

Norfolk Vanguard Offshore Wind Farm In Principle Norfolk Vanguard Southern North Sea Special Area of Conservation (SAC) Site Integrity Plan

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Glossary

ADD	Acoustic Deterrent Device
AA	Appropriate Assessment
DML	Deemed Marine Licence
EPP	Evidence Plan Process
EPS	European Protected Species
ES	Environmental Statement
ETG	Expert Topic Group
FCS	Favourable Conservation Status
FID	Financial Investment Decision
HRA	Habitats Regulations Assessment
JNCC	Joint Nature and Conservation Committee
LSE	Likely Significant Effect
MMO	Marine Management Organisation
MMMP	Marine Mammal Mitigation Plan
MU	Management Unit
NS	North Sea
OWFs	Offshore Wind Farms
PTS	Permanent Threshold Shift
SAC	Special Area of Conservation
SCANS	Small Cetaceans in the European Atlantic and North Sea
SIP	Site Integrity Plan
SNCBs	Statutory Nature Conservation Bodies
SNS	Southern North Sea
SoS	Secretary of State
TWT	The Wildlife Trust
UK	United Kingdom
UXO	Unexploded Ordnance
VWPL	Vattenfall Wind Power Limited
WDC	Whale and Dolphin Conservation

Terminology

Array cables	Cables which link the wind turbine generators and the offshore electrical platform.
Interconnector cables	Buried offshore cables which link offshore electrical platforms.
Landfall	Where the offshore cables come ashore.
Offshore accommodation platform	A fixed structure (if required) providing accommodation for offshore personnel. An accommodation vessel may be used instead.
Offshore cable corridor	The area where the offshore export cables would be located.
Offshore electrical platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbine generators for export to shore.
Offshore export cables	The cables which transmit electricity from the offshore electrical platform to the landfall.
Offshore project area	The overall area of Norfolk Vanguard East, Norfolk Vanguard West and the offshore cable corridor.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.
The Applicant	Norfolk Vanguard Limited.
The OWF sites	The two distinct offshore wind farm areas, Norfolk Vanguard East and Norfolk Vanguard West.
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure.

1 INTRODUCTION

1.1 Project Background

1. Norfolk Vanguard Limited ('the Applicant' an affiliate company of Vattenfall Wind Power Ltd (VWPL),) is seeking a Development Consent Order for Norfolk Vanguard, an offshore wind farm (OWF) located in the southern North Sea.
2. The OWF comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) ('the OWF sites'), within which wind turbines, associated platforms and inter-connector and array cables will be located (Figure 1.1). The offshore wind farm will be connected to the shore by offshore export cables installed within the offshore cable corridor from the wind farm to a landfall point at Happisburgh South, Norfolk. From there onshore cables would transport power over approximately 60km to the onshore project substation and National Grid substation at Necton, Norfolk. A full project description is given in the Environmental Statement (ES), Chapter 5 Project Description.
3. Once built, Norfolk Vanguard would have a capacity of up to 1800MW, with the offshore components comprising:
 - Wind turbines;
 - Offshore electrical platforms;
 - Accommodation platforms;
 - Met masts;
 - Lidar;
 - Array cables;
 - Inter-connector cables; and
 - Export cables.
4. The key onshore components of the project are as follows:
 - Landfall;
 - Onshore cable route, accesses, trenchless crossing (e.g. Horizontal Directional Drilling (HDD)) zones and mobilisation areas;
 - Onshore project substation; and
 - Extension to the Necton National Grid substation and overhead line modifications.
5. Norfolk Vanguard is located approximately 47km from the closest point of the Norfolk Coast. NV East covers an area of approximately 297km² and NV West covers an area of around 295km².
6. The detailed design of Norfolk Vanguard (including numbers of wind turbines, layout configuration, requirement for scour protection, etc.) will not be determined until

post-consent. Therefore, realistic worst case scenarios in terms of potential impacts/effects are adopted to undertake a precautionary and robust impact assessment.

7. Within Norfolk Vanguard, several different sizes of wind turbine are being considered in the range of 10MW and 20MW. In order to achieve the maximum 1,800MW export capacity, there would be between 90 (20MW) and 180 (10MW) wind turbines.
8. In addition, up to two offshore electrical platforms, two accommodation platforms, two meteorological masts, two LiDAR platforms and two wave buoys, plus a network of up to 600km of offshore cables are considered as part of the worst-case scenario.
9. Norfolk Vanguard Limited is currently considering constructing the project in either a single phase or two phases (up to a maximum of 1800MW).
10. The construction window is expected to be up to four years for the full 1,800MW capacity and offshore construction would be anticipated to commence around 2024. Chapter 5 Project Description of the ES provides indicative construction programmes for the single phase and two phase options.

1.2 The Southern North Sea SAC

11. Norfolk Vanguard is located within the Southern North Sea (SNS) Special Area of Conservation (SAC) (Figure 1.1). In March 2019, the SNS became designated as a SAC. The SNS SAC is located within the Southern North Sea and wholly within the North Sea Management Unit (MU)¹. Harbour porpoise *Phocoena phocoena* is the primary and only listed feature of the site.
12. Full details of the SNS SAC, including the Conservation Objectives (COs), are included in Section 3 of this document.

¹ <http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf>

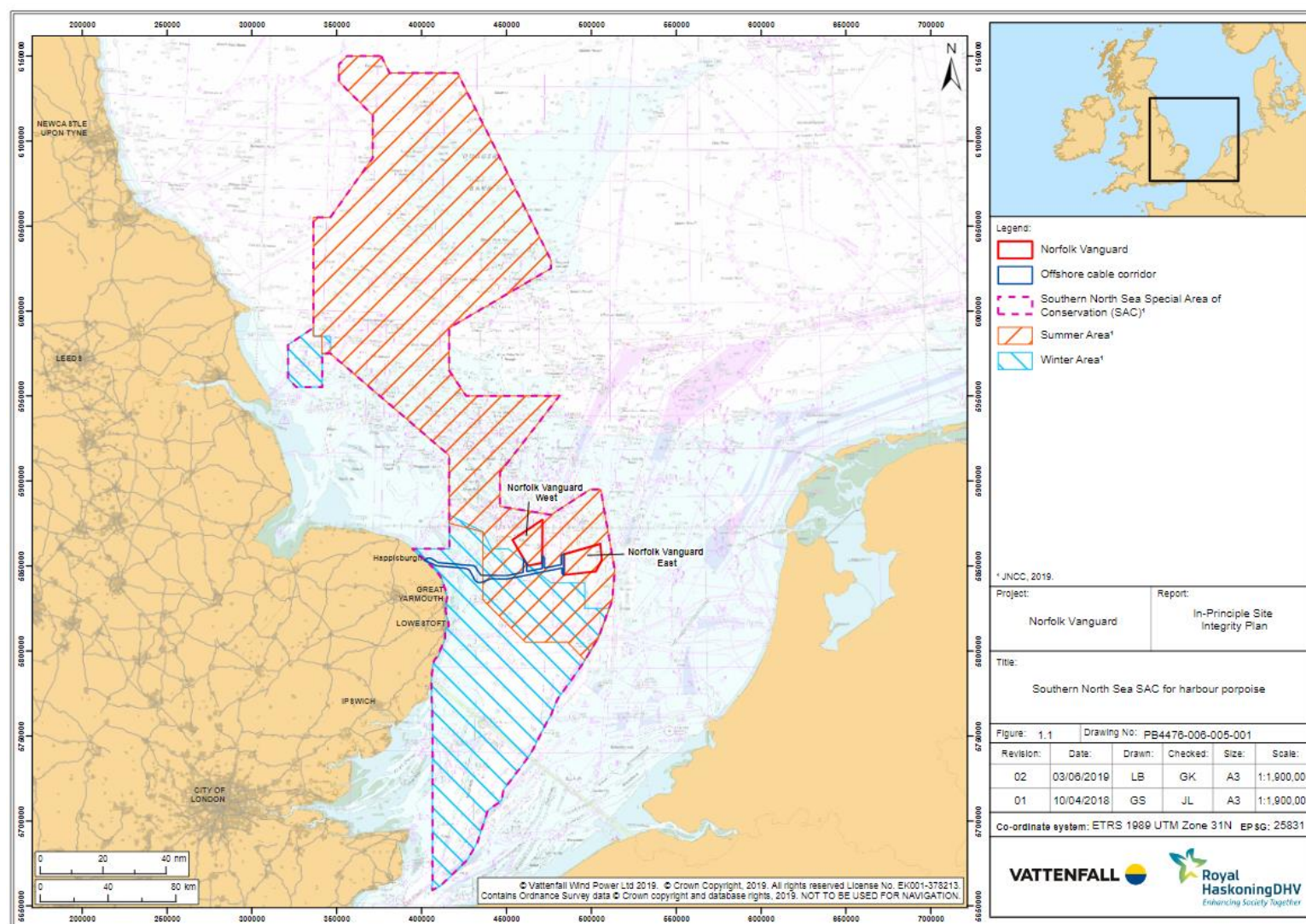


Figure 1.1: Location of Norfolk Vanguard and Southern North Sea SAC winter and summer areas

1.3 Purpose of this Document

13. The purpose of the In Principle Norfolk Vanguard SNS SAC Site Integrity Plan (hereafter 'the SIP') is to set out the approach for Norfolk Vanguard Limited to deliver any potential mitigation measures for Norfolk Vanguard, to ensure the avoidance of significant disturbance of harbour porpoise in relation to the SNS SAC site Conservation Objectives. The SIP is a requirement of DCO Schedules 9 and 10 condition [14(1)(m)] and Schedules 11 and 12 condition [9(1)(l)].
14. The approach and measures listed in the SIP are in relation to the Norfolk Vanguard project only, and are in response to the conclusions of the Information to Support Habitats Regulations Assessment (HRA, document 5.3). The Information to Support HRA concluded that, subject to the final design of Norfolk Vanguard and the actual in-combination scenario that overlaps with Norfolk Vanguard, further mitigation and management measures may be necessary in relation to the potential in-combination effects of pile driving noise in order to ensure there will be no adverse effect beyond reasonable scientific doubt on the SNS SAC.
15. Following completion of the Appropriate Assessment (AA) by the Competent Authority, it is acknowledged that the Norfolk Vanguard SNS SAC SIP may require revision to reflect the conclusions of the AA. The mitigation and management measures that may need to be secured in the SIP post-consent will be based on the AA as well as the final design of Norfolk Vanguard.
16. The SIP provides a framework for further discussion and consultation by Norfolk Vanguard Limited with the Marine Management Organisation (MMO) and other relevant stakeholders, including Statutory Nature Conservation Bodies (SNCBs), post-consent to agree the exact details of any required project related management measures. Indicative mitigation measures are outlined in this In Principle SIP which would be developed in consultation with the MMO and other relevant bodies (see section 2.3), post consent based on the final design of Norfolk Vanguard.
17. It is also possible that mitigation and management measures will be required for other plans and projects located within the vicinity of the project as part of the in-combination HRA, however, it is not possible for Norfolk Vanguard Limited to detail what these will be or how they will be secured, and is therefore outwith the scope of the SIP.
18. Finally, at the time of writing, the management measures are yet to be confirmed. As such, the SIP should be considered as In Principle until further guidance from Joint Nature and Conservation Committee (JNCC) and Natural England is provided. In its final form, the SIP will include updated information on Conservation Objectives and management measures for the SNS SAC.

1.4 Requirement for this document

19. Due to the long lead in times for the development of offshore wind farms it is not possible to provide final detailed method statements for construction prior to consent and as a result, the detail of any required mitigation also cannot be agreed at this stage. The agreement of guiding principles to mitigation, through this In Principle SIP as part of consent, therefore permits the final mitigation to be specified post-consent as part of the detailed design and allows refinements to be made based on the best practice, available knowledge and technology at that time.
20. This In Principle SIP reflects the commitment of Norfolk Vanguard Limited to undertake required measures to reduce the potential for any significant disturbance of harbour porpoise in the SNS SAC, whilst allowing scope for refinement of the measures through consultation once the management measures are available for the SNS SAC, and once final construction methods for the project have been confirmed. This will enable use of the most appropriate project related measures to be confirmed based on best knowledge, evidence and proven available technology at the time of construction.
21. The DMLs set out certain timescales in advance of commencement of the licensed activities, by when the SIP must be submitted to the MMO for their approval, following revision and consultation as per the outline schedule in section 2.3.
22. Norfolk Vanguard Limited acknowledge that any required mitigation or management measures should be precise, effective and deliverable in order to maintain the integrity of the SNS SAC for harbour porpoise. The SIP is a requirement of the DCO (Schedules 9 and 10 condition [14(1)(m)] and Schedules 11 and 12 condition [9(1)(l)]) and is designed to ensure that this will be the case once any required measures have been defined. Section 2.3 provides an outline of the proposed schedule for refinement and sign-off for the SIP.
23. Norfolk Vanguard Limited believe that DCO Schedules 9 and 10 condition [14(1)(m)] and Schedules 11 and 12 condition [9(1)(l)] secure necessary mitigation within the DML, whilst allowing scope for refinement of the precise mitigation measures to be adopted through consultation once final Conservation Objectives and management measures are available for the SAC, and once final construction methods for the project have been confirmed. This will enable use of the most appropriate project related measures to be confirmed based on best knowledge, evidence and proven available technology at the time of construction. This approach will also remove the need to revise the DML condition should the most suitable measures to be adopted change between the time of consent and construction.

24. It should also be noted that the Marine Mammal Mitigation Plan (MMMP) will provide details of the mitigation requirements in relation to any physical or auditory injury to marine mammals (Schedules 9 and 10 condition [14(1)(f)] and Schedules 11 and 12 condition [9(1)(f)] of the DCO).
25. Any requirements to reduce acoustic disturbance in relation to European Protected Species (EPS) will be captured through the EPS Licencing process, if required.

2 CONSULTATION

2.1 Pre-consent

26. The draft In Principle SIP was submitted to the marine mammal Expert Topic Group (ETG) in April 2018 as part of the Evidence Plan Process (EPP). Further consultation will be ongoing following submission of the DCO application.

2.2 Post-consent

27. There will be an ongoing requirement to review the need for project mitigation and management measures with the MMO and other relevant bodies as project design and construction plans are progressed. A consultation programme will be developed at the post-consent stage.

2.3 Schedule for Agreement

28. It is not possible at this stage to determine exact dates for agreement and refinement of the SIP. However, the key milestones have been outlined in Table 2.1 to indicate the likely development of the SIP between consent and construction.

Table 2.1: Indicative milestones for refinement and agreement of the SIP

Indicative Stage	When	Action for Norfolk Vanguard	Relevant Authority / Consultee	Status
In Principle SIP developed	Prior to examination	Draft In Principle SIP for review by ETG.	MMO and Natural England; TWT and WDC	Complete
Consent determination and AA	Expected mid/late 2019	Review In Principle SIP, identify areas for revisions/updates.	Internal only	To be completed
Southern North Sea SAC final Conservation Objectives and Management measures are defined / further advice is provided.	Unknown	Review In Principle SIP and identify areas for revisions/updates once further guidance on the SAC is received.	MMO and Natural England, potentially Secretary of State, TWT and WDC	To be completed
Front End Engineering Design (FEED)	Pre-construction	Norfolk Vanguard Limited will be refining the project design during the pre-construction period. Updates to design that could impact the conclusions of the AA may be subject to further assessment if deemed appropriate in consultation with the relevant authority. Any updated project design will	Internal only	To be completed

Indicative Stage	When	Action for Norfolk Vanguard	Relevant Authority / Consultee	Status
		also require consideration in the SIP.		
Submission and review of draft SIP and any associated documentation	Approximately 12 months prior to commencement of pile driving	The SIP will be updated to capture all relevant assessments and mitigation measures. Alongside the draft SIP implementation plan and any monitoring requirements will also be drafted for any required measures.	MMO and Natural England; draft Plan sent to TWT and WDC	To be completed
Final design	Approximately nine months prior to construction	Norfolk Vanguard Limited will confirm the project design and installation techniques during the pre-construction period. Based on the final project design, including any required updated underwater noise modelling, an updated assessment will be undertaken if necessary, this will include consideration of in-combination effects. Updates to the assessment that could impact the conclusions of the AA may be subject to further assessment if deemed appropriate in consultation with the relevant authority. Any assessment will also include the efficacy of mitigation or management measures.	MMO, Natural England, and potentially Secretary of State; with copies sent to TWT and WDC.	To be completed
Final SIP sign-off	The DMLs set out certain timescales in advance of commencement of the licensed activities, by when the SIP must be submitted to the MMO for their approval	The draft SIP will be updated and finalised. The final SIP will be submitted to the MMO for approval at a timescale in accordance with the DMLs, prior to the commencement of pile driving.	MMO for sign off.	To be completed
Construction monitoring and reporting	Construction (not expected before 2024)	Monitoring/management reports will be submitted to the MMO.	MMO	To be completed

3 SOUTHERN NORTH SEA SAC FOR HARBOUR PORPOISE

29. The SNS SAC has been recognised as an area with persistent high densities of harbour porpoise (JNCC, 2017a). The SNS SAC has a surface area of 36,951km² and covers both winter and summer habitats of importance to harbour porpoise, with approximately 66% of the candidate site being important in the summer and the remaining 33% of the site being important in the winter period (JNCC, 2017a).
30. The majority of the site is less than 40m in depth, reaching up to 75m in the northern most areas. The seabed is mainly sublittoral sand and sublittoral coarse sediment (JNCC, 2017a). The site overlaps with a number of existing Natura 2000 sites, including the Dogger Bank SAC, Margate and Long Sands SAC, Haisborough, Hammond and Winterton SAC and North Norfolk Sandbanks and Saturn Reef SAC, all of which have important sandbank and gravel beds.
31. Norfolk Vanguard is located within the SNS SAC. NV East is located wholly within the summer area. The majority of NV West is located within the summer area, with a small segment of the southern edge of the site being located within the winter area (Figure 1.1).

3.1 Conservation Objectives

32. The Conservation Objectives for the SNS SAC are designed to ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely.
33. The SIP will set out how the project will identify, agree and implement suitable and appropriate mitigation measures to ensure that the Conservation Objectives are upheld.
34. The Conservation Objectives for the site are (JNCC and Natural England, 2019):

“To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters

In the context of natural change, this will be achieved by ensuring that:

- 1. Harbour porpoise is a viable component of the site;*
- 2. There is no significant disturbance of the species; and*
- 3. The condition of supporting habitats and processes, and the availability of prey is*

maintained.” These Conservation Objectives ‘are a set of specified objectives that must be met to ensure that the site contributes in the best possible way to achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level (EC, 2012) (JNCC and Natural England, 2019).

3.1.1.1 1.

3.1.1.2 Conservation Objective 1. The species is a viable component of the site.

35. This Conservation Objective is designed to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the site. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoise using the site. Unacceptable levels can be defined as those having an impact on the FCS of the populations of the species in their natural range.
36. Harbour porpoise are considered to be a *viable component of the site* if they are able to live successfully within it. This site has been selected primarily based on the long term, relatively higher densities of porpoise in contrast to other areas of the North Sea. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies there is no exact value for the number of animals expected within the site (JNCC and Natural England, 2019).
37. Harbour porpoise are listed as EPS under Annex IV of the Habitats Directive and are therefore protected from deliberate killing (or injury), capture and disturbance throughout their range. Within the UK, The Habitats Directive is enacted through the Habitats Regulations². Under these Regulations, it is deemed an offence if harbour porpoise are deliberately disturbed in such a way as to:
 - a) Impair their ability to survive, to breed or reproduce, or to rear or nurture their young; or
 - b) To affect significantly the local distribution or abundance of that species.
38. The term *deliberate* is defined as any action that is shown to be any action ‘*by a person who knows, in the light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action*’.

² The Habitats Regulations in this case refers to the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017

39. In addition, Article 12 (4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States *‘shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned’*.

3.1.1.3 Conservation Objective 2. There is no significant disturbance of the species.

40. The disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise, including activities such as seismic surveys, pile driving and sonar. Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise³. However, disturbance is primarily a behavioural response to noise and may, for example, lead to harbour porpoises being displaced from the affected area.
41. As outlined above, JNCC and Natural England (2019) note that harbour porpoise in UK waters are considered part of a wider European population and that due to the mobile nature of this species the concept of a ‘site population’ may not be appropriate for this species. JNCC advise that assessments of effects of plans or projects (i.e. HRA) need to take into consideration population estimates at the MU level, to account for daily and seasonal movements of the animals (2017a).
42. Disturbance of harbour porpoise may lead to displacement from an area, and the temporary loss of habitat. As such, JNCC and Natural England (2019) suggest that activities within the SNS SAC should be managed to ensure that the animals’ potential usage of the site is maintained and any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site.
43. The draft SNCB advice / guidance for the assessment of significant noise disturbance on harbour porpoise in the SNS SAC is that:

‘Noise disturbance within an SAC from a plan/project individually or in-combination is significant if it excludes harbour porpoise from more than:

- 1. 20% of the seasonal component of the Southern North Sea SAC in any given day, and*
- 2. An average of 10% of the relevant area of the site over a season.’*

³ <http://jncc.defra.gov.uk/page-4273>

3.1.1.4 Conservation Objective 3. The condition of supporting habitats and processes, and the availability of their prey is maintained.

44. Supporting habitats, in this context, means the characteristics of the seabed and water column. Supporting processes encompasses the movements and physical properties of the habitat. The maintenance of these supporting habitats and processes contributes to ensuring prey is maintained within the site and is available to harbour porpoise using the site. Harbour porpoise are strongly reliant on the availability of prey species year round due to their high energy demands, and their distribution and condition may strongly reflect the availability and energy density of prey.
45. This Conservation Objective is designed to ensure that harbour porpoise are able to access food resources year round, and that activities occurring in the Southern North Sea SAC will not affect this.

3.2 Management Measures

46. Specific management measures are yet to be developed for the Southern North Sea SAC, however JNCC and Natural England (2019) advise that *'the maintenance of supporting habitats and processes contributes to ensuring that prey is maintained within the site and is available to harbour porpoises using the site.'*
47. JNCC and Natural England (2019) also state that *'management measures (e.g. the scale and type of mitigation) are the responsibility of the relevant regulatory or management bodies. These bodies will consider SNCB advice and hold discussions with the sector concerned, where appropriate.'*
48. In the absence of management measures for the SNS SAC at this time, Norfolk Vanguard Limited are confident that their commitments to develop a MMMP, SIP and EPS licencing (as secured by the DMLs), in consultation with the relevant authorities in the pre-construction period will ensure that appropriate project management and mitigation measures, if deemed necessary, can be agreed with the relevant regulators and will use the most appropriate methods, therefore upholding the Conservation Objectives.

4 PROJECT DESCRIPTION

49. A full description of the project design envelope is available in the Norfolk Vanguard ES (see Chapter 5 Project Description and Chapter 12 Marine Mammals). However, as the project description is refined during final design this section will be updated as necessary to reflect any relevant changes.

5 POTENTIAL EFFECTS

50. The HRA Screening (Appendix 5.1 of the Information to Support HRA report (document 5.3)) and consultation as part of the EPP (outlined in Chapter 7 of the ES (document 6.1) and in the Norfolk Vanguard Consultation Report (document 5.1)), identified the following potential effects as a result of Norfolk Vanguard on harbour porpoise, the qualifying feature of the SNS SAC, and so requiring further assessment for Norfolk Vanguard:
- Potential disturbance and displacement as a result of increased underwater noise levels;
 - Potential for any lethal effects, physical injury or auditory injury (Permanent Threshold Shift (PTS)), associated with underwater noise;
 - Increased potential collision risk with vessels;
 - Changes in prey availability; and
 - Changes in water quality.
51. As discussed in section 1.4, the overriding purpose of the MMMP, which is a requirement of DCO Schedules 9 and 10 Condition [14(1)(f)] and Schedules 11 and 12 Condition [9(1)(f)], is to provide mitigation for the potential to kill or injure harbour porpoise during construction. The SIP therefore focuses on behavioural effects as a result of underwater noise.
52. The Information to Support the HRA assessed the following potential effects during construction, operation and decommissioning of Norfolk Vanguard (Table 5.1)

Table 5.1: Potential effects of Norfolk Vanguard

Construction	Operation	Decommissioning
Permanent auditory injury resulting from the underwater noise associated with clearance of UXO.	N/A	N/A
Behavioural effects resulting from the underwater noise associated with clearance of UXO.	N/A	N/A
Permanent auditory injury resulting from the underwater noise during piling	N/A	N/A
Behavioural effects resulting from underwater noise during piling.	Behavioural effects resulting from the underwater noise associated with operational turbines.	Behavioural effects resulting from the noise associated with foundation removal (e.g. cutting).
Behavioural effects resulting from underwater noise during other construction activities, for example, seabed preparation, rock dumping and cable installation.	Behavioural effects resulting from the underwater noise associated with maintenance activities, such as any additional rock dumping and cable re-burial.	Behavioural effects resulting from the underwater noise associated with decommissioning activities, including infrastructure removal.

Construction	Operation	Decommissioning
Behavioural effects resulting from underwater noise and disturbance from vessels.	Behavioural effects resulting from underwater noise and disturbance from vessels.	Behavioural effects resulting from underwater noise and disturbance from vessels.
Vessel interaction (collision risk).	Vessel interaction (collision risk)	Vessel interaction (collision risk)
Changes to prey resource.	Changes to prey resource.	Changes to prey resource.
Changes to water quality	N/A	N/A

5.1 Summary of Potential Effects of Norfolk Vanguard Alone

53. Table 5.2 summarises the potential effects of Norfolk Vanguard alone.
54. The Information to Support the HRA (document 5.3) indicates there is no predicted adverse effect on the integrity of the SNS SAC from Norfolk Vanguard alone.

Table 5.2: Summary of the potential effects of Norfolk Vanguard alone

Potential Effect	Assessment in relation to the North Sea MU population	Spatial assessment in relation to the SAC summer and winter areas	Adverse effect on site integrity
During Construction			
Permanent auditory injury resulting from the underwater noise associated with clearance of UXO.	Less than 0.2% of the NS MU reference population	The effective implementation of a UXO MMMP would reduce the risk of permanent auditory injury (PTS) to harbour porpoise during any underwater detonations at Norfolk Vanguard	No
Behavioural effects resulting from the underwater noise associated with clearance of unexploded ordnance (UXO)	Less than 1% of the NS MU reference population	Temporary displacement of harbour porpoise would be less than 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Permanent auditory injury resulting from the underwater noise during piling	Less than 0.01% of the NS MU reference population	The MMMP for piling (in accordance with the draft MMMP (document 8.13) will reduce the risk of permanent auditory injury to harbour porpoise as a result of underwater noise during piling at Norfolk Vanguard	No
Behavioural effects resulting from underwater noise during piling – single piling	Less than 1% of the NS MU reference population	Temporary displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Behavioural effects resulting from underwater noise	Less than 1.7% of the NS MU reference population	Temporary displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal	No

Potential Effect	Assessment in relation to the North Sea MU population	Spatial assessment in relation to the SAC summer and winter areas	Adverse effect on site integrity
during piling – concurrent piling		component of the SAC area over the duration of that season.	
Behavioural effects resulting from underwater noise during other construction activities	Less than 0.3% of the NS MU reference population	Temporary displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the cSAC area over the duration of that season.	No
Behavioural effects resulting from underwater noise and disturbance from vessels	Less than 0.3% of the NS MU reference population	Temporary displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Vessel interaction (collision risk)	Less than 0.013% of the NS MU reference population	N/A	No
Changes to prey resource	Less than 0.3% of the NS MU reference population	Temporary displacement of harbour porpoise prey would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Changes to water quality	Less than 0.3% of the NS MU reference population	Areas of increased suspended sediment would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
During Operation and Maintenance			
Behavioural effects resulting from the underwater noise associated with operational turbines.	Less than 0.2% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Behavioural effects resulting from the underwater noise associated with maintenance activities	Less than 0.3% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No

Potential Effect	Assessment in relation to the North Sea MU population	Spatial assessment in relation to the SAC summer and winter areas	Adverse effect on site integrity
Behavioural effects resulting from underwater noise and disturbance from vessels	Less than 0.3% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Vessel interaction (collision risk)	Less than 0.013% of the NS MU reference population	N/A	No
Changes to prey resource	Less than 0.3% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the cSAC area over the duration of that season.	No
During Decommissioning			
Behavioural effects resulting from the noise associated with foundation removal	Less than 0.3% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the cSAC area over the duration of that season.	No
Behavioural effects resulting from underwater noise and disturbance from vessels	Less than 0.3% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No
Vessel interaction (collision risk)	Less than 0.013% of the NS MU reference population	N/A	No
Changes to prey resource	Less than 0.3% of the NS MU reference population	Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SAC area at any one time or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.	No

55. Table 5.3 summarises the potential effects of Norfolk Vanguard alone in relation to the Conservation Objectives of the SNS SAC for harbour porpoise.

56. The Information to Support the HRA (document 5.3) indicates that, based on the Conservation Objectives, development of Norfolk Vanguard would allow the Conservation Objectives to be upheld. There would be no potential for an adverse effect on the integrity of the SNS SAC in relation to the Conservation Objectives for harbour porpoise from Norfolk Vanguard alone (Table 5.3).

Table 5.3: Summary of the assessment of the potential effects of Norfolk Vanguard (alone) on the Southern North Sea SAC in relation to the Conservation Objectives for harbour porpoise

Conservation Objectives	Auditory injury from underwater noise - project alone	Disturbance from underwater noise - project alone	Increased collision risk – project alone	Changes to prey resources – project alone	Changes to water quality – project alone
The species is a viable component of the site	x	x	x	x	x
There is no significant disturbance of the species	x	x	x	x	x
The supporting habitats and processes relevant to harbour porpoises and their prey are maintained	x	x	x	x	x

x = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives.

5.2 Summary of Potential In-Combination Effects

57. Table 5.4 summarises the potential in-combination effects during the construction period at Norfolk Vanguard. Further details on the assessment methodology and in-combination scenarios are provided in the Information to Support HRA report (document 5.3). The in-combination effects during operation and maintenance or decommissioning would be less than those assessed for construction.
58. As a result of the in-combination effect of underwater noise during the construction period at Norfolk Vanguard, the Information to Support the HRA indicates that there is potential for Likely Significant Effects (LSE) and that without the SIP, there could be the potential for an adverse effect on the integrity (AEOI) of the SNS SAC.

Table 5.4: Summary of the potential in-combination effects for Norfolk Vanguard

Potential Effect	Assessment in relation to the North Sea MU population	Spatial assessment in relation to the SAC summer and winter areas	Adverse effect on site integrity
Behavioural effects from underwater noise	12,253 - 15,091 harbour porpoise (4-4.4% of NS MU)	Average overlap with summer SNS SAC area = 5,887-8,335km ² (22-31%) Average overlap with winter SNS SAC area = 3,481-5,929km ² (26-44%)	No Following application of mitigation through the SIP (as required under DCO Schedules 9 and 10 condition [14(1)(m)] and Schedules 11 and 12 condition [9(1)(l)])

Potential Effect	Assessment in relation to the North Sea MU population	Spatial assessment in relation to the SAC summer and winter areas	Adverse effect on site integrity
Indirect effects – changes in prey resources	No additional effects to those assessed for underwater noise		No
Direct interaction - collision risk	Less than 0.1% of the NS MU reference population	N/A	No

59. The in-combination assessment on potential changes to prey availability has assumed that any potential effects on harbour porpoise prey species from underwater noise, including piling, would be the same or less than those for harbour porpoise. Therefore, there would be no additional effects other than those assessed harbour porpoise, i.e. if prey are disturbed from an area as a result of underwater noise, harbour porpoise will be disturbed from the same or greater area, therefore any changes to prey availability would not affect harbour porpoise as they would already be disturbed from the same area. Any measures to reduce underwater noise and the disturbance to harbour porpoise would also reduce the disturbance of prey species.
60. As a precautionary approach, the number of harbour porpoise that could be at increased collision with vessels was been assessed based on the number of animals that could be present in the wind farm areas taking into account 95% avoidance rates. This is very precautionary, as it is highly unlikely that all marine mammals present in the wind farm areas would be at increased collision risk with vessels. In addition, based on the assumption that harbour porpoise would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
61. As a result, the SIP will focus on potential disturbance and displacement as a result of increased underwater noise levels during UXO clearance and piling.
62. Table 5.5 summarises the potential in-combination effects during the construction period at Norfolk Vanguard in relation to the Conservation Objectives of the SNS SAC for harbour porpoise.
63. The Information to Support the HRA (document 5.3) indicates that, without the SIP, there is the potential for an anticipated adverse effect on the integrity of the SNS SAC in relation to the Conservation Objectives for harbour porpoise from the potential in-combination effects of underwater noise during the construction period at Norfolk Vanguard (Table 5.5).

Table 5.5: Summary of the assessment of the potential in-combination effects during the Norfolk Vanguard construction period on the SNS SAC in relation to the Conservation Objectives for harbour porpoise

Conservation Objectives	Disturbance from underwater noise – in-combination	Increased collision risk – in-combination	Changes to prey resources – in-combination
The species is a viable component of the site	✘	✘	✘
There is no significant disturbance of the species	✘	?	✘
The supporting habitats and processes relevant to harbour porpoises and their prey are maintained	✘	✘	✘

✘ = No potential for any adverse effect on the integrity of the site in relation to the conservation objectives.

? = Potential adverse effect on the integrity of the site in relation to the conservation objectives, without Site Integrity Plan

64. In order to reach a conclusion of no adverse effect on site integrity, the Information to Support the HRA (document 5.3) concluded that, in-combination with other plans or projects further mitigation and management measures may be necessary in relation to potential disturbance from underwater noise during the construction period at Norfolk Vanguard. The potential for an adverse effect on site integrity was not concluded for any of the other in-combination assessments.
65. As such, only mitigation or management measures in relation to disturbance from UXO clearance and pile driving noise at Norfolk Vanguard are considered in this SIP as these are the potential noise sources that could result in the significant disturbance of harbour porpoise in-combination with other underwater noise sources during the construction period at Norfolk Vanguard. Significant disturbance is based on the current SNCBs thresholds for the site of:
- Displacement of harbour porpoise should not exceed 20% of the seasonal component of the SAC area at any one time and / or on average exceed 10% of the seasonal component of the SAC area over the duration of that season.
66. However, until a) further revisions are made to the other plan and project descriptions and timelines included in the HRA in-combination assessment and b) further guidance is provided by the JNCC and Natural England on management measures for the SNS SAC, the potential mitigation and management measures in the SIP cannot be fully defined. Therefore, Norfolk Vanguard Limited has listed project-specific measures that may be required and that can be secured through the SIP, if necessary (see Section 6.1).
67. Following completion of the AA by the competent authority, it is acknowledged that the SIP may require revision to reflect the conclusions of the AA. In addition to the AA, any new conservation objectives and any review of consent outcomes will be

used to determine any mitigation and management measures that need to be secured in the final SIP post consent.

6 MITIGATION AND MANAGEMENT MEASURES

6.1 Norfolk Vanguard Southern North Sea SAC Site Integrity Plan management and mitigation Measures

68. As discussed in Section 5, the Information to Support HRA (document 5.3), has determined that project management and mitigation measures may be required, regarding the potential for significant disturbance to harbour porpoise from the in-combination effects of underwater noise with other plans or projects during the construction period at Norfolk Vanguard.
69. This section of the In Principle SIP outlines the measures currently available or likely to be available in the future, which could be applicable to UXO clearance and pile driving noise at Norfolk Vanguard. For each of the measures, information will be provided to detail how the measure will result in the avoidance of significant disturbance to harbour porpoise and hence allow the conclusion of 'no adverse effect on integrity beyond reasonable scientific doubt' on the SNS SAC. It should be noted that the following factors need to be considered and taken into account in the final SIP:
 - The SNS SAC management measures are currently unavailable;
 - The Norfolk Vanguard project design parameters have not yet been finalised and the assessment to inform the HRA was based on the predicted worst-case scenario;
 - The final design and programme of other plans and projects has not yet been finalised and therefore the actual in-combination scenario is currently unknown; and
 - Potential strategic management measures such as scheduling of pile driving (section 6.1.3) would need to be carefully managed by the Regulators to achieve a coordinated approach with other developers.
70. The adopted project measures would be agreed and secured in the period between consent and the commencement of piling, following an updated assessment of the potential impacts from pile driving and an assessment of their efficacy (see Table 2.1).
71. Potential measures are outlined in this section of the In Principle SIP, however as explained previously, confirmation of any measure(s) that will be employed cannot be confirmed until project design parameters are finalised, and the management measures are known for the SNS SAC. At that point it will be clear what any required measures will be seeking to achieve in terms of mitigation.
72. Potential mitigation to be delivered by the project management measures include:

- **Spatial:** Minimising the total area of ‘significant disturbance’ at any one time. This could be a reduction in the area of the SNS SAC which is subject to noise levels⁴ that may cause significant disturbance to harbour porpoise; or
- **Temporal:** Minimising the duration of additional underwater noise generated through UXO clearance and piling events over any given time frame that may cause ‘significant disturbance’ to harbour porpoise in the North Sea MU or the SNS SAC⁵.

6.1.1 Measure 1: Alternate foundation methodologies

73. The use of alternate foundation methods, within the consented project envelope, such as floating foundations, suction piles or gravity base foundations will be considered and assessed, along with any other relevant technologies or methodologies, during the final design. This would be informed by post-consent site investigation and technology developments. If possible, the use of foundation types and/or installation methodology other than pile driving would result in lower noise levels during the construction of the wind farm.
74. Developments are on-going in relation to methods such as vibro-piling, double walled piles and the Blue Hammer⁶ which also have the potential to greatly reduce the area of potential disturbance from pile driving.

6.1.2 Measure 2: Noise mitigation systems

75. Noise mitigation systems are currently being developed that enable a reduction of pile driving noise (decibels) at source. These methods currently include various types of bubble curtain, hydro-sound dampers, screens or tubes, and cofferdams.
76. By a reduction in the noise at source, the total area of potential disturbance to harbour porpoise would be reduced. However, it should also be noted that many of these measures may increase the total duration of disturbance from underwater noise during foundation installation and this should be a consideration in an assessment of their efficacy.
77. It should be noted that suitability of any noise mitigation system will be dependent on a number of factors including pile diameter and length, ground conditions, and water depth. These factors will be considered in any assessment of the efficacy of the measure. The information to inform this selection will be contingent on the

⁴ currently based on the displacement of harbour porpoise should not exceed 20% of the seasonal component of the cSAC area at any one time, but, if required, to be reviewed following any further guidance

⁵ currently based on the displacement of harbour porpoise should not on average exceed 10% of the seasonal component of the cSAC area over the duration of that season, but, if required, to be reviewed following any further guidance

⁶ <http://renews.biz/110461/trust-put-in-dutch-hammer/>

selection of the chosen foundation type and supplier which will only be available once contracts are being finalised post consent and Financial Investment Decision (FID).

6.1.3 Measure 3: Scheduling of pile driving

78. Subject to the final design and programme of Norfolk Vanguard and other offshore wind farms and the availability of other management measures, refinement of the piling programme could potentially allow a reduction in the total in-combination area of disturbance from multiple projects, if required, thus reducing the area of the SNS SAC that harbour porpoise may be displaced at any one time. It could also be used as a measure to reduce the duration of any in-combination continuous disturbance within a given time period (month, season or year).
79. Amendments to the piling programme could allow the Regulator to schedule piling, having regard to previous, ongoing and future piling associated with other offshore developments and other activities likely to act in-combination such as seismic surveys. As discussed above, potential scheduling of pile driving would need to be carefully managed by the Regulator. Prior to the start of construction an updated underwater noise prognosis, if required, for the final design of the wind farm will be included in the SIP. This will clearly set out the predicted noise levels to be generated by the preferred foundation type, installation technique and construction programme. This will then be used to update the commitments within the SIP. An outline of the schedule for this work has been provided in Table 2.1.

6.1.4 Other potential measures

80. The SIP allows the consideration and assessment of other relevant technologies or methodologies that may emerge in the future. This will ensure that any new technologies or methods that may occur prior to construction can be used during construction of the project.
81. Given the time lag between consent and the start of offshore construction; it is possible that new measures will be available. The SIP should not be restricted only to potential measures at the time of consent.

6.1.5 Measures not applicable

82. Seasonal restrictions on pile driving or UXO clearance are not included in the SIP as potential project mitigation or management measures. While seasonal restrictions on pile driving and UXO clearance may be applicable to some projects in order to restrict pile driving or UXO clearance to a season in which harbour porpoise are less reliant on part of the seasonal area of the SNS SAC, the location of Norfolk Vanguard means that (based on a 26km radius for potential disturbance) pile driving and UXO

clearance noise could radiate into both summer and winter areas of the SNS cAC throughout the year and therefore would offer no further benefit.

83. Changes in the location of wind turbine generators are also not included in the SIP as a potential project mitigation or management measure. Norfolk Vanguard is located entirely within the SNS SAC, as such it is not possible to relocate wind turbine generators to locations outside the SNS SAC, or to maximise distance from the SNS SAC boundary.

6.1.6 Assessment of efficacy of measures and implementation

84. Prior to the potential implementation of project mitigation or management measures, an assessment of the ability of each measure (alone or in-combination with other measures) will be required to ensure the approach is able to contribute a discernible contribution to a reduction in disturbance to harbour porpoise within the SNS SAC. The assessment is expected to include a degree of likely confidence in each measure.
85. Norfolk Vanguard Limited will work with the MMO and other statutory consultees to ensure that any approach to such assessment, is done in timely manner, and using the most robust approach possible.
86. Following assessment of project mitigation and management measures, Norfolk Vanguard Limited will work with the MMO to develop a timescale for delivery of any measures, an implementation plan, as well as agree any reporting or monitoring requirements. The implementation plan will include the approach to enforcement of the measures, and how any failures will be rectified.
87. It is anticipated that following the provision of final Conservation Objectives for the SNS SAC and final management measures, details of acceptable levels of disturbance will be provided, as well as noise thresholds considered to disturb harbour porpoise. This will enable an approach to assessment to be agreed, which will then enable the requirements of any project mitigation and management measures employed by Norfolk Vanguard Limited to be identified and consulted upon, and appropriate implementation plans to be developed.

6.2 Other Mitigation Measures outside the Scope of the SIP

88. The project measures outlined in the SIP are in addition to the following mitigation secured within the MMMPs.
89. Embedded mitigation (i.e. those measures that have been incorporated into the design of the development to prevent or reduce any significant adverse effects) would include soft start and ramp up of piling activity in order to minimise potential

impacts on physical and auditory injury. A mitigation zone would be established in order to ensure marine mammals are outside the range of PTS. Mitigation measures would aim to remove marine mammals from the mitigation zone prior to the start of piling to reduce the risk of any physical or auditory injury.

90. The MMMP for piling will detail the proposed mitigation measures to reduce the risk of any physical or permanent auditory injury to marine mammals during all piling operations. This will include details of the embedded mitigation, for the soft-start, ramp-up and mitigation zone, as well as details of any further mitigation that could be required.
91. The MMMP for piling will be developed in the pre-construction period and will be based upon best available information and methodologies at that time in consultation with the relevant authorities.
92. A detailed MMMP will also be prepared for UXO clearance. The MMMP for UXO clearance will ensure there are embedded mitigation measures, as well as any additional mitigation, to prevent the risk of any physical or permanent auditory injury to marine mammals, if UXO clearance is required. The MMMP for UXO clearance would be developed in the pre-construction period, when there is more detailed information on what UXO clearance could be required and what the most suitable mitigation measures are, based upon best available information and methodologies at that time, in consultation with the relevant authorities.
93. Mitigation for cumulative disturbance impacts will be discussed with the MMO and other relevant bodies, and options will be outlined within the SIP, where relevant (see Section 6.1).

6.3 EPS Licence

94. An EPS Licence will be sought from the MMO supported by a detailed risk assessment of the potential risk to harbour porpoise (and any other EPS deemed necessary at the time of application) based on the finalised project parameters and piling schedule/details.
95. As discussed above and outlined in Chapter 12 Marine Mammals of the ES, Norfolk Vanguard Limited commits to the use of soft-start procedures and exclusion zones to prevent the risk of physical and auditory injury to EPS as a result of underwater noise during pile driving activities.

7 SUMMARY

96. The management measures for the site are yet to be confirmed. Once further guidance from JNCC and Natural England is provided the SIP will be updated in consultation with the MMO and other relevant bodies.
97. The final SIP will be used to identify and assess any potential management or mitigation measures that could ensure 'no adverse effect beyond reasonable scientific doubt' on the SNS SAC for the significant disturbance of harbour porpoise based on the final design of Norfolk Vanguard. The final SIP will also be used to record all consultation on the proposed project management or mitigation measures it contains.

8 REFERENCES

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Wageningen Marine Research.

JNCC (2017a) SAC Selection Assessment: Southern North Sea. January, 2017. Joint Nature Conservation Committee, UK. Available from: <http://jncc.defra.gov.uk/page-7243>.

JNCC (2017b) JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. April 2017.

JNCC and Natural England (2019). Harbour Porpoise (*Phocoena phocoena*) possible Special Area of Conservation: Southern North Sea Conservation Objectives and Advice on Operations. Advice under Regulation 21 of The Conservation of Offshore Marine Habitats and Species Regulation 2017 and Regulation 37(3) of the Conservation of Habitats and Species Regulations 2017

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