

Norfolk Vanguard Offshore Wind Farm Habitats Regulations Assessment - Integrity Matrices (Updated)

Applicant: Norfolk Vanguard Limited

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1 INTRODUCTION

1.1 Purpose of this Document

1. This document provides an update to the Norfolk Vanguard Habitats Regulations Assessment (HRA) Integrity Matrices, previously provided in The Applicant's Response to Section 51 Advice from The Planning Inspectorate (document reference PB4476-008-001) and subsequently updated at Deadline 1 (document reference ExA; WQApp23.1; 10.D1.3).
2. The integrity matrices for the following European sites have been updated in response to progress during the Norfolk Vanguard Examination:
 - Alde-Ore Estuary Special Protection Area (SPA) and Ramsar
 - Flamborough and Filey Coast SPA
 - Flamborough Head and Bempton Cliffs SPA
 - Greater Wash SPA
 - Haisborough Hammond and Winterton Special Area of Conservation (SAC)
 - Southern North Sea SAC
3. In addition, integrity matrices for the following sites have been added in response to updates to the screening matrices (document reference ExA;Screening;10.D6.5.2) submitted on 16 April 2019:
 - Breydon Water SPA and Ramsar
 - Broadland SPA and Ramsar
 - North Norfolk Coast SPA and Ramsar
 - Outer Thames Estuary SPA

1.2 European designated sites and qualifying features screened in for the Appropriate Assessment

4. Following screening of potential impacts of Norfolk Vanguard on European designated sites (provided in Appendix 5.1 and 5.2 of the Information to Support Habitats Regulations Assessment (HRA) report (document reference 5.3)), and advice from Natural England received during the course of the project Examination, the following features of European Sites were assessed to determine if there was a risk of Adverse Effects on the Integrity (AEIOI) of their qualifying features in the Information for Habitats Regulations Report.

Table 2.1 European designated sites and qualifying features screened in

Site				Qualifying feature
Alde-Ore	Estuary	SPA	and Ramsar	<ul style="list-style-type: none"> • Breeding lesser black-backed gull <i>Larus fuscus</i>

Site	Qualifying feature
Breydon Water SPA and Ramsar	<ul style="list-style-type: none"> • Wintering and passage waterbird assemblage including as named features Bewick's swan, ruff, golden plover, avocet, lapwing.
Broadland SPA and Ramsar	<ul style="list-style-type: none"> • Wintering and passage waterbird assemblage including as named features shoveler, wigeon, gadwall, Bewick's swan, whooper swan, ruff.
Flamborough and Filey Coast SPA	<ul style="list-style-type: none"> • Breeding kittiwake <i>Rissa tridactyla</i> • Breeding gannet <i>Morus bassanus</i>
Flamborough Head and Bempton Cliffs SPA	<ul style="list-style-type: none"> • Breeding kittiwake <p>*No longer applicable as now encompassed within the Flamborough and Filey Coast SPA. This is not discussed further.</p>
Greater Wash SPA	<ul style="list-style-type: none"> • Non-breeding red-throated diver <i>Gavia stellata</i> • Non-breeding little gull <i>Hydrocoloeus minutus</i>
North Norfolk Coast SPA and Ramsar	<ul style="list-style-type: none"> • Wintering and passage waterbird assemblage including as named features shoveler, wigeon, gadwall, Bewick's swan, whooper swan, ruff.
Outer Thames Estuary SPA	<ul style="list-style-type: none"> • Nonbreeding red-throated divers.
Haisborough Hammond and Winterton SAC	<ul style="list-style-type: none"> • Reef • Sandbanks slightly covered by seawater all the time
Southern North Sea SAC	<ul style="list-style-type: none"> • Harbour porpoise <i>Phocoena phocoena</i>
Humber Estuary SAC	<ul style="list-style-type: none"> • Grey seal <i>Halichoerus grypus</i>
The Wash and North Norfolk SAC	<ul style="list-style-type: none"> • Harbour seal <i>Phoca vitulina</i>
River Wensum SAC	<ul style="list-style-type: none"> • Water courses of plain to montane levels with the <i>Ranunculon fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation • Desmoulin's whorl snail <i>Vertigo moulinsiana</i>
Paston Great Barn SAC	<ul style="list-style-type: none"> • Barbastelle bat <i>Barbastella barbastellus</i>
Norfolk Valley Fens SAC	<ul style="list-style-type: none"> • Alkaline fens • Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> • Calcareous fens <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> • European dry heaths • Molinia meadows on calcareous peaty or clayey-silt-laden soils • Northern Atlantic wet heaths with <i>Erica tetralix</i>
The Broads SAC	<ul style="list-style-type: none"> • Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp. • Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation • Transition mires and quaking bogs • Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> • Alkaline fens • Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i>, <i>Alnion incanae</i>, <i>Salicion albae</i>) • Molinia meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>) • Desmoulin's whorl snail • Fen orchid <i>Liparis loeselii</i>

Site	Qualifying feature
	<ul style="list-style-type: none"> • Ramshorn snail <i>Anisus vorticulus</i> • Otter <i>Lutra lutra</i>

2 INTEGRITY MATRICES

5. The following tables provide the Integrity Matrix for each European site listed in Table 2.1. A summary of the evidence presented in the determination of the risk of AEOI on the relevant qualifying features is detailed within the footnotes of each integrity matrix below with cross references to the Information to Support HRA report (document reference 5.3).
6. The following abbreviations are used within the integrity matrices:
 - Y – AEOI **cannot** be excluded beyond reasonable scientific doubt
 - N - AEOI **can** be excluded beyond reasonable scientific doubt
 - C = construction
 - O = operation
 - D = decommissioning
7. Where effects are not applicable to a particular feature they are greyed out.
8. It should be noted that in some instances the ornithological impact estimates for collision and displacement for the Project alone and in-combination are slightly higher than those presented in previous versions of this document due to the presentation of estimates calculated using Natural England's preferred precautionary methods.

2.1 Alde-Ore Estuary SPA and Ramsar

Name of European Site: Alde-Ore Estuary SPA and Ramsar									
Distance to Norfolk Vanguard Site: 92km									
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality (in-combination)			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Breeding lesser black-backed gulls		N (a)							
<p>a) Band model predictions of collision mortality suggest a maximum of 31.7 collisions per year for lesser black-backed gulls (ExA; CRM; 10.D6.5.1, scenario a with two-thirds of the turbines in NV West and one-third in NV East). A review of population estimates in Norfolk and Suffolk, combined with use of the Scottish Natural Heritage (SNH) apportioning method suggested that 17% of the collisions at Norfolk Vanguard would be attributed to the Alde Ore Estuary SPA population (ExA; AS; 10.D7.21, paragraph 130).</p> <p>During the autumn and spring migration periods birds from Alde-Ore Estuary SPA make up 3.3% of the Biologically Defined Minimum Population Scales (BDMPS) population, and in winter these birds make up 5% of the BDMPS (ExA; AS; 10.D7.21, paragraph 131-132). Applying these percentages to the maximum collision predictions indicates a maximum Alde-Ore Estuary SPA mortality of 4.0 (using the extended breeding season ExA; AS; 10.D7.21, paragraph 136). This represents an increase of 0.9% on natural mortality which is below detection limits (taken as 1%) and so is considered negligible (ExA; AS; 10.D7.21, paragraph 137). Consequently, there will be no adverse effect on the integrity of the Alde-Ore Estuary SPA as a result of lesser black-backed gull collisions at the proposed Norfolk Vanguard project alone (ExA; AS; 10.D7.21, paragraph 138).</p> <p>In-combination assessment suggests mortality of 38 birds attributable to the Alde-Ore SPA population of lesser black-backed gulls (calculated on the basis of the Alde-Ore proportion of the wider population of lesser black-backed gulls, ExA; AS; 10.D7.21, paragraph 149). Compared with estimated natural mortality of about 460 birds per year, the additional in-combination mortality would increase the mortality rate by 8.3%. However, this mortality rate falls to 16.7 in the breeding season and 10 in the non-breeding season, equating to an increase in mortality of 5.8% if as-built wind farm designs are used in place of consented designs (ExA; AS; 10.D7.21, paragraph 151). Including breeding season collisions on the basis of the mean foraging range (72km) reduced the annual in-combination mortality to 30 (ExA; AS; 10.D7.21, paragraph 154).</p> <p>An updated population model was developed (ExA; AS; 10.D6.16) to predict the consequences of additional mortality on the population. At an adult mortality of 40 the growth rate of the population was reduced by 0.4% to 1.3% (for density dependent and density independent simulations respectively) (ExA; AS; 10.D7.21, paragraph 156). Thus, even the more precautionary, density independent prediction, based on consented rather than built wind farms and over-estimated nocturnal activity, was for a growth rate reduction of just over 1% these are considered very unlikely to cause a population decline (ExA; AS; 10.D7.21, paragraph 157). Use of collision estimates for built wind farms generates a density independent prediction of a 0.9% growth rate reduction, which further reduces concerns that in-combination collision would result in a population decline (ExA; AS; 10.D7.21, paragraph 158). The breeding success, and hence the population trend, of lesser black-backed gulls in the Alde-Ore</p>									

Estuary SPA population appears to be mainly determined by the amount of predation, disturbance and flooding occurring at this site (Department of Energy and Climate Change 2013a, Thaxter et al. 2015, ExA; AS; 10.D7.21, paragraph 163). Increased predation and disturbance by foxes has been considered the main factor causing reductions in breeding numbers. Management measures to reduce access by foxes has resulted in some recovery in the numbers of gulls. The main driver of gull numbers in this SPA therefore appears to be suitable management at the colonies to protect gulls from predators (Department of Energy and Climate Change 2013a). This aspect, taken together with the degree of precaution in reported collision assessments for other offshore wind farms, including the use of the much higher mortality predictions estimated for consented wind farm designs rather than for the as built wind farm designs, means the likelihood of an adverse effect on the integrity of the SPA due to in-combination collisions of lesser black-backed gulls is considered sufficiently small that it can be ruled out (ExA; AS; 10.D7.21, paragraph 161).

2.2 Breydon Water SPA and Ramsar

Name of European Site: Breydon Water SPA and Ramsar									
Distance to Norfolk Vanguard Site 53km									
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Wintering and passage waterbird assemblage including as named features Bewick's swan, ruff, golden plover, avocet, lapwing		N (a)							
a) Migrant collision risk modelling undertaken for all the species with potential for connectivity to Norfolk Vanguard on passage found that predicted collisions apportioned to this SPA were very small, only exceeding 1 individual per year for two species: golden plover (1.1) and lapwing (1.2) (ExA; AS; 10.D6.18, paragraph 17). These levels of additional mortality would not increase the background mortality rate by more than 1% and would therefore be undetectable against natural variations. It can therefore be concluded that there would be no adverse effect on the integrity of Breydon Water SPA as a result of collisions at Norfolk Vanguard alone. In-combination collision mortality with the adjacent East Anglia THREE project were similarly very small (increases in background mortality rates remained less than 1%, ExA; AS; 10.D6.18, paragraph 21) leading to the same conclusion of no adverse effect on the integrity of Breydon Water SPA as a result of collisions at Norfolk Vanguard in-combination with other plans and projects (ExA; AS; 10.D6.18, paragraph 21).									

2.3 Broadland SPA and Ramsar

Name of European Site: Broadland SPA and Ramsar									
Distance to Norfolk Vanguard Site 53km									
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Wintering and passage waterbird assemblage including as named features shoveler, wigeon, gadwall, Bewick's swan, whooper swan, ruff		N (a)							
<p>a) Migrant collision risk modelling undertaken for all the species with potential for connectivity to Norfolk Vanguard on passage found that predicted collisions apportioned to this SPA were very small, with none exceeding more than 1 individual per year (ExA; AS; 10.D6.18, paragraph 17). These levels of additional mortality would not increase the background mortality rate by more than 1% and would therefore be undetectable against natural variations. It can therefore be concluded that there would be no adverse effect on the integrity of Broadland SPA as a result of collisions at Norfolk Vanguard alone. In-combination collision mortality with the adjacent East Anglia THREE project were similarly very small (increases in background mortality rates remained less than 1%, ExA; AS; 10.D6.18, paragraph 21) leading to the same conclusion of no adverse effect on the integrity of Broadland SPA as a result of collisions at Norfolk Vanguard in-combination with other plans and projects (ExA; AS; 10.D6.18, paragraph 21).</p>									

2.4 Flamborough & Filey Coast SPA

Name of European Site: Flamborough & Filey Coast SPA									
Distance to Norfolk Vanguard Site: 205km									
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality (in-combination)			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Breeding kittiwake		N (a)							
Breeding gannet		N (b,g)			N (c,g)				
Breeding razorbill					N (d)				
Breeding guillemot					N (e)				
Breeding puffin					N (f)				

a) Collision mortality of kittiwakes at the Norfolk Vanguard site was estimated at 186.1 birds per year. Following a review of tracking data, the number of kittiwakes apportioned to the Flamborough & Filey Coast SPA population was 15.1 using the full breeding season and 15.0 using the migration-free breeding season (ExA; AS; 10.D7.21, paragraph 74). From a population of approximately 89,040 this would increase the background mortality rate by 0.12 which represents a negligible addition to natural mortality. Kittiwake collision mortality due to Norfolk Vanguard alone will therefore have no adverse effect on the integrity of this SPA (ExA; AS; 10.D7.21, paragraph 79). The in-combination assessment suggests a collision mortality of 495.5 (with the inclusion of Hornsea Project Three) and 337.6 (without this project). At the adult mortality rate of 0.146, the natural mortality of the population is 13,000. An addition of up to 495.2 to this would increase the mortality rate by 3.8%, and with the addition of 337.4 (i.e. without Hornsea Project Three) to 2.6% (ExA; AS; 10.D7.21, paragraph 90). Precautionary, density independent population modelling has found that this level of mortality would reduce the median population growth rate by a maximum of 0.6% (note the reduction in growth rate is 0.1% with the inclusion of density dependence, ExA; AS; 10.D7.21, paragraph 92). These reductions represent a very small risk to the population's conservation status, which has grown over the last 20 years (ExA; AS; 10.D7.21, paragraph 94). When allowance is made for the over-precaution in the assessment (e.g. consented designs compared with as-built, over-estimated nocturnal activity rates and density independent model predictions) the predicted impacts on the population are very small (no more than a 0.1% reduction in the population growth rate). Therefore, it can be concluded that there will be no adverse effect on the integrity of Flamborough & Filey Coast SPA from impacts on kittiwake due to Norfolk Vanguard in-combination with other plans and projects (ExA; AS; 10.D7.21, paragraph 96).

b) Collision mortality of gannets at the Norfolk Vanguard site was estimated at 111.7 birds per year, 60% of which was predicted in the autumn. Apportioning of the higher estimate to the Flamborough and Filey Coast SPA population gives an annual mortality of 32.8 individuals, from a population of approximately 22,122 birds (ExA; AS; 10.D7.21, paragraph 15). At an adult natural mortality rate of 0.081, the baseline mortality is approximately 1,792. An addition of 32.8 to this increases the mortality rate by 1.8%. Precautionary, density independent population modelling has found that this level of mortality would reduce the median population growth rate by a

maximum of 0.3%, which compares with the actual annual growth rate of this population over the last 25 years of 10% (ExA; AS; 10.D7.21, paragraph 18). This indicates that this level of mortality at the project alone represents a negligible risk to this population's status. The in-combination assessment suggests a maximum collision mortality of 244 birds from Flamborough & Filey Coast SPA population per year (including Hornsea Project Three; with this project omitted the total is 225). This additional mortality would increase the background mortality rate by up to 13.6% (ExA; AS; 10.D7.21, paragraph 36). Precautionary, density independent population modelling has found that this level of mortality would reduce the median population growth rate by a maximum of 1.1%, which compares with the actual annual growth rate of this population over the last 25 years of 10% (ExA; AS; 10.D7.21, paragraph 39). This indicates that this level of in-combination mortality represents a negligible risk to this population's status. The number of predicted in-combination gannet collisions attributed to the Flamborough & Filey Coast SPA is not at a level which would trigger a risk of population decline, and population modelling in fact indicates that the in-combination mortality predicted would only slow, rather than halt, the population increase currently seen at this colony. Therefore, it can be concluded that there will be no adverse effect on the integrity of Flamborough & Filey Coast SPA from impacts on gannet due to Norfolk Vanguard in-combination with other projects (ExA; AS; 10.D7.21, paragraph 43).

c) Annual displacement mortality of gannet at Norfolk Vanguard apportioned to the Flamborough and Filey Coast SPA population was estimated at between 2.5 (60% displaced, 1% mortality) and 3.3 (80% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 7). This would increase the background mortality by a maximum of 0.04% (ExA; AS; 10.D6.17, paragraph 29) which is less than the threshold for detectability (1%). It is therefore reasonable to conclude that there will be no adverse effect on the integrity of Flamborough and Filey Coast SPA as a result of gannet displacement from Norfolk Vanguard alone (ExA; AS; 10.D6.17, paragraph 29). In-combination displacement mortality of gannets apportioned to the Flamborough and Filey Coast SPA population was estimated at between 49 (60% displaced, 1% mortality) and 65 (80% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 7). This would increase the background mortality by a maximum of 0.85% which is less than the threshold for detectability (1%). It is therefore reasonable to conclude that there will be no adverse effect on the integrity of Flamborough and Filey Coast SPA as a result of gannet displacement from Norfolk Vanguard in-combination with other projects (ExA; AS; 10.D6.17, paragraph 30).

d) Annual displacement mortality of razorbills at Norfolk Vanguard apportioned to the Flamborough and Filey Coast SPA population was estimated at between 0.8 (30% displaced, 1% mortality) and 17.8 (70% displaced, 10% mortality) with an evidence based estimate of 1.3 (50% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 25). This would increase the background mortality by a maximum of 0.3% (ExA; AS; 10.D6.17, paragraph 155) which is less than the threshold for detectability (1%). It is therefore reasonable to conclude that there will be no adverse effect on the integrity of Flamborough and Filey Coast SPA as a result of razorbill displacement from Norfolk Vanguard alone (ExA; AS; 10.D6.17, paragraph 155). In-combination displacement mortality of razorbills apportioned to the Flamborough and Filey Coast SPA population was estimated at between 23 (30% displaced, 1% mortality) and 535 (70% displaced, 10% mortality) with an evidence based estimate of 38 (50% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 25). This would increase the background mortality by a maximum of 8.3% (ExA; AS; 10.D6.17, paragraph 156). These were converted to adult only estimates using an adult proportion of 0.57, giving a worst case (70% displaced, 10% mortality) range of between 230 and 305 (without and with the inclusion of Hornsea Project Three). Precautionary, density independent population modelling has found that this level of mortality would reduce the median population growth rate by a maximum of 1.4%, which compares with the actual annual growth rate of this population between 2000 and 2017 of 7.2% (ExA; AS; 10.D6.17, paragraph 160). This indicates that this level of in-combination mortality represents a negligible risk to this population's status. The number of predicted in-combination razorbill displacement mortalities attributed to the Flamborough & Filey Coast SPA is not at a level which would trigger a risk of population decline. Therefore, it can be concluded that there will be no adverse effect on the integrity of Flamborough & Filey Coast SPA from displacement impacts on razorbill due to Norfolk Vanguard in-combination with other plans and projects (ExA; AS; 10.D6.17, paragraph 163).

e) Annual displacement mortality of guillemots at Norfolk Vanguard apportioned to the Flamborough and Filey Coast SPA population was estimated at between 1 (30% displaced, 1% mortality) and 17 (70% displaced, 10% mortality) with an evidence based estimate of 1 (50% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 28). This would increase the background mortality by a maximum of 0.08% (ExA; AS; 10.D6.17, paragraph 172) which is less than the threshold for detectability (1%). It is therefore reasonable to conclude that there will be no adverse effect on the integrity of Flamborough and Filey Coast SPA as a result of guillemot displacement from Norfolk Vanguard alone (ExA; AS; 10.D6.17, paragraph 172). In-combination displacement mortality of guillemots apportioned to the Flamborough and Filey Coast SPA population was estimated at between 24 (30% displaced, 1% mortality) and 561 (70% displaced, 10% mortality) with an evidence based estimate of 40 (50% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 25). This would increase the background mortality by a maximum of 2.7% (ExA; AS; 10.D6.17, paragraph 173). These were converted to adult only estimates using an adult proportion of 0.57, giving a worst case (70% displaced, 10% mortality) range of between 283 and 323 (without and with the inclusion of Hornsea Project Three). Precautionary, density independent population modelling has found that this level of mortality would reduce the median population growth rate by a maximum of 0.4%, which compares with the actual annual growth rate of this population between 2000 and 2008 of 3.0% and between 2008 and 2017 of 4.0% (ExA; AS; 10.D6.17, paragraph 177). This indicates that this level of in-combination mortality represents a negligible risk to this population's status. The number of predicted in-combination guillemot displacement mortalities attributed to the Flamborough & Filey Coast SPA is not at a level which would trigger a risk of population decline. Therefore, it can be concluded that there will be no adverse effect on the integrity of Flamborough & Filey Coast SPA from displacement impacts on guillemot due to Norfolk Vanguard in-combination with other projects (ExA; AS; 10.D6.17, paragraph 180).

f) Annual displacement mortality of puffins at Norfolk Vanguard apportioned to the Flamborough and Filey Coast SPA population was estimated at between <0.01 (30% displaced, 1% mortality) and 0.12 (70% displaced, 10% mortality) with an evidence based estimate of <0.01 (50% displaced, 1% mortality) (ExA; AS; 10.D6.17, Table 23). This would increase the background mortality by a maximum of 0.02% (ExA; AS; 10.D6.17, paragraph 141) which is less than the threshold for detectability (1%). It is therefore reasonable to conclude that there will be no adverse effect on the integrity of Flamborough and Filey Coast SPA as a result of puffin displacement from Norfolk Vanguard alone (ExA; AS; 10.D6.17, paragraph 141). Given the level of mortality attributable to Norfolk Vanguard it is arguable that this project makes such a small contribution to the in-combination total that there is no requirement to undertake the incombination assessment. It is important to note that the Flamborough and Filey Coast SPA population is almost certainly significantly underestimated due to its inaccessibility and puffin nesting habits (ExA; AS; 10.D6.17, paragraph 144). It should also be noted that the HRA for Hornsea Project Two concluded: *"The Secretary of State recognises the methodological disagreements between the parties. He has considered the representations made by the Applicant, NE and the RSPB and the recommendation as made by the ExA. The Secretary of State agrees with the recommendations of the ExA, NE and the Applicant and is satisfied that the potential increased auk species displacement mortality as a result of the Project in-combination would not represent an adverse effect upon the integrity of the FFC pSPA. For this conclusion he places particular weight on the advice of NE that predicted mortalities for the Project in-combination would not exceed a level whereby the growth rate of the populations would be reduced by more than 0.4% p.a. for guillemot, 0.5% p.a. for razorbill, and 0.25% p.a. for puffin."* Projects consented since Hornsea Project Two have added only 3.47% to the in-combination total (ExA; AS; 10.D6.17, paragraph 146). Therefore, on the basis of the precautionary assumptions in the assessment, the Secretary of State's conclusion in relation to Hornsea Project Two, and the small additional contributions for recent projects, it can be concluded that there will be no adverse effect on the integrity of the Flamborough and Filey coast SPA from impacts on puffin due to the proposed Norfolk Vanguard project in-combination with other plans and projects (ExA; AS; 10.D6.17, paragraph 146).

g) Combined annual gannet displacement and collision mortality (as requested by Natural England) was estimated for all projects with potential connectivity to the Flamborough and Filey Coast SPA gave a mortality estimate of 294 to 310 (ExA; AS; 10.D7.21, paragraph 45). This would increase the background mortality rate between 16.4% and 17.3% (ExA; AS; 10.D7.21, paragraph 46). Precautionary, density independent population modelling has found that this level of mortality would reduce the median population growth rate by a maximum of 1.5%, which compares with the actual annual growth rate of this population over the last 25 years of 10% (ExA; AS;

10.D7.21, paragraph 48-49). This indicates that this level of in-combination mortality represents a negligible risk to this population's status. The number of predicted in-combination gannet collisions and displacement mortalities attributed to the Flamborough & Filey Coast SPA is not at a level which would trigger a risk of population decline, and population modelling in fact indicates that the in-combination mortality predicted would only slow, rather than halt, the population increase currently seen at this colony. Therefore, it can be concluded that there will be no adverse effect on the integrity of Flamborough & Filey Coast SPA from impacts on gannet due to this highly precautionary combined assessment of displacement and collision risk for Norfolk Vanguard in-combination with other projects (ExA; AS; 10.D7.21, paragraph 51).

2.5 Greater Wash SPA

Name of European Site: Greater Wash SPA

Distance to Norfolk Vanguard Site: 36km (a)

Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Nonbreeding red-throated divers				N (b)	N (c)				
Nonbreeding little gull		N (d)							

a) Note that this distance refers to the offshore wind farm itself. The export cable will pass through the SPA.

b) Cable laying operations during construction will disturb birds from the immediate vicinity of (up to two) cable-laying vessels (ExA; AS; 10.D6.17, paragraph 190). Assessment indicates that between 34 and 85 red-throated divers could be displaced at any one time during cable laying, but only if both vessels are operating within the SPA at the same time (ExA; AS; 10.D6.17, paragraph 195). This would lead to a 0.7% increase in diver density in other parts of the SPA, and on the basis of a highly precautionary maximum mortality rate associated with the displacement of red-throated diver by vessels in the wintering period of 10% (i.e. 10% of displaced individuals suffer mortality as a direct consequence). This leads to a highly precautionary assumption that a single instance of displacement is equivalent to nearly half the total annual adult mortality rate. At this level of additional mortality, a maximum of between 4 and 8 birds could be at risk of mortality across the entire winter period (September to April) as a result of any potential displacement effects from the offshore cable installation activities. However, owing to the Rochdale envelope approach and the nature of the calculations employed, this almost certainly over-estimates the duration of cable laying by a factor of around 7, since even travelling at the minimum speed of 30m per hour, if a working day lasts for 12 hours the vessel would traverse the SPA in approximately 40 days (assuming the cable route through the SPA is around 15km). Baseline average mortality is 0.228, therefore the estimated natural mortality for the SPA population (1,407), would be 321. The addition of a maximum of 4 to 8 to this total during a single year would increase the mortality rate in that year by approximately 1.3% to 2.6% (ExA; AS; 10.D6.17, paragraph 195). However, as this is based on highly precautionary assumptions about the magnitude and impact of displacement and would only be expected to apply during a single nonbreeding season (and only then if cable laying by two vessels occurs simultaneously within the SPA during the nonbreeding period), it is reasonable to conclude that

Name of European Site: Greater Wash SPA

Distance to Norfolk Vanguard Site: 36km (a)

there will be no adverse effect on the integrity of the Greater Wash SPA as a result of red-throated diver displacement due to cable laying for Norfolk Vanguard alone (ExA; AS; 10.D6.17, paragraph 196). There is potential that the export cable for Hornsea Project Three could be installed during the same period as for Norfolk Vanguard, giving rise a potential in-combination effect. The in-combination mortality for Norfolk Vanguard and Hornsea Project Three is between 6 and 10 individuals, although the likelihood of construction occurring over the same period is considered to be very small. The addition of a maximum of 6 to 10 to the baseline mortality of 300 during a single year would increase the mortality rate in that year by approximately 2% to 3.3%, while at the Applicant's evidence based rates this would be 0.3% (ExA; AS; 10.D6.17, paragraphs 198-199). However, this assessment is based on a combination of highly precautionary assumptions about the magnitude and impact of displacement and the potential for temporal overlap between the projects. This in-combination effect would only be expected to occur during a single nonbreeding season, if both cable laying vessels planned for Norfolk Vanguard are present at the same time, and this was also at the same time when those for Hornsea Project Three are present, and furthermore that this combination of events occurs within the SPA during the nonbreeding period (which is the least favoured period for such work due to less suitable weather conditions). If any of these conditions is not met, then there would not be an in-combination impact (ExA; AS; 10.D6.17, paragraph 200). Therefore, it is concluded that there is a negligible risk of an adverse effect on the integrity of the Greater Wash SPA due to this potential in-combination construction impact.

c) Natural England raised a concern with the Applicant that vessels transiting the Greater Wash SPA between the operations and maintenance port (the location of which is not yet confirmed) and the wind farm sites could cause disturbance to red-throated divers. However, Natural England also stated that their concern would be removed if best practice management measures were put in place to minimise such risks (ExA; AS; 10.D6.17, paragraph 202). The Applicant has agreed to these measures which are included in the DCO submitted on 16 April 2019 and noted in an updated version of PEMP (document 8.14 version 2) submitted at Deadline 7, and therefore there will be no adverse effect on the integrity of the Greater Wash SPA due to operation and maintenance vessel traffic (ExA; AS; 10.D6.17, paragraph 203).

d) Collision mortality of little gull at the Norfolk Vanguard site was estimated to be 8.3 individuals (ExA; AS; 10.D7.21, Table 24). The estimated regional population of little gull is approximately 10,000 to 20,000, of which the Greater Wash SPA population of 1,255 represents 6.3% to 12.6%. Collisions at Norfolk Vanguard would therefore affect 1 individual from the Greater Wash SPA. This would increase the background mortality rate by between 0.2% and 0.4% (assuming a wider populations of 20,000 and 10,000, respectively). This level of additional mortality due to collisions at Norfolk Vanguard alone will have an undetectable effect on the population and would not result in an adverse effect on the integrity of the Greater Wash SPA. An in-combination assessment estimated the total collision mortality for wind farms in the southern North Sea with potential connectivity to the Greater Wash SPA to be 63.3 (ExA; AS; 10.D7.21, paragraph 186). For wider population estimates of 10,000, 20,000 and 75,000 this would increase the background mortality for the SPA population by 3.2%, 1.6% and 0.5% respectively (ExA; AS; 10.D7.21, paragraph 187). This increase in mortality rate is based on consented wind farm designs rather than as-built ones. Updating for this, and also the recently revised design for Triton Knoll (turbine number reduction from 288 to 90) would reduce the increase in background mortality to 1% (ExA; AS; 10.D7.21, paragraph 187). The Secretary of State assessed an in-combination total mortality of 7 for the Greater Wash SPA population in relation to the application for a non-material change at Triton Knoll and concluded that '*such a small impact would be undetectable in the SPA population*' (ExA; AS; 10.D7.21, paragraph 188). Thus, on the basis of the very small magnitude of impact on the little gull population of the Greater Wash SPA the likelihood of an adverse effect on the integrity of the SPA can be ruled out for Norfolk Vanguard in-combination with other projects (ExA; AS; 10.D7.189).

2.6 North Norfolk Coast SPA and Ramsar

Name of European Site: North Norfolk Coast SPA and Ramsar									
Distance to Norfolk Vanguard Site 80km									
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Wintering and passage waterbird assemblage including as named features shoveler, wigeon, gadwall, Bewick's swan, whooper swan, ruff		N (a)							
a) Migrant collision risk modelling undertaken for all the species with potential for connectivity to Norfolk Vanguard on passage found that predicted collisions apportioned to this SPA were very small, with none exceeding more than 1 individual per year (ExA; AS; 10.D6.18, paragraph 17). These levels of additional mortality would not increase the background mortality rate by more than 1% and would therefore be undetectable against natural variations. It can therefore be concluded that there would be no adverse effect on the integrity of North Norfolk Coast SPA as a result of collisions at Norfolk Vanguard alone. In-combination collision mortality with the adjacent East Anglia THREE project were similarly very small (increases in background mortality rates remained less than 1%, ExA; AS; 10.D6.18, paragraph 21) leading to the same conclusion of no adverse effect on the integrity of North Norfolk Coast SPA as a result of collisions at Norfolk Vanguard in-combination with other plans and projects (ExA; AS; 10.D6.18, paragraph 21).									

2.7 Outer Thames Estuary SPA

Name of European Site: Outer Thames Estuary SPA									
Distance to Norfolk Vanguard Site: 21km									
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard								
	Collision mortality			Displacement/Disturbance			Barrier Effect		
	C	O	D	C	O	D	C	O	D
Nonbreeding red-throated divers					N (a)				

Name of European Site: Outer Thames Estuary SPA

Distance to Norfolk Vanguard Site: 21km

a) Natural England raised a concern with the Applicant that vessels transiting the Outer Thames Estuary SPA between the operations and maintenance port (the location of which is not yet confirmed) and the wind farm sites could cause disturbance to red-throated divers. However, Natural England also stated that their concern would be removed if best practice management measures were put in place to minimise such risks (ExA; AS; 10.D6.17, paragraph 202). The Applicant has agreed to these measures which have been included in the DCO submitted on 16 April 2019 and noted in an updated version of PEMP (document 8.14 version 2) submitted at Deadline 7, and therefore there will be no adverse effect on the integrity of the Outer Thames Estuary SPA due to operation and maintenance vessel traffic (ExA; AS; 10.D6.17, paragraph 203).

2.8 Haisborough Hammond and Winterton SAC

Name of European Site: Haisborough Hammond and Winterton SAC

Distance to Norfolk Vanguard: 0km (cable route intersects the SAC)

Site Features	Adverse Effect on Integrity due to Norfolk Vanguard														
	Temporary physical disturbance			Habitat loss			New substrate			Increased suspended sediment and smothering			In combination		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Annex I Sandbank slightly covered by seawater all the time	N (a, b)	N (a, c)	N (a, i)		N (a, d)			N (a, d)					N (a, e)	N (a, e)	N (a, i)
Annex I Reef (<i>Sabellaria spinulosa</i> reefs)	N (a, f)	N (a, f)	N (a, i)		N (a, d)			N (a, g)		N (a, h)		N (a, i)	N (a, b)	N (a, b)	N (a, i)

a) The wording of the Transmission DMLs (DCO Schedules 11 and 12), Condition 9(1)(m) ensures that a conclusion of no AEOL can be made at the consenting stage as construction cannot commence until the MMO is satisfied, in consultation with Natural England, that there is 'no adverse effect beyond reasonable scientific doubt' on the Haisborough, Hammond and Winterton (HHW) SAC. The condition requires that a HHW SAC Site Integrity Plan (SIP), in accordance with the Outline HHW SAC SIP (document reference 8.20), is agreed with the MMO in consultation with Natural England prior to construction.

b) The Outline HHW SAC SIP (document reference 8.20) shows that the aim of the installation strategy for cables in the SAC would be to bury cables below the mobile

Name of European Site: Haisborough Hammond and Winterton SAC

Distance to Norfolk Vanguard: 0km (cable route intersects the SAC)

sandwaves to avoid or minimise the requirement for routine re-burial of cables during the operational phase to ensure the effects are localised and temporary. Sediment arising from any pre-sweeping (dredging) within the SAC must be deposited within the SAC in accordance with Section 5.4 of the Outline HHW SAC SIP. A Sandwave study by ABPmer (Appendix 7.1 of the Information to Support HRA report) concluded that, as sediment will remain within the boundaries of the SAC within the natural limits, there will be no significant change to sandbank extent, topography and sediment composition. Once re-deposited on the seabed, the sediment will immediately re-join the local and regional sediment transport system and therefore the dredging and associated disposal will not affect the form or function of the sandbanks or the sandbank communities which are adapted to natural disturbance and are therefore likely to be able to recover within a few tidal cycles. The location(s) of sediment disposal will be informed by the pre-construction surveys and a primary aim of the sediment disposal strategy (i.e. locations and methodology for disposal) will be to facilitate recovery. The strategy will also be informed by any available evidence regarding recovery from other relevant projects. The cable installation strategy and the location(s) and methodology for disposal must be agreed with the MMO in consultation with Natural England through the HHW SAC SIP before works can commence.

The maximum area of temporary physical disturbance (2.45km^2) due to cable laying operations, including pre-sweeping equates to 0.37% of the sandbanks¹ and 0.17% of the total area of the SAC². Any additional area associated with sediment disposal will be a factor of the disposal areas to be agreed with the MMO in consultation with Natural England and as discussed above, deposited sediment will immediately re-join the local and regional sediment transport system. The Sandwave study by ABPmer (Appendix 7.1 of the Information to Support HRA report) concluded that as the cable corridor is oriented in most cases transverse to the sand wave crests which require levelling, only a small width of each sand wave would be disturbed, with the sand wave continuing to evolve and migrate along most of its length. As a result, the overall form and function of any particular sand wave, or the SAC sandbank system as a whole, would not be disrupted by cable installation activities. The cable corridor is in an active and highly dynamic environment, governed by current flow speeds, water depth and sediment supply, all of which are conducive for the development and maintenance of sandbanks. As a result, there would be no adverse effect on site integrity.

- c) The Outline HHW SAC SIP (document reference 8.20) shows that the aim of the installation strategy for cables in the SAC would be to bury cables below the mobile sandwaves to avoid or minimise the requirement for routine re-burial of cables during the operational phase to ensure the effects are localised and temporary. The Information to Support HRA report (document 5.3) considers a worst case scenario disturbance area for cable reburial activities within the SAC which equates to 0.4km^2 over the life of the project (0.03% of the total area of the SAC or 0.06% of the sandbank area). This is estimated from 4km per cable pair within the SAC, with a disturbance width of 10m. However, if reburial is required, it is likely that this would be for shorter sections (e.g. 1km) at any one time (Information to Support HRA report, paragraph 375) and recovery would occur between any reburial operations.

While it is not possible to determine the number and location of any repair works that may be required during the life of the project, an estimated average of one export cable repair every 10 years within the SAC is included in the Information to Support HRA (document 5.3). It is estimated that 300m sections would be removed

¹ The area of the Annex 1 Sandbank feature in the Haisborough, Hammond and Winterton SAC is 668.928km^2 (66,892.8ha) as quoted in the Natura 2000 Standard Data Form <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=UK0030369>

² The Haisborough, Hammond and Winterton SAC is $1,467.59\text{ km}^2$

Name of European Site: Haisborough Hammond and Winterton SAC

Distance to Norfolk Vanguard: 0km (cable route intersects the SAC)

and replaced per repair with a disturbance width of 10m and therefore an area of 3,000m² (0.003km²) per repair combined with approximately 150m² for any anchor placement associated with repair works (based on 6 anchors per vessel). Due to the short term, temporary nature and small scale of any maintenance works (if required) there would be no effect on the form or function of the sandbank systems or on the sandbank communities and therefore no adverse effect on site integrity.

- d) The worst case total area of cable protection installed within the SAC could be 0.03km² which includes cable protection required for crossing existing cables as well as a contingency in the unlikely event that cable burial is not possible. Norfolk Vanguard Limited has committed to reducing the cable protection contingency from 10% to 5% of the length of each cable pair. Analysis of geophysical data, including an Interim Cable Burial Study (Appendix 1 of the Outline HHW SAC SIP) has shown that the substrate along at least 95% of the offshore cable corridor is expected to be suitable for cable burial. The worst case scenario footprint of cable protection equates to 0.03km² (0.002% of the total area of the SAC² and 0.004% of the area of sandbanks¹ within the SAC). Due to the very small extent of potential persistent loss of Sandbank within the SAC, there would be no change to the physical processes associated with the sandbank form and function and no significant loss of the low abundance and low diversity sandbank communities. As a result, there would be no AEOI on the Annex 1 Sandbank.

The location and extent of *S. spinulosa* reef and therefore the overlap of the permanent infrastructure (i.e. cable protection) with reef feature is unknown and will be detailed in the final SIP based on the pre-construction surveys. It is expected that there will be no loss of reef where micro-siting can be undertaken (section 5.2 of the Outline HHW SAC SIP, document 8.20). *S. spinulosa* can also be expected to colonise cable protection, although Norfolk Vanguard Limited recognises that Natural England does not consider this to be Annex 1 reef. Norfolk Vanguard Limited maintains that any reef, regardless of what it is growing on, would have the same effect on biodiversity, noting also that the large area to be managed as reef which has been identified in relation to the DEFRA joint recommendation area is located on existing pipelines. In addition, Annex B of Natural England's Deadline 6 submission in relation to The Joint Nature Conservation Committee's and Natural England's advice to the MMO for protecting designated features in Haisborough Hammond and Winterton SCI/cSAC (document reference Rep6-032) states that "*Sabellaria spinulosa* reef extent is identified along the Baird Bacton pipeline, as in the HHW SAC SAD [Selection Assessment Document] and Regulation 35 package"

- e) Chapter 8 Marine Geology, Oceanography and Physical Processes of the Norfolk Vanguard ES (DCO document reference 6.1) states that theoretical bed level changes of up to 2mm are estimated as a result of cumulative effects of Norfolk Vanguard cable installation and dredging at nearby aggregate sites. This level of effect has no potential to affect the SAC and therefore the only project screened in to the in-combination assessment is Norfolk Boreas (Information to Support HRA report, paragraph 391). As Norfolk Vanguard and Norfolk Boreas share an offshore cable corridor there is potential for in-combination effects associated with construction, operation and maintenance, and decommissioning of the projects (Information to Support HRA report, paragraph 392). It is likely that installation of the Norfolk Boreas export cables will follow the Norfolk Vanguard export cables with no temporal overlap. There will be a minimum separation of 75m between cable pairs (as shown in Figure 11 of the Export Cable Installation Study, ES Appendix 5.1) and the maximum width of disturbance from pre-sweeping is 37m (Section 7.3.2.2.1 of the Information to Support HRA report), therefore there would be no repeated disturbance of the same footprint during construction. The spatial footprint of installation works for both Norfolk Vanguard and Norfolk Boreas is likely to be double that of Norfolk Vanguard alone as a worst case scenario, however the Sandwave study by ABPmer (Appendix 7.1 of the Information to Support HRA report) considered Norfolk Vanguard and Norfolk Boreas, and as discussed above, the study concluded that as the cable corridor is oriented in most cases transverse to the sand wave crests which require levelling, only a small width of each sand wave

Name of European Site: Haisborough Hammond and Winterton SAC

Distance to Norfolk Vanguard: 0km (cable route intersects the SAC)

would be disturbed, with the sand wave continuing to evolve and migrate along most of its length. As a result, the overall form and function of any particular sand wave, or the SAC sandbank system as a whole, would not be disrupted by cable installation activities of Norfolk Vanguard and Norfolk Boreas. The cable corridor is in an active and highly dynamic environment, governed by current flow speeds, water depth and sediment supply, all of which are conducive for the development and maintenance of sandbanks. As a result, there would be no adverse effect on site integrity.

- f) Due to the width available for micro-siting to avoid *S. spinulosa* reef where identified during pre-construction surveys, it is likely that no physical disturbance will occur in the offshore cable corridor (Information to Support HRA report, paragraph 409-410). In the unlikely event of disturbance, *S. spinulosa* shows good recoverability to disturbance, depending on the degree of impact and local conditions. Due to the existing presence of *S. spinulosa* reef, local environmental conditions in the area are known to be suitable for *S. spinulosa* growth and therefore recovery (Information to Support HRA report, paragraph 411, 416-423). Condition 9(1)(m) of the Transmission DMLs (Schedules 11 and 12) requires that the cable route through the HHW SAC, including any micro-siting must be agreed with the MMO in consultation with Natural England, through the HHW SAC SIP in accordance with the Outline HHW SAC SIP.
- g) Any new substrata created by cable protection may provide a larger area of suitable *S. spinulosa* substrate than was previously present. Therefore, there is no adverse effect on the integrity of the SAC in relation to the conservation objectives for Annex I *S. spinulosa* reefs due to introduction of a new substrate during operation (Information to Support HRA report, paragraph 452). As discussed in d) Norfolk Vanguard Limited recognises that Natural England does not consider reef on artificial substrate (i.e. cable protection) to be Annex 1 reef, However Norfolk Vanguard Limited maintains that any reef, regardless of what it is growing on, would have the same effect on biodiversity. The large area to be managed as reef which has been identified in relation to the DEFRA joint recommendation area is located on existing pipelines and Annex B of Natural England's Deadline 6 submission in relation to The Joint Nature Conservation Committee's and Natural England's advice to the MMO for protecting designated features in Haisborough Hammond and Winterton SCI/cSAC (document reference Rep6-032) states that "*Sabellaria spinulosa* reef extent is identified along the Baird Bacton pipeline, as in the HHW SAC SAD [Selection Assessment Document] and Regulation 35 package".
- h) As part of the embedded mitigation, sediment would not be disposed of within 50m of *S. spinulosa* reef and therefore changes to the extent or structure of the reef due to increased suspended solids and smothering are not anticipated (Information to Support HRA report, paragraph 470). The location(s) and methodology for disposal (i.e. release near the seabed or water surface) must be agreed with the MMO in consultation with Natural England before works can commence in accordance with the Outline HHW SAC (secured by Condition 9(1)(m) of the Transmission DMLs (Schedules 11 and 12)).
- i) It is expected that the potential effects during decommissioning will be no worse than construction (Information to Support HRA report, paragraphs 453, 457, 478, and 480). The effect of leaving cable protection *in situ* is captured in the consideration of permanent impacts above.

2.9 Southern North Sea SAC

Name of European Site: Southern North Sea SAC																					
Distance to Norfolk Vanguard 0km (the site is within the Southern North Sea SAC)																					
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard																				
	Auditory injury			Disturbance from underwater noise			Disturbance from vessels			Collision risk			Changes to prey resource			Changes to water quality			In combination		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Harbour porpoise	N(a)	N(a)	N(a)	N(b)	N(c)	N(d)	N(e)	N(c,e)	N(d,e)	N(f)	N(c)	N(d,f)	N(g)	N(c,g)	N(d,g)	N(h)		N(d,h)	N(i)	N(j)	N(d,i)
	<p>a) A Marine Mammal Mitigation Protocol (required under and Schedules 9 and 10 Part 4 condition 14(1)(f) and Schedules 11 and 12 Part 4 condition 9(1)(f)) will avoid potential for auditory injury (Information to Support HRA report, paragraph 645).</p> <p>b) Noise disturbance during piling and other construction activities is anticipated to be low, with a worst-case scenario of up to 10% overlap with the Southern North Sea (SNS) SAC winter area or up to 9.4% overlap with the summer SNS SAC area (Information to Support HRA report, Table 8.26) and a 3% seasonal average for the summer or winter areas ((Information to Support HRA report, Table 8.27). Therefore, temporary disturbance of harbour porpoise would be less than thresholds recommended by the Joint Nature Conservation Committee (JNCC) and Natural England of 20% of the seasonal component of the SAC area at any one time and less than 10% of the average seasonal component of the SAC area over the duration of that season.</p> <p>c) Operational and maintenance impacts are likely to be localised around the project infrastructure, and any maintenance impacts would be intermittent and temporary, therefore no AEOL would occur. (Information to Support HRA report, paragraphs 790; 792; 793; 798; 800; 801; 806; 808; 809; 830; 832; 833; 834)</p> <p>d) It expected that the activity levels and potential effects during decommissioning will be no worse than construction (with no pile driving). Information to Support HRA report, paragraphs 839; 840; 841; 842; 843)</p> <p>e) The NV West area (295km²) is approximately 1% of the summer SNS SAC/ area and the NV East area (297km²) is also approximately 1% of the summer SAC area. The total offshore cable corridor area (237km²) is less than 1% of the summer SAC area and less than 2% of the winter SAC area. It is unlikely that vessels would cause disturbance from the whole project areas and therefore this provides a conservative assessment. Disturbance from vessels is likely to be localised to areas of activity, thus there would be no exceedance of the 20% seasonal component at any one time or 10% of the average seasonal component thresholds and therefore there will be no AEOL. (Information to Support HRA report, paragraphs 734; 739)</p> <p>f) Approximately 1,180 vessel movements are estimated over the two to four year indicative offshore construction window, an average of approximately two vessel movements per day (Information to Support HRA report, paragraphs 742; 743). It is expected that harbour porpoise</p>																				

Name of European Site: Southern North Sea SAC

Distance to Norfolk Vanguard 0km (the site is within the Southern North Sea SAC)

would be able to detect the presence of vessels and, given that they are highly mobile, would be able to largely avoid vessel collision (Information to Support HRA report, paragraph 747), therefore there would be no AEOI.

g) Potential effects on fish species include physical disturbance, loss or changes of habitat, increased suspended sediment concentrations, and underwater noise. It is anticipated that as a worst-case scenario effects from the NV West area (295km²) would impact approximately 1% of the summer Southern North Sea SAC area, and for the NV East area (297km²), approximately 1% of the summer SAC area, and/or for the total offshore cable corridor area (237km²), less than 1% of the summer SAC area and less than 2% of the winter SAC area (Information to Support HRA report, paragraph 760). However, it is more likely that effects would be restricted to an area around the working sites, therefore no AEOI.

h) The NV West area (295km²) is approximately 1% of the summer Southern North Sea SAC area, the NV East area (297km²) is also approximately 1% of the summer cSAC area. The total offshore cable corridor area (237km²) is less than 1% of the summer SAC area and less than 2% of the winter SAC area. It is highly unlikely that any changes in water quality (suspended sediment) could occur over the entire offshore development area during construction therefore this is a highly conservative assessment (Information to Support HRA report, paragraph 770). It is more likely that effects would be restricted to an area around the working sites, therefore there would be no exceedance of the 20% seasonal component at any one time or 10% of the average seasonal component thresholds and therefore there will be no AEOI.

i) It is anticipated that through the SNS SAC Site Integrity Plan (SIP) (required under and Schedules 9 and 10 Part 4 condition 14(m) and Schedules 11 and 12 Part 4 condition 9(l)), impacts of underwater noise from construction and decommissioning will be mitigated. The Plan will set out the approach for Norfolk Vanguard Limited to deliver any project mitigation or management measures in relation to the SNS SAC in agreement with the Marine Management Organisation (MMO) and relevant Statutory Nature Conservation Bodies (SNCBs) to an extent whereby no AEOI is expected. (Information to Support HRA report, paragraph 882)

(j) Current data suggests that there is no lasting disturbance or exclusion of harbour porpoise around wind farm sites during operation and therefore there would be no AEOI.

2.10 Humber Estuary SAC

Name of European Site: Humber Estuary SAC

Distance to Norfolk Vanguard 112km

Site Features	Adverse Effect on Integrity due to Norfolk Vanguard														
	Disturbance at haul out sites			Collision risk			Disturbance of seals foraging at sea			In combination at haul out sites			In combination at sea		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Grey seal	N (a)	N (a)	N (a)	N (b)			N (c)	N (c)	N (c)	N (a)	N (a)	N (a)	N (d)	N (e)	N (d)
<p>a) Vessels would be highly unlikely to be within 300m of the coast, in areas of close proximity to the seal haul-out sites within the Humber Estuary SAC, therefore there would be no potential for AEOL. (Information to Support HRA report, paragraph 985; 986)</p> <p>b) Approximately 1,180 vessel movements are estimated over the two to four year indicative offshore construction window, an average of approximately two vessel movements per day. It is expected that seals would be able to detect the presence of vessels and, given that they are highly mobile, would be able to largely avoid vessel collision. (Information to Support HRA report, paragraph 989)</p> <p>c) The maximum potential area of disturbance is based on a 26km range for piling and Unexploded Ordnance (UXO). The Humber Estuary SAC is located 150km from Norfolk Vanguard OWF sites and 112km from the offshore cable corridor (at closest point). It is highly unlikely, especially taking into account the movements of tagged seals, that all grey seal in the offshore development area are from the Humber Estuary SAC (Information to Support HRA report, paragraphs 999; 1000). Therefore, there is no anticipated AEOL of the Humber Estuary SAC in relation to the conservation objectives for grey seal.</p> <p>d) Given the distance between the projects offshore and their distance from the coast, it is not anticipated that foraging grey seal would be significantly displaced from foraging areas or from moving between haul-out sites and foraging areas. (Information to Support HRA report, paragraph 1015)</p> <p>e) Current data suggests that there is no lasting disturbance or exclusion of grey seal around wind farm sites during operation.</p>															

2.11 The Wash and North Norfolk SAC

Name of European Site: The Wash and North Norfolk SAC															
Distance to Norfolk Vanguard 33km															
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard														
	Disturbance at haul out sites			Collision risk			Disturbance of seals foraging at sea			In combination at haul out sites			In combination at sea		
	C	O	D	C	O	D	C	O	D	C	O	D	C	O	D
Harbour seal	N (a)	N (a)	N (a)	N (b)			N (c)	N (c)	N (c)	N (a)	N (a)	N (a)	N (d)	N (e)	N (d)
<p>a) Vessels would be highly unlikely to be within 300m of the coast, in areas of close proximity to the seal haul-out sites within the Wash and North Norfolk SAC, therefore there would be no potential for AEOL. (Information to Support HRA report, paragraph 1018)</p> <p>b) Approximately 1,180 vessel movements are estimated over the two to four year indicative offshore construction window, an average of approximately two vessel movements per day. Therefore, the increase in vessel movements during construction would be relatively small compared to existing vessel traffic. It is expected that seals would be able to detect the presence of vessels and, given that they are highly mobile, would be able to largely avoid vessel collision.</p> <p>c) The maximum potential area of disturbance is based on a 26km range for piling and UXO (Information to Support HRA report, paragraph 1030). The Wash and North Norfolk SAC is located 82km from Norfolk Vanguard OWF sites and 33km from the offshore cable corridor (at closest point) (Information to Support HRA report, paragraph 1031). It is highly unlikely, especially taking into account the movements of tagged seals, that all harbour seal in the offshore development area are from the Wash and North Norfolk SAC. Therefore, there is no anticipated AEOL of the Wash and North Norfolk SAC in relation to the conservation objectives for harbour seal.</p> <p>d) Given the distance between the projects offshore and their distance from the coast, it is not anticipated that foraging harbour seal would be significantly displaced from foraging areas or from moving between haul-out sites and foraging areas. (Information to Support HRA report, paragraph 1045)</p> <p>e) Current data suggests that there is no lasting disturbance or exclusion of harbour seal around wind farm sites during operation.</p>															

2.12 River Wensum SAC

Name of European Site: River Wensum SAC												
Distance to Norfolk Vanguard 0km (onshore cable route intersects the SAC)												
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard											
	Direct effects within ex-situ habitats of the SAC			Indirect effects within the SAC arising from geology / contamination and groundwater / hydrology effects			Indirect effects within ex-situ habitats of the SAC arising from geology / contamination and groundwater / hydrology effects			In-combination		
	C	O	D	C	O	D	C	O	D	C	O	D
Water courses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)	N (b)	N (b)	N (b)	N (c)	N (c)	N (c)
Desmoulin's whorl snail	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)	N (b)	N (b)	N (b)	N (c)	N (c)	N (c)
<p>a) Features are not present within the drains and ditches of the floodplain habitats of the River Wensum on the right-hand (southern) bank of the river (Information to Support HRA report, paragraph 1158; 1170). The drain on the left-hand (northern) bank of the river is located outside of the proposed trenchless crossing technique zone (Information to Support HRA report, paragraph 1159; 1171). Therefore, potential direct effects upon this habitat have been avoided at this location. Additionally, given the absence of these features from the other ex-situ habitats located within the onshore project area, it is considered unlikely that habitat is present within this drain.</p> <p>b) There are no springs or seepages located within the floodplain habitats on the right-hand bank of the River Wensum (Information to Support HRA report, paragraph 1162). The floodplain on the left-hand bank will be avoided through the use of trenchless crossing techniques, however a narrow section of the floodplain below ground in this location will be affected by the trenchless crossing. A pre-construction survey on the left-hand floodplain habitat will be conducted to identify any springs or seepages and, if identified, these will be avoided through micro-siting (Information to Support HRA report, paragraph 1162)³. As such, works in this area will not result in direct changes to any springs directly connected to the River Wensum. Introduction of cable ducts is not anticipated to have any effect upon groundwater flows for the River Wensum (Information to Support HRA report, paragraph 1162). Furthermore, for a river</p>												

³ As detailed in the Outline Landscape and Ecological Management Strategy (OLEMS) (Document Reference 8.7) and to be secured via the Ecological Management Plan (EMP) under Requirement 24 of the draft DCO (Document Reference 3.1).

Name of European Site: River Wensum SAC

Distance to Norfolk Vanguard 0km (onshore cable route intersects the SAC)

crossing, trenchless crossing ducts would be installed 5-15m below the floodplain, and at least 2m below the river bed. As a result, the buried ducts will have no effect upon surface water flows.

Mitigation measures (included in the Outline Code of Construction Practice, document 8.1 and secured through DCO Schedule 1 Part 3 Requirement 20) will be put in place to minimise the risk of sediment or pollutant release into the watercourses which are functionally connected to the River Wensum (Information to Support HRA report, paragraph 1164; 1165). These are considered suitable for minimising the risk of sediment / pollutant release into watercourses functionally connected with the River Wensum to a negligible level.

- c) The in-combination assessment for the onshore elements of the assessment for potential for adverse effect upon site integrity has adopted the following principle: in order for Norfolk Vanguard to be considered to have the potential to contribute to in-combination effects, there must be sufficient cause to consider that a relevant habitat or species is sensitive to effects due to the project alone. If a potential for adverse effect upon site integrity is not determined with respect to a site due to Norfolk Vanguard alone, there is no real prospect of an in-combination effect occurring with another plan or project. Therefore, as there is no effect from Norfolk Vanguard alone, there is no potential for in-combination effects (Information to Support HRA report, paragraph 1177).

2.13 Paston Great Barn SAC

Name of European Site: Paston Great Barn SAC									
Distance to Norfolk Vanguard 2.9km									
Site Features	Adverse Effect on Integrity due to proposed Norfolk Vanguard project								
	Direct effects on barbastelle present in ex-situ habitats of the SAC (hedgerows / watercourses)			Indirect effects on barbastelle present within ex-situ habitats of the SAC (hedgerows / watercourses) arising from light and groundwater / hydrology effects			In-combination		
	C	O	D	C	O	D	C	O	D
Barbastelle bats	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)	N (c)	N (c)	N (c)
<p>a) Hedgerows to be removed as part of pre-construction and construction works will be minimised by reducing the cable corridor working width at these locations to 20m (at perpendicular crossings with the cable) and a maximum of 25m (where the cable crosses at a diagonal) (Information to Support HRA report, paragraph 1184). The hedgerow will be removed in advance of construction phase works at each important barbastelle feature, and the land will remain open during the construction phase works at each location (for approximately one week, with the exception of Dilham Canal and land east of Dilham Canal, where works will take place over up to eight weeks due to trenchless drilling techniques at this location) (Information to Support HRA report, paragraph 1185). Hedgerows will be replanted following works at each location. To minimise the potential effect upon commuting and foraging barbastelle arising from this temporary loss of habitat, several mitigation measures (outlined in the Outline Landscape and Ecological Management Strategy, document 8.7 and secured through DCO Schedule 1 Part 3 Requirement 24) will be implemented and Norfolk Vanguard will seek to avoid mature trees within hedgerows through the micro-siting of individual cables where possible (Information to Support HRA report, paragraph 1186). Once replanted hedgerows have reached maturity (expected to be 3-7 years following planting on completion of construction), they will provide an improved commuting and foraging habitat for bats (Information to Support HRA report, paragraph 1185).</p> <p>Across the five important barbastelle habitat features potentially present within the onshore project area, a total of approximately 11ha of habitat used by barbastelles of the Paston Great Barn maternity colony is anticipated to be isolated by hedgerow removal during the project construction phase. This represents approximately 0.6% of the home range of the Paston Great Barn maternity colony (Information to Support HRA report, paragraph 1192).</p> <p>Following mitigation, these small-scale, temporary effects are not anticipated to result in any potential for adverse effect upon site integrity upon the qualifying habitats and species of the Paston Great Barn SAC.</p> <p>b) The proposed works will involve ground excavation, and therefore will have a small, localised effect upon surface water flows. However, due to removal of hedgerows, commuting and foraging habitats will not be present in these locations during the construction phase, and therefore the habitat within this location</p>									

Name of European Site: Paston Great Barn SAC

Distance to Norfolk Vanguard 2.9km

will not be affected. Furthermore, a pre-construction drainage plan will also be developed and implemented to minimise water within the cable trench and ensure ongoing drainage of surrounding land (Information to Support HRA report, paragraph 1198).⁴

Construction phase lighting for cable duct installation will be used between 7am-7pm, only if required (i.e. in low light conditions). Lighting will not be used overnight, except at trenchless crossing locations. In these instances, lighting may be needed for eight weeks at Dilham Canal and land east of Dilham Canal. Any lighting used will be directional i.e. angled downwards and a cowl provided for the light to minimise light spill (Information to Support HRA report, paragraph 1199).⁵ There will be no lighting required during the operational phase of Norfolk Vanguard (Information to Support HRA report, paragraph 1201).

- c) The in-combination assessment for the onshore elements of this assessment for potential for adverse effect upon site integrity has adopted the following principle: in order for Norfolk Vanguard to be considered to have the potential to contribute to in-combination effects, there must be sufficient cause to consider that a relevant habitat or species is sensitive to effects due to the project itself. If a potential for adverse effect upon site integrity was not determined with respect to a site due to Norfolk Vanguard, there is no real prospect of an in-combination effect occurring with another plan or project. Therefore, as there is no effect from Norfolk Vanguard alone, there is no potential for in-combination effects (Information to Support HRA report, paragraph 1209; 1210).

⁴ As detailed in the outline Code of Construction Practice (CoCP) (Document Reference 8.1) and to be secured via the final CoCP under Requirement 20 of the draft DCO (Document Reference 3.1).

⁵ As detailed in the Outline Landscape and Ecological Management Strategy (OLEMS) (Document Reference 8.7) and to be secured via the Ecological Management Plan (EMP) under Requirement 24 of the draft DCO (Document Reference 3.1).

2.14 Norfolk Valley Fens SAC

Name of European Site: Norfolk Valley Fens SAC						
Distance to Norfolk Vanguard 0.6 – 5km (5 sites within 5km)						
Site Features	Adverse Effect on Integrity due to Norfolk Vanguard					
	Indirect effects on features present within ex-situ habitats of the SAC arising from air quality and groundwater / hydrology effects			In-combination		
	C	O	D	C	O	D
Alkaline fens	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)
Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i>	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)
Calcareous fens <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)
European dry heaths	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)
Molinia meadows on calcareous, peaty or clayey-silt-laden soils	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)
Northern Atlantic wet heaths with <i>Erica tetralix</i>	N (a)	N (a)	N (a)	N (b)	N (b)	N (b)
<p>a) Out of the five component SSSIs, only one (Booton Common) has a functional connection to the onshore project area. Where the onshore cable route crosses two tributaries of the Blackwater Drain, trenched crossing techniques are proposed (Information to Support HRA report, paragraph 1221). Following construction at these locations, reinstatement of the trench would be conducted to the pre-construction depth of the watercourse and the dams removed. As water flow would be maintained, and given the distance of these sites from Booton Common, effects from trenching works at these locations upon the Blackwater Drain will be minimal (Information to Support HRA report, paragraph 1223; 1224).</p> <p>An air quality impact assessment in line with IAQM guidance (IAQM, 2014) has been conducted for Norfolk Vanguard to understand the potential effects of dust and fine particle emissions. Booton Common is located approximately 1.4km south of the nearest access route for construction vehicles for the proposed</p>						

Name of European Site: Norfolk Valley Fens SAC

Distance to Norfolk Vanguard 0.6 – 5km (5 sites within 5km)

project, and is located 600m from the onshore project area. As such, following IAQM guidance, it is considered to be outside the potential zone of influence of the project in terms of air quality emissions (Information to Support HRA report, paragraph 1226).

- b) The in-combination assessment for the onshore elements of this assessment for potential for adverse effect upon site integrity has adopted the following principle: in order for Norfolk Vanguard to be considered to have the potential to contribute to in-combination effects, there must be sufficient cause to consider that a relevant habitat or species is sensitive to effects due to the project itself. If a potential for adverse effect upon site integrity was not determined with respect to a site due to Norfolk Vanguard, there is no real prospect of an in-combination effect occurring with another plan or project. Therefore, as there is no effect from Norfolk Vanguard alone, there is no potential for in-combination effects (Information to Support HRA report, paragraph 1228).

2.15 The Broads SAC

Name of European Site: The Broads SAC												
Distance to Norfolk Vanguard 3.6km												
Site Features	Adverse Effect on Integrity due to proposed Norfolk Vanguard project											
	Direct effects upon ex-situ habitats which may support the qualifying feature otter, due to suitable ex-situ habitats for this feature being present			Indirect effects upon habitats and species within the SAC boundary arising from changes in local groundwater / hydrology conditions			Indirect effects upon ex-situ habitats which may support the qualifying feature otter, arising from changes in groundwater / hydrology conditions			In-combination		
	C	O	D	C	O	D	C	O	D	C	O	D
Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara spp.</i>				N (a)						N (a)		
Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation				N (a)						N (a)		
Transition mires and quaking bogs				N (a)						N (a)		
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> [Priority feature]				N (a)						N (a)		

Name of European Site: The Broads SAC

Distance to Norfolk Vanguard 3.6km

Site Features	Adverse Effect on Integrity due to proposed Norfolk Vanguard project											
	Direct effects upon ex-situ habitats which may support the qualifying feature otter, due to suitable ex-situ habitats for this feature being present			Indirect effects upon habitats and species within the SAC boundary arising from changes in local groundwater / hydrology conditions			Indirect effects upon ex-situ habitats which may support the qualifying feature otter, arising from changes in groundwater / hydrology conditions			In-combination		
	C	O	D	C	O	D	C	O	D	C	O	D
Alkaline fens				N (a)						N (a)		
Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>) [Priority feature]				N (a)						N (a)		
<i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>)				N (a)						N (a)		
Desmoulin's whorl snail				N (a)						N (a)		
Fen orchid				N (a)						N (a)		
Ramshorn snail				N (a)						N (a)		

Name of European Site: The Broads SAC

Distance to Norfolk Vanguard 3.6km

Site Features	Adverse Effect on Integrity due to proposed Norfolk Vanguard project											
	Direct effects upon ex-situ habitats which may support the qualifying feature otter, due to suitable ex-situ habitats for this feature being present			Indirect effects upon habitats and species within the SAC boundary arising from changes in local groundwater / hydrology conditions			Indirect effects upon ex-situ habitats which may support the qualifying feature otter, arising from changes in groundwater / hydrology conditions			In-combination		
	C	O	D	C	O	D	C	O	D	C	O	D
Otter	N (b)	N (b)	N (b)				N (b)	N (b)	N (b)	N (b)		
<p>a) As part of the project's embedded mitigation (listed as part of the detailed design and secured through DCO Schedule 1 Part 3 Requirement 16(17)(f)), the North Walsham and Dilham Canal will be crossed using a trenchless crossing technique (e.g. HDD). This means that the North Walsham and Dilham Canal will be avoided, and no works will take place within this watercourse (Information to Support HRA report, paragraph 1241). The East Ruston Stream is proposed to be crossed using a trenching methodology, however, given the distance to The Broads SAC (4.6km), the risk of groundwater pollution of The Broads SAC is low. Good practice pollution prevention measures will also be employed. For watercourses which are shallower than 1.5m, temporary damming and diverting of the watercourse may be employed during trenching works (Information to Support HRA report, paragraph 1243). The suitability of this method would be advised at detailed design. Several mitigation measures will be employed, and the trench would be reinstated to the pre-construction depth of the watercourse. Where culverts may be required, additional mitigation measures (captured within the Outline Code of Construction Practice, document 8.1 and secured through DCO Schedule 1 Part 3 Requirement 20) will be employed (Information to Support HRA report, paragraph 1245). In addition, no stage of the onshore transmission works involving the crossing, diversion and subsequent reinstatement of any designated main river or ordinary watercourse may commence until a scheme and programme for any such crossing, diversion and reinstatement in that stage has been submitted to and, approved by the relevant planning authority in consultation with Natural England as secured through DCO Schedule 1 Part 3 Requirement 25.</p> <p>b) A review of the desk-based records obtained from Norfolk Biodiversity Information Service (NBIS) in July 2016 indicates that there are no records of otter on the Hundred Stream. There is one record of an otter spraint on the North Walsham and Dilham Canal, recorded in 2015 and located at TG28863183. This is located approximately 700m upstream of the onshore project area. The absence of records of otter on the Hundred Stream is not conclusive proof of the absence of this species from the watercourse (Information to Support HRA report, paragraph 1235). However, water depths are likely to be too shallow to form part of an otter's home range, especially given the superior habitat available downstream on other parts of the river network connected to The Broads SAC. In light of this it is considered unlikely that otter are present within the reaches of the Hundred Stream in which the onshore project area is located (Information to Support HRA report, paragraph 1235).</p>												

Name of European Site: The Broads SAC

Distance to Norfolk Vanguard 3.6km

Site Features	Adverse Effect on Integrity due to proposed Norfolk Vanguard project											
	Direct effects upon ex-situ habitats which may support the qualifying feature otter, due to suitable ex-situ habitats for this feature being present			Indirect effects upon habitats and species within the SAC boundary arising from changes in local groundwater / hydrology conditions			Indirect effects upon ex-situ habitats which may support the qualifying feature otter, arising from changes in groundwater / hydrology conditions			In-combination		
	C	O	D	C	O	D	C	O	D	C	O	D
<p>It is considered that otters may be commuting along the North Walsham and Dilham Canal within the onshore project area, but that they are not resting or making other use of bankside habitat in these locations (Information to Support HRA report, paragraph 1236). As part of the project's embedded mitigation, the North Walsham and Dilham Canal will be crossed using a trenchless crossing technique (e.g. HDD), to minimise impacts to the watercourse at this location. This means that the North Walsham and Dilham Canal and its immediate bankside habitat will be avoided, and no works will take place within these habitats (Information to Support HRA report, paragraph 1237). As a precaution, while works are taking place within 100m of North Walsham and Dilham Canal, all excavations will be either covered overnight or left with escape ramps to allow otters to escape if they enter, and all vehicles wheels / tracks will be checked in the morning for the presence of sleeping otter (Information to Support HRA report, paragraph 1239).⁶</p>												

⁶ As detailed in the Outline Landscape and Ecological Management Strategy (OLEMS) (Document Reference 8.7) and to be secured via the Ecological Management Plan (EMP) under Requirement 24 of the draft DCO (Document Reference 3.1).

3 REFERENCES

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