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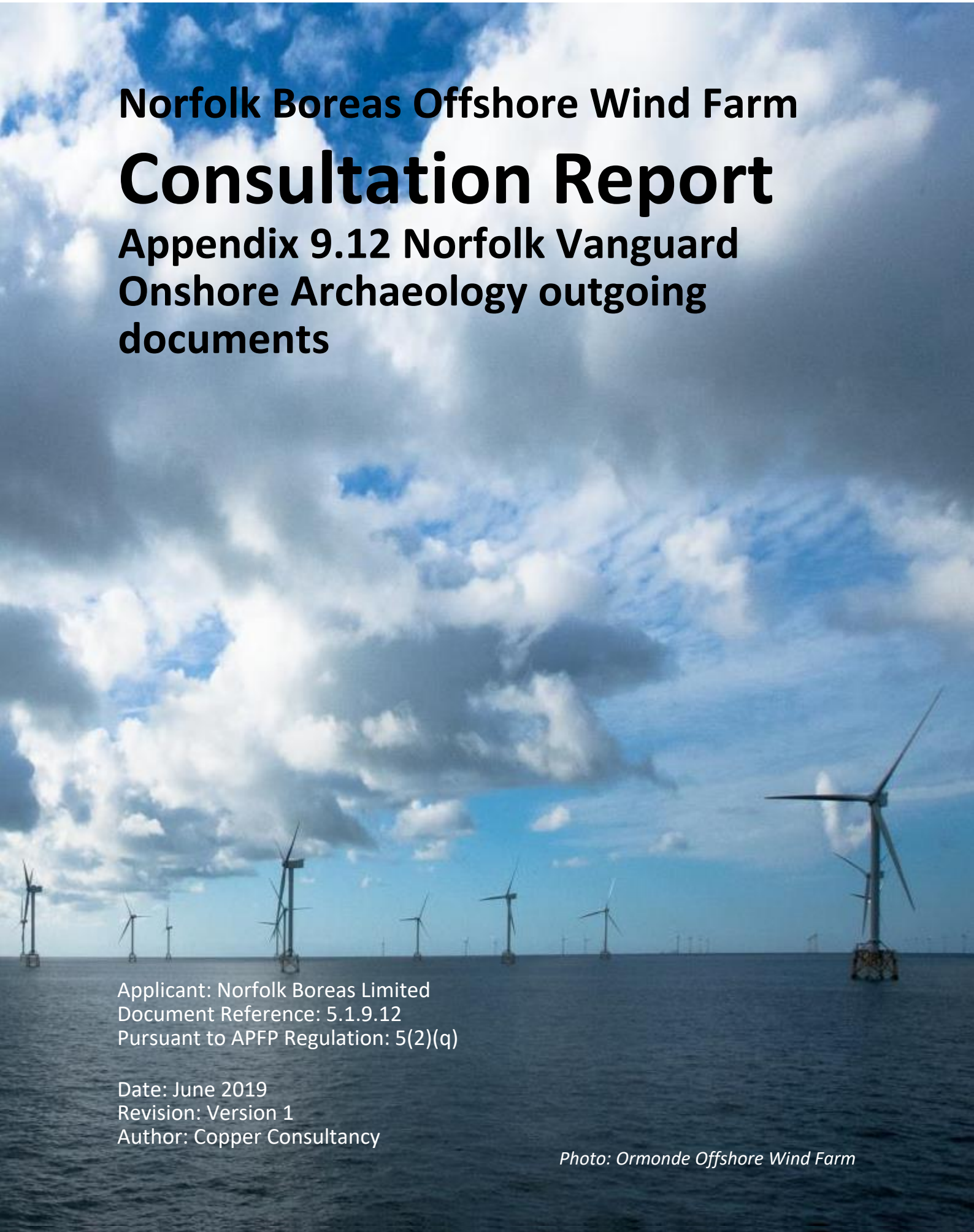
Norfolk Boreas Offshore Wind Farm

Consultation Report

Appendix 9.12 Norfolk Vanguard Onshore Archaeology outgoing documents



Applicant: Norfolk Boreas Limited
Document Reference: 5.1.9.12
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Revision: Version 1
Author: Copper Consultancy

Photo: Ormonde Offshore Wind Farm

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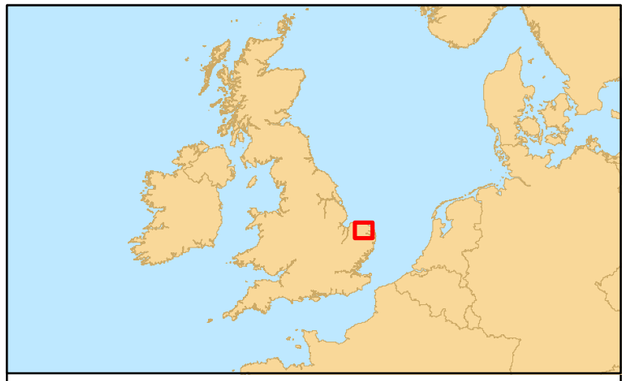

Legend:

Norfolk Vanguard Onshore Works

- Zone 1 - National Grid Substation Extension
- Zone 2 - Overhead Line Modification
- Zone 3 - Substation Search Zone
- Zone 4 - Onshore Cable Corridor
- Zone 5 - HDD Areas
- Zone 6 - Mobilisation Areas
- Zone 7 - Cable Relay Station Search Zones
- Zone 8 - Landfall HDD Corridors

Project:	Report:
Norfolk Vanguard	Method Statement

Title: Onshore Infrastructure Overview

Figure:	Drawing No:				
1	PB4476-003-MS-015				
Revision:	**Date:**	**Drawn:**	**Checked:**	**Size:**	**Scale:**
01	05/01/2017	JE	DC	A3	1:200,000

Co-ordinate system: British National Grid **EPSG:** 27700

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Norfolk Vanguard Offshore Wind Farm

Environmental Impact Assessment

Onshore Archaeology and Cultural Heritage Method Statement

Document Reference: PB4476-003-034

Author: Royal HaskoningDHV
Date: 25th January 2017
Client: Vattenfall Wind Power Ltd

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
06/01/17	00	Draft for (internal technical) comment	FS	VC	
11/01/17	00	Draft for internal (project level) comment	FS	GK	AD
18/01/17	01	Issue for Vattenfall review	FS	GK	AD
25/01/17	02	Issue for EPP Topic Group Review	FS	RH	KW

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.

Table of Contents

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 onshore archaeology and cultural heritage effects of the proposed development.

2. This onshore archaeology and cultural heritage specific EIA method statement has been informed by the views expressed in 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).

1.1 Background

3. 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

4. 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

1.2.1 DCO Programme

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

1.2.2 Evidence Plan Process Programme

5. 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

6. Regular and ongoing consultation with the Expert Topic (Steering) Group with respect to onshore archaeology and cultural heritage will be an important and central element to the archaeology and heritage assessment, survey and evaluation work undertaken as part of the EIA process and beyond.

1.2.3 Onshore Archaeology Survey Programme

7. From past and current experience (within the project team), it is envisaged that a comprehensive onshore archaeological assessment, survey and evaluation programme is likely to be required (followed by the agreement of appropriate mitigation measures/responses), and will likely consist of a combination of the following elements shown in Table 1.1 below.

8. The timings of surveys (non-intrusive and intrusive) will be discussed with the Heritage Steering Group. It is, however, envisaged that it will be necessary to undertake a number of surveys (in part or in full) during the post-consent / pre-construction window.

Table 1.1: Onshore Archaeology Programme

Survey/ Data Review	Programme
Desk Assessment: Onshore Archaeological Desk Based Assessment (DBA): will constitute the fundamental initial baseline data and information gathering exercise, including full record searches of the Norfolk Historic Environment Record (NHER) and Historic England's National Record of the Historic Environment (NRHE), as well as historic map, aerial photographic and LiDAR assessment/analysis (where possible), and a heritage settings assessment with respect to potential impacts of proposed (predominantly above ground) infrastructure on the setting	- Q1/Q2/Q3/Q4 2017

Survey/ Data Review	Programme
of heritage assets in the immediate and wider vicinity of the proposed development (this will be of particular relevance to the Cable Relay Station, Onshore Substation and the extension of Necton 400kv National Grid substation options). Wherever possible the DBA will be supported by site walkover(s) and site visits.	
Non-Intrusive and Intrusive Evaluation:	
• Archaeological Geophysical Survey (anticipated to be largely a scheme-wide requirement).	- TBC. Highly dependent on landowner access, as well as specific programme requirements and associated project risk. - Geophysical survey would initially be prioritised at the cable relay station and substation options, as well as potentially at any areas highlighted as being of particular archaeological sensitivity and priority following the DBA.
• Archaeological Metal Detecting Survey (targeted, only if required).	- TBC. Highly dependent on landowner access, as well as specific programme requirements and associated project risk.
• Archaeological Fieldwalking Survey (targeted, only if required).	- TBC. Highly dependent on landowner access, as well as specific programme requirements and associated project risk.
• Earthwork Condition (GPS/topographic) Survey (targeted, only if required).	- TBC. Highly dependent on landowner access, as well as specific programme requirements and associated project risk.
• Geoarchaeological Assessment / Palaeoenvironmental Survey (scheme wide approach, but targeted).	- TBC. 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.

Survey/ Data Review	Programme
• Archaeological Trial Trenching (scheme-wide approach, but targeted, predominantly on the geophysical survey results and a sample of apparent 'blank' areas).	- TBC. Highly dependent on landowner access, as well as specific programme requirements and associated project risk. - Proposed to be undertaken post-consent when for example land access rights are more strongly in favour of required intrusive project surveys being granted access.
• Archaeological Watching Brief / Geoarchaeological Monitoring of Site Investigation Works (targeted).	- TBC. Dependent on SI approach/programme.
Likely Mitigation Requirements (a combination of the following recognised standard approaches):	
• Set-piece (open-area) Excavation. Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate).	TBC (in advance of construction).
• Preservation in-situ (avoidance/micrositing/re-routing/HDD).	TBC (in advance of, at and during construction).
• Strip, Map and Record (or Sample) Excavation. Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate).	TBC (at/during construction).
• Watching Brief (targeted and general). Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate).	TBC (at/during construction).

2 PROJECT DESCRIPTION

2.1 Site Selection Update

9. Further to the site selection information provided within the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016), additional site selection work has been undertaken to refine the locations of the onshore infrastructure. The Norfolk Vanguard EIA Scoping Report identified search areas for the onshore infrastructure which were identified following constraints mapping to avoid or minimise potential impacts (e.g. noise, visual, landscape, traffic, human health and socio-economic impacts). Further data review has been undertaken to understand the engineering and environmental constraints within the search areas identified. The public drop-in-exhibitions in October 2016 and Scoping Opinion (the Planning Inspectorate, 2016) have also contributed to our broader understanding of local constraints and opportunities, feeding into the ongoing site selection and development of the EIA strategy. The project areas shown in Figure 1 are a draft for stakeholder consultation only and 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 (the Planning Inspectorate, 2016), has influenced our design. Given the broad range and complexity of the factors influencing site selection 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. There are currently three landfall options with associated cable relay station search zones as well as an onshore substation search zone in proximity to the existing Necton 400kV National Grid substation (the grid connection point). A 200m wide cable corridor has been identified, within which the cable route will be located (see cable route parameters in Section 2.2.1). 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 (Zone 8), Bacton Green, Walcott Gap and Happisburgh South, 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. Data on coastal erosion, including estimates of coastline movement over the life time of the wind farm, and the likelihood of archaeological finds, will be reviewed to understand the feasibility of a landfall south of Happisburgh. This site is outside the MCZ but siting the required onshore infrastructure within a rural location would require careful consideration.

2.1.2 Cable Relay Station Options

13. The cable relay station search area was presented in the Scoping Report as Figure 1.6. Refined search zones (Zone 7) have been defined based on the initial constraints mapping work, the updated landfall site selection and initial consultation. A number of receptors and impacts have been considered during the selection of the scoping search area and the refined search zones, particularly noise and visual impacts, ecology, traffic, human health and socio-economic impacts. As with the landfall location, discussions with the owners of the gas terminal will inform the final cable relay station location.

2.1.3 Onshore Cable Route

14. The onshore cable corridor search area was presented in the Scoping Report (Royal HaskoningDHV, 2016) as Figure 1.5. The route shown on Figure 1 (Zone 4) is considered to be the shortest possible route (thereby minimising disturbance impacts) whilst also aiming to avoid main residential areas and impacts to landscape and nature conservation designations where possible.

15. Routes in the north of the scoping search area were discounted owing to the presence of existing gas pipelines and the cables from the Dudgeon Offshore Wind Farm which significantly affected the number of complex crossings that would be required. The proposed route skirts around the main towns of North Walsham, Aylsham, Reepham and Dereham. The route corridor is currently 200m wide thereby allowing for further micro-siting following feedback from the public drop-in-exhibitions planned for March 2017 and information from planned survey work.

2.1.4 Substation Zone

16. The onshore substation search area, comprising five sectors, was presented in the Scoping Report (Royal HaskoningDHV, 2016) as Figure 1.4. Public consultation during the drop-in exhibitions indicated Sector 5 (to the south of the existing Necton 400kV National Grid substation) and Sector 1 (to the east) would be the best options in this location.

17. Sectors 2, 3 and 4 were discounted due to the proximity of the residential areas of Necton, Little Dunham, Great Fransham and Little Fransham.

18. Sector 1 was maintained as an option due to the existing woodland and topography of this area which could provide screening (in addition to project screening mitigation) which may limit visual impacts. Additional access would however be required for this sector.

19. Sector 5 was maintained as an option on the basis of keeping all existing and proposed development together, the lack of housing in this sector and good access from the A47. However, concerns were raised regarding the ongoing industrialisation of the area.

20. The refined substation search zone (Zone 3) includes the parts of Sectors 1 and 5, south of the A47 and south of the existing overhead line.

21. A search area for underground cables has also been delineated (the western end of Zone 4) which is required to connect the substation located within Zone 3 to the existing Necton 400kV National Grid substation.

2.1.5 Extension to the Existing Necton 400kV National Grid Extension

22. Since completion of the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) a decision has been made by VWPL to include the required extension works to the existing Necton 400kV National Grid substation within the EIA and DCO application for Norfolk Vanguard. The aim of this approach is to enable a more transparent impact assessment and allow the development of more effective mitigation.

23. Appropriate search zones for the extension works have been developed in consultation with National Grid, including:

- Zone 1 - Land adjacent to the existing substation which could accommodate extension to the existing busbars (see Section 2.2.1.5).
- Zone 2 - Land where overhead line realignment works maybe required adjacent to the existing National Grid substation (see Section 2.2.1.5).

24. VWPL will work closely with National Grid to ensure the design of the extension works is appropriate.

2.1.6 Norfolk Boreas

25. Since completion of the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016) a grid connection agreement has been granted by National Grid for Norfolk Boreas at the existing Necton 400kV National Grid substation. Therefore the Norfolk Vanguard EIA will include the option for Norfolk Boreas cable ducts to be installed at the same time as Norfolk Vanguard.

2.2 Indicative Worst Case Scenarios

26. The following sections set out the indicative worst case scenarios for onshore archaeology and cultural heritage. 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. The impacts on the onshore archaeology and cultural heritage (historic environment) resource will be fully considered, initially within the Archaeological DBA as an underpinning technical report (appendix) to, as well as within, the Onshore Archaeology and Cultural Heritage Chapter of the PEIR/ES. Additionally, the anticipated cumulative impacts of Norfolk Vanguard will be considered with other relevant projects which could have a cumulative impact on the receptors under consideration.

27. With respect to the landfall zones and cable relay station options, proximity to previously identified, recorded and highly significant coastal archaeological remains at Happisburgh (between Bacton Green and Eccles-on-Sea) will be one of the primary considerations, as will the proximity to a number of non-designated and designated heritage assets.

28. Above ground infrastructure, such as the cable relay station and substation, will be given particular consideration with respect to possible impacts on the setting of heritage assets (both designated and non-designated).

29. The worst case scenarios will be more fully understood following further progression of the onshore archaeology and cultural heritage elements of the EIA, starting with the Archaeological DBA.

30. In terms of assumptions with respect to anticipated worst case scenarios, generally the greater the land-take or footprint of the onshore infrastructure (in terms of area and depths of impact) the more likely that direct impacts (e.g. damage or destruction) to any surviving subsurface archaeological remains may occur. This is based on the sizes of areas proposed to be subject to soil stripping and ground intrusive activities.

31. A wide range of factors can affect whether indirect setting impacts may occur to heritage assets, including the siting and massing of proposed onshore infrastructure, and often key to this is the height. Generally the taller or more visible and intrusive the structure or buildings (e.g. as part of the cable relay station and the substation complexes) the wider the area across which potential setting impacts may occur.

2.2.1 Infrastructure Parameters

32. Two export schemes 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 onshore infrastructure. Typically the HVAC scenario involves a greater area of land take and additional infrastructure, and as such the HVAC scenario is assumed as the worst case in the remainder of this section. Where the worst case assumes the HVDC scenario, this is stated in the text.

33. The remainder of this section sets out the key parameters of the project worst case scenario relevant to onshore archaeology and cultural heritage. The section is subdivided into the key elements of the onshore electrical infrastructure (landfall, onshore cable route, cable relay station, substation, and National Grid substation extension) and covers the construction, operation and maintenance and decommissioning phases of the project.

2.2.1.1 Landfall

34. Three landfall zones are to be currently considered in the assessment:

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

35. 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.

36. 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 Horizontal Directional Drilling (HDD) which is a trenchless installation technique. The HDD will exit at one of the following two locations, however the impacts of the HDD exit point will be considered in the Offshore Archaeology impact assessment:

- 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").

37. Key parameters:

- 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.
- Temporary footprint of works will be 3000m^2, of which 900m^2 (6 transition pits) will involve excavation (for Norfolk Vanguard).
- There will be no permanent above ground infrastructure at landfall.

38. If Norfolk Boreas cable ducts are installed concurrently with the Norfolk Vanguard ducts, the Norfolk Boreas ducts will be installed up to the joint pits on the landward side of the landfall works. No landfall works (e.g. transition pits, HDD works) will be undertaken for Norfolk Boreas and therefore the landfall works for Norfolk Boreas do not form part of the Norfolk Vanguard DCO and will be considered in the CIA (see Section 2.2.6).

2.2.1.2 Cable Relay Station

39. A cable relay station is required for an HVAC electrical solution only and would not be included in a HVDC connection solution. Therefore the HVAC option is the worst case scenario for this element of the onshore infrastructure.

40. The cable relay station accommodates the reactive compensation equipment required to compensate the capacitive losses generated by long HVAC power cables, and will be located near to the landfall.

41. There are currently seven cable relay station search zones being considered and a final location will be defined following landfall site selection for the EIA and DCO application. The PEIR and ES will present a single cable relay station location.

42. Key parameters:

- There will be a maximum temporary footprint of 15,000m^2 during construction of the cable relay station.
- The operational area of the cable relay station will be approximately 10,500m^2.
- The height of the reactors would be up to 8m.

2.2.1.3 Onshore Cable Route

43. The main export cable onshore route will connect the landfall to the existing Necton 400kV National Grid substation.

44. There are several potential scenarios for the cable easement:

- Norfolk Vanguard HVDC: This would require a 35m temporary strip during construction, and a 13m permanent strip (including 8m access) during operation.
- Norfolk Vanguard HVAC: This would require a 50m temporary strip during construction, and a 25m permanent strip (including 8m access) during operation.
- Norfolk Vanguard and Norfolk Boreas HVDC: This would require a 45m temporary strip during construction, and a 20m permanent strip (including 8m access) during operation.
- Norfolk Vanguard and Norfolk Boreas HVAC: This would require a 100m temporary strip during construction, and a 54m permanent strip (including two separate 8m access tracks and 6m separation between circuits) during operation.

45. Key parameters:

- The length of the onshore cable route will be approximately 60km.
- The main cable installation method will be through the use of open cut trenching with High Density Polyethylene (HDPE) ducts installed, backfilled and cables pulled though the pre-laid ducts.
- Under the worst case scenario cable easement described above, an onshore temporary easement of 100m width corridor will be required. This will result in a temporary loss of a 100m area strip along the full length of the onshore cable corridor during the installation of the cable ducts. This will include a 38m wide strip for cable excavation (up to 12 cable trenches), two 6m wide access tracks either side of the 38m strip, and two 9m and two 13m strips for excavated material storage and topsoil storage respectively.

- The access tracks will be formed of protective matting, temporary metal road or permeable gravel aggregate dependant on the ground conditions.
- Joint pits with a footprint of 90m^2 will be required every 800m along the cable route (i.e. approximately 75 in total) for installation of cables in the pre-installed cable ducts.
- Where trenchless techniques (i.e. HDD) are required (e.g. at water crossings), there will a temporary footprint (ground subject to stripping) of approximately 2500m^2 and 5000m^2 to support the HDD launch and receptor sites.
- Mobilisation areas will also be required for servicing the cable installation. These will be required to store equipment and provide welfare facilities. These will involve a temporary footprint (ground subject to stripping) of 10,000m^2 for the footprint of these areas. Hardstanding will be laid for the duration of construction.

2.2.1.4 Onshore Substation

46. A single onshore substation will be required regardless of whether HVAC or HVDC options are selected and the two options will have similar land take requirements:

- HVAC:
  - Construction area approximately 400m x 400m
  - Substation footprint (within construction area) approximately 250m x 300m
  - Containing phase reactors, transformers, harmonic filters, STATCOMs, SVC or equivalent and control buildings all set out in the open. The transformers would be the largest component at a maximum height of 10.1m, with the other components not exceeding 6m.
- HVDC:
  - Construction area approximately 400m x 400m
  - Substation footprint (within construction area) approximately 250m x 300m
  - Containing two converter stations of 110 x 70m constructed of a steel framed and cladding panelled structure of a maximum height of 25m. The other electrical equipment on the site and control building would not exceed 10m in height.

47. A substation search zone (which has been refined from the substation search area shown in the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016)) is located to the south and east of the existing Necton 400kV National Grid substation. Initial survey and data collection, and feedback from the local community and stakeholders, will enable the selection of the substation location for Norfolk Vanguard. Therefore the approach to baseline characterisation will initially consider

the search zone and will then be refined once a final substation location is selected. The PEIR and ES will present a single substation location.

2.2.1.5 National Grid substation extension

48. An extension to the existing Necton 400kV National Grid substation will be required regardless of whether the HVAC or HVDC electrical solution is selected.

49. The busbar would be extended in an east west direction with seven additional Air Insulation Switchgear (AIS) bays for Norfolk Vanguard.

50. The extension to the existing Necton 400kV National Grid substation for Norfolk Vanguard and Norfolk Boreas combined would require a further busbar extension and five further AIS bays for Norfolk Boreas. This extension to the Necton 400kV National Grid substation will be included in the Norfolk Vanguard DCO and EIA.

51. Re-configuration of overhead lines to change the arrangements of the 400kV circuits in close proximity to the substation would also be required.

2.2.2 Construction Programme

52. The HVAC option is based on a three phase development programme which would take a total of seven years (2020-2026), while the HVDC option is based on a two phase development programme which would take a total of six years (2020-2025). Both programmes include two years of enabling works during 2020 and 2021, consisting of road modifications, hedge and tree removal, preconstruction drainage, mobilisation area establishment and major crossing construction.

53. Duct installation for the landfall and onshore cable and primary works for the substation and cable relay station are due to take place during 2022 and 2023. The installation of the onshore cables will occur in phases in parallel with the commissioning of the phases of the offshore wind farm. In the HVAC programme, the cable and electrical plant installation and commissioning will take place over three years from 2024 to 2026. In the HVDC programme, installation and commissioning will take place over 2 years, from 2024 to 2025.

54. Construction and decommissioning works will not take place continuously in all locations during the proposed construction time. Construction activity along the onshore cable route will move along the route, between different sections and activity will be phased, with the trenching and laying of ducts taking place first, followed by the cable installation.

55. The construction period for the cable relay station and substation is expected to be approximately 18 months.

56. In terms of onshore archaeology and cultural heritage the longer the construction programme, potentially the longer any temporary setting impacts on certain identified heritage assets from construction activities will be.

2.2.3 Construction Methodology

57. The main cable installation method will be through the use of open cut trenching. With cable circuits installed to a depth of 1.2m (top of duct) and 2m max burial depth (outside of crossings) in trenches approximately 1m wide. Alternatively to open trenching methods, a tracked trenching machine may be used which allows ducting installation to be achieved without excavation, as was widely used on the Dudgeon Offshore Windfarm Onshore Electrical Connection.

58. Topsoil will be stripped from the entire corridor and stored and capped to minimise wind and water erosion within the easement.

59. At this stage it is not known whether the substation foundations would be ground-bearing or piled based on the prevailing ground conditions. Again the predicted impacts on the subsurface and above ground archaeological and cultural heritage resource with respect to this element will be further established and assessed through the EIA process, starting with the Archaeological DBA and following a staged approach as outlined within Section 1.2.3.

2.2.4 Operation and Maintenance (O&M) Strategy

60. The operation (post-construction appearance and use) of the onshore above ground infrastructure (e.g. cable relay station and substation) will be a fundamental consideration with respect to the setting of heritage assets at the assessment (PEIR/ES) stages, starting with the settings assessment work to be undertaken as part of the Archaeological DBA. This is primarily related to the parameters of the proposed onshore infrastructure, as outlined within Sections 2.2.1.2, 2.2.1.4 and 2.2.1.5 above.

61. There is no ongoing requirement to maintain the onshore cables following installation. However, periodic access to installed link boxes / test pits may be required for inspection, estimated to be annually. No emissions are anticipated to arise from the onshore cables during operation.

62. The operational emissions from the substation and cable relay station are restricted to light and noise. It is not anticipated that the cable relay station or substation will be illuminated under normal operating conditions. Site lighting will be provided during operations and maintenance activities only, which are anticipated to occur on average once per week during operation.

2.2.5 Decommissioning

63. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected that the onshore cables will be removed from ducts and recycled, with the joint pits and ducts left in situ. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided.

2.2.6 Cumulative Impact Scenarios

2.2.6.1 Norfolk Boreas

64. If Norfolk Boreas uses the same landfall as Norfolk Vanguard, a total of 12 ducts would be required at the landfall (under the worst case HVAC electrical solution). The Happisburgh South landfall site is the only landfall option which can accommodate 12 ducts.

65. 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)

66. As discussed in Section 2.2.1, initial data collection for the Norfolk Vanguard EIA will enable selection of the landfall location for Norfolk Vanguard which will also inform the site selection 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.

67. The Norfolk Boreas cable relay station (only required under the HVAC scenario) will be located within one of the cable relay station search zones shown for Norfolk Vanguard. The Norfolk Vanguard and Norfolk Boreas cable relay stations may be co-

located or at separate locations, subject to the landfall site selection. Final cable relay station site locations will be known for the Norfolk Vanguard CIA. The cable relay stations for Norfolk Vanguard and Norfolk Boreas will be constructed separately, although construction periods could overlap. The footprint of the Norfolk Boreas cable relay station will be the same as described for Norfolk Vanguard in Section 2.2.1.

68. The CIA for Norfolk Boreas cable installation includes the following scenarios:

- Ducts for Norfolk Boreas are pre-installed during Norfolk Vanguard construction with cable pull through required during Norfolk Boreas construction;
  - Norfolk Boreas duct installation will be assessed in the project impact assessments for Norfolk Vanguard;
  - The cable pull through for Norfolk Boreas will be considered as part of the Norfolk Vanguard CIA); or
- Norfolk Boreas ducts and cables are installed at a separate time to Norfolk Vanguard.
  - This scenario will also be considered in the CIA, together with the parameters of Norfolk Vanguard alone.

69. The Norfolk Boreas substation will be located in the substation search zone shown for Norfolk Vanguard but will be constructed separately, although Norfolk Vanguard and Norfolk Boreas construction periods could overlap. The footprint of the Norfolk Boreas substation will be the same as those described for Norfolk Vanguard (Section 2.2.1).

70. As discussed in Section 2.2.1, the extension to the existing Necton 400kV National Grid substation for Norfolk Boreas would be done concurrently with Norfolk Vanguard construction under the Norfolk Vanguard DCO and therefore this is considered as part of the Norfolk Vanguard EIA.

2.2.6.2 Other Projects

71. Construction and commissioning of the substation for the Dudgeon Offshore Wind Farm is complete and operation is due to commence in 2017.

72. The cable corridor for the Hornsea Project 3 Offshore Wind Farm makes landfall at Weybourne with grid connection at Norwich Main. Where the Hornsea Project 3 cable corridor crosses, or comes into close proximity of, the Norfolk Vanguard cable corridor, there may be potential cumulative impacts on onshore archaeology and cultural heritage and this will be assessed in the CIA.

73. Other developments (such as housing, any pipelines and roads) will be considered in the CIA. CIA screening will be undertaken in consultation with stakeholders.

3 BASELINE ENVIRONMENT

3.1 Desk Based Review

74. A full and comprehensive Archaeological Desk Based Assessment (DBA) will be undertaken as part of the EIA, feeding into the PEIR and ES, as described in Section 1.2.3 (Table 1.1) above and 3.2 below. The DBA will be carried out in strict adherence to a Written Scheme of Investigation (WSI) or specification for Desk Based Assessment and Field Reconnaissance survey to be produced by Vattenfall Wind Power Ltd.'s (VWPL's) Heritage Consultants (Royal HaskoningDHV) and undertaken by Royal HaskoningDHV or a suitably experienced and qualified archaeological sub-contractor, managed directly by Royal HaskoningDHV.

75. The WSI will be agreed in advance with the Heritage Steering Group (Norfolk County Council Historic Environment Service and Historic England, and where applicable the Conservation Officers from the relevant district councils).

3.1.1 Available Data

76. Existing desk based data and information will predominantly be acquired from:

- The Norfolk Historic Environment Record (NHER)
- Historic England's National Record of the Historic Environment (NRHE)
- The National Heritage List online (including Historic England's downloadable Listing Data as GIS shapefiles), available at: https://historicengland.org.uk/listing/the-list/data-downloads/
- The Norfolk Record Office
- The Portable Antiquities Scheme
- Other Aerial Photographic, Cartographic, and relevant Documentary and Internet Sources.

77. Assessments and surveys will be undertaken with reference and adherence to the following (non-exhaustive) list of heritage related legislation, policy and guidance documentation.

- Archaeological Archives Forum (AAF) (2007). Archaeological Archives. A guide to best practice in creation, compilation, transfer and curation, Archaeological Archives Forum
- Ancient Monuments and Archaeological Areas Act (1979)
- Department for Communities and Local Government (2012). National Planning Policy Framework. Available at: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf>

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- Gaffney, C., Gater, J. and Ovenden, S. (2002). The Use of Geophysical Techniques in Archaeological Evaluations. IFA Paper No. 6. The Institute for Archaeologists (now the Chartered Institute for Archaeologists - CIfA)
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- Gurney, D. (2003). Standards for Field Archaeology in the East of England, in East Anglian Archaeology, Occasional Papers 14
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- Historic England (2015). The Management of Research Project in the Historic Environment (MoRPHE)
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- Medlycott, M. (2011). Research and Archaeology Revisited: a revised framework for the East of England. East Anglian Archaeology Occasional Papers 24. Association of Local Government Archaeological Officers
- National Heritage Act 1983 (amended 2002)
- Schmidt, A. and Ernenwein, E. (2011). Guide to Good Practice: Geophysical Data in Archaeology, Archaeological Data Service
- The Chartered Institute for Archaeologists (2014). Standard and guidance for historic environment desk-based assessment, CIfA, Reading
- The Chartered Institute for Archaeologists (2014). Standard and guidance for archaeological geophysical survey, CIfA, Reading
- The Chartered Institute for Archaeologists (2014). Code of Conduct, CIfA, Reading
- The Chartered Institute for Archaeologists, (2014), Standard and guidance for an archaeological watching brief, CIfA, Reading
- The Chartered Institute for Archaeologists, (2014), Standard and guidance for the collection, documentation, conservation and research of archaeological materials, CIfA, Reading
- The Chartered Institute for Archaeologists, (2014), Standard and guidance for the creation, compilation, transfer and deposition of archaeological archives, CIfA, Reading
- The Chartered Institute for Archaeologists (2014). Standard and guidance for archaeological field evaluation, CIfA, Reading
- Planning (Listed Buildings and Conservation Areas) Act (1990)
- Walker, K. (1990). Guidelines for the Preparation of Excavation Archives for Long-term Storage, UKIC, London

3.1.2 Non Designated Heritage Assets

78. The location of known non-designated heritage assets within 500m of the current 200m cable corridor easement will initially be established as part of the DBA.

79. A 1km study area around the cable relay station and substation options will initially be implemented, again with respect to non-designated heritage assets.

80. The study area dimensions will be agreed with the Heritage Steering Group and detailed within the WSI for Archaeological DBA.

3.1.3 Designated Heritage Assets

81. Designated heritage assets will be considered from a direct impacts perspective, and also particularly in respect to potential settings impacts, for example from the above ground infrastructure e.g. the cable relay station and the substation options, but also from other elements of the scheme (onshore infrastructure), where relevant. Various study areas will be established and tie-in made with the Landscape and

Visual Impact Assessment (LVIA) process and tool kits such as Zones of Theoretical Visibility (ZTVs) and photomontages, where appropriate.

3.2 Planned Data Collection

82. The methodology for each of the staged (phased) assessment and survey approaches outlined below (whether undertaken in-part or in-full, pre or post-consent) will be set out in separate 'survey-specific' Written Schemes of Investigation (WSIs) and agreed and approved in consultation with the Heritage Steering Group (predominantly the primary contacts within Norfolk County Council Historic Environment Service and Historic England).

83. **Archaeological Desk Based Assessment (ADBA)** will be one of the main technical appendices to the PEIR / later ES Chapter for Onshore Archaeology and Cultural Heritage (Historic Environment). This is essentially a desk based baseline data and information gathering exercise, to include: searches and scrutiny of all available records, historic maps, aerial photographs, LiDAR data (where available/applicable) and site walkover(s)/site visits, where possible. An assessment of the impact of the various elements of the proposed development will also be undertaken with respect to the setting of heritage assets, which will be of particular relevance to the cable replay station and substation options.

84. **Geophysical Survey** (generally a standard detailed magnetometry technique for linear schemes). There is anticipated to be largely a requirement for 'scheme-wide' geophysical survey in order to further establish areas of archaeological potential. This would initially be targeted on/prioritised at the cable relay station and substation options, as well as potentially at any areas highlighted as being of particular archaeological sensitivity and priority following the ADBA. Given the multiple landowners involved and likely access constraints across a *c*. 60km cable corridor, the survey programme, particularly pre-consent, will be subject to (and likely limited by) both landowner access agreements needing to be in place and the agricultural cycle across the scheme.

85. Whether undertaken pre or post-consent, using a standard detailed magnetometry technique, the geophysical survey will aim to identify anomalies representing archaeological sites and features across the projected onshore route (cable corridor and associated infrastructure). The survey will help build upon the desk based assessment results to gather initial further information on the presence, perceived absence, character and extent of any sub-surface archaeological anomalies within the survey area. Data collected from geophysical survey will then contribute directly to informing archaeological trial trench locations and positioning. At present a 200m cable corridor easement has been retained by the project, which will potentially allow the results to inform the positioning of the cable route and micrositing.

However, *c*. 60km x 200m (in addition to other areas associated with cable relay station and substation options, as well as crossings and compounds) does equate to a very large amount of geophysical survey, the implications of and approach to which will be discussed in consultation between VWPL, Royal HaskoningDHV and the Heritage Steering Group.

86. **Archaeological Metal Detecting Survey** of targeted areas, only if required and justified. Metal detecting survey(s) would aim to ascertain the presence/absence, character and extent of any surviving archaeological remains (through the recovery of any associated metallic artefacts) and would again build upon previous desk based assessment information, where applicable.

87. **Archaeological Fieldwalking Survey** of targeted areas, only if required and justified. Any fieldwalking surveys would involve the methodical walking of targeted areas of the onshore cable corridor route and associated infrastructure, to recover and map archaeological material on the field surface, and to identify potential archaeological sites below or within the modern plough zone.

88. **Earthwork Condition (GPS/topographic) Survey** would target locations (for example areas of pasture and non-arable, if required and justified) to record the presence/absence, extent, profile and 'on the ground' condition of any surviving, above ground historic earthworks, which may be impacted by construction within the onshore cable corridor easement and associated infrastructure. Data collected would predominantly feed into an additional approach (in certain identified areas) with respect to construction related backfilling and reinstatement (e.g. the 'restoration' of any historic earthwork features).

89. **Geoarchaeological Assessment / Palaeoenvironmental Survey** is largely designed to identify deposits that often lie outside the main areas of traditional archaeological interest along a large linear scheme, and that have a high potential for yielding information that would permit the reconstruction of the past environmental, vegetational and land use history of the areas through which the cable route is laid. Where required and justified such a survey often facilitates the recognition of localised palaeochannel sediments, small bogs or lake deposits, valley floodplain sediments and dry valley fills, as well as buried soils from which the palaeoenvironmental history of an area may be reconstructed through the analysis of a series of identified features. For example of any identified areas of peat-rich soils, with the potential for organic preservation.

90. **Archaeological Trial Trenching** on linear schemes often represents a fairly extensive programme of ground intrusive evaluation, which will be focused primarily on potential archaeological anomalies identified from analysis of the geophysical survey

data (in conjunction with previous desk based information, including aerial photographic and LiDAR data assessments). A number of trenches will also need to investigate apparent blank areas and potentially any concentrations of metal-detected/fieldwalking finds (where appropriate and where previously undertaken). The data and findings from the trial trenching will then further inform the approaches to mitigation, for example set-piece (open-area) excavations (normally within the pre-construction programme); strip, map and record (sample) areas (often fitted into/alongside the construction programme) and monitoring (watching briefs) often undertaken during the construction topsoil strip, sometimes also on the excavation of the cable trench(es), and any subsequent/associated open cut trenching works, e.g. bell-mouths, joint bays, compound and laydown areas etc.

91. Particularly for intrusive works, such as trial trenching, the programme will be highly dependent on landowner access, as well as specific programme requirements and associated project risk. It is therefore proposed that the archaeological trial trenching works be (in full or in the main) undertaken post-consent when land access rights are more strongly in favour of required intrusive project surveys being granted access.

92. **Archaeological Watching Brief / Geoarchaeological Monitoring** of Ground / Site Investigation works (being undertaken for geotechnical purposes for instance). This will often feed into a wider geoarchaeological assessment / palaeoenvironmental survey (see above).

4 IMPACT ASSESSMENT METHODOLOGY

93. The impact assessment methodology adopted for onshore 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 designated and non-designated heritage assets, whether visually, or in the form of noise, dust and vibration, spatial associations and a consideration of historic relationships between places.

94. More specifically the impact assessment will present:

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

95. In the absence of a specific industry standard methodology for heritage impact assessment within the framework of EIA, the impact assessment methodology adopted will be broadly in line with the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 2: Cultural Heritage (Highways Agency document 208/07) (2008), in conjunction with various recent policy and guidance documents, including:

- The National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012);
- National Planning Policy Guidance: Conserving and enhancing the historic environment;
- 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).

96. The consideration of designated heritage assets will take account of the Planning (Listed Buildings and Conservation Areas) Act (1990) and the Ancient Monuments and Archaeological Areas Act (1979).

97. Consequently, the impact assessment methodology adopted may differ from the standard approach adopted more generally within the PEIR/ES, for other technical disciplines. The standardised and tailored EIA matrices will provide a useful guidance

framework for the expert judgement of suitably experienced and qualified heritage practitioners based on the heritage specific legislation, policy and guidance documents available (see Section 3.1.1 above), and using the fundamental concepts from the NPPF of benefit, harm and loss.

4.1 Defining Impact Significance

4.1.1 Heritage significance (importance)

98. The assessment of the significance of any identified impact is largely a product of the heritage significance (importance) of an asset and the perceived magnitude of the effect on it, assessed and qualified by professional judgement.

99. An assessment of effects on an asset involves an understanding of the heritage significance of the asset and in the case of an effect on the setting of that asset, the contribution that the setting makes to the heritage significance of the asset. Policy sets out that the level of detail should be proportionate to the significance of the heritage asset and no more than is sufficient to understand the potential impact of the proposed development (NPPF paragraph 128, 2012).

100. The initial indicative (outline) criteria for determining the heritage significance of any relevant heritage assets are described in Table 4.1 below.

101. The categories and definitions of heritage significance do not necessarily reflect a definitive level of importance of an asset. They are intended to provide a provisional guide to the assessment of perceived heritage significance, which is to be based upon professional judgement incorporating the evidential, archaeological, historical, aesthetic, architectural and communal heritage values of the asset or assets.

102. Establishing heritage significance (or likely heritage significance) of an asset or group of assets, and the related impact significance by considering the perceived magnitude of effect on the asset or assets, assists in the development of appropriate evaluation and mitigation approaches. It is important to note that the heritage significance of an asset can be amended or revised as more information comes to light.

103. 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 heritage significance (importance)

Heritage Significance (Importance)	Definitions / Example Assets
High **(perceived International / National Importance)**	• World Heritage Sites • Scheduled Monuments • Grade I, II* and II Listed Buildings or structures • Designated historic landscapes of outstanding interest • Conservation Areas containing very important buildings • Assets of acknowledged international / national importance • Assets that can contribute significantly to acknowledged international / national research objectives
Medium **(perceived Regional Importance)**	• 'Locally Listed' buildings or structures • Conservation Areas containing buildings that contribute significantly to its historic character • Designated special historic landscapes • Assets that contribute to regional research objectives • Assets with regional value, educational interest or cultural appreciation
Low **(perceived Local Importance)**	• Assets that contribute to local research objectives • Assets with local value, educational interest or cultural appreciation • Assets that may be heavily compromised by poor preservation and/or poor contextual associations
Negligible	• Assets with no significant value or archaeological / historical interest
Uncertain (unknown)	• The importance / existence / level of survival of the asset has not been ascertained (or fully ascertained/understood) from available evidence

104. It is important that there is a narrative behind the assessment for example as a modifier (qualifier) for the heritage significance assigned to an asset, or the perceived magnitude of effect on the asset.

4.1.2 Magnitude of effect (change)

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

- The physical scale and nature of the anticipated impact; 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.

106. 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.

107. 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.

108. 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 Impact Significance

109. 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			
		High	Medium	Low	Negligible
Sensitivity	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 value 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 value 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.

110. 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 (or historic landscape).

111. Embedded mitigation (for example where potential impacts may be avoided through detailed design, and hence heritage assets therefore preserved 'in-situ, where possible, and/or through the use of trenchless crossing techniques for instance) 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

112. The project has the potential to impact upon the archaeological and cultural heritage (historic environment) resource in a number of ways, through both direct permanent physical changes and indirect non-physical changes to the setting of heritage assets. Some impacts and changes will be temporary and others permanent, some confined to the construction stages and others more permanent during operation and the lifespan of the project, and subsequent decommissioning.

4.2.1 Potential Impacts during Construction

4.2.1.1 Direct impact on (permanent change to) buried archaeological remains

113. The extent of any impact will depend on the presence, nature and depth of any such remains, in association with the depth of the proposed construction-related groundworks. Any adverse effects would likely be permanent and irreversible in nature.

4.2.1.2 Approach to assessment

114. A staged approach, commencing with Archaeological Desk Based Assessment, as described in Sections 1.2.3 (Table 1.1) and 3.2 above.

4.2.1.3 Direct impact on (permanent change to) above ground archaeological remains – e.g. historic earthworks (including the historic landscape character)

115. The extent of any impact will depend on the presence and nature of any such remains. Any adverse effects may be permanent and irreversible in nature.

4.2.1.4 Approach to assessment

116. A staged approach, commencing with Archaeological Desk Based Assessment, as described in Sections 1.2.3 (Table 1.1) and 3.2 above.

4.2.1.5 Indirect impact on the setting of heritage assets (designated and non-designated, including historic landscape character)

117. Would likely occur through the presence of machinery, construction traffic and general construction activities taking place within the onshore proposed development areas. The sight, noise and smell as well as any dust and vibration created during the construction phase could have an indirect (non-physical) impact upon heritage assets and their settings.

4.2.1.6 Approach to assessment

118. Settings assessment following Historic England guidance, as part of the Archaeological DBA. Using LVIA type tools such as ZTVs and photomontages, particularly in relation to above ground infrastructure such as the Cable Relay Station and Substation options.

4.2.1.7 Impact on potential geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces

119. It is possible that elements of the scheme may effect below ground deposits over a wider area than that of the footprint of the infrastructure. For example through hydrological changes that may cause desiccation and drying out of wetland deposits and associated preserved waterlogged archaeological remains.

4.2.1.8 Approach to assessment

120. A staged approach, commencing with Archaeological Desk Based Assessment, as described in Sections 1.2.3 (Table 1.1) and 3.2 above. Followed by geoarchaeological assessment / palaeoenvironmental survey, as required. The survey would include scrutiny of existing borehole logs, monitoring of future planned site/ground investigation works, and bespoke geoarchaeological survey methods, where appropriate.

4.2.2 Potential Impacts during O&M

4.2.2.1 Indirect impact on the setting of heritage assets (designated and non-designated)

121. The presence of above ground infrastructure could have an ongoing impact on the setting of heritage assets following completion of construction through into operation and maintenance phase; as a result of for example the presence of the cable relay station and substation within the landscape and their day to day uses.

4.2.2.2 Approach to assessment

122. Settings assessment following Historic England guidance, as part of the Archaeological DBA. Using LVIA type tools such as ZTVs and photomontages, particularly in relation to above ground infrastructure such as the Cable Relay Station and Substation options.

4.2.3 Potential Impacts during Decommissioning

4.2.3.1 Direct impact on (permanent change to) buried archaeological remains

123. The extent of any impact will depend on the presence, nature and depth of any such remains, in association with the depth of the proposed decommissioning-related

groundworks. Any adverse effects would likely be permanent and irreversible in nature. It was noted by Historic England in the Scoping Opinion (the Planning Inspectorate, 2016) that the demolition of buildings and infrastructure can have an impact greater than that of construction e.g. if grubbing out of foundations or remediation of contaminants is required.

4.2.3.2 Approach to assessment

124. No decision has been made regarding the final decommissioning policy for the onshore cables and other onshore elements of the project. It is, however, likely that the onshore cables will be removed from the ducts and recycled, with the transition pits and ducts capped and sealed then left in situ. Possible impacts to buried archaeological remains associated with the decommissioning stage(s) will be further considered as part of the EIA.

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

4.2.3.3 Indirect impact on the setting of heritage assets (designated and non-designated)

126. Would likely occur through the presence of machinery, decommissioning traffic and general decommissioning activities taking place within the onshore decommissioning areas. The sight, noise and smell as well as any dust and vibration created during the decommissioning phase could have an indirect (non-physical) impact upon heritage assets and their settings.

4.2.3.4 Approach to assessment

127. Settings assessment following Historic England guidance, as part of the Archaeological DBA. Using LVIA type tools such as ZTVs and photomontages, particularly in relation to above ground infrastructure such as the Cable Relay Station and Substation options and proposals for decommissioning.

4.2.4 Potential Cumulative Impacts

4.2.4.1 Cumulative Impact on the setting of designated and non-designated heritage assets

4.2.4.2 Approach to assessment

128. Settings assessment following Historic England guidance, as part of the Archaeological DBA. Using LVIA type tools such as ZTVs and photomontages, particularly in relation to above ground infrastructure such as the Cable Relay Station and Substation options, and identifying any connections/associations with other existing and/or planned infrastructure of relevance, including Norfolk Boreas and associated infrastructure.

4.2.4.3 Cumulative Impact from groundworks on above ground, or buried archaeological remains

4.2.4.4 Approach to assessment

129. 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, and the cable route for Hornsea Project 3.

4.2.4.5 Cumulative Impact from groundworks on potential geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces

4.2.4.6 Approach to assessment

130. 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, and the cable route for Hornsea Project 3.

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REPORT

Written Scheme of Investigation: Priority Archaeological Geophysical Survey (Terrestrial Archaeology) Norfolk Vanguard Offshore Wind Farm

WSI: Priority Archaeological Geophysical Survey

Client: Norfolk Vanguard Ltd.

Reference: PB4476.003.046

Revision: 0.2/Draft

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Disclaimer

Royal HaskoningDHV

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Executive Summary

This Written Scheme of Investigation (WSI) has been prepared to provide details and methodologies of the initial phase of Priority Archaeological Geophysical Survey associated with the onshore elements of the Norfolk Vanguard Offshore Wind Farm.

All (non-intrusive) archaeological geophysical survey work will be undertaken in line with the Chartered Institute for Archaeologists (CIfA) standard and guidance for geophysical survey, as well as other specific and relevant heritage guidance documentation, including 'Geophysical Survey in Archaeological Field Evaluation' (English Heritage - now Historic England, 2008).

This WSI document, detailing the proposals for the Priority Archaeological Geophysical Survey work, has been submitted to and approved in advance of commencement by Norfolk County Council (NCC) Historic Environment Service (HES), as the relevant historic environment consultee with respect to the proposed survey work.

The document also provides the methodology, scope of work and other information and requirements that must be strictly adhered to by the appointed archaeological contractor (Headland Archaeology) in undertaking and reporting on the geophysical survey.

The Priority Archaeological Geophysical Survey has been discussed in detail with NCC HES, including the individual areas being proposed for priority survey on an area by area basis, and the methodology broadly follows the same requirements and approaches undertaken on other recent linear schemes of a similar/comparable nature, including in Norfolk.

1 Introduction and Project Background

Norfolk Vanguard Offshore Wind Farm is being developed by Norfolk Vanguard Ltd., with a capacity of 1800MW, enough to power 1.3 million UK households. The offshore elements of the wind farm comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) and will be connected to the shore by offshore export cables installed within the offshore cable corridor. The project will also require onshore infrastructure in order to connect the offshore wind farm to the Necton National Grid substation. The onshore project area comprises:

- Landfall;
- Cable relay station (only required under the HVAC electrical scenario);
- Buried electrical cables in the onshore cable corridor, from landfall at Happisburgh to the onshore project substation;
- Onshore project substation; and
- Extension to the Necton National Grid substation, including overhead line modification.

The current Development Consent Order (DCO) application programme for the project is as follows:

- Preliminary Environmental Information (PEIR) submission – Q4 2017
- Environmental Statement (ES) and DCO application submission – Q2 2018

Regular and ongoing consultation with the Expert Topic Group (the historic environment consultees) with respect to onshore archaeology and cultural heritage forms an important and central element to the archaeology and cultural heritage assessment, as well as survey and evaluation work to be undertaken as part of the EIA process and beyond.

As noted in previous documentation, it is envisaged that a comprehensive onshore archaeological assessment, survey and evaluation programme is likely to be required (followed by the agreement of appropriate mitigation measures/responses).

The results of the Aerial Photographic (AP) and LiDAR data assessment have now been reviewed alongside the Historic Environment Record (HER) data with a view to identifying areas within the onshore project area in which buried archaeological remains may be present and may require further investigation. The features identified in the AP and LiDAR data assessment have formed the basis of the Priority Archaeological Geophysical Survey areas highlighted (see **Maps 1-24** below), i.e. where these features were mapped as either intersecting or located wholly within the onshore project area boundary. For the majority, these AP/LiDAR features are also encapsulated within the NHER, although there are a number of instances in which the AP/LiDAR features do not correspond to existing, previously recorded HER records.

In addition, as part of this corroboration exercise, areas in which HER records with no corresponding AP/LiDAR feature were also reviewed. Records for assets within or intersecting the onshore project area boundary, considered to be of some importance, and which were considered to warrant and benefit from additional survey (in order to understand the potential risks) have also been included within the Priority Archaeological Geophysical Survey areas.

As a general rule the Priority Archaeological Geophysical Survey will only cover the extent of the recorded AP assets located within the onshore project area boundary. An exception to this approach is the recorded grounds of St Mary's Chapel at Reepham (**AP 24** to **26** – **Map 14**). Due to this asset receiving a lot of

public interest, the proposed priority survey extends beyond the onshore project area boundary in order to capture the full extent of the recorded asset with the aim of satisfying the growing interest in the project and its location in proximity to St. Mary's Chapel.

There are also two areas of potential 'Contingency' geophysical survey associated with **APs 6 / 7** (**Map 17**) and **APs 51 / 52** (**Map 8**). These are related to ongoing routing/re-routing discussions, and geophysical survey will only be undertaken in these areas if viable, feasible re-routes can be established in principle (taking account of other environmental, engineering and land option constraints), and if the Norfolk Vanguard Project Team wishes to explore these options further. They do not in any way represent a firm requirement or formal commitment to establish re-routing in these areas, as a result of potential buried archaeological remains, at this stage.

The total area identified as requiring/benefitting from Priority Archaeological Geophysical Survey equates to approximately **750** hectares (ha) out of a total onshore project area of approximately **1680ha**. These areas are based on the onshore project area boundary (see **Maps 1-24**).

The potential 'Contingency Areas' equate to an additional approximately **33**ha.

Data collected from the archaeological geophysical survey within the Norfolk Vanguard onshore project area boundary will ultimately directly inform archaeological trial trench locations and a survey-specific WSI for trial trenching. Trial trenching is, however, proposed to be undertaken post-consent when for example land access rights are more strongly in favour of required intrusive project surveys being granted access.

Table 1.1: Potential Heritage Assets (recorded features and anomalies) identified as requiring Priority Geophysical Survey

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 69 / RHDHV 1547 / NHER 38785 **AP 71** / RHDHV 1508 / NHER 38781 **AP 78** / RHDHV 1135 & RHDHV 1144 / NHER 38743 & 38777 **AP 79** / RHDHV 715 / NHER 38775 **AP 80** / RHDHV 814 / NHER 36495 **AP 81** / RHDHV 714 / NHER 38774 **AP 84** / RHDHV 1143 / NHER 38773 **AP 86** / RHDHV 1529 / NHER 15918 **AP 87** / RHDHV 1142 / NHER 38772 **AP 88** / RHDHV 1627 / NHER 38776 **AP 90** / RHDHV 1566 / NHER 15917 **AP 91** / RHDHV 828 / NHER 16015 **AP 118** / RHDHV 712 / NHER 38768 **AP 119** / RHDHV 908 / NHER 36765 **AP 120** / RHDHV 915 / NHER 38769 **AP 125** / RHDHV 1134 / NHER 38740 **AP 126** / RHDHV 710 / NHER 38736 **AP 127** / RHDHV 709 / NHER 38735 **AP 128** / RHDHV 1133 / NHER 38738 **AP 129** / RHDHV 708 / NHER 38731 **AP 130** / RHDHV 1131 / NHER 38732 **AP 131** / RHDHV 818 / NHER 38739 **AP 249** / RHDHV 707 / NHER 38729 **AP 250** / RHDHV 784 / NHER 38730 **AP 253** / RHDHV 1127 / NHER 38720 **AP 254** / RHDHV 621 / NHER 38728 **AP 255** / RHDHV 1132 / NHER 38737 **AP 256** / RHDHV 1136 / NHER 38748	Features/possible features identified as being of possible archaeological interest are numerous across the proposed landfall area and moving immediately westwards. The majority of features comprise evidence of former field systems, including trackways, field boundaries, enclosures, ditches and pits. Many of these features are currently undated, although date ranges between the Iron Age and Post-Medieval have been assigned variously. Notable features include possible Bronze Age round barrows (**AP 79, AP 81, AP 118, AP 126, AP 127, AP 129, AP 249, AP 250** and **AP 254**). Other features of interest include a possible Iron Age round house (**AP 250**) and possible Saxon grubenhauser (sunken house) (**AP 91**). Features not representative of former field systems and related settlement are predominantly WWII in date, relating to defensive measures employed in the 20th century: e.g. **AP 69, AP 71, AP 86** and **AP 90**). Find spots in this area are numerous and represent a broad date range from the prehistoric to modern day. (**Maps 1 & 2**)
AP 132 / RHDHV 783 / NHER 38716	Probable Iron Age or Roman trackway. (**Map 2**)
AP 150 / RHDHV 1284 / NHER 38758 **AP 151** / RHDHV 1285 / NHER 38759 **AP 152** / RHDHV 836 / NHER 21775	Area containing enclosures, field boundaries and ditches with dates assigned as unknown, Roman and / or Post-Medieval. (**Maps 2 & 3**)

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 135 / RHDHV 1139 / NHER 38757	Cropmarks of probable medieval to post medieval bank and a ditch. (**Maps 2 & 3**)
AP 115 / RHDHV 1624 / NHER 38702	Undated ditches. (**Map 2**)
AP 136 / RHDHV 1146 / NHER 38842 **AP 137** / RHDHV 807 / NHER 21835 RHDHV 1673	Area containing ditches, trackways, enclosures and boundaries assigned variously as undated, Iron Age, Roman, Medieval and Post-Medieval. The NHER also records low banks in this area (**RHDHV 1673**). (**Map 3**)
AP 153 / RHDHV 1631 / NHER 38853	Multi-period field boundaries. (**Map 3**)
AP 155 / RHDHV 1148 / NHER 38859	Medieval or post medieval boundary bank. (**Map 3**)
AP 154 / RHDHV 789 / NHER 38861	Undated enclosure and pit, possible Iron Age / Roman date. (**Map 3**)
AP 157 / RHDHV 1632 / NHER 38860	Undated ditch. (**Map 3**)

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 219 / RHDHV 1212 / NHER 7071 **AP 220** / RHDHV 1166 / NHER 27241 **AP 221** / RHDHV 918 / NHER 38872 **AP 222** / RHDHV 730 / NHER 27240 **AP 223** / RHDHV 1149 / NHER 38864 **AP 224** / RHDHV 846 / NHER 38866 **AP 225** / RHDHV 854 / NHER 27242 **AP 226** / RHDHV 747 / NHER 27243 **AP 227** / RHDHV 1290 / NHER 39031 **AP 231** / RHDHV 822 / NHER 27237 **AP 232** / RHDHV 717 / NHER 38874 **AP 233** / RHDHV 792 / NHER 39041 **AP 234** / RHDHV 795 / NHER 7014 **AP 237** / RHDHV 1019 / NHER 39111 **AP 238** / RHDHV 953 / NHER 39028 **AP 239** / RHDHV 1635 / NHER 39026 **AP 240** / RHDHV 791 / NHER 39032 RHDHV 539 / RHDHV 2955 / RHDHV 400 / RHDHV 1456 / RHDHV 457 / RHDHV 1028 / RHDHV 547 / RHDHV 771 / RHDHV 546, RHDHV 1212, RHDHV 589	Area containing complex multi-period features. **AP 219** represents the site of a Medieval/Post-medieval post mill. **AP 220 – 227** comprise multi-period enclosures assigned as being of unknown date, Bronze Age, Iron Age, Roman, Medieval and Post-medieval. Features include ditches, trackways and pit features, a possible Bronze Age settlement (**AP 222**) and a Post-Medieval road (**AP 223**). **AP 231 – 234** are dated as unknown, Bronze Age, Iron Age, Roman and Post-Medieval. Features are representative of former field systems, with field boundaries, enclosures, ditches and pit features present, as well as a possible Bronze Age round barrow (**AP 232**). **AP 237 – 240** comprise field boundaries, ditches, trackways and roads of unknown, Iron Age, Roman, Saxon, Medieval and Post-Medieval date. The NHER records a Late Bronze Age or Early Iron Age Hearth in this area (**RHDHV 771**) and a possible Late Bronze Age cremation cemetery, Roman kiln and multi-period finds (**RHDHV 546**). Finds in the area are multi-period, dating between the prehistoric and Post-Medieval period, including prehistoric lithics (**RHDHV 539, 547, 589**). (**Maps 3 & 4**)
RHDHV 1604 / NHER 32172 RHDHV 1675 / NHER 52898	Possible prehistoric hearths (**RHDHV 1604**) and undated pits (**RHDHV 1675**). (**Map 4**)
AP 160 / RHDHV 1150 / NHER 39002 **AP 161** / RHDHV 719 / NHER 39006 **AP 162** / RHDHV 1151 / NHER 39003 **AP 163** / RHDHV 1586 / NHER 39000 **AP 164** / RHDHV 1152 / NHER 39007 **AP 261** RHDHV 623 RHDHV 674 RHDHV 1321	An area of multi-period features, including field boundaries, enclosures, ditches and pits. Such features may be of medieval / Post-Medieval date although they are currently undated. Features include a military camp dating to WWII and a possible Bronze Age ring-ditch. A Post-Medieval brickworks site is recorded in this area (**RHDHV 1321**). Finds from the area include prehistoric lithic discoveries (**RHDHV 623, 674**). Boundaries, which may be linked to similar features in the vicinity recorded by the NMP. (**Maps 4 & 5**)
AP 262 / RHDHV 1608 / NHER 36504	Enclosures and boundaries of possible Iron Age / Roman date. (**Map 5**)

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 259 / RHDHV 1574 / NHER 32551 **AP 260** **AP 270** / RHDV 1609 / NHER 36505 RHDHV 1377 / RHDHV 1069 / RHDHV 973 / RHDHV 1408	WW2 pill box, defensive structure. An area of undated ditches and boundaries indicative of a former field system and possible enclosures. Features include a possible ring-ditch of possible Bronze Age date. Finds discovered in the area have been dated to the Late Saxon / Medieval period. Also in the area is the former Old Quaker burial ground. (**Maps 5 & 6**)
AP 54 **AP 55** / RHDHV 435 / RHDHV 762 / NHER 12821 / NHER 37987 **AP 56** **AP 57** / RHDHV 435 / NHER 12821 RHDHV 1230 RHDHV 1030	Area of undated field boundaries, trackways, ditches and possible enclosures. Includes possible Bronze Age ring ditch. Features are undated or multi-period. Finds in the area recorded in the NHER date to the Medieval / Post-Medieval period. (**Maps 6 & 7**)
AP 51 / RHDHV 1607 / NHER 36499 **AP 53** / RHDHV 1612 / NHER 35549 RHDHV 937 RHDHV 827	Area with possible field system including square enclosures and a ring-ditch. Finds in the area are multi-period, dating between the Romano-British and Post-Medieval period. (**Maps 7 & 8**)
AP 50	Area with multi period ditched features which may form part of a wider field system and track ways and disturbed ground with possible archaeological features. (**Map 8**)
AP 48 and **49** / RHDHV 1615 / NHER 36454 RHDHV 554 / NHER 58489 RHDHV 636 / NHER 36792	A series of ditches, former field boundaries and trackways. Associated enclosure with possible pits. Findspots in the area are multi-period, ranging from the Early Upper Palaeolithic to Post-Medieval. (**Map 8**)
AP 42 / RHDHV 1038 / NHER 7403 **AP 43** / RHDHV 1616 / NHER 36453 **AP 44** / RHDHV 531 / NHER 60062 **AP 45** / RHDHV 531 / NHER 3370 **AP 46** / RHDHV 531 and RHDHV 1614 / NHER 60062 and NHER 36456 RHDHV 679 / NHER 12772 RHDHV 755 / NHER 18530	Area containing a possible former moated manor of Medieval / Post-Medieval date and a series of undated and /or multi-period field boundaries, ditches and enclosures. Features include a causewayed ring ditch, assigned a Late Neolithic to Late Bronze Age date in the NHER. (**Map 9**)

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 40 / RHDHV 1589 / NHER 12975 **AP 41** / RHDHV 692 / NHER 12785	Area containing former field boundaries, possible Post-Medieval in date, and earlier features including ditches and a possible ring ditch which may natural in origin. (**Map 10**)
AP 39 / RHDHV 1588 / NHER 12974	Field system with associated trackways and enclosures. (**Map 10**)
AP 38 RHDHV 578	Possible enclosure, ditches and former field boundaries. A Neolithic axehead is also recorded to have been discovered in this area. (**Map 11**)
AP 37	Undated possible enclosures and ditches. (**Map 11**)
AP 36 / RHDHV 1600 / NHER 29565	Undated trackway and ditches. (**Map 11**)
AP 30 / RHDHV 1597 / NHER 22903	An undated enclosure. It is possible that this site is related to the extensive Roman features to the south. (**Maps 11 & 12**)
AP 34	Linear ditches of unknown date, although possibly associated with an extensive roman settlement recorded to the south-east. (**Map 12**)
RHDHV 1266 / NHER 23276	Site of Post-Medieval brickworks. (**Map 12**)
AP 35	Linear ditches of unknown date, although possibly associated with an extensive roman settlement recorded to the east. (**Map 12**)
AP 28 / RHDHV 1183 and 968 / NHER 51469 and 21848	Linear ditches of unknown date, possibly part of a field system and enclosures. Medieval / Post-medieval finds have been reported in the area, including multi-period pottery of Saxon to Medieval date. (**Map 12**)
AP 27	Undated former field boundaries and ditches. *Crossing point with Hornsea P3*. (**Map 13**)

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 24 / RHDHV 977 / NHER 57967 **AP 25** / RHDHV 812 / NHER 3150 **AP 26**	Site of chapel with associated round tower, thought to be the site of St Mary's Chapel. Area containing a range of features, including the site of a Saxon-Medieval chapel, medieval moat, possible Iron Age enclosure and ditches and a series of undated former field boundaries and ditches. (**Map 14**)
AP 32	Former field boundaries of unknown date, possibly Post-Medieval. (**Map 14**)
AP 31	Former field boundaries of unknown date. (**Map 14**)
AP 23 RHDHV 963	Possible ditched features in area in which medieval and post-medieval find spots are recorded. (**Map 16**)
AP 14 / RHDHV 1104 / NHER 3024	Post-Medieval field boundaries. (**Map 16**)
AP 10 / RHDHV 735 / NHER 50641	Possible ring ditch of unknown date. (**Maps 16 & 17**)
AP 11 / RHDHV 701 / RHDHV 734 / NHER 3053 **AP 12** / RHDHV 1309 / NHER 50640	Area containing three likely Bronze Age round barrows and a series of former field boundaries of unknown date. (**Maps 16 & 17**)
AP 6 / RHDHV 811 / NHER 2999 **AP 7** / RHDHV 763 / NHER 50874	Extensive area of multi-period field boundaries with proximity to a ring-ditch of unidentified origin. (**Map 17**)
AP 16 / RHDHV 688 / NHER 12296	Curvilinear ditched enclosures which survive as earthworks in grassland. Photographed from the air on multiple occasions. (**Maps 17 & 18**)
AP 159 / RHDHV 1180 / NHER 50699	Medieval road. (**Map 20**)
RHDHV 1255 / NHER 12948	Area of a recorded 16th / 17th century pottery kiln. (**Map 20**)
AP 5	Possible former field system of unknown date. (**Map 21**)
AP 19	Slight embanked features of unknown origin. (**Map 21**)

APS / RHDHV / NHER Pref Ref ID(s)	Brief Description
AP 4	Post enclosure field boundaries which were extant in the 1940s and are now removed and visible only as marks in crops. (**Maps 22 & 23**)
AP 3	Series of field systems and drains of unknown date – possible post-medieval and / or modern. (**Maps 22 & 23**)
AP 1 / RHDHV 1015 / NHER 4190 RHDHV 1316 / NHER 58191	Medieval moat and associated ditch boundaries/enclosures with proximity to possible post-medieval clay extraction pits. (**Map 24**)

2 Archaeological and Historical Background

An Onshore Archaeological Desk Based (Baseline) Assessment has been produced as part of the Preliminary Environmental Information Report (PEIR) for the Norfolk Vanguard Offshore Wind Farm (RHDHV, 2017c). This document and its associated appendices will be thoroughly reviewed by the appointed archaeological contractor (Headland Archaeology) prior to commencing the priority geophysical survey programme.

The archaeological evidence reflects a human presence from the earliest evidence of hominin activity in the UK (Happisburgh) to the present day.

The onshore project area has been examined in detail as part of the aerial photographic and LiDAR data assessment, and found to contain a high potential for the further discovery of buried archaeological sites/features (see **Section 1** and **Table 1.1** above). This assessment confirmed and revealed a series cropmarks, including extensive and complex looking cropmark sites, indicative of a complex multi-period buried archaeological landscape dating from the earlier prehistoric through to modern periods.

Cropmark features were more abundant in the northern sector of the cable corridor, thought to be due to the ease with which crops respond to soil moisture deficits in this area. By comparison, cropmark features are less plentiful in the southern section of the cable corridor, although it is noted that well drained soils may mask the appearance of buried features in certain instances.

The potential for buried remains to be present across the onshore project area is considered to be high. Following the programme of Priority Archaeological Geophysical Survey, it is anticipated that the remainder of the onshore project area will also need to be subject to survey, either pre or post consent.

3 Geology and Topography

The British Geological Survey (BGS) online viewer shows that the solid geology beneath the onshore project area in respect to the onshore cable corridor compromises White Chalk and Crag Group deposits, which dip gently to the south-east.

The Chalk is a white or grey limestone, which principally outcrops as a low, rolling plateau in west Norfolk, along the north Norfolk coast and near Norwich where the Rivers Yare and Wensum have cut down through overlying beds to expose it. The Crag Group deposits are a sequence of sandy, marine deposits which outcrop in the eastern parts of the onshore project area.

The solid deposits are overlain predominantly by glacial till dating from the Anglian glaciation, interspersed with sheets of glacial sands and gravels. Small isolated pockets or channels of superficial deposits exist over the Glacial Till Alluvium where watercourses are crossed.

The majority of the onshore project area is agricultural land, interspersed with predominantly small rural settlements, including the towns of North Walsham, Aylsham, Reepham and Dereham, as well as watercourses, areas of woodland and hedgerows.

(Note: the above high-level information has been referenced from PEIR Chapters 19 - Ground Conditions and Contamination; and 21 - Land Use and Agriculture). This will be supplemented further as part of the archaeological geophysical survey reporting by the appointed contractor (Headland Archaeology).

4 Survey Aims and Objectives

The aims and objectives of the archaeological geophysical (magnetometer - gradiometer) survey are to:

- Undertake an initial programme of priority (targeted) detailed magnetometry across the areas highlighted in **Appendix A** – **Maps 1** to **24**.
- Corroborate, identify and characterise sub-surface anomalies that may have an archaeological origin (including defining the spatial limits of already known or suspected heritage assets).
- Discount areas within the survey area that are found to have been subject to previous 'modern' disturbance, for example where the geophysical survey data indicate the presence of 'made' or previously heavily disturbed ground.
- Provide an interpretation of all recorded geophysical anomalies in order to inform the design of a scheme-wide programme of archaeological evaluation trial trenching, proposed to be undertaken post-consent.
- Prepare a fully illustrated report on the results of the geophysical survey that is compliant with all relevant standards, guidance and good practice (see **Sections 5** and **10** below).

5 Methodology

All archaeological geophysical survey work will be carried out in accordance with accepted good practice, including 'Standard and guidance for archaeological geophysical survey' prepared by the Chartered Institute for Archaeologists (CIfA) and the CIfA 'Code of Conduct' (CIfA, 2014a / 2014b), as well as Historic England's guide to 'Geophysical Survey in Archaeological Field Evaluation' (English Heritage, 2008).

The fieldwork and reporting will also be undertaken in adherence to 'The Use of Geophysical Techniques in Archaeological Evaluations: IfA Paper 6' (Gaffney et. al., 2002), regional guidelines in 'Standards for Field Archaeology in the East of England' (Gurney, 2003) and regionally specific research aims. See **Section 10** for relevant references.

The anticipated commencement of the priority archaeological geophysical survey work is October 2017.

Archaeological geophysical (magnetometer - gradiometer) survey will subsequently (programme to be confirmed) be undertaken across the whole Norfolk Vanguard onshore project area. The priority archaeological geophysical survey works account for approximately 45% of the total Norfolk Vanguard onshore project area at this stage.

In addition to this survey-specific WSI, Headland Archaeology have produced a separate health and safety focused Risk Assessment Method Statement (RAMS) document with respect to the geophysical survey for review by Royal HaskoningDHV (RHDHV) and Norfolk Vanguard Ltd.

Due to the linear nature of the project, predominantly arable fields and the need to regularly move from plot to plot (field to field), in order to continue survey work across the outlined areas, the instrumentation to be used will be hand-held gradiometers, rather than a cart-based system.

5.1 Geophysical Survey Methodology (hand-held)

The geophysical (magnetometer - gradiometer) survey will be carried out across the footprint of the onshore project area highlighted for priority archaeological geophysical survey, an area of up to 783 hectares (including contingency areas identified at this stage).

The survey will be undertaken using four Bartington Grad601 sensors mounted at 1m intervals (allowing for a 1m traverse interval) onto a rigid carrying frame. The system will be programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses spaced 4m apart. These readings will be stored on an external weatherproof laptop and later downloaded for processing and interpretation. MLGrad601 and MultiGrad601 (Geomar Software Inc.) software will be used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software will be used to process and present the data.

The magnetometer system will be linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) and a Trimble R2 receiver outputting in NMEA mode to ensure a high positional accuracy of each data point.

A series of temporary sight markers will be established within each survey area using a Trimble dGPS system. The markers will guide the operator and ensure full coverage with the magnetometer system within the survey corridor within each plot.

The survey will be carried out by experienced surveyors (site-based geophysicists) in order to provide quality, consistent results with regard to pattern recognition and to initially screen out any noise produced by local magnetic 'pollution' and/or any recent ferrous disturbance.

At the completion of each day of survey a 30m traverse from the start of the final area (field/plot) covered that day will be repeated prior to leaving site in order to demonstrate the repeatability of the results.

On completion of each day's site operations, the survey results will be processed and reviewed.

A record will be maintained of surface conditions and of possible sources of modern geophysical interference that may have a bearing on subsequent interpretation of field data. The surveyors on site will have access to and will have read all relevant previous archaeological desk-based reporting in order to ensure an informed data review and ultimately interpretation of the results.

The interpretation of the survey data will be undertaken by an experienced archaeological geophysicist. This specialist will also be knowledgeable of the prevailing conditions across the large survey area that could affect the interpretation of the results. See **Section 7** for further information on staffing and resources. Reference to the underlying geological conditions should also be made.

Any areas where it is considered to be unsafe to work will be excluded from the survey. If any problems are encountered during the geophysical survey these will be reported immediately to the Norfolk Vanguard Ltd. Land Agents (Landowner Team) and RHDHV.

Due to access restrictions/constraints it is unlikely that the priority survey areas will occur sequentially from one end of the survey route to the other, and as a result interim reports may be required. The most appropriate approach to reporting will be agreed with Headland Archaeology in consultation with Norfolk Vanguard Ltd., RHDHV and NCC HES.

5.2 Access

Access will initially be arranged through the Norfolk Vanguard Ltd. Land Agents (Landowner Team) and will be from public access points or from private access points previously agreed with the landowner and/or land occupier (tenant). Headland Archaeology will also be required to progress specific access arrangements on a day to day and week to week basis, including direct contact (phone calls) with landowners, prior to gaining access.

Vehicles must be parked off the road, safely and appropriately within and at designated locations. No vehicles are to be parked across field accesses or blocking any other form of access route. A surveyor's vehicle sheet must be placed in the windscreen of any vehicle on site during surveying work, which should include a contact name and number.

Contact details, including names, company address and vehicle registration, of those attending site must be provided to the Norfolk Vanguard Ltd. Land Agents in advance of the site survey.

5.3 Monitoring

RHDHV will monitor the archaeological geophysical survey fieldwork progress on behalf of Norfolk Vanguard Ltd.

A minimum of one week's notice will be given to NCC HES (who hold curatorial responsibility for the geophysical survey), in advance of survey works commencing.

If required, arrangements for NCC HES to visit site and monitor the geophysical survey in progress will be made through RHDHV in the first instance.

5.4 Reporting

Verbal progress reports and brief written weekly progress reports will be provided to RHDHV and Norfolk Vanguard Ltd. during the course of the survey, and also at any juncture upon request.

Raw greyscale imagery and draft interim plots (greyscales and interpretations), including brief summaries of results (as they become available) will be submitted to RHDHV, Norfolk Vanguard Ltd. and NCC HES on a regular basis.

'Headlines' and in particular any results of a significant nature will be communicated in a timely manner.

The formal draft report on the geophysical survey will be submitted to RHDHV for review within six working weeks of the completion of fieldwork. The report will consist of a fully illustrated text and accompanying figures containing the following information:

- Site code/project number; dates for fieldwork visits; grid references; location plan, and a plan showing the limits of the survey area (accurately located to the national grid);
- A non-technical summary of the reason, aims and main results of the survey;
- An introduction to outline the circumstances leading to the commission of the project and any restrictions encountered;
- Aims and objectives of the survey;
- Site location and description;
- Geology, soils and land use;
- Planning background;
- Archaeological and historical background;
- The methodology used;
- Detailed survey results of individual fields (plots) and interpretation;
- Plans showing detailed and summary interpretation of results, including both processed and unprocessed data (at appropriate scales). Figures will also include cross reference to and correlation with relevant HER, LiDAR and aerial photographic data, where appropriate. The summary and synthesis of the archaeological results in relation to the methods used shall be supported by survey location plans and plots of minimally processed (X-Y traceplot) and fully processed (greyscale) data at a minimum scale of 1:2500 with larger scale (1:1000) plots of all areas of archaeological significance. Each plan/plot will have a scale bar and accurately oriented north arrow;
- An assessment of the importance of anomalies (potential features) within the survey area against a background of national, regional or local importance;
- Recommendations regarding the future treatment of the potential remains and/or any further archaeological work necessary on site in advance of, or during, construction;
- References to all primary and secondary sources consulted; and
- A review of the effectiveness of the methodology, within different areas, locations and 'landscapes' (i.e. differing geology and topography encountered).

All figures will be reproduced from Ordnance Survey mapping with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

6 Archive Preparation and Deposition

The project will be archived in-house (at Headland Archaeology's Offices) in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

The archive will consist of the final priority archaeological geophysical survey report within which documentary, raw and processed digital data records generated during the fieldwork will be presented. This will include a georeferenced .dxf or MapInfo .tab file copy of the interpretation of the results for the NHER.

The documentation and records generated by the project will also be assembled in accordance with the national guidelines in 'Archaeological Archives: A guide to best practice in creation, compilation, transfer and curation' (AAF, 2007) and in accordance with regional guidelines set out in 'Standards for Field Archaeology in the East of England' (Gurney, 2003).

The archiving requirements for this phase of work are to be discussed by Headland Archaeology with the Norfolk Museums and Archaeology Service ahead of works and an accession number and deposition date will be requested, as necessary.

Headland Archaeology will also contact the NHER in advance of survey to obtain an HER Event number specific to the survey. The HER can be contacted via (heritage@norfolk.gov.uk). GIS shapefiles of the priority archaeological geophysical survey areas are to be supplied with the event number request.

In addition to including a copy of the geophysical survey results and reporting (as available at the time) within the DCO application submission documents, copies of the final geophysical survey report will be supplied separately to the NHER. This will consist of one unbound hardcopy and a PDF/A on CD upon the completion of the survey, and following relevant internal reviews and Norfolk Vanguard Ltd. sign off, as well as external reviews by NCC HES.

In addition, Headland Archaeology will make their work accessible to the wider research community by submitting digital data and copies of the report on line to OASIS (Online Access to the Index of Archaeological Investigations) at - http://www.oasis.ac.uk/, upon approval by Norfolk Vanguard Ltd.

7 Resources

The appointed archaeological contractor (Headland Archaeology) will adhere to all national, regional and local standards and guidance as identified throughout this document and referenced below in **Section 10**.

Headland Archaeology will ensure that:

- All personnel involved in the project are suitably qualified and experienced professionals.
- All equipment, instrumentation and tools required (and to be supplied by the archaeological contractor) are in good working and functioning order.

Headland Archaeology will ultimately be responsible for the compliant delivery of this survey-specific WSI.

As noted above in **Section 5** all work will conform with Historic England's guide to 'Geophysical Survey in Archaeological Field Evaluation' (English Heritage, 2008), and with respect to staffing the minimum experience will be met as outlined on page 5 Section 2.8 of the guidance.

The works will be staffed by a geophysical survey team of at least 4 surveyors for the initial stages, with numbers increasing depending on access arrangements and the requirement to respond quickly to land availability and programme.

Headland Archaeology will be directly responsible for all setting out and the surveying in of all grid points, as appropriate, and for ensuring that the correct (and only the required) survey areas within the Norfolk Vanguard onshore project area are subject to survey.

Pen portrait (concise short-form style) CVs will be provided for Headland Archaeology's survey personnel to NCC HES in advance of survey work commencing.

A standard working day will involve driving to site, condition surveys of the survey area, survey area setting out and detailed geophysical survey. Data will be sent back to the Head Archaeology Office on a regular basis and regular progress reports provided to Norfolk Vanguard Ltd., RHDHV and NCC HES, as noted above in Section 5.4.

Key Contacts for Headland Archaeology, include:

Alistair Webb, Regional Manager	0113 387 6430
Sam Harrison, Manager	0113 387 6432
Eddie Bailey, Health and Safety Coordinator	0131 467 7748
David Harrison, Senior Geophysicist	[redacted]

Survey team leaders:	Ross Bishop	[redacted]
	Mark Evans	[redacted]

Additional survey support is to be supplied by Barlett-Clarke Consultancy, to be directly managed, coordinated and overseen by Headland Archaeology for the project. Barlett-Clarke is run by Alister Bartlett, a very experienced archaeological geophysicist based out of Oxford.

8 Health and Safety

The archaeological contractor (Headland Archaeology) have produced and will strictly adhere to their own (RHDHV and Norfolk Vanguard Ltd. reviewed) Health and Safety focused Risk Assessment Method Statement (RAMS) documentation, specific to the archaeological geophysical survey works. Headland Archaeology will also strictly follow any site specific health and safety requirements and protocols as outlined by RHDHV and/or Norfolk Vanguard Ltd.

Point of Work (Dynamic) Risk Assessments will be carried out by Headland Archaeology's survey team once on site and when moving between/changing work locations.

All geophysical survey personnel must adhere to the Norfolk Vanguard Ltd. site safety policies at all time and shall wear/use the correct (most appropriate) safety clothing and equipment. The following Personal Protective Equipment (PPE) is anticipated to be considered mandatory during site survey work:

- High visibility vest / jacket;
- Hard hat (to be available and worn, as appropriate);
- Non-metallic boots with ankle support, or wellington boots at the archaeological contractors survey personnel's own risk;
- Light eye protection and gloves should be available and used wherever necessary; and
- Due to surveying restrictions and in order to maintain the effectiveness of the instrumentation (no metal is to be present on the survey team during survey).

In undertaking the work all geophysical survey personnel are to abide by all statutory provisions and by-laws relating to the work in question, and in particular the Health and Safety at Work Act 1974.

No lone working will be permitted at any time.

All field teams (survey staff) must have at least one qualified first aider trained to HSE First Aider at Work or St John's Ambulance First Aid at Work (3 day course) standard. If sub-teams are working separately (in different fields/plots, or areas of the cable corridor) each sub-team will require a separate qualified first aider.

An Automated External Defibrillator (AED) must be carried by all field teams (survey staff) with personnel trained in the use of the device.

Further specifics and details of the HSE requirements and approaches will be documented in the Headland Archaeology's RAMS documentation, which will be reviewed in advance of survey commencement by Norfolk Vanguard Ltd. and RHDHV.

9 General Provisions

The archaeological contractor (Headland Archaeology) will leave all work sites and areas accessed for survey in a tidy and workmanlike condition. Headland Archaeology shall remove any material brought onto site, including grid pegs and other markers. The use of spray paint or similar means of marking will not be permitted.

In the event of any enquiries by the public, Headland Archaeology will refer all enquiries to the Norfolk Vanguard Ltd. Landowner Team and RHDHV without making any unauthorised statements or comments.

Headland Archaeology will not disseminate information or images associated with the project for publicity or information purposes, without the prior consent of Norfolk Vanguard Ltd.

Project specific business cards will be provided by RHDHV to be carried by surveyors and should they be approached by members of the public, surveyors will be sufficiently briefed in advance, remaining courteous at all times, and can hand out such cards upon request.

10 References

AAF (2007). Archaeological Archives: A guide to best practice in creation, compilation, transfer and curation, Archaeological Archives Forum

Brown, N and Glazebrook, J (eds), 2000, Research and Archaeology: A Framework for the Eastern Counties: 2. Research Agenda and Strategy. East Anglian Archaeology Occasional Paper No.8

English Heritage (2008). Geophysical Survey in Archaeological Field Evaluation, English Heritage (now Historic England)

Gaffney, C., Gater, J. and Ovenden, S. (2002). The Use of Geophysical Techniques in Archaeological Evaluations. IFA Paper No. 6. The Institute for Archaeologists (now the Chartered Institute for Archaeologists - CIfA)

Glazebrook, J. (ed.), 1997, Research and Archaeology: A Framework for the Eastern Counties: 1. Resource Assessment. East Anglian Archaeology, Occasional Paper 3

Gurney, D, in East Anglian Archaeology, 2003, Standards for Field Archaeology in the East of England, Occasional Papers 14

Medlycott, M. (ed), 2011, Research and Archaeology Revisited: A Revised Framework for the East of England'. East Anglian Archaeology Occasional Paper No. 24

Royal HaskoningDHV (2016). Norfolk Vanguard Offshore Wind Farm Environmental Impact Assessment Scoping Report

Royal HaskoningDHV (2017a). Norfolk Vanguard Offshore Wind Farm Environmental Impact Assessment Onshore Archaeology and Cultural Heritage Method Statement Draft

Royal HaskoningDHV (2017b). Norfolk Vanguard Offshore Wind Farm Written Scheme of Investigation: Archaeological Desk Based Assessment (Terrestrial Archaeology)

Royal HaskoningDHV (2017c). Norfolk Vanguard Offshore Wind Farm Onshore Archaeological Desk Based (Baseline) Assessment (DBA)

The Chartered Institute for Archaeologists (2014a). Standard and guidance for archaeological geophysical survey, CIfA, Reading

The Chartered Institute for Archaeologists (2014b). Code of Conduct, CIfA, Reading

The Planning Inspectorate (2016). Scoping Opinion; Proposed Norfolk Vanguard Offshore Wind Farm. Planning Inspectorate Reference: EN010079

Royal HaskoningDHV

Acronyms

Acronym	Acronym description
ADS	Archaeology Data Service
AED	Automated External Defibrillator
BGS	British Geological Survey
CIfA	The Chartered Institute for Archaeologists
DBA	Desk Based Assessment
DCO	Development Consent Order
DGPS	Differential Global Positioning System
EIA	Environmental Impact Assessment
ES	Environmental Statement
ITT	Invitation to Tender
GIS	Geographic Information System
LiDAR	Light Detection and Ranging
NCC HES	Norfolk County Council Historic Environment Service
NHER	Norfolk Historic Environment Record
NV	Norfolk Vanguard
OASIS	Online Access to the Index of Archaeological Investigations
OD	Ordnance Datum
OS	Ordnance Survey

PEIR	Preliminary Environmental Information Report
PPE	Personal Protective Equipment
RAMS	Risk Assessment Method Statement
WSI	Written Scheme of Investigation

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Appendix A: Figures (Maps 1 to 24)

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