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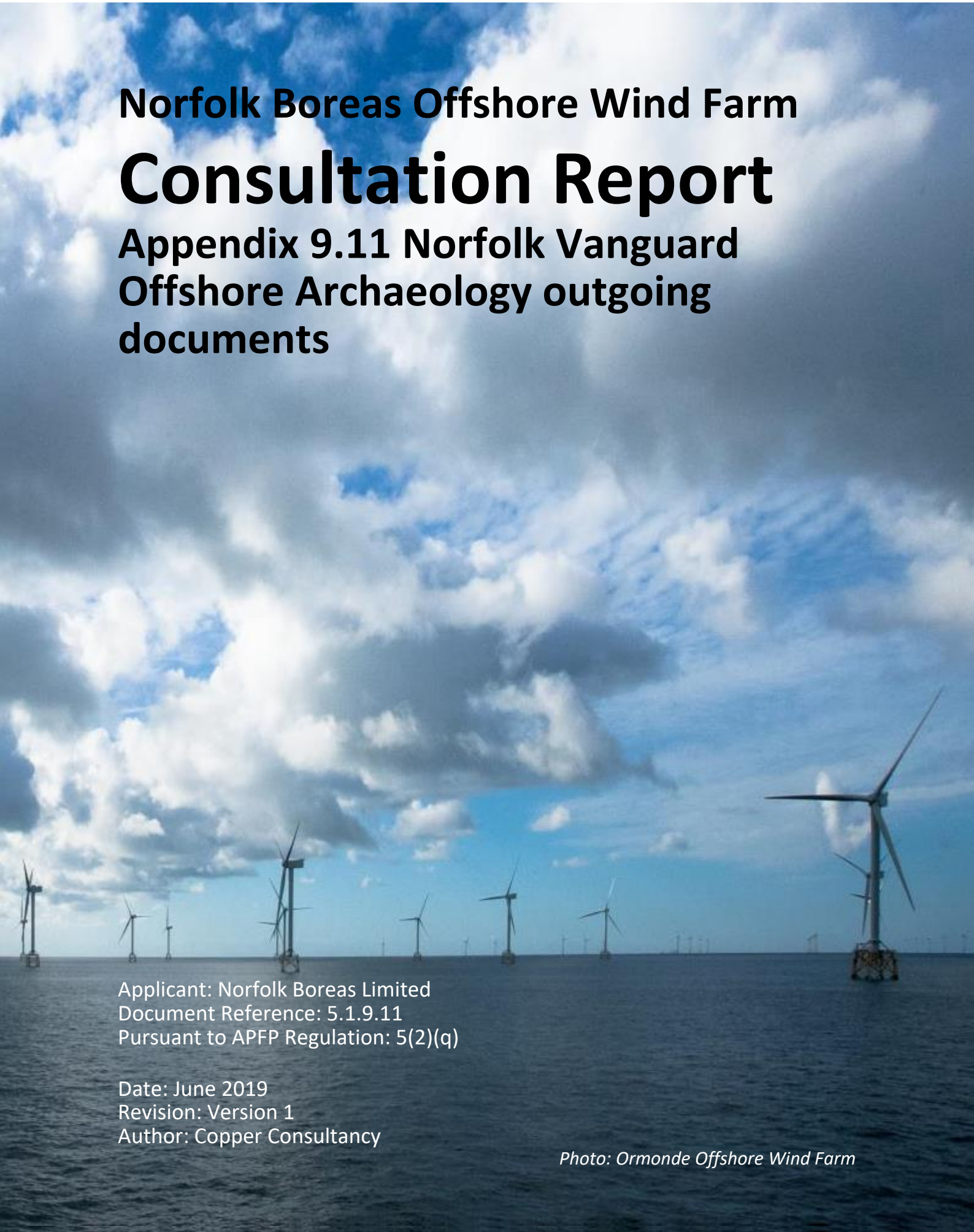
Norfolk Boreas Offshore Wind Farm

Consultation Report

Appendix 9.11 Norfolk Vanguard Offshore Archaeology outgoing documents



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Norfolk Vanguard Offshore Wind Farm

Environmental Impact Assessment

Offshore Archaeology Method Statement

Document Reference: PB4476-003-033

Author: Royal HaskoningDHV
Date: January 2017
Client: Vattenfall Wind Power Ltd

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
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This method statement has been prepared by Royal HaskoningDHV on behalf of Vattenfall Wind Power Limited (VWPL) in order to build upon the information provided within the Norfolk Vanguard Environmental Impact Assessment (EIA) Scoping Report. It has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate. All content and material within this document is draft for stakeholder consultation purposes, within the Evidence Plan Process.

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1 INTRODUCTION

1. The purpose of this method statement is to build upon the information provided within the Norfolk Vanguard Environmental Impact Assessment (EIA) Scoping Report, in outlining the proposed approach to be taken and considerations to be made in the assessment of the offshore archaeological effects of the proposed development. The offshore assessment will also encompass the intertidal zone section of the export cable route at the landfall below Mean High Water Springs (MHWS).

2. This offshore archaeology and cultural heritage method statement has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate and associated advice provided within Historic England's letter of 1st November 2016 (Appendix 3 of the Scoping Opinion).

3. The approach outlined in this method statement also takes account of previous correspondence with Historic England, including:

   - Vattenfall introduction meeting with Historic England in January 2016;
   - The East Anglia North Tranche 1[1]; Offshore Wind Farm Site Investigation Survey – Archaeology Position Paper (Document Ref: PB4476.003.002, provided to Historic England in March 2016; and
   - Email correspondence providing an update on the approach to offshore geotechnical survey and data analysis in October 2016.

1.1 Background

4. A Scoping Report for the Norfolk Vanguard EIA was submitted to the Planning Inspectorate on the 3rd October 2016. Further background information on the project can be found in the Scoping Report which is available at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-000022-Scoping%20Report.pdf

5. The Scoping Opinion was received on the 11th November 2016 and can be found at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-000018-Scoping%20Opinion.pdf.

1.2 Norfolk Vanguard Programme

6. This section provides an overview of the planned key milestone dates for Norfolk Vanguard.

[1] East Anglia North Tranche 1 is the former name of Norfolk Vanguard

1.2.1 DCO Programme

- Scoping Request submission - 03/10/16 (complete)
- Preliminary Environmental Information submission - Q4 2017
- Environmental Statement and Development Consent Order (DCO) submission - Q2 2018

1.2.2 Evidence Plan Process Programme

7. The Evidence Plan Terms of Reference (Royal HaskoningDHV, 2017) provides an overview of the Evidence Plan Process and expected logistics, below is a summary of anticipated meetings:

- Steering Group meeting 21/03/16 (complete)
- Steering Group meeting - 20/09/16 (complete)
- Post-scoping Expert Topic Group meetings - Q1 2017
  - Discuss method statements and Project Design Statement
- Expert Topic Group and Steering Group meetings as required - 2017
  - To be determined by the relevant groups based on issues raised
- PEIR Expert Topic Group and Steering Group meetings - Q4 2017/ - Q1 2018
  - To discuss the findings of the PEI (before or after submission)
- Pre-submission Expert Topic Group and Steering Group meetings - Q1/Q2 2018
  - To discuss updates to the PEIR prior to submission of the ES

1.2.3 Survey Programme

Table 1.1: Offshore Archaeology Programme

Survey/ Data Review	Programme
Desk Assessment Offshore Archaeological Desk Based Assessment (DBA): will constitute the fundamental initial baseline data and information gathering exercise, including full record searches of the United Kingdom Hydrographic Office (UKHO) wreck and obstructions data, Norfolk Historic Environment Record (NHER) and Historic England's National Record of the Historic Environment (NRHE) integrated with the results of the geophysical and geotechnical survey data assessment. Wider discussion of the known and potential archaeological resource will be placed in context through consideration of additional information such as geological data and admiralty charts and existing archaeological studies and published sources. The offshore DBA will be prepared by Wessex Archaeology under the direct management of Royal HaskoningDHV.	- Q1/Q2 2017
Geophysical Data Assessment Geophysical data (sub-bottom profiler data, sidescan sonar, multibeam echosounder and magnetometer data) were acquired in 2012 (NV East) and in 2016 (NV West and the provisional offshore cable corridor) in accordance with a position paper prepared following consultation with Historic England (Royal HaskoningDHV, 2016b). Data are currently being processed, interpreted and assessed by Wessex Archaeology for integration with the results of the DBA.	- Q1/Q2 2017
Geoarchaeological Assessment Geotechnical data (cone penetration testing and vibrocoring) along the provisional offshore cable corridor and within NV East and NV West were acquired in 2016 in accordance the position paper for site investigations (Royal HaskoningDHV, 2016b). • Stage 1: a stage 1 desk based review of the core logs has been undertaken, following attendance at the Fugro laboratory by Wessex Archaeology's geoarchaeologist. • Stage 2: the stage 1 report will outline the objectives for stage 2. The specification for stage 2 will be developed and carried out in consultation with the Historic England Science Advisor.	2016 (complete) Q1 2017 Q2/Q3 2017

Survey/ Data Review	Programme
Geoarchaeological Assessment / Palaeoenvironmental Survey within the intertidal zone at the landfall will be undertaken, as required, in conjunction with any planned geotechnical site investigation and a scheme wide, but targeted, approach to geoarchaeological survey as part of the onshore assessment.	TBC. Dependent on site investigation approach/programme. Partly dependent on landowner access, as well as specific programme requirements and associated project risk. Any field work elements are proposed to be undertaken post-consent.
Intertidal Walkover Survey/Site Visit A walkover survey at the landfall will be carried out within the intertidal zone to ground truth data from the DBA.	Q2/Q3/Q4 2017

2 PROJECT DESCRIPTION

2.1 Site Selection Update

8. Further to the site selection information provided within the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016a), additional site selection work has been undertaken to refine the locations of the onshore infrastructure. Offshore, the boundaries of the site and offshore cable corridor are the same as those already presented in the Scoping Report. The Norfolk Vanguard EIA Scoping Report identified search areas for the onshore infrastructure, including a landfall search area. Further data review has been undertaken to understand the engineering and environmental constraints within this search areas identified. Public drop-in-exhibitions in October 2016 and the Scoping Opinion have also contributed to our broader understanding of local constraints and opportunities.

9. Information provided in this Method Statement is a draft for stakeholder consultation only and is provided in confidence. Equivalent information will be presented during open drop-in-exhibitions in March 2017, providing an opportunity for local people and the wider public to understand the way in which their feedback, as well as the Scoping Opinion, has influenced our design. Given the broad range and complexity of the factors influencing onshore site selection, including landfall, and the scale of the area under discussion, it is our intention that local people and interested parties view the map for the first time, with Vattenfall and suitably qualified experts on hand. This enables a meaningful discussion of the proposed options and enables participants to refer directly to points of reference they may wish to discuss. During the March drop-in exhibitions, participants will also be invited to provide feedback on the latest design.

10. Ongoing public and stakeholder consultation as well as initial EIA data collection will be used to inform selection of final locations for the EIA and DCO application, with the aim to further avoid sensitive areas. Impacts that cannot be avoided through site selection will aim to be reduced through sensitive siting, alternative engineering solutions (mitigation by design) and additional mitigation measures, where possible. Mitigation options will be developed in consultation with stakeholders.

2.1.1 Landfall Zones

11. The landfall search area was presented in the Scoping Report as Figure 1.3. This has been refined to three landfalls options; Bacton Green, Walcott Gap and Happisburgh South (shown in Figure 1 of the Onshore Archaeology Method Statement), following studies on the engineering feasibility of horizontal directional drilling (HDD). The two northern landfalls have the advantage that related onshore infrastructure (the cable relay station) could be placed close to the existing Bacton gas terminal in what is already an industrialised area thereby reducing landscape impacts, a preference stated by many at the public drop-in exhibitions. Discussions with the owners and operators of the gas terminal will inform the final landfall location.

12. Both northern options would require offshore cabling through the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ) and concerns have been expressed by members of the public and a number of statutory authorities about impacts on the MCZ. Information from the offshore cable corridor geophysical and benthic survey from within the Cromer Shoal Chalk Beds MCZ will be reviewed to understand the extent of designated features and therefore the feasibility of installing offshore cables.

13. The international importance of Happisburgh for archaeology was identified in the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) as well as being raised at the public drop in exhibitions. Further data review to understand existing assets and the potential for future finds will be undertaken to understand both impacts from, and risk to, the project associated with the Happisburgh South landfall option. Data on coastal erosion, including estimates of coastline movement over the life time of the wind farm will also be reviewed to understand the long-term feasibility of a landfall south of Happisburgh. Owing to the rural character of this area, siting the required onshore infrastructure within 5km of the landfall will require careful consideration.

2.1.2 Offshore Project Area

14. The offshore project area remains unchanged from that presented in the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016a) and consists of:

- The offshore cable corridor;
- Norfolk Vanguard West (NV West); and
- Norfolk Vanguard East (NV East).

2.2 Indicative Worst Case Scenarios

15. The following sections set out the indicative worst case scenarios for offshore archaeology. The PEIR/ES will provide a detailed Project Description describing the

final Rochdale Envelope for the Norfolk Vanguard DCO application. Each chapter of the PEIR/ES will define the worst case scenario arising from the construction, operation and decommissioning phases of the Norfolk Vanguard project for the relevant receptors and impacts. Additionally, each chapter will consider separately the anticipated cumulative impacts of Norfolk Vanguard with other relevant projects which could have a cumulative impact on the receptors under consideration.

16. The indicative worst case scenario for archaeology below MHWS is based upon the general assumption that the greatest footprint represents the greatest potential for direct impacts (e.g. damage / destruction) to surviving archaeological material. This equates to:

- The greatest potential area of contact with the sea floor/intertidal zone;
- The maximum number of locations at which contact may occur; and
- The greatest volume of disturbed seabed sediments and intertidal deposits.

17. Indirect impacts may occur as a result of changes to prevailing marine physical processes caused by the development. In general, buried archaeological material survives better than material exposed to marine processes. The worst case scenario for these indirect impacts equates to those aspects of the development which result in the greatest potential for increased scour and sediment stripping across an area as a result of changes to physical processes. A method statement for Marine Physical Processes will be available in February and can be provided on request.

18. Indirect impacts to setting may occur if a development affects the surroundings in which a heritage asset is experienced. The historic character of a landscape or seascape may also be affected by development if elements of that development result in a change to that character. The worst case scenario for the disturbance of setting and character will be the maximum intrusive effect (e.g. number and type of new infrastructure elements, height of infrastructure, access restrictions, noise, dust and light disturbance during construction) for the longest duration.

19. The following sections provide key information on the worst case scenarios for offshore archaeology.

2.2.1 Wind Turbine Generator

20. A range of 7MW to 20MW wind turbines is included in the Norfolk Vanguard Rochdale Envelope in order to future proof the EIA and DCO to accommodate foreseeable advances in technology.

21. Turbines of 15MW to 20MW are estimated to have the same physical parameters due to potential developments in efficiency allowing a 20MW turbine (rather than increased physical size). As a result, where the worst case scenario is associated with

the largest turbines, 120 x 15MW will be the worst case scenario, rather than 90 x 20MW, due the greater number of devices making up the maximum site capacity of 1800MW. The maximum number of wind turbines will be 257 x 7MW.

22. A range of foundation options; jacket, gravity base, suction caisson, monopile and floating foundations will be included in the Rochdale Envelope. Table 2.1 provides indicative footprints for 7MW and 15MW to 20MW turbines.

23. Further to the information provided in the Scoping Report, floating foundations will be included in the Norfolk Vanguard Rochdale Envelope. Ongoing review by the Vattenfall Wind Power Limited (VWPL) engineering team has identified that this is necessary in order to future proof the EIA and DCO to include the types of foundations that are likely to be available by the time of Norfolk Vanguard construction, potentially starting in 2023. Parameters of the floating foundations are currently being reviewed by the VWPL engineering team and will be available for the EIA and DCO application. The following parameters will be considered in order to calculate the footprint of floating foundations on the seabed:

- Anchor options, e.g.:
  - Suction caisson;
  - Piled;
  - Drag anchor;
  - Gravity base with Tension Cables (Tension Leg Platform (TLP))
- Number of anchors required per turbine;
- Scour protection around anchors (if applicable);
- Mooring line options;
  - Tension;
  - Catenary (with slack to allow the turbine to rise and fall with the tide); and
- Footprint of catenary mooring lines on the seabed (if applicable).

24. Table 2.1 shows that the maximum footprint may be associated with gravity base or floating foundations. Based on the indicative parameters provided for gravity base systems, the greater number of 257 x 7MW turbines may represent the worst case scenario footprint rather than 120 x 15MW turbines. Consideration will also be given to seabed preparation requirements, particularly for gravity base foundations which have a preparation area of 50m diameter for the 7MW turbine and 60m for the 15-20MW turbines.

Table 2.1: Indicative Wind Turbine Footprints

Foundation Type	7MW Turbine	15MW-20MW Turbine
Monopile	8.5m pile diameter = 57m^2	10m pile diameter = 79m^2
Piled quadropod	3m pile diameter = 7m^2 x 4 piles = 28m^2	5m pile diameter = 20m^2 x 4 piles = 80m^2
Piled tripod	3m pile diameter = 7m^2 x 3 piles = 21m^2	5m pile diameter = 20m^2 x 3 piles = 60m^2
Suction caisson	25m bucket diameter = 57m^2	35m bucket diameter = 79m^2

Foundation Type	7MW Turbine	15MW-20MW Turbine
monopile		
Suction caisson quadropod	12m bucket diameter = 113m^2 x 4 piles = 452m^2	15m bucket diameter = 177m^2 x 4 piles = 708m^2
Suction caisson tripod	12m bucket diameter = 113m^2 x 3 piles = 339m^2	15m bucket diameter = 177m^2 x 3piles = 531 m^2
Gravity base	40m base slab diameter = 1257m^2	50m base slab diameter = 1963m^2
Floating	TBC	TBC

25. Scour protection around each foundation type is estimated to be approximately 5 times the diameter of the foundation.

26. The location of the wind turbines will be finalised pre-construction based on ground investigation and constraints identified in the EIA (including the location of heritage assets identified in the offshore archaeology assessments). The maximum capacity that may be located in NV West is estimated to be 1800MW (i.e. 100% of the turbines) and the maximum capacity in NV East is estimated to be 1200MW (i.e. 67% of the turbines) with the remaining 600MW in NV West.

2.2.2 Offshore Cabling

27. Two electrical solutions are being considered for Norfolk Vanguard, a High Voltage Alternating Current (HVAC) and a High Voltage Direct Current (HVDC) scheme. The decision as to which option will be used for the project will be agreed post consent and will depend on availability, technical considerations and cost. Both electrical solutions will have implications on the required offshore infrastructure.

28. The preferred construction technique and depth of burial for the offshore electrical infrastructure will be decided pre-construction based on ground investigation. Possible installation techniques include:

- Ploughing;
- Jetting;
- Dredging;
- Mass flow excavation[2]; and
- Trenching.

29. In some cases, cable burial cannot be undertaken and surface laying with cable protection will be required. Consideration will be given to the footprint of cable protection compared with the footprint of a cable trench to determine the worst case scenario. Cable protection options include:

- Rock placement;
- Concrete mattresses;

[2] An example of a mass flow excavator is available at http://www.rotech.co.uk/subsea/

- Frond mattresses; and
- Uraduct (protective shell fixed around the cable).

30. In terms of potential impacts to offshore archaeology indicative offshore cabling parameters are as follows:

- Number of cables;
  - 6 subsea HVAC export cables or 2 subsea HVDC export cables;
  - 2 subsea HVAC interconnector cable, linking the three offshore substations (see Section 2.2.3) or 1 subsea interconnector cable, linking the two offshore converter stations (see Section 2.2.3);
  - Inter-array cabling - subject to number of turbines and layout;
- Export cable length;
  - NV East - approximately 110km for HVAC and HVDC;
  - NV West - approximately 100km for HVAC and HVDC;
- Interconnector cable length up to 50km for HVAC and HVDC options
- Inter-array cable length up to 515km;
- Temporary footprints during installation;
  - Export cable– temporary trench width 10m for installation with a 20m pre-sweeping (dredging) corridor;
  - Interconnector cable– temporary trench width 10m for installation with a 20m pre-sweeping (dredging) corridor;
  - Inter-array cable jetting or ploughing – trench width 1m with additional temporary disturbance of 3m;
- Number of trenches;
  - 1 trench per export cable (210km total trench length for HVDC option and 620km for HVAC option);
  - 1 trench per interconnector cable (50km total trench length for HVDC option and 100km total trench length for HVAC option);
- Burial depth;
  - Export cable - 1m and 3m for the majority of the route. In soft sediments burial up to 5m may be necessary;
  - Interconnector cable - 1m and 3m for the majority of the route. In soft sediments burial up to 5m may be necessary;
  - Inter-array cable - up to 3m.

2.2.3 Ancillary Infrastructure

2.2.3.1 Offshore substation/convertor station platforms

31. Up to three substation platforms (HVAC) or two convertor station platforms (HVDC) will be required. Foundation options include:

- Piled monopile (10m diameter);

- Suction caisson monopile (20m diameter);
- Piled tripod (3m diameter pile x 3);
- Suction caisson tripod (3m diameter caisson x 3);
- Piled quadropod (3m diameter pile x 4);
- Suction caisson quadropod (3m diameter caisson x 4).

2.2.3.2 Accommodation platforms

32. A single accommodation platform may be required. Foundation options are as described in Section 2.2.3.1).

2.2.3.3 Met Masts

33. Up to 2 operational meteorological masts (met masts) may be installed within Norfolk Vanguard. Foundation options include:

- Jacket with pin piles;
- Jacket with suction caissons;
- Gravity Base;
- Suction caisson monopile; and
- Piled Monopile.

34. In addition two LiDAR buoys and two wave buoys may be required.

2.2.4 Construction Vessels

35. Further to the infrastructure parameters outlined in sections 2.2.1 to 2.2.3.3, vessel anchors and jack ups required for construction also have the potential to impact archaeology on the seabed with the maximum number of anchors/jack-ups representing the worst case scenario. The number and specification of vessels employed during the construction of the Norfolk Vanguard project would be determined by the marine contractor and the construction strategy. It is anticipated that several types of construction vessel could work in parallel during the construction of Norfolk Vanguard. For turbine installation, the most likely installation vessel would be a jack-up vessel, although DP vessels are also under consideration.

2.2.5 Landfall

36. There are three potential landfall locations for Norfolk Vanguard:

- Bacton Green;
- Walcott Gap; and
- Happisburgh South.

37. Initial survey and data collection for the EIA will enable the selection of the landfall location for Norfolk Vanguard. Therefore the approach to baseline characterisation

will initially consider all options and will then be refined once a final landfall location is selected. The PEIR and ES will present a single landfall option.

38. The Norfolk Vanguard offshore cables will be jointed to the onshore cables on the landward side of the landfall site. Cable ducts would be installed at the landfall so that the ends of the offshore cables can be pulled through to this joint location. These will be installed using HDD with cable burial (see Section 2.2.2) from the HDD exit point. The HDD will exit at one of the following two locations:

- On the beach, above the level of mean low water spring (classified as "short HDD").
- At an offshore location, away from the beach (up to 1000m in drill length) (classified as "long HDD").

39. For a short HDD, temporary beach closures would be required during drilling exit and duct installation. Beach access would be required for an excavator and 4x4 support vehicles.

40. A total of 6 ducts for the HVAC option or 2 ducts for the HVDC option would be required at the landfall for Norfolk Vanguard. Therefore the HVAC option represents the worst case scenario for intertidal archaeology.

41. The ducts are typically floated into position at the offshore/intertidal exit point via barges, the ducts are then flooded with water and pulled into the reamed drill hole from the entry pit. Once the duct has been installed, the offshore cables can be installed when convenient by positioning the cables at the offshore exit point and pulling through the ducts to the transition joint pit.

2.2.6 Construction Programme

2.2.6.1 Foundations

42. The construction programme with the longest duration has the greatest potential to disturb the setting of heritage assets. It is expected that installation of all foundations would take up to 12 months over a two year period, with up to 4 foundation installation vessels used to install foundations simultaneously.

2.2.6.2 Offshore cable laying

43. Cable laying may take up to 12 months over a 2 year period, with up to 2 cable laying vessels used simultaneously.

2.2.6.3 Landfall

44. It is expected that landfall HDD works would take up to 30 weeks for HVAC or 10 weeks for HVDC. Cable pull-through will be undertaken subsequent to the duct installation.

2.2.7 Operation and Maintenance (O&M) Strategy

45. The operation (post-construction appearance and use) of the offshore above sea level infrastructure (e.g. turbines and ancillary structures) will be considered with respect to the setting of heritage assets at the assessment (PEIR/ES) stages.

46. Once commissioned, the wind farm would operate for up to 25 years. All offshore infrastructure including wind turbines, foundations, cables and offshore substations would be monitored and maintained during this period in order to maximise efficiency.

47. As for construction, vessel anchors and jack-ups required for these maintenance activities also have the potential to impact archaeology on the seabed with the maximum number of anchors/jack-ups representing the worst case.

2.2.8 Decommissioning

48. Decommissioning would most likely involve the accessible installed components comprising: all of the wind turbine components; part of the foundations (those above sea bed level); and the sections of the inter-array cables close to the offshore structures, as well as sections of the export cables. The process for removal of foundations is generally the reverse of the installation process. Possible impacts to buried archaeological remains associated with the decommissioning stage(s) will be further considered as part of the EIA.

49. It is anticipated that a full EIA will be carried out ahead of any decommissioning works to be undertaken.

2.2.9 Cumulative Impact Scenarios

50. In addition to Norfolk Vanguard, Vattenfall is also developing the Norfolk Boreas offshore wind farm to the north of NV East, with the EIA following approximately a year behind the Norfolk Vanguard EIA. The development of Norfolk Boreas will use the same offshore cable corridor as Norfolk Vanguard with the addition of a spur to the Norfolk Boreas site.

51. If Norfolk Boreas uses the same landfall as Norfolk Vanguard, a total of 12 offshore cables and 12 ducts at the landfall would be required (six for each project under the

worst case HVAC electrical solution). The Happisburgh South landfall site is the only landfall option which can accommodate all 12 ducts at one site.

52. The following landfall scenarios for Norfolk Vanguard and Norfolk Boreas are currently being considered:

- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Bacton Green (4 ducts in total);
- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Walcott Gap (4 ducts in total);
- HVDC - Landfalls for Norfolk Vanguard and Norfolk Boreas at Happisburgh South (4 ducts in total);
- HVAC North - Landfall for Norfolk Vanguard at Bacton Green (6 ducts) with Norfolk Boreas at Walcott Gap (additional 6 ducts); or
- HVAC South - Landfall for Norfolk Vanguard and Norfolk Boreas at Happisburgh South (12 ducts).

53. As discussed in Section 2.2.5, initial data collection for the Norfolk Vanguard EIA will enable selection of the landfall location for Norfolk Vanguard which will also inform the selection of the landfall for Norfolk Boreas. Final landfall locations for Norfolk Vanguard and Norfolk Boreas will be confirmed in the Norfolk Vanguard CIA. The options of HVAC and HVDC will be retained in the Norfolk Vanguard DCO application. Due to the greater number of ducts, an HVAC option will represent the worst case scenario.

54. The full implications of Norfolk Vanguard and Norfolk Boreas cumulative impact scenarios, as well as cumulative impacts with respect to other existing and planned projects (including, but not limited to, East Anglia One, East Anglia Three, East Anglia One North and East Anglia Two), will be fully considered as part of EIA process.

55. Other offshore wind farm developments (and other project types where applicable) will be considered in the CIA. CIA screening will be undertaken in consultation with stakeholders.

56. Direct cumulative impacts to known heritage assets are unlikely to occur due to the avoidance of known archaeological sites and features identified through EIA for each of the constructed and planned projects as part of the consenting process. With regard to potential archaeological sites, although the effect of unavoidable impacts will be mitigated by agreed measures, the cumulative impact of multiple unavoidable impacts from multiple projects will be considered as part of the PEIR/ES.

57. Across the region, cumulative effects to the setting of heritage assets and historic seascape character will occur, although effects associated with construction will be

temporary and transitory, while decommissioning will result in further change to the character, reminiscent of the pre-wind farm character.

2.2.10 Transboundary Impact Scenarios

58. Transboundary impacts may be relevant to archaeology and cultural heritage where wrecks of non-British, European nationality are subject to impact from development and may therefore fall within the jurisdiction of another country. Transboundary impacts may also occur if the cumulative effects of changes to physical processes have the potential to impact archaeology across extended sea areas. In addition there is potential for developments, individually and cumulatively, to affect larger-scale archaeological features such as palaeolandscapes and to affect the setting of heritage assets and historic landscapes/seascapes which may also extend across these boundaries. These will be considered further in the PEIR/ES as appropriate.

3 BASELINE ENVIRONMENT

59. The Scoping Report provides an overview of available information in relation to offshore archaeology. This section outlines the approach to further characterising the baseline environment for the EIA.

3.1 Desk Based Assessment

60. The offshore archaeology DBA will address both marine areas and the intertidal area below MHWS. The onshore archaeology DBA will address terrestrial areas above MHWS. However, data gathering and assessment will be integrated and cross referenced between the onshore and offshore archaeological assessments, as this will be essential for understanding the full extent of the known and potential archaeological resource in the coastal region.

61. The offshore archaeology DBA will take account of:

- Seabed prehistory (i.e. archaeological remains on the seabed corresponding to the activities of prehistoric populations that may have inhabited what is now the seabed when sea levels were lower);
- Maritime archaeology (i.e. the remains of boats and ships and archaeological material associated with prehistoric and historic maritime activities);
- Aviation archaeology (i.e. the remains of crashed aircraft and archaeological material associated with historic aviation activities);
- Historic seascape character (i.e. the attributes that contribute to the formation of the historic character of the seascape); and
- Buried archaeology (including palaeoenvironmental deposits) within the intertidal zone below MHWS.

3.2 Available Data

62. Information to support the scoping study for Norfolk Vanguard was primarily taken from the Zonal Environmental Appraisal (ZEA) for the former East Anglia Zone (EAOW, 2012a). The baseline data was supplemented by records of wrecks and obstructions held by the United Kingdom Hydrographic Office (UKHO) obtained through OceanWise.

63. Further available data that will be used to inform the DBA is as follows:

- Geophysical data (sub-bottom profiler, sidescan sonar, multibeam echosounder and magnetometer) acquired for the project, processed and interpreted by Wessex Archaeology (full geophysical coverage of project areas);

- Geotechnical data (vibrocores) acquired for the project and subject to geoarchaeological assessment by Wessex Archaeology;
- Records held by the NRHE, including documented losses of vessels;
- Other relevant records held by the NHER;
- The National Heritage List online and downloadable GIS shapefiles for listing data provided by Historic England (https://historicengland.org.uk/listing/the-list/data-downloads/);
- Background British Geological Survey (BGS) geological information and relevant Admiralty Charts for the study area;
- Existing archaeological studies and published sources including, but not limited to:
    - Newcastle University, Historic Seascape Characterisation (HSC) East Yorkshire to Norfolk (Aldred, 2014);
    - North Sea Palaeolandscapes Project (e.g. Gaffney *et al*, 2009)
    - Ancient Human Occupation of Britain Project (e.g. Ashton *et al*, 2010) with specific reference to excavations at Happisburgh; and
    - Norfolk Rapid Coastal Zone Archaeological Survey (Robertson *et al*, 2005).

3.2.1 Non Designated Heritage Assets

64. The location of known marine and intertidal non-designated heritage assets will be established within a study area comprising the project areas (NV East, NV West and the provisional offshore cable corridor below MHWS) plus an agreed buffer (study area). The buffer will be added to ensure that all records of sites within and in close proximity to the project areas are captured and to provide the context for the discussion and interpretation of the known and potential intertidal and offshore archaeological resource.

65. As described in the scoping response from Historic England, of particular note is the proposed landfall. This area is internationally recognised for recently discovered evidence of prehistoric human activity, in particular relating to the earliest evidence of human existence in the UK in the area around Happisburgh.

3.2.2 Designated Heritage Assets

66. There are no designated sites (heritage assets) within NV East, NV West or the provisional offshore cable corridor below MHWS.

3.3 Planned Data Collection

67. The DBA will comprise the acquisition of desk based baseline data and information as described in Section 3.1 above. This will include searches and assessment of all available records, geological data and admiralty charts and existing archaeological studies and published sources. The DBA will be informed by the acquisition of marine geophysical and geotechnical data and potentially an intertidal walkover survey dependent upon the schedule for site visits. An assessment of the impact of the various elements of the proposed development will also be undertaken, including consideration of the potential impacts to the setting of heritage assets from intertidal and offshore activities and infrastructure.

68. Geophysical data comprising sub-bottom profiler data, sidescan sonar, multibeam echosounder and magnetometer data were acquired within NV West and the provisional offshore cable corridor in 2016. Geophysical survey was completed in NV East in October 2012. Data from NV East has been assessed by Wessex Archaeology and integrated with existing interpretations of data acquired for the East Anglia ZEA. The 2016 raw data has been provided to Wessex Archaeology and is currently being processed and interpreted to inform the DBA and the PEIR/ES.

69. Geotechnical data (cone penetration testing and vibrocoring) along the provisional offshore cable corridor, and within NV East and NV West were also acquired in 2016.

70. Wessex Archaeology operates a five stage approach to geoarchaeological assessment (**Table 3.1**) and a stage 1 desk based review of the core logs has already been undertaken, following attendance at the geotechnical contractor's (Fugro) laboratory by Wessex Archaeology's geoarchaeologist. Cores of geoarchaeological interest have been identified for transfer to Wessex Archaeology for stage 2 recording. The stage 1 report will outline the objectives for stage 2 in order to inform further consultation with the Historic England Science Advisor. The results of the offshore geotechnical survey will also inform the specification for geoarchaeological/palaeoenvironmental survey at the landfall as necessary.

71. A walkover survey of the intertidal zone will be carried out in order to ground truth known non-designated heritage assets, to examine the potential for any further heritage assets to be present and to recover and map any archaeological material which may be observed on the surface.

72. Trial trenching or test pits within the intertidal zone are not currently anticipated. The specification for onshore geotechnical site investigations will, however, be prepared with consideration of requirements for the acquisition of geotechnical data within the intertidal zone and subsequent geoarchaeological assessment and palaeoenvironmental analysis , if required. This may include an archaeological

watching brief/geoarchaeological monitoring of site investigation works as part of a scheme-wide (but targeted) approach to geoarchaeological assessment/palaeoenvironmental survey. Any planned geotechnical and associated / subsequent geoarchaeological investigations at the landfall will take particular account of the international importance of Happisburgh and the potential for the presence of the Cromer Forest Bed deposits within the area of the landfall. The archaeological and geoarchaeological input with respect to this element of the scheme will be dependent on the geotechnical site investigation approach and programme, taking into account access agreements and associated project risk. It is currently anticipated that intertidal and onshore geotechnical site investigation would be undertaken during the post-consent / pre-construction window.

Table 3.1 Wessex Archaeology stages of geoarchaeological assessment and recording

Stage	Method	Description
1	Assessment	A desk-based archaeological assessment of the trial pit, borehole and CPT logs generated by geotechnical contractors aims to establish the likely presence of horizons of archaeological interest and broadly characterise them, as a basis for deciding whether and what Stage 2 archaeological recording is required. The Stage 1 report will state the scale of Stage 2 work proposed.
2	Geoarchaeological Recording	Archaeological recording of selected retained or new core samples will be undertaken. This will entail the splitting of the cores, with half of each core being cleaned and recorded. The Stage 2 report will state the results of the archaeological recording and will indicate whether any Stage 3 work is warranted.
3	Sampling and Assessment	Dependent upon the results of Stage 2, sub-sampling and palaeoenvironmental assessment (pollen, diatoms and foraminifera) may be required. Subsamples will be taken from one core-half, with the other core-half retained intact for further sub-sampling, should it be required. Assessment will comprise laboratory analysis of the samples to a level sufficient to enable the value of the palaeoenvironmental material surviving within the cores to be identified. Subsamples will also be taken and retained at this stage in case radiocarbon dating is required during Stage 4. The Stage 3 report will set out the results of each laboratory assessment together with an outline of the archaeological implications of the combined results, and will indicate whether any Stage 4 work is warranted.
4	Analysis and Dating	Full analysis of pollen, diatoms and/or foraminifera assessed during Stage 3 will be undertaken. Typically, Stage 4 will be supported by radiocarbon dating of suitable subsamples. Stage 4 will result in an account of the successive environments within the coring area, a model of environmental change over time, and an outline of the archaeological implications of the analysis.
5	Final Report	If required Stage 5 will comprise the production of a final report of the results of the previous phases of work for publication in an appropriate journal. This report will be compiled after the final phase of archaeological work, whichever phase that is.

4 IMPACT ASSESSMENT METHODOLOGY

4.1 Defining Impact Significance

73. The scoping response provided by Historic England advises that a full assessment of the historic environment should determine the impact of the proposed development upon designated and non-designated heritage assets (and their settings), and assess the level of any resulting benefit, harm or loss to their significance.

74. The impact assessment methodology adopted for archaeology and cultural heritage will define those assets likely to be impacted by the proposed scheme. The assessment will not be limited to direct physical impacts, but will also assess possible indirect impacts upon the setting of heritage assets, whether visually, or in the form of noise, dust and vibration, spatial associations and a consideration of historic relationships between places and the historic seascape character.

75. More specifically the impact assessment will present:

- The importance of any heritage assets identified as being affected;
- The anticipated magnitude of effect (change) upon those assets and their settings;
- The significance of any identified impacts upon those assets and their settings; and
- The level of any harm (or benefit) and loss of heritage significance (importance).

76. In the absence of an industry standard methodology for heritage impact assessment within the framework of EIA, the impact assessment methodology adopted will take account of overarching principles presented in policy and guidance:

- National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012);
- Marine Policy Statement (HM Government, 2011);
- The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Historic England, 2015); and
- Conservation Principles: Policy and Guidance for Sustainable Management of the Historic Environment (Historic England, 2008).

77. Hence the impact assessment methodology adopted will differ from the standard approach adopted more generally within the PEIR/ES, for other technical disciplines. The standardised and tailored EIA matrices will provided a useful framework for the identification and appropriate responses to identified impacts, however, when analysing impacts upon heritage setting and heritage significance, the outcomes of

the matrix-based approach will be qualified through expert judgement and further comments / arguments based upon the heritage specific legislation, policy and guidance documents available (see Section 5 below), and using the fundamental concepts from the NPPF of benefit, harm and loss.

4.1.1 Sensitivity

78. The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. However, while impacts to a heritage asset's setting or character can be temporary, impacts which result in damage or destruction of the assets themselves, or their relationship with their wider environment and context, are permanent. Once destroyed an asset cannot recover. For this reason, the assessment of impacts is defined solely by their archaeological importance.

79. The importance of a heritage asset is a function of a range of factors. The Marine Policy Statement (2011) states that the value of heritage assets to this and future generations lies in their heritage interest, which may be archaeological, architectural, artistic or historic.

80. In accordance with this definition, the importance of heritage assets are assessed by examining the asset's age, type, rarity, survival and condition, fragility and vulnerability, group value, documentation, associations, scientific potential and outreach potential. These factors help to characterise a heritage asset and to assess how representative it is in comparison to other similar archaeological, architectural, artistic or historic heritage assets. In the majority of cases, statutory protection is only provided to a site or feature judged to be an above average example in regard to these factors. The criteria used for assessing the importance of intertidal and offshore archaeology are specified in in **Table 4.1**.

81. Where uncertainty occurs, the precautionary approach is to assign high importance. This precautionary approach represents good practice in archaeological impact assessment and reduces the potential for impacts to be under-estimated.

Table 4.1 Indicative (outline) criteria for determining archaeological importance

Sensitivity	Definition
High	• Assets of acknowledged international / national importance (e.g. World Heritage Sites, Scheduled Monuments, Protected Wreck Sites and undesignated assets of the quality and importance to be designated under national and international legislation) • Assets that can contribute significantly to acknowledged international / national research objectives
Medium	• Assets that contribute to regional research objectives

Sensitivity	Definition
	• Assets with regional importance, educational interest or cultural appreciation
Low	• Assets that contribute to local research objectives • Assets with local importance, educational interest or cultural appreciation • Assets that may be heavily compromised by poor preservation and/or poor contextual associations
Negligible	• Assets with no significant importance or archaeological / historical interest
Unknown	• The importance / existence / level of survival of the asset has not been ascertained (or fully ascertained/understood) from available evidence

82. It is crucial that for each asset there is a narrative accompanying the assessment which clearly sets out the reasoning (in accordance with the above factors) and the measure of professional judgment employed in assessing the importance of that asset.

4.1.2 Magnitude

83. The classification of the magnitude of effect on heritage assets takes account of such factors as:

- the physical scale and nature of the anticipated disturbance; and
- whether specific features or evidence would be lost that are fundamental to the historic character and integrity of a given asset, and its understanding and appreciation.

84. Both direct physical and indirect non-physical (e.g. visual, setting) impacts on heritage assets are considered relevant. Impacts may be adverse or beneficial. Depending on the nature of the impact and the duration of development, impacts can also be temporary and / or reversible or permanent and / or irreversible.

85. The finite nature of archaeological remains means that physical impacts are almost always adverse, permanent and irreversible; the 'fabric' of the asset and, hence, its potential to inform our historical understanding, will be removed. By contrast, effects upon the setting of heritage assets will depend upon the scale and longevity of the development and the sensitivity with which the landscape is re-instated subsequent to decommissioning / demolition, if applicable.

86. The indicative criteria used for assessing the magnitude of effect with regard to archaeology and cultural heritage are presented in **Table 4.2** below.

Table 4.2 Indicative criteria for assessing magnitude of effect

Magnitude	Definition
High	• Total loss of or substantial harm to an asset. • Complete and permanent loss of, or change to, those characteristics of an asset's setting which contribute to its significance, such as could be caused by its disassociation with its historical setting.
Medium	• Partial loss of, harm to or alteration of an asset which will substantially affect its significance. • Substantial change to the key characteristics of an asset's setting, which falls short of being a total disassociation with the historical context, or a more total loss which is temporary and/or reversible.
Low	• Minor loss of or alteration to an asset which leave its current significance largely intact. • Minor and/or short term changes to setting which do not affect the key characteristics and in which the historical context remains substantially intact.
Negligible	• Minor alteration of an asset which does not affect its significance in any notable way. • Minor and short term, or very minor and reversible, changes to its setting which do not affect the key characteristics of the asset's significance.

4.1.3 Significance

87. An initial indication of impact significance is gained by combining the predicted magnitude of effect and heritage significance (importance) in accordance with the impact assessment matrix provided in **Table 4.3** below.

Table 4.3 Indicative Impact Significance Matrix

		Magnitude of Effect			
		High	**Medium**	**Low**	**Negligible**
Heritage Significance (Importance)	**High**	*Major*	*Major*	*Moderate*	*Minor*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*

Table 4.4 Indicative Impact Significance Categories

Impact Significance	Definition
Major (Substantial)	Substantial harm or total loss of the significance of a designated heritage asset (or asset worthy of designation) such that development should not be consented unless substantial public benefit is delivered by the development.
Moderate (Less than Substantial)	Less than substantial harm to the significance of a designated heritage asset (or asset worthy of designation) such that the harm should be weighed against the public benefit delivered by the development to determine consent.
Minor (Slight)	Harm to a designated or non-designated heritage asset that can be adequately compensated through the implementation of a programme of industry standard mitigation measures.
Negligible	Impact that is nil, imperceptible and not significant.

88. Note that for the purposes of the EIA, 'major' and 'moderate' impacts are generally deemed to be significant (in EIA terms). In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively or through interactions between heritage assets or elements of the historic environment (historic landscape).

89. Embedded mitigation (for example where potential impacts to known heritage assets are avoided through Archaeological Exclusion Zones (AEZs) and micrositing through design) will be referred to and included in the initial assessment of impacts as part of the PEIR/ES. If the impact does not require mitigation (or none is possible) the residual impact will remain the same. If however, mitigation is required then there will be an assessment of the post-mitigation residual impact.

4.2 Potential Impacts

90. Direct impacts on heritage assets, either present on the seafloor or buried within seabed deposits, may result in damage to, or total destruction of, archaeological material or the relationships between that material and the wider environment (stratigraphic context or setting). These relationships can often be crucial to developing a full understanding of an asset.

91. Indirect impacts to heritage assets may occur as a result of changes to the processes acting upon a site as a result of windfarm construction, operation or decommissioning. Buried heritage assets that become exposed to marine processes, due to increased wave/tidal action for example, will deteriorate faster than those protected by sediment cover. Conversely, if increased sedimentation results in an exposed site becoming buried this may be considered a beneficial impact.

92. In assessing impacts to the setting of heritage assets, defined as 'the surroundings in which an asset is experienced' (Historic England, 2015: 2), it is necessary to consider visual considerations and other environmental factors such as noise, dust and vibration, spatial associations, and consideration of the historic relationship between places. Restrictions on access during construction, for example, may also impact the setting of a heritage asset if individuals are prevented from experiencing that asset in its surroundings.

93. Impacts to the historic seascape character will occur with the introduction of new elements causing a change in that character which may affect present perceptions of that seascape across an area.

4.2.1 Potential Impacts during Construction

4.2.1.1 Direct impacts to known heritage assets

94. It is anticipated that direct impacts to known heritage assets will not occur through the application of embedded mitigation (e.g. AEZs and micrositing through design).

4.2.1.1.1 Approach to assessment

95. The locations, nature and extent of known heritage assets will be established through the DBA incorporating the results of the geophysical and geoarchaeological assessment and, potentially, the walkover survey at the landfall.

96. Further survey to be undertaken post-consent and pre-construction (e.g. geophysical survey, geotechnical survey and ROV/diver survey) will supplement initial assessments undertaken for EIA in order to inform the required embedded mitigation.

97. The nature of embedded mitigation to prevent impacts to known heritage assets will be agreed in consultation with Historic England and Norfolk County Council.

4.2.1.2 Direct impacts to potential heritage assets

98. Unavoidable direct impacts to potential (as yet undiscovered) archaeology could occur through any activity which disturbs the seabed, which makes contact with the seabed or, with regard to heritage assets with height (i.e. shipwrecks), which occurs in the water column. Direct impacts may also occur during activities at the landfall which disturb intertidal deposits.

99. Any adverse effects would likely be permanent and irreversible in nature.

4.2.1.2.1 Approach to assessment

100. The potential for previously undiscovered archaeological material to be present within the footprint of the development will be established through the DBA incorporating the results of the geophysical and geoarchaeological assessment and, potentially, the walkover survey at the landfall.

101. Measures to mitigate the effect of unavoidable impacts will be identified and described in the EIA including, for example, the implementation of the Offshore Renewables Protocol for Archaeological Assessment (ORPAD) (The Crown Estate, 2014). The Protocol will ensure that any unexpected discoveries of archaeological material are addressed in a timely and appropriate manner.

4.2.1.3 Indirect impacts associated with the effect of changes to physical processes

102. Changes to erosion and sedimentation regimes during construction could cause indirect impacts to heritage assets (i.e. increased sediment erosion leading to degradation of newly exposed assets, or increased sediment accretion leading to protection from degradation through burial).

4.2.1.3.1 Approach to assessment

103. Physical processes will be assessed as part of the EIA process based upon new and existing survey data acquired for the development. The results of this assessment, and the nature of any significant effects upon physical processes from the development, will be reviewed and assessed to identify any potential indirect impacts to intertidal and offshore archaeology.

4.2.1.4 Impacts to setting and Historic Seascape Character

104. The Scoping Report for Norfolk Vanguard proposed scoping out the assessment of the setting of heritage assets for offshore archaeology due to the distance from shore of the wind farm and due to the existing context of a busy shipping channel as well as gas rigs and service vessels. However, as set out in the Scoping Opinion it is the opinion of the Secretary of State that consideration of setting should not be scoped out at this stage. In particular, the scoping response from Historic England explains that there is a connection between the seabed area and the site of Second World War shipping casualties and that from further surveys it will be possible to elucidate such special features within a wider battlefield context and setting.

4.2.1.4.1 Approach to assessment

105. The level of the setting (including visual setting) impact will be assessed with regard to a number of factors including the height and size of the turbines and blades and

the degree of night time illumination. This will include the extent of visibility from selected heritage assets on the adjacent coast during both daylight and any impression of night time illumination.

106. The assessment of the historic seascape character will set out the historic cultural influences which shape present seascape perceptions across marine and coastal areas. The aim will be to demonstrate any potential change to that historic seascape from the construction of Norfolk Vanguard. The EIA will reference the HSC work undertaken by Historic England for this area (Aldred, 2014) in order to establish the capacity of the presently perceived historic character to accommodate that change.

4.2.2 Potential Impacts during O&M

4.2.2.1 Direct impact to known heritage assets

107. It is anticipated that direct impacts to known heritage assets will not occur during the operation phase due to the retention of embedded mitigation (e.g. AEZs) throughout the project lifecycle.

4.2.2.1.1 Approach to assessment

108. The approach to assessment will be as for construction outlined above.

4.2.2.2 Direct impacts to potential heritage assets

109. Unavoidable direct impacts to potential (as yet undiscovered) archaeology could occur through ongoing maintenance required for the wind farm infrastructure, including vessel anchors/jack ups and repair/replacement of turbines/cables.

110. Any adverse effects would likely be permanent and irreversible in nature.

4.2.2.2.1 Approach to assessment

111. The approach to assessment will be as for construction outlined above.

4.2.2.3 Indirect impacts associated with the effect of changes to physical processes

112. Changes to erosion and sedimentation regimes from the physical presence of the wind farm infrastructure during operation could cause indirect impacts to heritage assets.

4.2.2.3.1 Approach to assessment

113. The approach to assessment will be as for construction outlined above.

4.2.2.4 Impacts to setting and Historic Seascape Character

114. The physical presence of the wind farm infrastructure once installed could impact the setting and character of heritage assets and the wider seascape.

4.2.2.4.1 Approach to assessment

115. The approach to assessment will be as for construction outlined above.

4.2.3 Potential Impacts during Decommissioning

4.2.3.1 Direct impact to known heritage assets

116. It is anticipated that direct impacts to known heritage assets will not occur due to the retention of embedded mitigation (e.g. AEZs) throughout the project lifecycle.

4.2.3.1.1 Approach to assessment

117. The approach to assessment will be as for construction outlined above.

4.2.3.2 Direct impacts to potential heritage assets

118. The extent of any impact will depend on the presence, nature and depth of any such remains and the nature of decommissioning (i.e. cables and foundations left in place will have no further impact whilst removal could result in new impacts to archaeological material).

119. Any adverse effects would likely be permanent and irreversible in nature.

4.2.3.2.1 Approach to assessment

120. It is anticipated that a full EIA will be carried out ahead of any decommissioning works to be undertaken.

4.2.3.3 Indirect impacts associated with the effect of changes to physical processes

121. If components are left in place, there will be no effect upon physical or coastal processes. If components are removed, the effects could be similar to those described during construction.

4.2.3.3.1 Approach to assessment

122. It is anticipated that a full EIA will be carried out ahead of any decommissioning works to be undertaken.

4.2.3.4 Impacts to setting and Historic Seascape Character

123. A change will occur with the decommissioning of the wind farm with the partial or complete removal of the wind turbines and associated infrastructure resulting in further change to the character, reminiscent of the pre-wind farm character.

4.2.3.4.1 Approach to assessment

124. It is anticipated that a full EIA will be carried out ahead of any decommissioning works to be undertaken.

4.2.4 Potential Cumulative Impacts

4.2.4.1 Direct impact to known heritage assets

125. Direct cumulative impacts to known heritage assets are unlikely to occur due to the avoidance of known archaeological sites and features identified through EIA for constructed and planned projects as part of the consenting process.

4.2.4.1.1 Approach to assessment

126. The approach to assessment will be as for construction outlined above.

4.2.4.2 Direct impacts to potential heritage assets

127. With regard to potential archaeological sites, although the effect of unavoidable impacts will be mitigated by agreed measures, the cumulative impact of multiple unavoidable impacts from multiple projects to the archaeological resource will need to be considered as part of the EIA.

128. For example, the extents of palaeolandscapes, from various periods, are largely unmapped and may be confined within a 'project area', but may equally extend beyond the bounds of a project. Likewise, shipwrecks and aircraft within the study area form part of a wider body of data relating to maritime and aviation networks which extend beyond the boundary of the Norfolk Vanguard offshore project area and the wider region.

129. It is possible that unique aspects of former landscapes and seascapes may be lost as a result of projects, plans and activities both within and beyond the east coast region. In addition, if a site is damaged or destroyed, comparable sites elsewhere may increase in importance as a result of greater rarity and any future direct impacts will be of greater significance. Thus, a cumulative impact is expected to occur.

130. However, together with the accumulation of archaeologically interpreted geophysical and geotechnical data carried out for offshore developments in recent years, the information provided by chance discoveries is contributing significantly to

a greater understanding of the offshore archaeological resource. As such, these unavoidable impacts and the data and records produced in mitigating their effects can also be regarded as a significant, positive cumulative effect. Any positive effect, however, must be demonstrated by the completion of studies to professional archaeological standards, and the results produced must be made publicly available.

4.2.4.2.1 Approach to assessment

131. Further consideration will be given to this potential cumulative scenario as part of the EIA, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios.

4.2.4.3 Indirect impacts associated with the effect of changes to physical processes

132. Changes to physical processes, which in themselves may not be significant on a project level, may have a significant cumulative effect when considered alongside other offshore and coastal developments across the region.

4.2.4.3.1 Approach to assessment

133. The cumulative effect of Norfolk Vanguard in terms of physical processes will be assessed as part of the EIA. The results of the physical processes assessment will be employed to undertake a full assessment of potential cumulative indirect impacts to heritage assets.

4.2.4.4 Impacts to setting and Historic Seascape Character

134. In their scoping response Historic England drew specific attention to the need to assess the impact upon the setting of heritage assets, including the extent of visibility from selected heritage assets on the adjacent coats and including cumulative factors with other similar developments. In addition, Historic England draw attention to the fact that the historic seascape is not limited to the setting of onshore heritage. Rather this encompasses the land settled by people after the last Ice Age, but now submerged, as well as material remains from past marine and coastal activity and the areas of activities that produced those remains, for example historic naval battles or former maritime trading routes.

135. As for direct impacts to potential heritage assets, discussed above, the extents of palaeolandscapes and maritime and aviation networks, as part of the historic seascape, may extend beyond the bounds of a project. Therefore, the assessment of the cumulative impact upon this seascape is imperative to understanding the ability of an area to accommodate change associated with new developments.

4.2.4.4.1 Approach to assessment

136. Further consideration will be given to this potential cumulative scenario as part of the EIA, particularly in respect to the wider East Coast offshore wind industry alongside other marine and coastal developments.

4.2.4.5 Potential Transboundary Impacts

137. Transboundary impacts may occur where a planned activity results in an effect within a transboundary context (i.e. across state borders). For offshore archaeology this could comprise:

- Wrecks or aircraft of non-British, European nationality subject to impact from development which may fall within the jurisdiction of another country;
- Indirect impacts to heritage assets in neighbouring sea areas if cumulative effects of changes to physical processes extend across borders; and
- Potential for developments, individually and cumulatively, to impact paolaeolandscapes and historic seascapes which may extend across borders.

4.2.4.5.1 Approach to assessment

138. If wrecks or aircraft of non-British, European nationality are present they will be identified through the DBA and the potential for significant transboundary effects assessed in the EIA.

139. Further consideration will be given to the potential for impacts to larger scale feature such as the extensive North Sea palaeolandscape, and to historic seascapes which transverse borders, including such elements as naval battles and maritime trade networks.

4.3 Written Scheme of Investigation

140. In accordance with the Scoping Opinion provided by the Planning Inspectorate, and associated advice provided within Historic England's letter of 1st November 2016 (Appendix 3 of the Scoping Opinion), a draft Written Scheme of Investigation (WSI) for archaeology below MHWS will be prepared and provided with the DCO application for Norfolk Vanguard. The WSI will set out the following measures for agreement to be agreed with Historic England and the MMO:

- expected methodological approach to post-consent survey and archaeological assessment of acquired data;
- embedded mitigation (e.g. Archaeological Exclusion Zones and micrositing to avoid sites) that will be integrated into the project design to prevent impacts to known heritage assets;

- the procedures that would be put in place for unknown assets discovered during pre-construction or construction activity (e.g. ORPAD).

141. The WSI will be prepared in accordance with the Model Clauses for Archaeological Written Schemes of Investigation (Crown Estate, 2010). Through the consenting process the WSI will be agreed as a point in time document as a means to ensure enforcement of the agreed mitigation measures through the DCO and DML. Specific methodological requirements and any required revisions (e.g. to the nature and extent of AEZs) will be addressed through Method Statements, as required, to underpin the delivery of the WSI.

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