) for installation."*

4. The Applicant agrees with Natural England that selection of an appropriate location for provision of artificial nest sites for kittiwakes is an important consideration. While there are merits in having a site within the existing offshore Order limits for the project, the Applicant agrees that it would be appropriate to consider a range of possibilities, including the possibility of a location for artificial nesting sites distant from the Norfolk Boreas offshore wind farm site, as stated in REP11-012. A site that might be established within the existing offshore Order limits for the project would score favourably in a Red-Amber-Green (RAG) classification in terms of most of the key criteria identified by Natural England in that it would be:

- Distant from large existing colonies of kittiwakes (and other seabird species with which kittiwakes may compete for nesting space or food);
- distant from high densities of foraging kittiwakes within the foraging area from the artificial site;
- Away from human disturbance and predators; and,
- Close to high densities of foraged fish (i.e. sandeels).

5. However, any site created within the existing offshore Order limits for the project would inevitably be within the vicinity of wind farms and so kittiwakes nesting at the structure could be subject to collision risk given the extensive foraging range of the species (Woodward et al. 2019)

6. There may, therefore, be merit in considering construction of artificial nest sites onshore at a location that already has small or moderate numbers of kittiwakes nesting on artificial structures, that fulfils most of the criteria identified by Natural England but is more distant from offshore wind farms, or possibly at a novel location that has not previously held nesting kittiwakes. Two existing artificial sites warrant particular consideration; Lowestoft and the River Tyne. There may also be some suitable sites in areas that currently do not hold any breeding kittiwakes but where artificial structures are likely to be utilised to form a new colony. In addition, although it is not being considered as a suitable location for the current proposal, kittiwakes nest on artificial structures in Dunbar and therefore this site is included in terms of the wider understanding of the nesting behaviour and requirements of this species.

7. It is not possible to completely rule out potential connectivity between southern North Sea kittiwake colonies and offshore wind farms (see Figure 4, appended at the end of this document) since the maximum foraging distance reported for this species is 770 km (Woodward et al. 2019). However, most foraging will occur within the mean foraging range of 55 km and mean maximum of 156 km (Woodward et al. 2019), with some taking place at more than 200 km. Therefore some risk of collision for kittiwakes nesting anywhere around the southern North Sea must exist, so that the RAG will necessarily score colony sites either amber or red, rather than green.

8. Sandeel and sprat, the favoured food of breeding kittiwakes, are found through the entire southern North Sea (Figure 1, sandeel and sprat nursery grounds; Figure 2, sandeel and sprat spawning grounds; Figure 3, sandeel assessment areas (these figures are also appended at the end of this document)), but in the case of sandeels, which require specific substrates on which to burrow as well as for spawning, mainly where the sediment comprises the appropriate fraction of coarse sand. Sandeels and sprats are widespread and moderately abundant in the Norfolk Boreas area, though sandeels are less abundant than in areas to the north of the project (APP-224a 6.1.11 Environmental Statement -Chapter 11 Fish and Shellfish Ecology). Fishing effort by

the Danish sandeel fleet, the main fleet to target the fishery (as shown in Figures 1 and 2) confirms the widespread distribution of sandeels in the southern North Sea and also that the main fishery is located some distance to the north of the project, in areas such as the Dogger Bank. Probably the best evidence of there being good local food supplies for breeding kittiwakes is high breeding success achieved regularly over the years by kittiwakes in that area (Frederiksen et al. 2005, Carroll et al. 2017, Olin et al. 2020). That has been the case for kittiwakes breeding on artificial structures at Lowestoft, at the River Tyne and at Dunbar.

9. The reported foraging ranges of kittiwake (Woodward et al. 2019) are shown in relation to the onshore locations discussed in this addendum and also in relation to the prey fish spawning and nursery grounds, sandeel fishery VMS data and sandeel management areas. The figures do not include specific offshore locations for a colony as these have not been determined. However the predicted foraging ranges for a colony located within the order limits have been included for illustration purposes by buffering the Norfolk Boreas order limit with the kittiwake foraging ranges.

10. The onshore locations are discussed in sections 1.1.1 to 1.1.4 below, and Table 1.1 provides a comparison of the suitability of these locations as well as for offshore locations (both within and outside the project Order limits), using red-amber-green scoring, for each of the following criteria:

- Collision risks for birds using them;
- Proximity to other colonies, of both kittiwake and other species (i.e. sources of potential competition for prey);
- Distance to foraging grounds;
- Risks of disturbance and predation;
- Ease of monitoring and maintenance; and
- Likelihood that the site would be colonised.

1.1.1 Lowestoft

11. Lowestoft is distant from any large colonies of kittiwakes or of other seabird species with which kittiwakes may compete (Mitchell et al. 2004). Kittiwakes have been nesting at Lowestoft since the 1940s, and breeding numbers have increased, reaching 364 pairs in 2017 (this being the most recent count given in the JNCC SMP database). Kittiwakes used to nest on structures of the Lowestoft pier pavilion, but that was scheduled for demolition, so in 1989 Associated British Ports constructed purpose-built ledges on the Lowestoft harbour wall for kittiwakes to nest on after demolition of the pier pavilion. Birds immediately began using those newly-provided ledges, but have also colonised several nearby buildings, including a church. Although the kittiwakes are welcome on the harbour wall ledges, their nesting on

buildings may be less popular with some people. That habit may be a consequence of the limited space on the harbour wall ledges, which were constructed with the aim of providing nest sites for the 120 pairs of kittiwakes that were nesting on the pavilion structure that was to be demolished but the harbour wall ledge proved so attractive that it held twice that number by 1995.

12. More recently the purpose built wall has suffered chick and egg predation by foxes and large gulls, which has led to this site being abandoned (pers. comm M.Swindells). Discussion with the local ringing group, who monitor the Lowestoft colonies, has indicated that simple modifications could be made to the existing structure (e.g. adding an overhang to prevent large gull access and installing barriers to foxes) which would be expected to enable successful breeding at this location to recommence. The provision of such measures, once the feasibility is determined, would be included in any proposals by the Applicant for provision of additional nest sites at this (or any other) location. Any lessons to be learned about minimising predation risk would also be applied to the design of new structures.

13. Coulson (2017) estimated that kittiwakes at colonies in the UK need to produce about 0.8 chicks per nest to maintain a stable population. Breeding success of the Lowestoft kittiwakes is among the highest at any colonies in the UK, which is clear evidence that there are good supplies of food for breeding kittiwakes in that area. In 2010-2017 they produced an average of 1.1 chicks per nest (JNCC SMP database). By comparison, kittiwakes breeding at Flamborough and Filey Coast SPA have had much lower breeding success over the same period (Aitken et al. 2017) despite being within the same sandeel spatial unit as the Lowestoft birds, so affected by the same sandeel dynamics (Olin et al. 2020). The RSPB data show breeding success of kittiwakes at Flamborough and Bempton was below 0.8 chicks per nest at monitored plots in six years out of eight during 2010-2017, and at Filey was below 0.5 chicks per nest in six years out of the six monitored (Aitken et al. 2017). Increasing the numbers of kittiwakes breeding at Lowestoft could help to revive the poor performing population at Flamborough and Filey Coast SPA by providing increased numbers of potential recruits to the meta-population.

1.1.2 River Tyne

14. Along the banks of the River Tyne, about 2 to 20 km inland from the open sea, kittiwakes nest on many artificial structures (warehouses and other buildings, walls, bridges, and a purpose-built ‘kittiwake tower’ structure). This general area has been used by breeding kittiwakes for many decades and has been the subject of the most detailed long-term research into kittiwake breeding biology anywhere in the world (Coulson 2011). The colonies have grown in numbers of breeding pairs, reaching about 1000 nests in recent years (Turner 2010, JNCC SMP database). It is noteworthy that the numbers breeding on artificial nest sites have increased faster

than numbers at the nearby natural colony of Tynemouth Cliffs, despite the fact that some of the artificial nest sites have been demolished and replaced by new artificial structures and work has been done at some of the buildings on which kittiwakes breed to deter birds from nesting on those sites (Turner 2010).

15. Despite some persecution and deterrence, during 2010-2019 the mean productivity of the River Tyne artificial colony was 0.96 chicks per nest, so above the 0.8 chicks per nest threshold identified by Coulson (2017) to sustain the population and therefore this colony is expected to be exporting young birds. Kittiwakes have been forced off some buildings by putting up nets to prevent nesting on the structures, which has inadvertently resulted in the death of some birds that have become tangled in the nets. However, two new structures (kittiwake towers) were built to provide artificial nest sites in locations that avoided the unwelcome close association between kittiwakes and people in particular buildings, and that has reduced the conflict and there is generally strong popular support for the kittiwakes in this area (Turner 2010).

16. Breeding success varies considerably among the different buildings and structures, suggesting that careful selection of where to provide additional nest sites would influence the productivity that would be achieved. This point (which is expanded on below) emphasises that not all artificial structures are equally good for kittiwakes to use and the breeding success will vary according to the quality of the artificial structure provided. The variation evident within the Tyne River colony merits study to assess which structures perform best; that research has not yet been carried out. Breeding success in 2010-2019 averaged over 1 chick per nest at Akzo Nobel and Baltic Flour Mill, and 0.95 chicks per nest at Tyne Bridge and Guildhall (JNCC SMP database).

1.1.3 Dunbar

17. Kittiwakes have been recorded nesting on the wall of the ruined castle overlooking Dunbar harbour, East Lothian, since 1934 (Coleman et al. 2011). Between 1991 and 2007 the colony increased from 641 nests to 1155 nests (Coleman et al. 2011). Breeding success of the kittiwakes at Dunbar ranged from 1.0 to 1.7 chicks per nest over this period but varied considerably. Although part of the colony is on a natural rock face, many nests are on the castle and harbour walls, and the breeding success at this site is higher than at nearby natural sites such as St Abbs Head and the Isle of May, despite those natural sites being in the same sandeel area as Dunbar so subject to the same fluctuations in sandeel abundance (Olin et al. 2020). During 1991-2007, the Isle of May colony produced fewer than 0.8 chicks per pair in all but two of those years and breeding success was lower than at Dunbar in every year (Coulson 2011).

18. This location has not been considered further in these proposals but does provide additional supporting evidence of the range of artificial structures which kittiwake will use for nesting.

1.1.4 Kent coast

19. Historically kittiwakes have nested on natural sites in Kent in relatively small numbers (about 1,200 pairs in total in 2000; Mitchell et al. 2004; however there are some indications that numbers have declined further since and these colonies may have become abandoned, McMurdo Hamilton *et al*. 2016). It is possible that a novel artificial site constructed on the Kent coast might attract formation of a new colony, but it is uncertain whether the low numbers breeding in Kent are entirely a result of limited natural nesting habitat or whether food supplies in the breeding season may be limiting in that area (Brown and Grice 2005). Sandeels are generally not found where the sea sediment is pebbles rather than sand, such as that found around the Kent coast. There is also more uncertainty about whether a novel artificial site would be successful in attracting colonisation by kittiwakes on a coast that is frequented by large numbers of people in summer and does not have a history of kittiwakes nesting on artificial structures in that area. Therefore, it is likely to be a less suitable option compared to enhancing existing artificial sites and it is not considered any further in this addendum.

1.1.5 Strategic considerations

20. It is clear there are a number of existing programmes for the creation of artificial nests and others may be proposed in the future. Therefore, where other parties have an interest in the creation of artificial nest structures for kittiwakes the Applicant will seek to engage with them to work collaboratively and strategically where appropriate.

Table 1.1 Red-Amber-Green classification of potential sites for enhancing artificial nest site provision for kittiwakes

	Risk of collision at offshore wind farms	Proximity of large colonies of kittiwakes likely to compete for food	Proximity of large colonies of other seabird species with which competition is likely	Distance to foraging grounds for breeding adults	Risk of disturbance or predation impacts on breeding success	Ease of monitoring and maintenance	Highly likely that birds will use sites provided
Offshore within the Order limits	red	green	green	green	green	amber	green
Offshore outside the Order limits	amber	green	green	green	green	red	green
Lowestoft harbour wall	amber	green	green	green	amber	green	green
Shore of the River Tyne	amber	amber	green	amber	amber	green	green

1.2 Assessment of evidence regarding potential recruits

21. *Natural England's advice states: "The success of this measure depends on the availability of a pool of breeding age kittiwakes that would either be unable to breed in a given season, or be able to breed but in suboptimal locations and experience low or no productivity. The provision of 'ecological additionality' needs to be demonstrated i.e. a sufficient increase in kittiwake fledging and eventually recruitment rates than would otherwise happen were it not for the compensatory measures. Otherwise the compensatory measures cannot be considered to address the impact of the development."*

22. It is well established that kittiwake populations include large numbers of immature birds. Modelling a typical UK kittiwake population, in which age of first breeding averages four years old, indicates that about 47% of the population comprises immature kittiwakes and 53% breeding adults (Furness 2015a), so the numbers of immature birds looking for nest sites are considerable. Some of these immature birds can be seen at kittiwake colonies in summer. They tend to arrive after established breeding adults have reoccupied their nest sites and hang around the periphery of the colony, often in loose flocks on the rocks below the cliff, or on walls near the edge of the colony when on artificial sites. These immature birds then tend to leave the area shortly before chicks start to fledge from nests.

23. During their time attending the colony the immature birds may often attempt to settle on an existing nest, but are chased away by breeding adults. Some manage to establish a site between existing nests, or where a nest has been abandoned, and then may return the next year to breed at that site (Coulson 2011). This process of recruitment of immatures into the breeding colony may take several years, and immature kittiwakes may try to recruit into one colony but fail to do so and may move elsewhere to try to recruit where there is less competition for sites. As a consequence, there is a wide range of age at first breeding in the kittiwake (Wooller and Coulson 1977, Porter 1990, Coulson 2011) as found in other long-lived birds.

24. A very few kittiwakes start to breed for the first time when two years old, whereas some do not breed for the first time until ten years old (Coulson 2011, Table 11.6). Kittiwakes seeking to establish a nest site within a colony normally spend at least one year visiting the colony as an immature bird before establishing a nest site, and often take several years to succeed in obtaining a site. At North Shields, where kittiwakes were individually ringed so their recruitment behaviour could be observed, almost all marked birds that bred had been seen at the colony attempting to establish a site in the previous summer, and over 10% of female kittiwakes that started to breed at the colony had been seen there attempting to obtain sites at least three years before they managed to do so (Coulson 2011).

25. Furthermore, kittiwakes recruiting into a particular colony may originate from many different colonies, often from a considerable distance away. Coulson and Neve de Mevergnies (1992) showed that many kittiwakes moved between 300 and 1500 km from where they were born to where they recruited to breed. Danchin et al. (1998) and Boulinier et al. (2008) showed that immature kittiwakes, or adult kittiwakes that have failed in their breeding attempt, prefer to move to try to establish a breeding site within a colony where breeding success is high. This means that there is more competition for nest sites at more successful colonies. Tracking of kittiwakes seeking nesting opportunities (not only immatures but also failed breeders from unsuccessful colonies) has shown that birds may visit many colonies over a short period in summer in order to evaluate prospects for breeding, and seek to find a nest site where prospects are best (Ponchon et al. 2017).

26. Consistent with this evidence for kittiwakes competing to obtain better sites in more successful colonies, McKnight et al. (2019) found evidence for density-dependence in survival of immature kittiwakes and subsequent recruitment into the breeding population, implying strong competition for nest sites. Coulson (2011) found that the age of first breeding of kittiwakes at his study colony in North Shields changed significantly over decades, decreasing in breeding males from a mean of 4.59 in 1961-70 to 3.69 in 1981-90. Coulson (2011) attributed this change to reduced density-dependent competition for nest sites in the colony during the 1980s as a consequence of increased adult overwinter mortality at that time. This further supports the view that there is normally strong competition for high quality nest sites among kittiwakes, and that the birds are physiologically capable of breeding at a much younger age than they actually do, because competition limits access to suitable nesting opportunities (Coulson 2011).

27. A similar plasticity in age of first breeding that relates to density-dependent competition has been found in several other seabird species, including great skua (Furness 2015b), wandering albatross (Croxall et al. 1990), puffin (Harris and Wanless 2011) and herring gull (Coulson et al. 1982), so it is evident that this is a widespread and general feature of seabirds. It can therefore be concluded from the evidence that there is a large pool of nonbreeding kittiwakes physiologically capable of breeding but constrained by competition. This clearly demonstrates the principle of ecological additionality and therefore, the provision of artificial nesting sites will address the impact of the development.

28. Furthermore, since the precautionary estimate is that up to 14 kittiwakes per year from Flamborough & Filey Coast SPA may collide with wind turbines with the Norfolk Boreas site (applying Natural England's preferred collision modelling parameters, while the Applicant considers that a more realistic evidence based estimate would be 6.1 per year), it is clear that the amount of compensation

required for this development would not be difficult to achieve. Establishing new artificial nest sites would permit kittiwakes to breed at a younger age because of less competition for sites, and for a carefully selected location would allow high breeding success because of the low level of local competition for food, lack of disturbance or predation. Both of these demographic consequences would increase the rate of growth of the kittiwake population (overall) so would represent suitable compensation for losses attributable to Norfolk Boreas.

1.3 Detailed calculations of number of nests required

29. *Natural England's advice states: "Natural England recommends a more detailed calculation of the number of nests required. This should be informed by evidence gathering on some key parameters for the calculations, namely:*

- *Likely rates of structure colonisation following installation and evidence of attraction measures e.g. model nests being effective;*
- *Likely productivity of colonising birds;*
- *Annual survival rates between fledging and entering breeding population;*
- *Likely age of first breeding, and likely productivity of new recruits to colony;*
- *Likely philopatry/dispersal rates from a new colony;*
- *Consideration of potential lag between structure installation, time to sufficient colonisation and the predicted impacts arising.*

Once the required number of nests is calculated, consideration of the appropriate ratio for compensatory measures should be made, given that 1:1 ratios are generally only considered acceptable in cases where there is high certainty that a compensatory measure will be successful."

30. It should be noted that the impact to be compensated for is the estimated mean collision mortality of up to 14 kittiwakes per year that originate from Flamborough and Filey Coast SPA (based on the highly precautionary methods favoured by Natural England, while the Applicant considers that a more realistic evidence based estimate would be 6.1 per year). However, Natural England has advised that, incorporating their views on uncertainty, the Applicant should estimate the degree of compensation required using the upper 95% confidence estimate of mortality 28 [REP5-059], which equates to twice as many collisions as the mean value of 14 (this is also 4 to 5 times higher than the Applicant's evidence based mortality estimate). The aim of compensation is not to provide exactly the number of birds estimated to be lost, but to provide more than the equivalent of the loss of 28 adults per year from the population, and therefore more than a 1:1 ratio (Natural England has advised this ratio should be 1:2 or 1:3). However, each of the points raised by Natural England will be considered in turn in the sections below.

1.3.1 Likely rates of structure colonisation following installation and evidence of attraction measures e.g. model nests being effective

31. For existing sites with artificial nests such as Lowestoft and the River Tyne where the proposal could be to extend an existing colony, the likely rate of structure colonisation is expected to be effectively 100% as birds already nest at these sites and the high breeding success in these colonies would attract more recruitment to newly provided ledges for nest sites. Provision would add further nest sites to those already available so would allow the population to increase further. The presence of existing nests and high breeding success means that it is virtually certain that such deployments of extra nest sites would be colonised immediately. The history of provision of artificial sites in these three areas is that new artificial sites have been accepted almost immediately, providing they give good shelter from sun, rain, predators and disturbance. If the structure is in a new location (i.e. not an extension to an existing site) then colonisation could be lower, and it would be important to take this into consideration. This is allowed for in the calculation of the number of nests which could be required in section 1.3.6, which includes a minimum compensation ratio of 2:1 for the upper 95% confidence estimate mortality of 28 (which relates to the highly precautionary mean estimate of 14)and up to 9:1 for a mortality rate of 6.1 (as estimated using the Applicant's more realistic evidence based methods).

32. Provision of more ledges at Lowestoft would appear to be the most effective approach as these are known to be used by kittiwakes, and are known to allow high breeding success (the Applicant has also received in principle support for this option from the Port of Lowestoft, see the letter of comfort attached at the end of this addendum). As stated in REP11-012, the experience at Lowestoft was that when the pavilion was demolished in 1989-90, kittiwakes that had nested on that building moved immediately to the newly constructed ledge on the harbour wall. Not only was that new site occupied immediately, but within five years the numbers nesting on the new ledge were twice as many as had previously nested on the pavilion, indicating the success achieved by providing high quality artificial nest sites.

33. For a novel site on land (e.g. in the vicinity of one of the sites discussed above in sections 1.1.1 to 1.1.2) the likelihood of colonisation is less clear. If a novel site was considered desirable it would be sensible to trial that and to use adaptive management such that if the novel site was not colonised there could be provision of extra nest sites at one or more of the existing artificial sites (probably most appropriate would be Lowestoft) to ensure more than enough compensation for the losses of up to 28 birds per year from the population.

34. For a novel site offshore, the likelihood of colonisation is thought to be high, as kittiwakes have colonised offshore sites when allowed to do so (which has often not

been the case) and when the site provides suitable nesting ledges for kittiwakes and does not provide a roosting platform occupied by large gulls. There have been numerous attempts by kittiwakes to nest on offshore structures such as oil and gas platforms. In most cases birds have been deterred from nesting because of perceived health & safety issues caused by bird droppings that represent a slip hazard as well as a disease risk, and concerns that nesting material may block drainage. However, kittiwakes have been tolerated at a few offshore structures and the evidence is that these birds do well in those situations because of the proximity to their feeding grounds, lack of predation risk and suitability of nest sites (Christensen-Dalsgaard, pers. comm.).

1.3.2 Likely productivity of colonising birds

35. Kittiwakes nesting for the first time tend to be less productive than experienced adults (Coulson 2011) so it is typical for breeding success achieved by new populations to increase over the first few years. However, evidence shows clearly that kittiwakes nesting on artificial nest sites tend to have higher breeding success than kittiwakes at natural colonies. Breeding success at Lowestoft has averaged 1.1 chicks per nest (2010-2017), at River Tyne artificial sites 0.96 chicks per nest (2010-2019) and over 1 chick per nest at some of the structures within that group of sites, at Dunbar averaged 1.2 chicks per nest (1991-2007). By comparison, breeding success at natural colonies has included periods with fewer than 0.8 chicks per nest, such as at the Isle of May (1991-2007) and Flamborough and Filey Coast SPA (2010-2019).

36. Coulson (2017) showed that productivity of 0.8 chicks per nest is required to keep a UK kittiwake population stable, so it is clear that the artificial nest-site colonies of kittiwakes perform not only well enough to provide emigrants to support other colonies, but also perform better than some large natural colonies of kittiwake. This is likely to be mainly because the colony size at artificial sites is smaller and so results in less competition for food resources at sea; density-dependence results in greater competition at larger colonies and that impact is seen particularly on breeding success.

37. Research on the breeding of kittiwakes at the Heidrun platform at sea off Norway indicates that kittiwakes nesting on that steel structure achieve higher breeding success than kittiwakes at nearby natural colonies. That is thought to be due to the birds on the Heidrun platform being closer to their feeding grounds as well as being safe from predators or disturbance that affect birds nesting at natural colonies on the cliff coast (Christensen-Dalsgaard pers. comm.).

1.3.3 Annual survival rates between fledging and entering breeding population

38. There is a possibility that birds reared at artificial nest sites may survive better than birds reared at large natural colonies, since it is known that competition for resources is greater at large colonies and breeding success tends to be reduced by that competition. If, as seems plausible, chicks that fledge from large colonies are in poorer body condition due to that competition (in addition to the lower overall productivity), then it also seems likely that the opposite would be the case for chicks from smaller artificial colonies, and hence early survival rates may be higher. However, it is probably more appropriate to assume that survival between fledging and recruiting into a breeding population is similar for kittiwakes originating from different colonies as there is no clear evidence to indicate that is not the case.

39. Horswill and Robinson (2015) recommend that kittiwake population modelling should use the most up to date available demographic data for the UK kittiwake population, which they summarise as: adult (age 1 and older) survival 0.854, juvenile survival 0.79, age of first breeding four years. Using those values, for every 100 kittiwakes that fledge, 79 would be alive at one year of age, 67.5 at 2 years, 57.6 at 3 years and 49.2 would be available to recruit to a colony at 4 years old. Thus, it can be estimated that 49% of fledglings will return to enter the breeding population (but not necessarily in the colony where they were born). This is consistent with the conclusion reached earlier by Newton (1989) that about 50-60% of the birds that fledge from any bird population die before reaching breeding age, regardless of species-specific age of first breeding.

40. Although the data presented by Horswill and Robinson (2015) are generally considered to be the most appropriate to use in modelling UK seabird population dynamics, the age of first breeding may vary among colonies, most likely being younger at smaller, growing colonies and older at larger, stable or declining colonies (Coulson 2011, Furness 2015b). That would result in the percent of fledglings surviving to enter the breeding population most likely being slightly lower than 49% for large and/or declining colonies and slightly higher than 49% for small and growing colonies.

1.3.4 Likely age of first breeding, and likely productivity of new recruits to colony

41. Horswill and Robinson (2015) recommend the use of a mean age of first breeding of four years old for modelling the dynamics of UK kittiwake populations. More detailed data on age of first breeding are available only for the North Shields colony, where age of first breeding varied between the sexes and between decades. Age of first breeding averaged 3.97 years old in 151 males (range 2 to 10 years old), and 4.7 years old in 56 females (range 3 to 9 years old) that bred at North Shields but had been ringed as chicks so were of known age.

42. The age of first breeding at newly provided nest sites is likely to be younger than is typical at established colonies because there is likely to be less competition for nest sites when many new sites have suddenly been made available. Breeding success of new recruits will most likely be lower in their first breeding season than subsequently. That is to be expected in long-lived birds such as kittiwake where breeding success improves with age/experience (Coulson 2011). Comparing 165 instances of first breeding with the second breeding a year later, first time breeders studied by Coulson had 10% lower breeding success than second time breeders (Coulson 2011, Table 11.4).

43. Coulson (2011) makes the point that the experience of the bird influences breeding success more than the absolute age at first breeding; birds starting to breed at an older age had only marginally higher breeding success than birds starting at a younger age. It is worth noting that even the likely breeding success of new recruits to a colony such as Lowestoft is likely to be higher than the typical breeding success of established birds at Flamborough and Filey Coast SPA (Lowestoft colony mean was 1.1, 2010-2017) discounted by 10% for first time breeders so 0.99 chicks per nest for first time breeders at Lowestoft compared with the colony mean breeding success of <0.8 chicks per nest at FFC SPA in 2010-2017.

44. It is also important to recognise that birds starting to breed at a younger age will be likely to produce more chicks over their lifetime (Newton 1989), and so provision of artificial nest sites will not only increase rate of population growth by allowing higher breeding success than at large natural colonies, but will also increase the rate of population growth by allowing breeding to start at a younger age because there is less competition for nest sites or for food.

1.3.5 Likely philopatry/dispersal rates from a new colony

45. Analysis of ringing data from numerous colonies in Britain and Ireland (Coulson and Neve de Mevergnies 1992) and analysis of sightings of colour ringed kittiwakes and of kittiwakes initially ringed as chicks then caught at nests as breeding adults (Coulson 2011) shows that philopatry is generally low in the kittiwake, and lower in females than in males. Most individuals recruit into a colony that is within 500 km of where they were born, but relatively few recruit into their natal colony. Coulson (2011) found that 91% of female kittiwakes recruiting into his study colony were immigrants from other colonies, as were 63.5% of males.

46. There is no evidence to suggest that young birds from a new colony show significantly different natal recruitment or dispersal from young birds from established colonies. However, there is a very strong tendency for young kittiwakes to try to establish themselves at a colony that has high breeding success (Danchin et al. 1998, Boulinier et al. 2008, Coulson 2011). Small colonies generally tend to have

higher breeding success than nearby large colonies, and so there is likely to be a greater attraction of immigrants to smaller growing colonies. However, not all individuals can recruit into their colony of first choice, and some spend several summers attempting to recruit, and visiting several colonies in this process (Boulinier et al. 2008, Coulson 2011).

47. It is likely that kittiwakes will find it much easier to recruit into a colony that has vacancies created by natural mortality of established breeding adults but has relatively low productivity of young. In such cases, there will be nests that are re-occupied in spring by one of the pair of birds but their partner has died during the winter. Those birds will try to pair up with a recruit seeking breeding status in the colony. If breeding success has been low at that colony, there will be fewer local birds in the population to recruit, and the colony will be less attractive to potential recruits compared with a colony with higher breeding success. However, joining an established bird that has lost its partner is an easy way to recruit. Larger colonies will have larger numbers of such vacancies arising. This will tend to even out the distribution of potential recruits among colonies, and is a likely mechanism by which birds fledged from the compensation colony may recruit into the Flamborough and Filey Coast SPA colony. Therefore, it can be predicted that most of the kittiwakes that fledge from a compensation colony with newly created nest sites will end up nesting at other colonies, mostly but not exclusively within 500 km of the compensation colony.

1.3.6 Consideration of potential lag between structure installation, time to sufficient colonisation and the predicted impacts arising. Once the required number of nests is calculated, consideration of the appropriate ratio for compensatory measures should be made, given that 1:1 ratios are generally only considered acceptable in cases where there is high certainty that a compensatory measure will be successful

48. The time lag between structure installation offshore and colonisation by kittiwakes is uncertain. It may be reduced by putting model kittiwakes on nests and playing kittiwake vocalisations to attract birds into the new site, as that has been shown to work well for many seabird species (including kittiwake). But it may take a few years for birds to start to breed on a novel offshore structure.

49. Evidence is strong that artificial sites made available at onshore artificial colonies are colonised very quickly. At Lowestoft, the artificial ledges constructed on the harbour wall were colonised in the year they were constructed. At the River Tyne, the Gateshead kittiwake tower was built by Gateshead Council in January 1998. The metal-framed structure comprises 24 wooden nesting ledges starting at 8 m above ground. It is rather exposed to sunshine, wind and rain. However, despite evidence that this is not the ideal design for an artificial colony (indicated by lower breeding success there than achieved on the Tyne Bridge and other stone buildings in the

area) kittiwakes were successfully attracted to the tower by clay kittiwake decoys and disused old kittiwake nests that were placed on the ledges, and 18 pairs nested on this structure in its first year of availability in 1998 (i.e. within six months of construction). There were 131 pairs nesting there by 2000. In winter 2000/01 the structure was then relocated 1 km downstream from its original site to make way for commercial development of the area. Despite being moved 1 km, many of the kittiwakes followed the tower; 112 pairs nested there in 2001 (slightly fewer than in the year before the structure was moved) and there were 143 pairs in 2007 (Turner 2010).

50. These examples suggest that there would be an immediate colonisation of high quality artificial nests added to Lowestoft harbour wall or an appropriate structure on the River Tyne. The same is likely to be the case at Dunbar given that colony has higher breeding success than natural colonies in the region so is likely to be particularly attractive to kittiwake recruits.

51. It is perhaps useful to consider that the requirement is to compensate for an estimated loss of up to 28 adult kittiwakes per year due to Norfolk Boreas. Setting aside gains resulting from earlier age of first breeding and therefore being precautionary in only considering the consequences of effects on breeding success, that equates to the equivalent of 60 fledglings per year (because a fledgling has a 0.49 probability of becoming a breeding adult). To estimate the number of nests required to produce the surplus recruits for the SPA population, the productivity at the SPA (0.6 in recent years) has been subtracted from the predicted productivity at the artificial site (1.2), giving an estimate of 0.6 fledglings per nest available to be recruits to the SPA.

52. To produce the equivalent number of chicks to offset a loss of 6 adults per year (Applicant's evidence based mean estimate), 14 or 28 (the predicted mean and upper 95% confidence estimate using Natural England's highly precautionary methods) requires production of between 13 and 60 chicks per year (based on estimated survival to maturity). With surplus production of 0.6 chicks per year per nest at artificial sites requires 22 nests to compensate for loss of 6 adults, 50 to compensate for 14 and 100 nests to compensate for loss of 28. Applying a 2:1 ratio of compensation would therefore require:

- 44 nests for 6 collisions,
- 100 nests for 14 collisions, or
- 200 nests for 28 collisions.

These calculations are set out in Table 1.2 below.

Table 1.2 Calculation of the number of nests required to compensate for collisions at Norfolk Boreas. Note that the number of nests have been rounded up slightly.

Step	Aspect	Applicant's evidence based mean estimate	Natural England's precautionary mean estimate	Natural England's precautionary upper 95% c.i. estimate
1	Estimated productivity at artificial site		1.2	
2	Productivity at Flamborough and Filey Coast SPA		0.6	
3	Available recruits - surplus (step 1 minus step 2)		0.6	
4	Predicted adult mortality at Norfolk Boreas	6	14	28
5	Survival to maturity		0.49	
6	No. chicks required to produce required no. of adults (step 4/step 5)	13	30	60
7	No. nests required to obtain surplus production adults (step 6/step 3)	22	50	100
8	No. nests required at 2:1 compensation ratio (step 7 x 2)	44	100	200

53. It should be noted that 200 additional nests represents a 2:1 compensation ratio for Natural England's highly precautionary upper collision estimate of 28, while for the average collision estimate agreed with Natural England of 14 collisions this represents a 4:1 compensation ratio, and for the Applicant's evidence based estimate of 6 collisions this represents a compensation ratio of 9:1.

54. At Lowestoft, over 300 pairs have nested on artificial nest sites so adding another 200 nests would appear to be straightforward to achieve (that number could fit onto one or two ledges added to the harbour wall immediately below the one already added there, with extensions if necessary) and the Applicant can expect those to be occupied almost immediately. The same is true at the River Tyne. In practice it may be appropriate to aim to increase breeding numbers by over 100 pairs at more than one location. Adding new nesting sites at two artificial colonies would be more robust than doing so at only one. However, the Lowestoft colony appears to be the most suitable site to enhance (Table 1.1).

55. It is important to note that, to accommodate Natural England's advice that the mortality to be compensated should be 28, considerable precaution has been built into the calculation of 200 nests. The sources of precaution have been detailed in the Applicant's previous submissions [e.g. REP2-035, REP5-060] and are summarised here.

56. The precautionary mean collision estimate of kittiwake from the Flamborough and Filey Coast SPA at Norfolk Boreas is 14 [REP5-059]. This estimate (of 14) is derived with the following precautionary collision modelling parameters:

- An avoidance rate of 98.9%, while evidence indicates that 99% is more appropriate (this increases the estimate by 10%);
- A nocturnal activity rate of 50%, while evidence indicates this is more than double the realistic levels for this species (this increases the estimate by around 14%);
- A flight speed of 13.1m/s, while evidence indicates a value of around 10m/s is more appropriate (this increases the estimate by around 15%);
- Assumption that 86% of the birds on Norfolk Boreas between March and August originate from the SPA, while the Applicant's evidence-based estimate is 26% between April and August (this increases the estimate by 55%); and
- Use of the upper 95% confidence interval rather than the mean (this doubles the final estimate, over and above all of the other aspects).

57. Taken together, the predicted collisions estimated with the application of an appropriate level of combined precaution (instead of Natural England's approach of combining upper levels of precaution at each step) the predicted number of collisions of birds from the SPA is 4 (with an upper 95% estimate of 7). It should be noted that these figures (of 4 and 7) have not been presented previously, but rather the Applicant has drawn attention to the individual elements of over-precaution in Natural England's recommended approach (e.g. on flight speed in REP5-060). However, the Applicant considers these aspects should be borne in mind when reviewing the compensation proposals presented by the Applicant.

58. Thus, requiring compensation level for a mortality figure of 28 increases the degree of compensation by a factor of 7 (28/4) compared with the mean calculated using an appropriate level of precaution, or a factor of 4 (28/7) using the upper 95% confidence estimate. It is clear therefore, that the current proposals include a very considerable degree of over-compensation , and the SoS can have high confidence that, if compensation is required, there are both proven means to achieve this and that the predicted mortality due to Norfolk Boreas could be readily compensated for.

59. An offshore artificial colony could be added to this plan or could be used alone; if used alone then there would be uncertainty about risks of collision mortality for birds attracted to nest at the offshore site and moderate uncertainty about the site attracting colonisation by kittiwakes. However, the principle of a new offshore colony on an artificial structure would be good to establish as that could be a long-term route for compensation whereas the number of artificial nest sites that could be created onshore will be more restricted.

1.4 Detailed description of structure

60. Natural England's advice states: "There is limited information provided on the proposed design of the structure, other than it will be located on a structure similar in *size and form to a meteorological mast. Evidence from provision of artificial nests elsewhere e.g. Gateshead kittiwake tower, Lowestoft kittiwake wall should be gathered to provide evidence that a sufficiently robust structure can be constructed to accommodate the required number of nests. Lessons learnt from implementation of such structures from elsewhere should be gathered to identify key issues and constraints that would influence success e.g. large gull predation, orientation and aspect.*

If Norfolk Boreas wish to pursue an offshore rather than onshore/coastal structure, it will need to be demonstrated that such a structure will be sufficiently robust to cope with at sea conditions, and be readily maintained in the event of e.g. ledge collapse."

61. The artificial towers built specifically for kittiwakes beside the River Tyne achieved productivity of only 0.69 chicks per nest (Turner 2010), suggesting that those structures have not provided ideal nesting conditions. It seems likely that those structures provide less adequate shelter from sun, wind and rain than is the case with ledges on warehouses and the stone-built Tyne Bridge. The specific features of successful and less successful artificial nest sites merit further study, as there has been no research into the breeding success achieved, and specific causes of breeding failure, in relation to the features of individual artificial sites. It is known that overheating of nests by direct exposure to sun can result in death of embryos or chicks, as can exposure to rain.

62. An example of what appears to be a very good quality artificial nest site can be seen in Photo 1.3. The photo shows kittiwake nests on narrow ledges that are sheltered from above by an overhang so are well protected from rain, somewhat protected from direct sunshine, and are inaccessible to predators. Not only do these structures look ideal for kittiwakes to nest on, but the breeding success at this site is higher than at nearby natural colonies. That is thought to be due to these nest site quality factors together with the fact that this colony is very close to the birds' foraging grounds. As a consequence, breeding birds do not have to travel far to obtain food, and can spend more time at the nest, which allows them to maintain higher body condition as well as to provision chicks more often and at lower energy cost (Christensen-Dalsgaard, pers. comm.).

Photo 1.3. Kittiwakes nesting on the Heidrun offshore production platform, Norwegian Sea. Photo by Signe Christensen-Dalsgaard (Christensen-Dalsgaard et al. 2019).

63. Artificial ledges added to Lowestoft harbour wall (Photo 1.4) also seem to provide good quality nest sites for kittiwakes. The lowest ledge may be somewhat at risk of splash from waves and is potentially rather exposed to rain and to water running down the wall from above. The upper ledges are fully occupied, as kittiwakes space nests such that birds in adjacent nests cannot quite reach each other while incubating (to avoid fights). These upper ledges provide good shelter from direct sunshine and from predators, but may be somewhat exposed to rain because there is no overhang to shelter them and rain may run down the vertical wall onto the nesting ledges. Adding another ledge below the top one but above the middle one would provide a large number of new nest sites for kittiwakes, and would probably improve the quality of the lower ledges by increasing the overhang above those which would increase shelter from rain and further exclude potential predators.

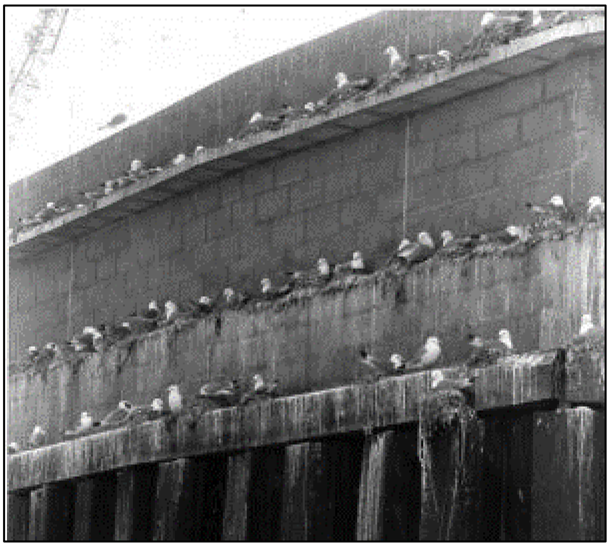

Photo 1.4. Kittiwakes nesting on ledges along the harbour wall in Lowestoft, Suffolk in 1989 (Photo from https://www.suffolkarchives.co.uk/places/suffolk-day-2018/k-is-for-kittiwakes/).

64. There are many photographs of artificial nest sites at the River Tyne colony which can be viewed by searching on Google Images using '*tyne kittiwakes*'. There are also some examples in Turner (2010). Those photographs show that there is a high diversity of nest site features available to kittiwakes at the River Tyne – some are high quality stone ledges that allow kittiwakes to nest in sheltered positions protected from predators, disturbance, sunshine or rain. Others are more exposed positions that appear less suitable, and those include the Gateshead kittiwake tower built by Gateshead Council in January 1998 specifically for kittiwake nesting.

65. In view of the high diversity of nest sites the Applicant considers that, if compensation is required, it would be important to carry out a study (e.g. in summer 2021) at existing artificial colonies to score the features of individual kittiwake nests on the different structures and to determine how those features have influenced the breeding success achieved by pairs nesting in different situations within those colonies. That would inform the design of new artificial structures and thereby optimise breeding success that kittiwakes could achieve, so would be considered important preparatory work to support development of this compensation strategy. Natural England has indicated their support for this proposed study and, should the Secretary of State decide that compensation is required, the Applicant has committed to this in sub-paragraph (3) of the draft condition which secures compensation for the Flamborough and Filey Coast SPA, as set out in section 1.5 below (and which will be included in the final draft DCO to be submitted at Deadline 18 on 12 October 2020).

1.5 Delivery mechanisms

66. *Natural England's advice states: As noted above, Natural England seek evidence to demonstrate that installation within the Boreas existing offshore Order limits will not result in significant collision impacts on kittiwakes colonising the structure. Should a more detailed spatial analysis indicate that an alternative location(s) would be appropriate, the relevant mechanisms for securing the delivery of the structure should be considered e.g. marine licence, seabed lease, planning application, land purchase etc. We also noted in our Deadline 9 response that Natural England does not consider it appropriate to restrict the potential compensation for kittiwakes at the FFC SPA to just the option of provision of artificial nesting sites at this time. Therefore, we would recommend that alternative draft conditions are produced which allow for a range of compensatory measures (e.g. to also include fisheries management). This would allow the Secretary of State (SoS) to consider the appropriateness of a range of potential compensatory measures. More generally, the chance of adequately compensating for kittiwake mortality at FFC SPA over the lifetime of an offshore windfarm seems likely to require a package of measures focussed on both short- and longer-term compensation, the latter likely to form part of a more strategic approach*."

67. As the Applicant explains in paragraph 100 of the In Principle Habitats Regulations Derogation Provision of Evidence - Appendix 1 - Flamborough and Filey Coast SPA In Principle Compensation [REP11-012] if, following consultation with Natural England, it is proposed that the final compensation mechanism is an offshore artificial nest site then the Applicant could consent a bespoke nesting structure by way of a separate Marine Licence application. In the event that a new structure is consented, the artificial nest sites are likely to be constructed within the existing offshore Order limits for the project, but could be constructed outside of the Order limits if agreed with The Crown Estate. The Applicant would therefore either have rights to the land (seabed) required for the works or would need to engage with The Crown Estate to extend the area over which rights are granted.

68. Adding nest sites for kittiwakes at existing onshore artificial nest site colonies (Lowestoft and/or River Tyne) would be effective in the short and long term. That would not require land purchase, but could be achieved through partnership with existing bodies (e.g. with the harbour authorities at Lowestoft and local authorities and land/property owners at Gateshead/Newcastle; see the letter of comfort, attached at the end of this addendum, in this regard received by the Applicant from the Port of Lowestoft). To the extent that new structures were proposed then these could be consented either through permitted development rights available to port authorities and/or statutory undertakers (if applicable) or by way of a separate planning application. Any new structure which is likely to give rise to significant

environmental effects cannot be constructed under permitted development rights and would be subject to a separate planning application. This would be accompanied by an environmental impact assessment which would identify measures necessary to mitigate any significant environmental effects predicted (as appropriate). It is not, however, anticipated that structures at port locations would give rise to likely significant effects and so the Applicant expects that the permitted development regime is likely to be appropriate for this type of structure.

69. As set out in the New Anglia Local Economic Partnership's Local Industrial Strategy (New Anglia 2020), the Applicant is an important contributor to the delivery of the East of England offshore wind O&M cluster, and is therefore working closely with a number of companies in the local and regional supply chain. This includes Great Yarmouth and Lowestoft ports. As part of this relationship, the Applicant would hope to be able to secure rights to an appropriate structure/facility on which additional nesting sites could be located in the event that compensation measures are deemed necessary by the SoS.

70. Given the scale of compensation required, it would be possible to achieve the necessary increase in kittiwake nesting numbers at both offshore and onshore sites. Whilst a decision on the most appropriate structure to be taken forward (whether onshore or offshore) would be made post consent, it is recognised that the deployment of an offshore structure for kittiwakes to colonise would be a useful proof of concept test and could open up wider opportunities for conservation management if it proved as successful as anticipated.

71. An artificial colony structure within the Norfolk Boreas offshore Order limits would permit monitoring not only of the extent to which such a structure was adopted by kittiwakes for breeding and what breeding success they achieved, but could also be used to monitor the survival rates of kittiwakes breeding on that structure. That would provide a useful comparison with survival rates of kittiwakes at colonies more distant from offshore wind farms which could inform on risk associated with nesting near to an offshore wind farm. It is not self-evident that survival of kittiwakes at such a site would be lower than at natural colonies (as suggested by Natural England). It is entirely possible that kittiwakes nesting at an artificial colony within the Boreas existing offshore Order limits may have higher survival than birds at natural colonies because the lower cost of foraging (as they are closer to their preferred foraging grounds and would experience lower intraspecific competition) may allow the birds to maintain better body condition (Oro and Furness 2002).

72. The Applicant's view is that provision of new artificial nest sites (whether offshore or at the suggested onshore sites, or a combination of these) would be more than adequate to compensate for the potential losses of kittiwakes caused by Norfolk Boreas. There would therefore be no need to consider additional arrangements

such as sandeel fisheries management. However, it is recognised that closure of the sandeel fishery in UK southern North Sea waters would be a highly effective compensation for kittiwakes (as set out in detail in REP11-012).

73. Recent modelling has demonstrated that the sandeel fishery has caused depletion of sandeel biomass in this region (Lindegren et al. 2018), and that high fishing effort on sandeels has led to reduced breeding success of kittiwakes at Flamborough & Filey Coast SPA because of the reduced abundance of sandeels (Carroll et al. 2017). Reducing the level of fishing effort on sandeels, or closing the fishery in waters close to the colony, would, therefore, represent mechanisms to improve breeding success of kittiwakes at that colony by making it possible for the biomass of the sandeel stock to recover from the high fishing mortality that has been imposed in recent decades. The ICES estimate of sandeel total stock biomas (Figure 1.5) now indicates that the stock has been reduced over recent years.

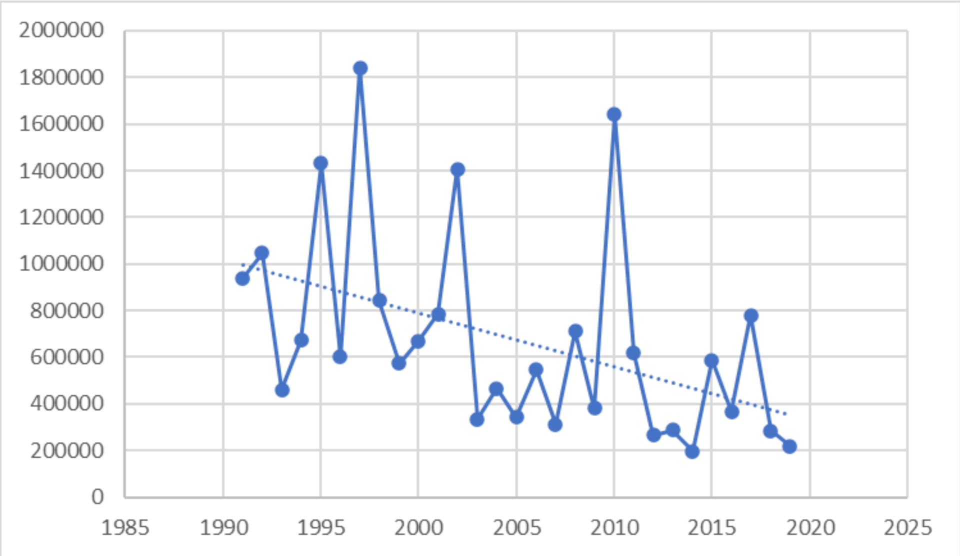

Figure 1.5. Sandeel Total Stock Biomass (tonnes) estimated by the stock assessment for North Sea sandeel assessment area *1r* (Dogger Bank stock and south-west North Sea). The dotted line indicates the long-term trend in the biomass.[1]

74. Indeed, it is now around the lowest level it has been for the 50-year history of the fishery. Of particular note is that the latest estimates of sandeel spawning stock biomass in sandeel management area *1r* (which includes waters used for foraging by kittiwakes from Flamborough and Filey Coast SPA) published by ICES (ICES 2020) show the stock has been reduced below *Blim*, the defined critical level where there is a serious risk (to the stock) of a future failure of recruitment and recovery.

[1] Data from ICES 2020 assessment published by the Herring Assessment Working Group HAWG (ICES 2020).

75. Modelling shows this low abundance to be largely due to high fishing mortality (Lindegren et al. 2018), and this therefore represents a threat to the sustainability of the kittiwake population at Flamborough and Filey Coast SPA. It is consequently very concerning that Lindegren et al. (2018) expressed pessimism over the ability of this stock to fully recover even if fishing effort was reduced.

76. The closure of sandeel fishing in the sandeel box off east Scotland was carried out when that sandeel stock declined in abundance. The sandeel abundance has eventually recovered in that area (Figure 1.6), and it would be logical to close the southern North Sea UK waters now, on the same basis that the sandeel stock there has fallen below levels that are safe to sustain because spawning stock is now below the threshold for safe management (*Blim*).

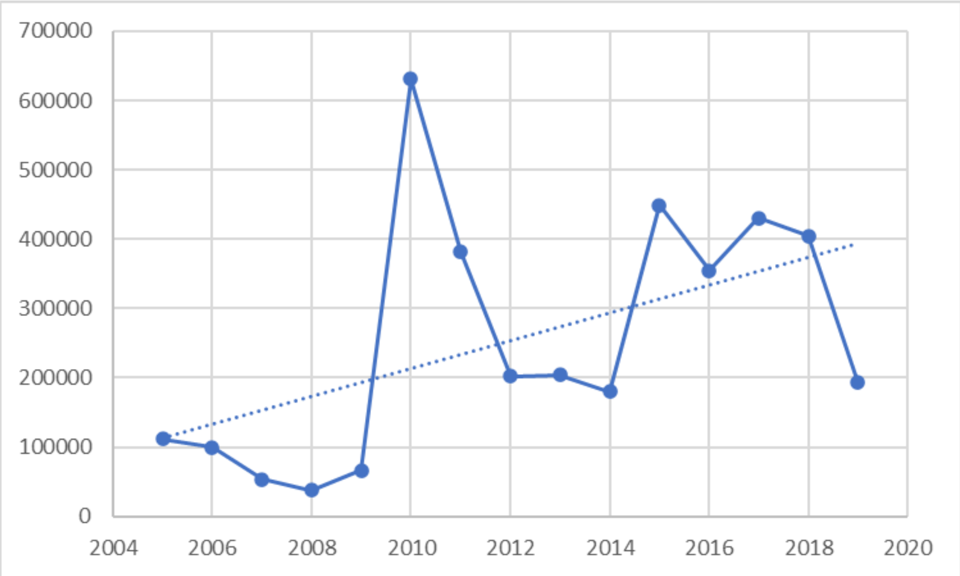

Figure 1.6. Sandeel Total Stock Biomass (tonnes) estimated by the stock assessment for North Sea sandeel assessment area 4 (North Sea off east Scotland and north-east England) from 2005 to 2019[2].

77. Nonetheless, while managing the sandeel stock appears to be critical for the long term viability of the Flamborough and Filey Coast SPA kittiwake population, as discussed in REP11-012, management of fishery stocks is not a compensation option over which Norfolk Boreas Limited has control. Therefore irrespective of the merits of this option the Applicant does not consider, at this stage, that this can be offered as compensation for the potential impacts at Norfolk Boreas. Notwithstanding this,

[2] Data from ICES 2020 assessment published in HAWG (ICES 2020). Median annual catch in 1993-2004 was 55,000 tonnes, but from 2005-2016 was reduced to 1,500 tonnes (ICES 2020). The recovery of sandeel biomass in this stock following drastic reduction in fishing mortality in 2005 can be seen (linear trend shown by dotted line). As a result of a large increase in fishing effort in 2018, catch in 2018 jumped to over 42,000 tonnes (despite part of area 4 being closed to sandeel fishing), which may have contributed to the fall in estimated stock biomass between 2018 and 2019 (ICES 2020).

and in response to the points raised by Natural England on the FFC SPA compensation condition wording, the Applicant has revised Part 1 of Schedule 19 to the DCO to broaden the drafting so that, should it be deemed necessary by the SoS, the eventual compensatory measure taken forward in respect of the Flamborough and Filey Coast SPA is not restricted to a single option of provision of artificial nesting sites. By introducing this flexibility, management of fishery stocks is not precluded as a compensation option to the extent that this subsequently becomes deliverable within the required timescales. The condition to be included in the final draft DCO reads as follows, and the Applicant has agreed these revisions with Natural England:

PART 1

Flamborough and Filey Coast Special Protection Area: Delivery of measures to compensate for kittiwake loss

***1.**—(1) No later than 12 months prior to the commencement of any offshore works, a strategy for the delivery of measures to compensate for the predicted loss of adult kittiwakes from the Flamborough and Filey Coast Special Protection Area as a result of the authorised project and proposals for monitoring and reporting on their effectiveness, must be submitted to the Secretary of State for written approval, in consultation with the MMO and the relevant statutory nature conservation body.*

(2) The strategy must include measures to increase the number of adult kittiwakes available to recruit to the Flamborough and Filey Coast Special Protection Area in accordance with the principles contained in Flamborough and Filey Coast Special Protection Area (SPA) – In principle Compensation, and must be approved in writing by the Secretary of State prior to the commencement of any offshore works.

(3) Where the strategy proposes the construction of artificial kittiwake nest sites, it must be supported by a feasibility review of other artificial kittiwake nest sites (both in the vicinity of the proposed nest sites and more widely) and which assesses the likely success of the proposals submitted under sub-paragraph (1).

(4) The strategy must include timescales for the measures to be delivered prior to operation of the offshore generating station, unless otherwise approved in writing by the Secretary of State.

(5) Results from the monitoring scheme required under sub-paragraph (1) including any proposals to address the effectiveness of the measures must be submitted to the Secretary of State, the MMO and the relevant statutory nature conservation body, and any proposals to address effectiveness must thereafter be implemented by the undertaker as approved in writing by the Secretary of State.

2 Monitoring and adaptive management

78. The Applicant agrees with Natural England's advice that monitoring of artificial nest sites is important and the results should be used to inform adaptive management of these sites to optimise breeding success of kittiwakes. There is already monitoring at Lowestoft of breeding numbers, breeding success and colour ringing to assess movements of birds among breeding sites and adult survival. Therefore the Applicant proposes that additional monitoring should augment any existing ongoing work as it would not be appropriate to conflict with the established work of local ornithologists and ringing group volunteers. Where monitoring is not already taking place, it will be proposed as a stand-alone package of works. The monitoring study design would be developed and agreed with Natural England, with the monitoring results provided for discussion. As suggested by Natural England, this could include counting nest numbers and productivity, colour ringing to attempt to identify whether the artificial nest sites are providing recruits into other colonies, diet studies and similar monitoring of other local colonies (if any) to determine if birds have relocated to the new sites.

79. The Applicant agrees that there is scope for adaptive management based on monitoring evidence, for example if there is an indication of a need to minimise impacts of predators on kittiwake breeding success or to adjust nest site provision to facilitate achievement of higher numbers of nests or higher breeding success.

80. Provision for both monitoring and adaptive management are included in sub-paragraphs (1) and (5) of the draft DCO condition set out above (which will also be included in the final draft DCO to be submitted at Deadline 18 on 12 October 2020).

3 Conclusion

81. The Applicant has sought to address the requests for additional detail from Natural England through the evidence review presented above which has further demonstrated that provision of additional nesting opportunities for kittiwakes at either onshore or offshore locations in the southern North Sea is feasible, with well-established approaches to follow. Furthermore, on the basis of evidence from existing sites, the higher reproductive success of birds in new (or extensions to existing) colonies will provide the additional recruits required to compensate for any losses of individuals from the Flamborough and Filey Coast SPA due to collisions at the Norfolk Boreas wind farm.

82. The Applicant considers that any further details on compensation can be addressed following consent, if the Secretary of State determines that this is required.

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Associated British Ports, The Port of Lowestoft Kittiwake nest facility - Letter of Comfort

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Mr Laws
Norfolk Boreas Limited
First Floor
1 Tudor Street
London
EC4Y 0AH

25th September 2020

Dear Mr Laws

Norfolk Boreas Offshore Wind Farm (the Project), Kittiwake nest facility - Letter of Comfort

We write further to our recent conversations in relation to the potential use of Port of Lowestoft for an operations and maintenance base for Norfolk Vanguard and/or the Project.

As you know, ABP owns and operate the Lowestoft port facility, which is one of the twenty-one ports we operate around the United Kingdom.

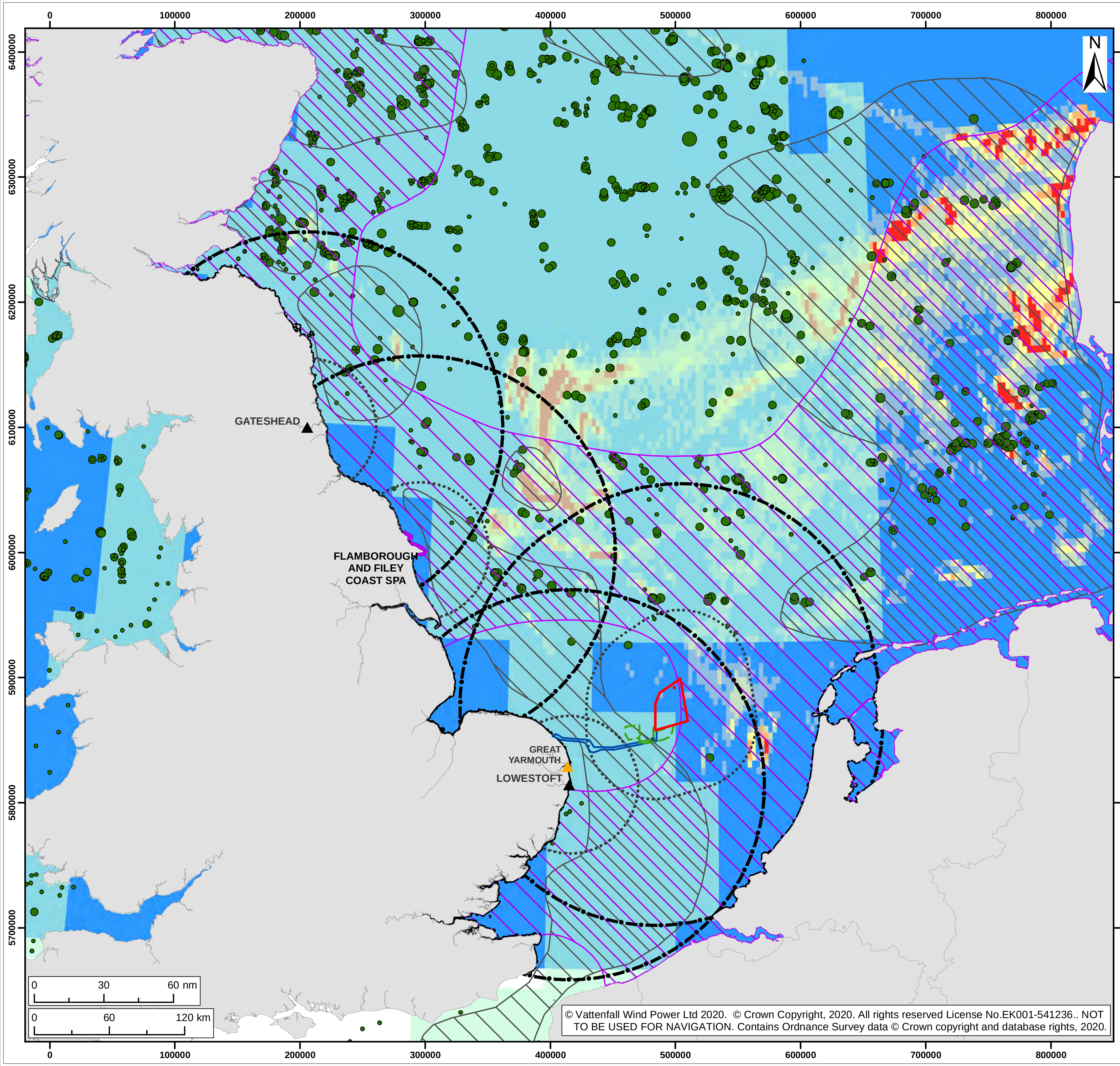
We understand that you have been asked to put forward measures to compensate for potential impacts on Kittiwakes as a result of the Project, and if required these measures are likely to be delivered through the provision of artificial nesting sites. We are aware that artificial nesting sites have previously been successfully constructed at other port and harbour facilities, such as at the Port of Lowestoft outer harbour.

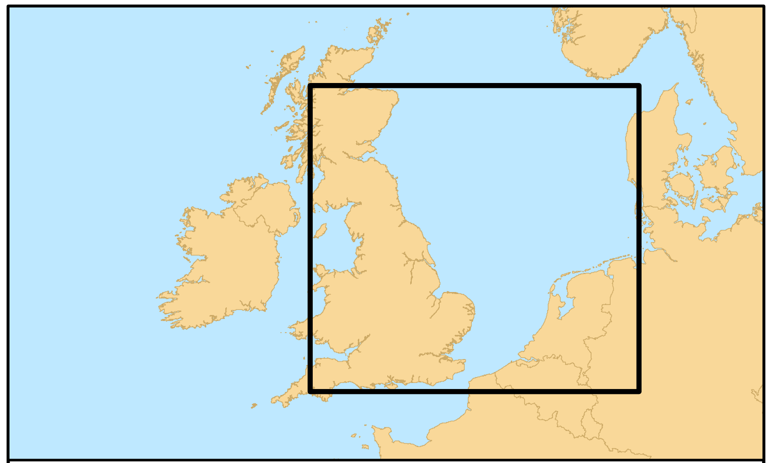
I write to confirm, that should the Applicant be required to compensate for impacts to Kittiwakes as a result of the Project we would, in principle, be willing to assist the Applicant to deliver such artificial nesting sites at The Port of Lowestoft.

Y[redacted]urs sincerely

[redacted]

Andrew Harston
Regional Director
Wales & Short Sea Ports
Associated British Ports





Legend:

- Norfolk Boreas site
- Offshore cable corridor
- Project interconnector search area
- Potential O&M operations location
- Flamborough and Filey Coast SPA[1]

Foraging Ranges[2]

- 55 km
- 156 km

Sprat Nursery Ground

- Sprat grounds[3]

Sandeel Nursery Ground

- Sandeel grounds[3]
- High Intensity[4]
- Low Intensity[4]

Nursery Grounds Maximum Juvenile Catch Rate (n/m^2)[4]

- 1 - 10
- 11 - 100
- 101 - 1,000
- 1,001 - 10,000
- 10,001 +

Danish VMS Effort Sandeel Trawl (2011-2015)[5]

- 0 to 2 days
- 2 to 5 days
- 5 to 10 days
- 10 to 20 days
- 20 to 40 days
- 40 to 80 days
- Over 80 days

[1] JNCC, 2018
[2] Woodward et al. 2019
[3] Coull et al, 1998
[4] Ellis et al, 2010
[5] Ministeriet for Fødevarer, Landbrug og Fiskeri, 2017

Project:	Report:
Norfolk Boreas	In principle Habitats Regulations Derogation Provision of Evidence Appendix 1 Addendum

Title: Sandeel and Sprat Nursery grounds

Figure: 1 Drawing No: PB5640-008-007-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	23/09/2020	JT	DT	A3	1:3,000,000
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Co-ordinate system: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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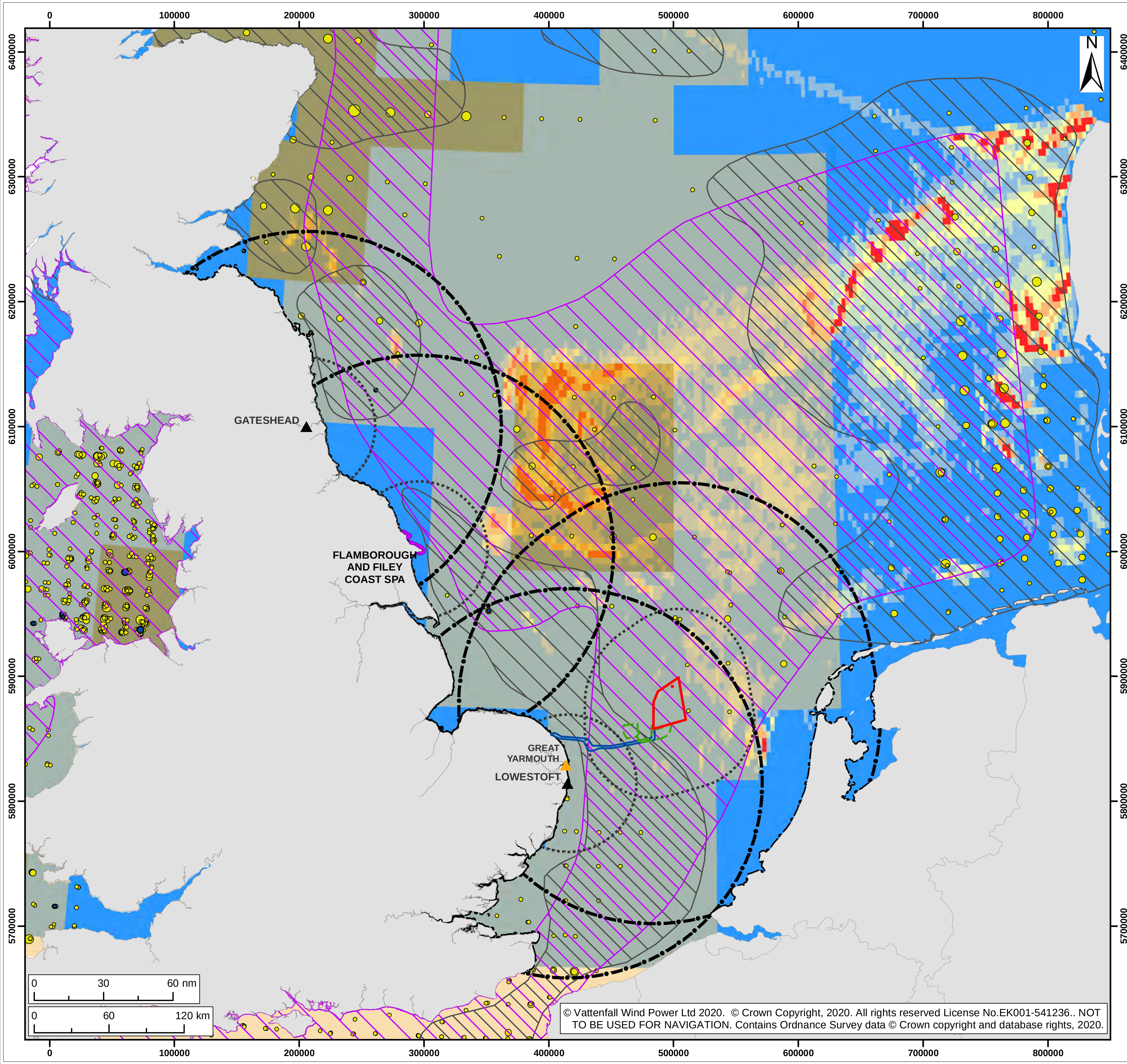

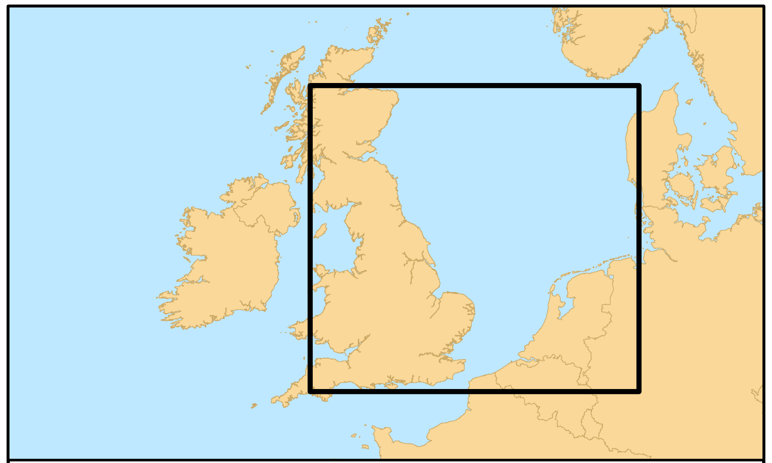

Legend:

- Norfolk Boreas site
- Offshore cable corridor
- Project interconnector search area
- Potential O&M operations location
- Flamborough and Filey Coast SPA[1]

Foraging Ranges[2]

- 55 km
- 156 km

Sprat Spawning Grounds

- Sprat grounds[3]

Sandeel Spawning grounds

- Sandeel grounds[3]
- High Intensity[4]
- Low Intensity[4]

Spawning Grounds Eggs (n/m^2)[4]

- 1 - 10
- 11 - 100
- 101 - 1,000
- 1,001 - 10,000
- 10,001 +

Larvae (n/m^2)[4]

- 1 - 10
- 11 - 100
- 101 - 1,000
- 1,001 - 10,000
- 10,001 +

Danish VMS Effort Sandeel Trawl (2011-2015)[5]

- 0 to 2 days
- 2 to 5 days
- 5 to 10 days
- 10 to 20 days
- 20 to 40 days
- 40 to 80 days
- Over 80 days

[1] JNCC, 2018
[2] Woodward et al. 2019
[3] Coull et al, 1998
[4] Ellis et al, 2010
[5] Ministeriet for Fødevarer, Landbrug og Fiskeri, 2017

Project: Norfolk Boreas

Report: In principle Habitats Regulations Derogation Provision of Evidence Appendix 1 Addendum

Title: Sandeel and Sprat Spawning grounds

Figure: 2 Drawing No: PB5640-008-007-002

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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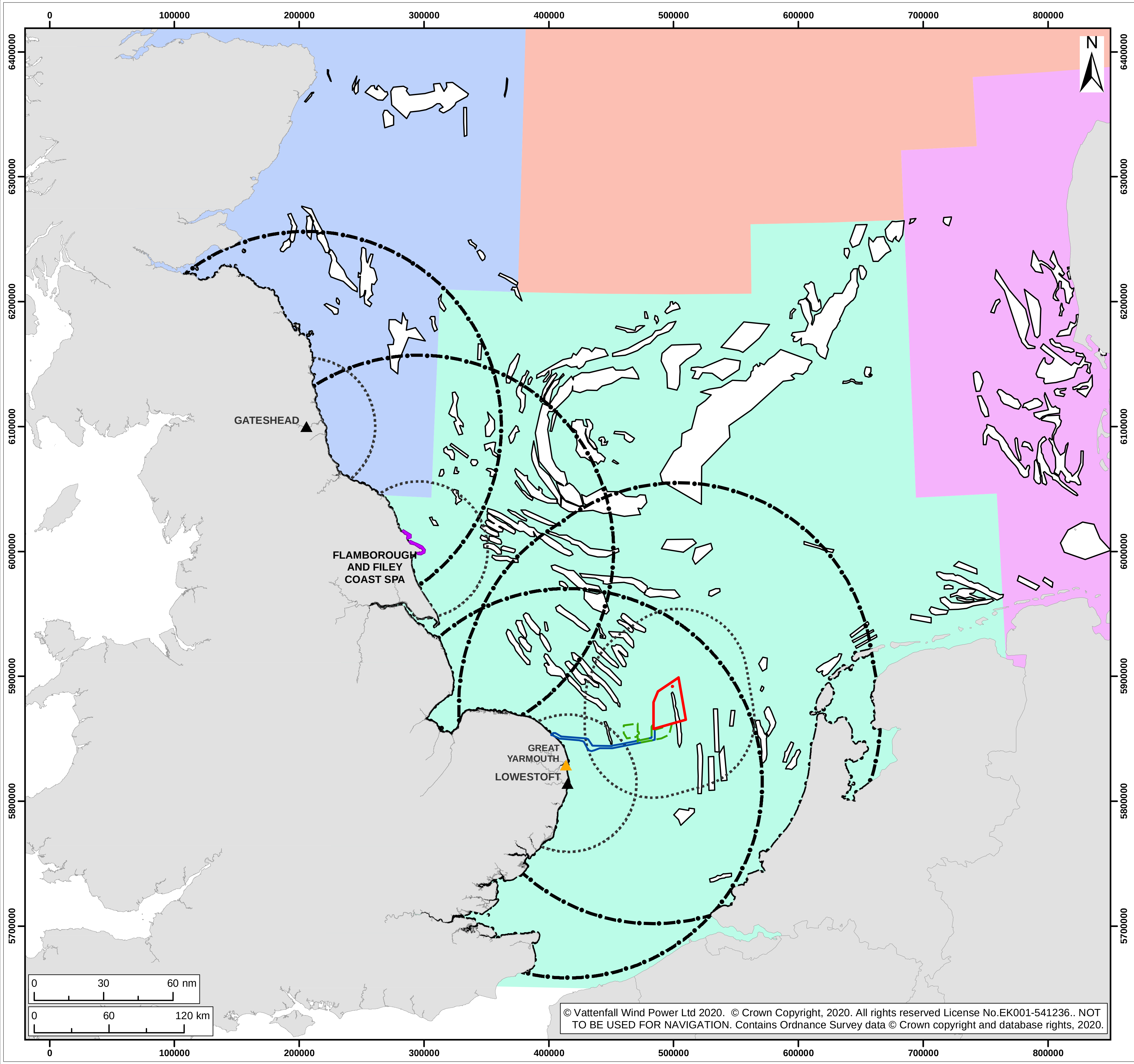

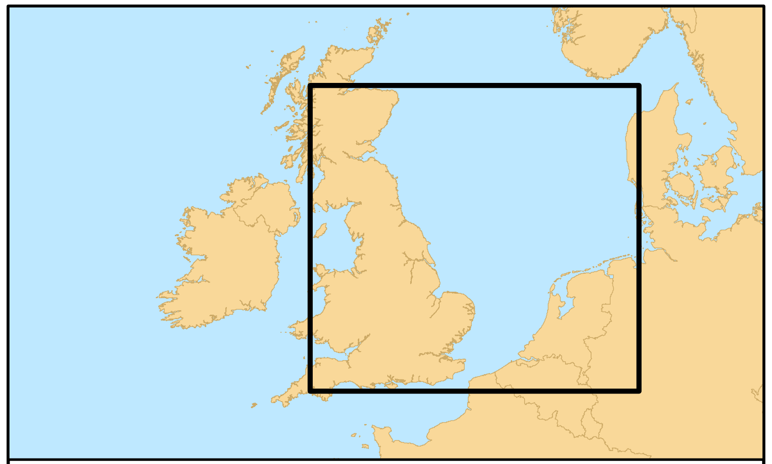

Legend:

- Norfolk Boreas site
- Offshore cable corridor
- Project interconnector search area
- Potential O&M operations location
- Flamborough and Filey Coast SPA[1]

Foraging Ranges[2]

- 55 km
- 156 km
- Sandeel Fishing Banks[3]

Sandeel Assessment Areas[4]

- 1r
- 2r
- 3r
- 4

[1] JNCC, 2018
[2] Woodward et al. 2019
[3] MESL (2011) and Fugro (2016)
[4] Jensen et al. (2011)

Project:	Report:
Norfolk Boreas	In principle Habitats Regulations Derogation Provision of Evidence Appendix 1 Addendum

Title: Sandeel assessment areas

Figure: 3 Drawing No: PB5640-008-007-003

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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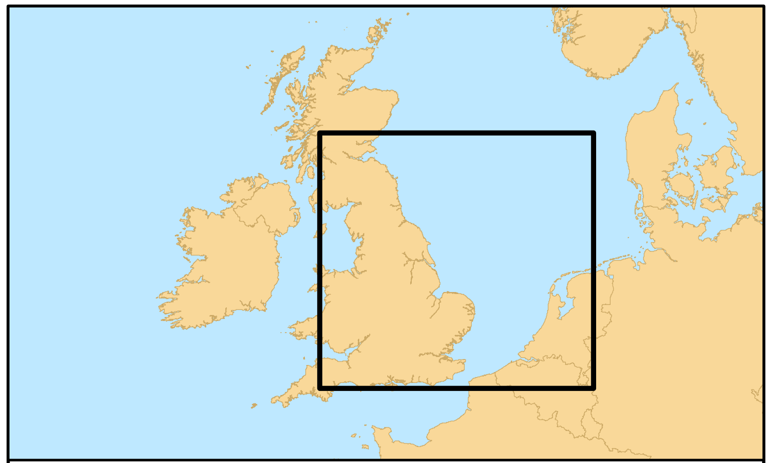

Legend:

- Norfolk Boreas site
- Offshore cable corridor
- Project interconnector search area
- Potential O&M operations location
- Flamborough and Filey Coast SPA[1]

Foraging Ranges[2]

- 55 km
- 156 km
- Wind farm sites[3]

[1] JNCC, 2018
[2] Woodward et al. 2019
[3] TCE, 2018/ 4COFFSHORE Ltd, 2018

Project:	Report:
Norfolk Boreas	In principle Habitats Regulations Derogation Provision of Evidence Appendix 1 Addendum

Title:

Offshore wind farm sites

Figure: 4 Drawing No: PB5640-008-007-004

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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