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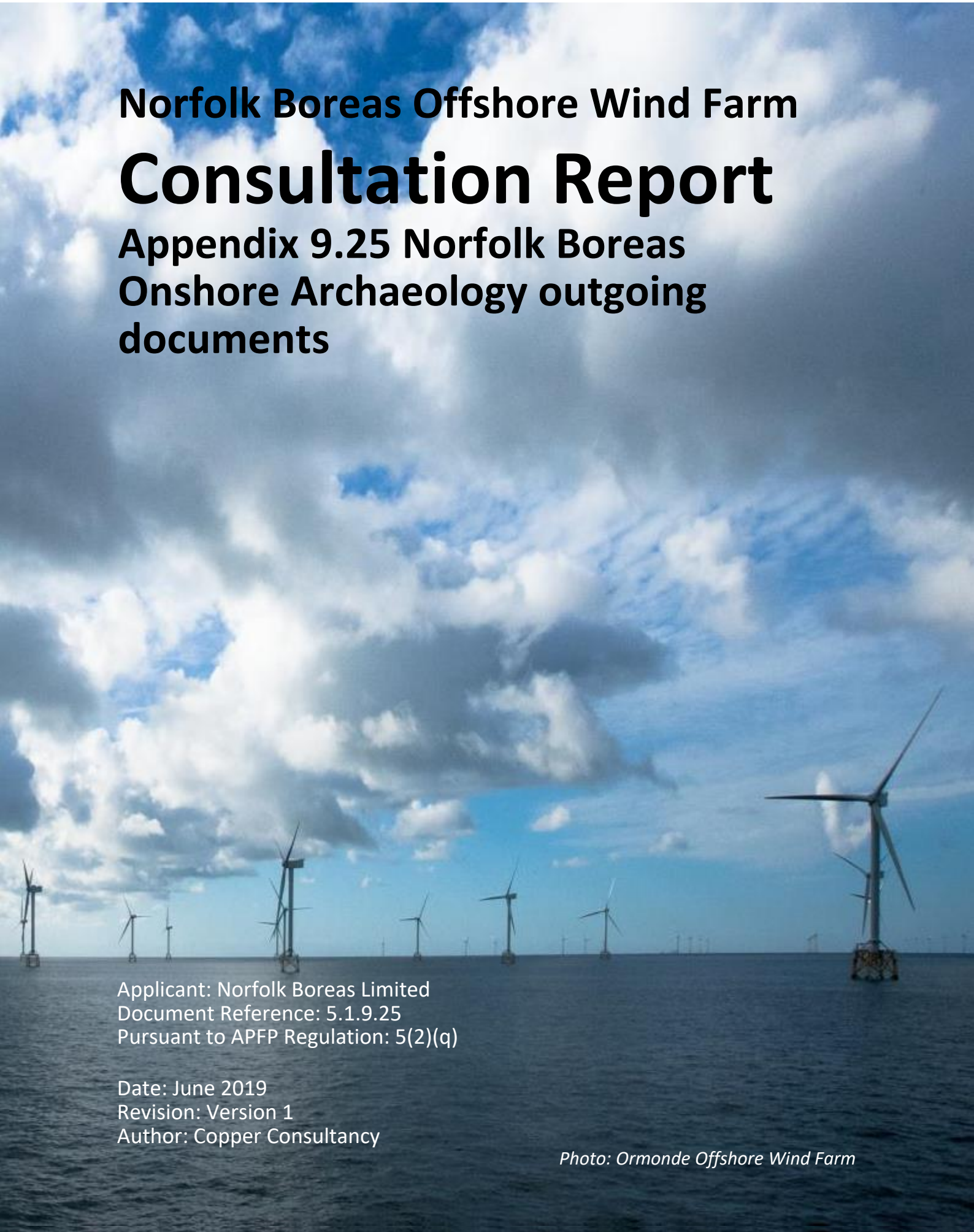
Norfolk Boreas Offshore Wind Farm

Consultation Report

Appendix 9.25 Norfolk Boreas Onshore Archaeology outgoing documents



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Norfolk Boreas Offshore Wind Farm

Environmental Impact Assessment

Onshore Archaeology and Cultural Heritage Method Statement

Document Reference: PB5640-004-012

Author: Royal HaskoningDHV
Applicant: Norfolk Boreas Ltd
Date: January 2018

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
01/12/17	01D	Draft for (RHDHV internal technical) comment	DD	FS	AD
20/12/17	02D	Draft for Vattenfall comment	DD	DT	AD
16/02/17	01F	Issue to consultees	DD	JL	AD

This method statement has been prepared by Royal HaskoningDHV on behalf of Norfolk Boreas Limited in order to build upon the information provided within the Norfolk Boreas 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 Norfolk Boreas Evidence Plan Process.

Many participants of the Norfolk **Boreas** Evidence Plan Process will also have participated in the Norfolk **Vanguard** Evidence Plan Process. This document is presented as a complete and standalone document however in order to maximise resource and save duplication of effort, the main areas of deviation from what has already been presented through the Norfolk Vanguard Evidence Plan Process and PEIR or in the Norfolk Boreas Scoping Report are presented in orange text throughout this document.

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Glossary of Acronyms

AAF	Archaeological Archives Forum
AHOB	Ancient Human Occupation of Britain
CBS	Cement Bound Sand
CIA	Cumulative Impact Assessment
CIfA	Chartered Institute for Archaeologists
DBA	Desk Based Assessment
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
GIS	Gas Insulated Switchgear
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HLC	Historic Landscape Character
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
LiDAR	Light Detection and Ranging
MCZ	Marine Conservation Zone
MoRPHE	Management of Research Project in the Historic Environment
NHER	Norfolk Historic Environment Record
NPPF	National Planning Policy Framework
PAB	Pathways to Ancient Britain
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PMA	Primary Mobilisation Area
SAC	Special Area of Conservation
SPL	Sound Pressure Level
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
TBC	To Be Confirmed
VWPL	Vattenfall Wind Power Ltd
WSI	Written Scheme of Investigation
ZTV	Zones of Theoretical Visibility

1 INTRODUCTION

1. The purpose of this method statement is to build upon the information provided within the Norfolk Boreas 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 method statement and the consultation around it form part of the Norfolk Boreas Evidence Plan Process (EPP). The aim is to gain agreement on this method statement from all members of the Onshore Archaeology and Cultural Heritage Expert Topic Group (ETG), all agreements will be recorded in the agreement log.

3. This method statement has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate and associated advice provided within Historic England's letter of 6th June 2017 (Appendix 3 of the Scoping Opinion). The EIA Scoping Opinion comments received that relate to onshore archaeology and cultural heritage are summarised in **Table 1.1.** This document has also been informed by consultation undertaken through the EPP and the Preliminary Environmental Information Report (PEIR) stakeholder responses undertaken for Norfolk Vanguard, where relevant.

4. Information provided in this Method Statement is a draft for stakeholder consultation only and is provided in confidence. It is recognised that some Norfolk Vanguard ETG meetings were held in January 2018 and that agreements will be made during those meetings which are not reflected here. However due to certain project "Mile Stones" which have been set by the Crown Estate require Norfolk Boreas to progress on a programme which requires consultation on the Norfolk Boreas Method Statements prior to the conclusion of the Norfolk Vanguard EPP. Therefore, the material provided in this document represents the best available information at the time of writing.

Table 1.1 Scoping opinion responses relevant to Onshore Archaeology and Cultural Heritage

Consultee	Comment	Response / where addressed
Secretary of State	"Paragraph 1188 of the Scoping Report explains that the onshore archaeological study area is as described in section 1.1.4 of the Scoping Report. The SoS considers the defined areas to be relatively limited in terms of the archaeological assessment, particularly for potential consideration of indirect effects. The Applicant should ensure that the study area around the cable route corridor, cable relay station and substation are sufficiently broad to give consideration to heritage assets that could be indirectly impacted."	The study area presented in the PEIR and ES will be designed to give sufficient consideration to all heritage assets that could be impacted by the project under either Scenario.
Historic England	It has been stated in paragraph 1213 that the development may alter the hydrology of an area that may result in the desiccation and degradation of wetland deposits and the	Further information on how impact to wetland deposits and the archaeological and

Consultee	Comment	Response / where addressed
	archaeological and palaeoenvironmental evidence that they may hold. The potential impacts of the development on these vulnerable deposits needs to be investigated and an appropriate strategy implemented to mitigate any damage. We recommend that this is addressed in the WSI and further information provided in the ES. References to appropriate Historic England guidance would be appropriate (see 'Preservation of Archaeological Remains' <https://historicengland.org.uk/imagesbooks/publications/preserving-archaeological-remains/>)	palaeoenvironmental evidence that they may hold is provided in sections 4 and 5.1.4

1.1 Background

5. A Scoping Report for the Norfolk Boreas EIA was submitted to the Planning Inspectorate on the 9th May 2017. 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/EN010087/EN010087-000015-Scoping%20Report.pdf

6. The Scoping Opinion was received on the 16th June 2017 and can be found at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000013-Scoping%20Opinion.pdf

1.2 Norfolk Boreas Programme

7. This section provides an overview of the planned key milestone dates for Norfolk Boreas.

1.2.1 Development Consent Order (DCO) Programme

- EIA Scoping Request submission - 09/05/17 (complete)
- Preliminary Environmental Information (PEI) submission - Q4 2018
- Environmental Statement (ES) and DCO submission - Q2 2019

1.2.2 Evidence Plan Process Programme

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

- Agreement of Terms of Reference -Q3 2017
- Post-scoping Expert Topic Group meetings / correspondence

- Discuss method statements and Project Design Statement -Q1 2018

- Expert Topic Group and Steering Group meetings as required - 2018
  - To be determined by the relevant groups based on issues raised
- PEI Report (PEIR) Expert Topic Group and Steering Group meetings - Q4 2018/ - Q1 2019
  - To discuss the findings of the PEI (before or after submission)
- Pre-submission Expert Topic Group and Steering Group meetings - Q1/Q2 2019
  - To discuss updates to the PEIR prior to submission of the ES

1.2.3 Consultation to Date

9. Norfolk Boreas is the sister project to Norfolk Vanguard (See Section 2 for further details). A programme of consultation has already been undertaken for Norfolk Vanguard which is of relevance to Norfolk Boreas. Elements of consultation undertaken for Norfolk Vanguard that are completed are listed below:

- EIA Scoping Request submission - 03/10/16
- Receipt of Scoping Opinion - 11/11/16
- Steering Group meeting - 21/03/16
- Steering Group meeting - 20/09/16
- Post-scoping Expert Topic Group meeting - 01/02/17
  - Agreed the scope of the archaeological desk based assessment to be documented in a Written Scheme of Investigation
  - Agreed that if pre-consent non-intrusive geophysical survey is possible, this should target above ground infrastructure locations and any key sensitive areas identified in the ADBA
  - Agreed that archaeology / geoarchaeology approaches and requirements are built into pre-consent engineering geotechnical surveys
  - Agreed that if required field walking / metal detecting surveys are targeted on key areas rather than project-wide programmes
  - Discussions regarding temporary construction in Conservation Areas

  - Agreed that archaeological trial trenching will not be undertaken pre-consent unless surveys / assessment indicate a particular necessity or risk in certain areas
  - Agreed Method Statement

- Expert Topic Group (coastal, inter-tidal and nearshore archaeology) meeting - 02/05/17
  - Discussed aims of the Ancient Human Occupation of Britain (AHOB) engagement process
  - Agreed establishment of a coastal, inter-tidal and nearshore steering group
  - Discussed funding opportunities to support further academic research at Happisburgh
  - Discussed geotechnical survey opportunities and the need for a survey-specific WSI
  - Discussed the landfall option refinement
  - Discussed the potential for archaeological deposits and methodologies for data acquisition
  - Discussed relevant points of contact

- Final call for comments on the following documents - 05/17
  - Onshore archaeology method statement
  - WSI for Archaeological desk based assessment
- Final call for comments on the WSI for the Geoarchaeological Watching brief - 06/17
- Expert Topic Group Meeting to discuss the PEIR for Norfolk Vanguard - 19/07/17
  - Discussed refined project areas for Norfolk Vanguard
  - Visualisation of cable relay station infrastructure
  - Settings implications, particularly with regards to the onshore project substation and the cable relay stations
  - Requirement for heritage-specific viewpoints
  - Approach to priority geophysical survey
  - Update on geoarchaeological survey
  - Discussed that heritage and archaeological assessments for the Norfolk Boreas project would be combined with the Norfolk Vanguard project where possible to avoid duplication of effort
- Meeting to discuss priority archaeological geophysics and heritage settings - 06/09/17
  - The priority archaeological geophysical survey areas identified
  - Timescales leading up to the appointment of a geophysics

contractor and the commencement of survey work
- Settings assessment and options with respect to the Cable Relay Station and project onshore Substation

10. Responses to the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b) were received in December 2017. This method statement has been updated to incorporate any key comments made that affect the proposed methodology for the Norfolk Boreas EIA.

2 PROJECT DESCRIPTION

2.1 Context and Scenarios

11. Norfolk Boreas is the sister project to Norfolk Vanguard. Vattenfall Wind Power Ltd (VWPL) is developing the two projects in tandem, and is planning to co-locate the export infrastructure for both projects in order to minimise overall impacts. This co-location strategy applies to the offshore and onshore parts of the export cable route, the cable landfalls, cable relay stations, and onshore substations.

12. The Norfolk Boreas project is approximately 12 months behind Norfolk Vanguard in the DCO process. As such, the Norfolk Vanguard team is leading on site selection for both projects. Although Norfolk Boreas is the subject of a separate DCO application, the project will adopt these strategic site selection decisions.

13. In order to minimise impacts associated with onshore construction works for the two projects, VWPL is aiming to carry out enabling works for both projects under the Norfolk Vanguard DCO. This covers the installation of buried ducts along the onshore cable route, from the landfall to the onshore substation, modifications at the Necton National Grid substation, visual screening works, access road construction, utility connections (water, electricity and phone) and site drainage.

14. However, Norfolk Boreas needs to consider the possibility that the Norfolk Vanguard project may not be constructed. In order for Norfolk Boreas to stand as an independent project, this scenario must be provided for within the Norfolk Boreas DCO. Thus, for the onshore archaeology assessment there are two alternative scenarios to be considered in the context of the EIA and this method statement:

- **Scenario 1:** Norfolk Vanguard consents and constructs transmission infrastructure which would be used by Norfolk Boreas. This includes, cable ducts, access routes to jointing pit locations, extension of the Necton National Grid substation, overhead line modification at the Necton National Grid substation and any site drainage, landscaping and planting schemes around co-located infrastructure. Under Scenario 1 Norfolk Boreas will seek to consent the Horizontal Directional Drilling (HDD) at landfall, the creation of the jointing and transition pits, onshore project substation, cable relay station (if required) and the installation of cables into the ducts through a process of cable pulling.

- **Scenario 2:** Norfolk Vanguard is not constructed and therefore Norfolk Boreas will seek to consent and construct all required project infrastructure including: HDD at landfall, creation of transition and jointing pits, installation of cable ducts, cable installation, cable relay station (if required), onshore project substation, 400kV interface works (between the onshore project substation and the Necton National

Grid substation), extension to the Necton National Grid substation, overhead line modification and any site drainage and landscape and planting schemes. For the sake of clarity, the Norfolk Boreas project would, under Scenario 2, involve the construction and installation of all onshore infrastructure necessary for a viable project.

15. Appendix 1 contains a set of figures showing the onshore infrastructure and Appendix 2 contains a detailed comparison of what is included in the two different scenarios across all elements of the project. Both these appendices are provided in separate documents.

16. Norfolk Boreas are proposing to employ a construction strategy whereby there are multiple moving work fronts which complete the majority of all construction works in each area before moving on. This reduces overall construction time as most works are completed in one pass and allows flexibility for areas to be avoided at sensitive times and to minimise impact through scheduling of works.

2.2 Site Selection Update

17. A detailed programme of site selection work has been undertaken by VWPL to refine the locations of the onshore infrastructure for both the Norfolk Vanguard and Norfolk Boreas projects. The Norfolk Vanguard EIA Scoping Report presented 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. This process has been informed by public drop in exhibitions (October 2016, March and April 2017), along with the Scoping Opinion for Norfolk Vanguard and the feedback from the Expert Topic Groups (see section 1.2.3). Details of the site selection process are provided in Chapter 4 of the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b) with a summary provided below.

2.2.1 Landfall Zone

18. The Norfolk Boreas Scoping report presented three potential landfall locations. Data was reviewed on a broad range of environmental factors, including existing industrialised landscape, the presence of the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ), coastal erosion and archaeology alongside statutory and non-statutory consultation.

19. After publication of the scoping report, VWPL concluded, taking account of all engineering and environmental factors, as well as public feedback, that the most suitable landfall location would be Happisburgh South. The decision to go to

Happisburgh South was presented to the Norfolk Vanguard Evidence Plan Expert Topic groups in June and July 2017 and in the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b). Given the international importance of Happisburgh as a significant area for Lower Palaeolithic remains, a specific independent academic steering group has been established with respect to coastal, intertidal and nearshore archaeological considerations at the proposed Happisburgh South landfall. Regular engagement with the Coastal, Intertidal and Nearshore Steering Group will be undertaken as the Norfolk Vanguard and Norfolk Boreas projects progress. The first meeting was held on the 2nd May 2017 (see section 1.2.3).

20. Happisburgh South landfall area also has the benefit of being large enough to accommodate landfall works of both Norfolk Vanguard and Norfolk Boreas, therefore reducing the spatial extent of impacts associated with the two projects.

2.2.2 Cable Relay Station Options

21. The Norfolk Boreas Scoping report presented seven potential cable relay station search zones. A single cable relay station would be required for a High Voltage Alternating Current (HVAC) electrical solution. No cable relay station would be require for a High Voltage Direct Current (HVDC) electrical solution. The decision between HVDC and HVAC solutions is not expected to be taken until post consent, therefore for the purposes of the EIA, and under the project envelope approach, assessment would be conducted on the basis of the realistic worst case.

22. Following the scoping opinion further work has been completed and two potential locations are being proposed for the cable relay station (Appendix 1). The final siting of the cable relay station on either footprint will have due consideration for existing watercourses, hedgerows, landscaping, archaeology, ecology, noise, access and other known infrastructure/environmental constraints to minimise impacts, along with feedback from statutory and non-statutory consultation. Impacts arising as a result of the proposed cable relay stations upon the setting of heritage assets have been discussed as part of a specific programme of consultation with Historic England, the Norfolk County Council Historic Environment Service and North Norfolk District Council. Such consultation includes a consideration of the opportunities and constraints for each cable relay station option, including a review of potential impacts and any proposed mitigation that may be necessary. These ongoing discussions will help to inform the final site selection process as the project design development and heritage setting assessment progress.

23. A Norfolk Boreas cable relay station temporary construction compound area has not yet been identified, however a location will have been determined prior to the Norfolk Boreas PEIR being published in Q4 2018.

2.2.3 Onshore Cable Route

24. A 200m wide cable corridor was presented within the Norfolk Boreas scoping report. This corridor, shared with Norfolk Vanguard, is the shortest realistic route between landfall and the Necton National Grid substation (thereby minimising disturbance impacts) whilst also aiming to avoid main residential areas and impacts to landscape, nature conservation designations, designated heritage assets and other key environmental constraints where possible.

25. The proposed route skirts around the main towns of North Walsham, Aylsham, Reepham and Dereham. Since the Norfolk Boreas scoping report was published further work has been completed (see Royal HaskoningDHV, 2017b for detail) to refine the cable corridor and an indicative cable route has been established suitable for infrastructure for both the Norfolk Vanguard and Boreas onshore export cables (Appendix 1). Archaeological information and known constraints have also fed into the ongoing route refinement process.

2.2.4 Onshore Project Substation

26. The Norfolk Boreas scoping report presented an onshore project substation zone within which the onshore project substation was to be located. Following further site selection work (presented in Royal HaskoningDHV, 2017b) a preferred onshore project substation location has been identified. Although the Norfolk Boreas onshore project substation location is now proposed there remains the possibility that its exact location may change slightly following consultation on the Norfolk Vanguard PEIR, therefore an onshore project substation search area has been retained (Appendix 1).

27. A Norfolk Boreas onshore project substation temporary construction compound area has not yet been identified, however a location will have been determined prior to the Norfolk Boreas PEIR being published in Q4 2018.

2.2.5 Extension to the Existing Necton National Grid substation

28. The Norfolk Boreas Scoping report presented a National Grid substation extension zone. Since the publication of that report further work has been done to define the footprint of these extension works (**Appendix 1**). Further detail on this process is presented in Chapter 4 of the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b).

29. Also presented in the Norfolk Boreas Scoping report was an overhead line modification zone within which the overhead lines leading into the Necton National Grid substation would be realigned (section 2.3.1.5). The area within which this work will be undertaken has been refined and is presented in **Appendix 1**. Further detail

on the process behind this refinement is provided in the Norfolk Vanguard PEIR (Royal HaskoningDHV 2017b) Chapter 4 site selection and alternatives.

2.3 Indicative Worst Case Scenarios

30. The following sections set out the current predicted worst case scenarios for onshore archaeology and cultural heritage.

31. The parameters discussed in this section are based on the best available information for Norfolk Boreas at the time of writing and are subject to change as the project progresses. The Norfolk Boreas PEIR and the ES will provide further detail on the Project Description describing the final project design envelope for the DCO application.

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

33. 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.

34. 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.

2.3.1 Infrastructure Parameters

35. HVAC and HVDC electrical solutions are being considered for Norfolk Boreas. Both electrical solutions would have implications for the required onshore infrastructure. Typically the HVAC solution involves a greater area of land take and additional infrastructure, and as such the HVAC solution is assumed as the worst case in relation to buried archaeological remains. Conversely, the HVDC solution would require taller buildings within the substation compound, which could be considered as the worst case in relation to the setting of heritage assets at this location. The cable relay station which is the other permanent piece of above ground

infrastructure in addition to the onshore project substation, is only required under a HVAC solution and not a HVDC solution, therefore in relation to heritage settings at the cable relay site options, the HVAC is considered the worst case scenario. On this basis, the HVAC solution is assumed as the worst case in the remainder of this section. Where the worst case assumes the HVDC solution, this is stated in the text.

36. The following key onshore project parameters are considered within this method statement. Explanation of which parameters are considered for Scenario 1 and for Scenario 2 is provided in the sections below. For full detail of what is considered in Scenario 1 and what is considered in Scenario 2 please see **Appendix 2**:

- Landfall (Horizontal Directional Drilling (HDD) and associated compounds);
- Cable relay station (required for HVAC only);
- Cable corridor (with associated trenchless crossing technique areas, construction compounds and mobilisation areas and access);
- Onshore project substation;
- Interface cables connecting the onshore project substation and the Necton National Grid substation; and
- Extension to the existing Necton National Grid Substation, including overhead line modification.

37. Under Scenario 1, The Norfolk Vanguard project would be considered within the Cumulative Impact Assessment (CIA), together with the parameters of Norfolk Boreas (as listed in the bullets points above). Other projects which would be considered in the CIA are discussed in section 2.3.5.

2.3.1.1 Landfall

38. The landfall compound zone (**Appendix 1**) denotes the location where up to six Norfolk Boreas offshore export cables would be brought ashore. These would be jointed to the onshore cables in transition pits located within the eastern most "trenchless crossing technique" area shown in **Appendix 1**. Under Scenario 1Norfolk Boreas would share the landfall area with Norfolk Vanguard at Happisburgh South.

39. Works at the landfall would be the same under both scenarios. Under Scenario 1, if Norfolk Boreas cable ducts would be installed concurrently with the Norfolk Vanguard ducts, the Norfolk Boreas ducts would be installed only on the landward (western) side of the transition pits. Ducts on the seaward side of the transition pits would be installed using HDD which is a trenchless installation technique. The HDD would exit at one of the following locations:

- On the beach, above the level of mean low water spring (classified as "short HDD").

- At an offshore location, seaward the beach (up to 1000m in drill length) (classified as “long HDD”).

40. The impacts of the HDD exit point will be considered in the offshore archaeology impact assessment.

41. In the case of a short HDD, temporary beach closures would be required during drilling exit and duct installation to maintain public safety. Beach access would be required for an excavator and 4x4 vehicles.

42. Key parameters of works at landfall:

- Installation of temporary construction compound area to accommodate the drilling rig, ducting and associated materials and welfare facilities (60m x 50m).
- Onshore temporary access route (6m in width) leading towards the drilling compound and transition pits (length to be confirmed in the PEIR).
- In the case of a short HDD, this will include a fenced vehicle access route required to access the drill exit point at the beach.
- A total of up to six ducts for the HVAC solution or two ducts for the HVDC solution would be required at the landfall for Norfolk Boreas.
- Joints would be buried to a depth of 1.2m using stabilised backfill, pre-excavated material or a concrete box.
- Volume of material excavated during HDD works: 1,178m^3
- Maximum of six joint transition pits, each measuring 10m x 15m x 5m.
- Temporary footprint of works would be up to 3,000m^2 per compound (up to six compounds).
- There will be no permanent above ground infrastructure (apart from Link Boxes) at landfall and the site would fully reinstated upon completion of the landfall works.
- Link boxes for each of the transition pits would also be required for an HVAC solution and may be required to a lesser degree for the HVDC solution. The link box, with dimensions 1.5m x 1.5m, per circuit, will be buried to ground level within an excavated pit, providing access via a secured access panel. Alternatively, above ground link box cabinets may be utilised. One cabinet would be required for each circuit. The footprint of each cabinet would be 1.0m x 0.5m, and its height would be approx. 1.0m.

43. Indicative worst case scenario parameters outlined in the Noise and Vibration assessment will be incorporated as part of the onshore archaeology and cultural heritage assessment, where relevant (e.g. maximum construction noise in relation to setting).

2.3.1.2 Cable Relay Station

44. Under the HVAC solution a cable relay station would be required. No cable relay station would be required for a HVDC solution. Therefore the HVAC solution is the worst case scenario for this element of the onshore infrastructure. The cable relay station would be constructed by Norfolk Boreas under both Scenarios 1 and 2 and would be located within one of the sites identified in **Appendix 1**.

45. Key parameters of works at cable relay station are as follows:

- The cable relay station would consist of a three phase reactor per HVAC circuit (a total of six reactors) with associated outdoor GIS (Gas Insulated Switchgear).
- The maximum height of the reactor and associated GIS equipment would be 8.0m.
- The maximum height of the main building (the control building) would be 4m.
- The building material for the control building would be brick.
- The access site road width would be 6m with an approximate length of 1000m.
- The total cable relay station fenced area would be 73m x 135m, with a perimeter fence height of 2.4m. External to the perimeter fence would be a small control building with associated parking with combined dimensions of 31m x 18m.
- There would be an additional temporary construction area with a maximum temporary footprint of 15,000m^2 during construction of the cable relay station. Under Scenario 2, this compound would also serve as a Primary Mobilisation Area (PMA) for cable installation works. Under Scenario 1 PMAs are not required.
- Maximum construction noise level would be: Dozer - 98 dB(A) LwA, Backhoe loader - 85 dB(A) LwA, Cement Mixer Truck - 93 dB(A) LwA, Dumper - 95 dB(A) LwA, Excavator - 93 dB(A) LwA, Mobile Crane - 96 dB(A) LwA and Truck mounted concrete pump and boom arm - 96 dB(A) LwA.

46. Indicative worst case scenario parameters outlined in the Noise and Vibration assessment will be incorporated as part of the onshore archaeology and cultural heritage assessment, where relevant (e.g. maximum construction noise in relation to setting).

47. The site would be stripped of soil and soil graded as required by the final design. Excavations and laying of foundations, trenches and drainage would commence after grading is complete.

48. At this stage it is not known whether the foundations would either be ground-bearing or piled. The design would be based on the prevailing ground conditions.

49. The construction programme for the cable relay station would be 18 months.

2.3.1.3 Onshore cable corridor

50. The onshore cable corridor will contain the final onshore cable route. Currently an indicative cable route has been identified and is displayed in **Appendix 1**.

2.3.1.3.1 Onshore cable route

51. The onshore cable route would contain the main 220kV HVAC or ±320kV HVDC export cables housed within High Density Polyethylene (HDPE) ducts and 400kV HVAC interface cables connecting the onshore project substation with the Necton National Grid substation. The main export cable onshore corridor connects the landfall to the onshore project substation. A plan of the onshore cable route is shown in **Appendix 1**.

52. The key elements of the onshore cable route for Scenario 1 and Scenario 2 are detailed in **Appendix 2**, and summarised below.

Scenario 1

53. Norfolk Vanguard would install cable ducts and undertake enabling works (e.g. running track, accesses etc.) for Norfolk Boreas along the entire length of the onshore cable corridor. Therefore, all excavations (except jointing pits and associated temporary construction compounds) and crossings would have already been undertaken. In addition, all ducts would be installed and ground reinstated by Norfolk Vanguard.

Scenario 2

54. Norfolk Boreas would install all onshore cable route infrastructure required for the project, including installing ducts along the entire cable route and reinstating land (cable pulling would then happen at a later date). Under this scenario the cable duct installation would also require;

- Trenches for the cable circuits;
- A running track to deliver equipment to the installation site from mobilisation areas; and
- Storage areas for topsoil and subsoil.

55. An indicative cable route plans have been developed to illustrate the cable corridor required to install the ducts and cables for the HVAC and HVDC electrical solutions for Norfolk Boreas, see **Plate 2.1** and **Plate 2.2** below.

56. For each electrical solution the following are illustrated:

- The total temporary strip (total land requirement to install the cables);
- Permanent strip (total ongoing land requirement of the installed cables); and
- Ongoing right of access strip (temporary area required to be reserved for access for future repair or maintenance activities).

57. Dependant on the land agreement approach taken, the ongoing right of access strip could be absorbed within the permanent easement, however, they are identified separately at this time.

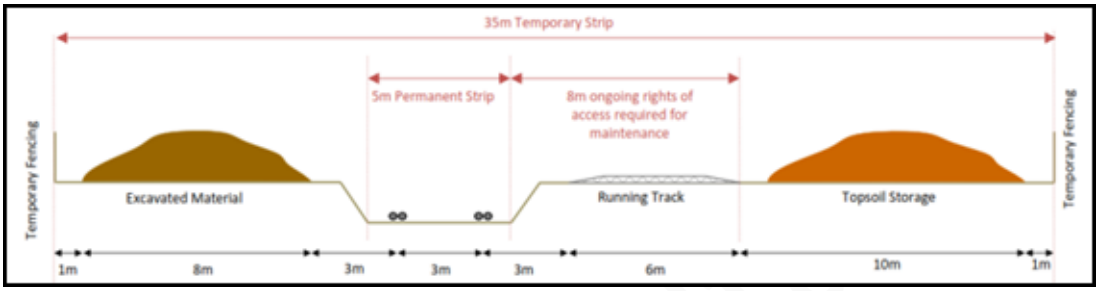

Plate 2.1 Indicative Norfolk Boreas HVDC Onshore Cable Corridor

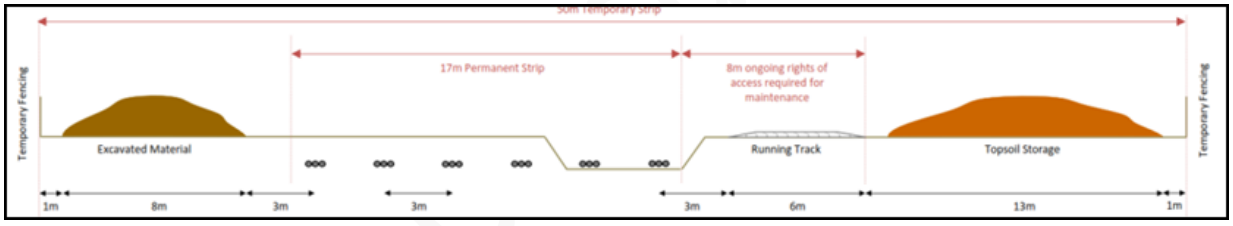

Plate 2.2: Indicative Norfolk Boreas HVAC Onshore Cable Corridor

2.3.1.3.2 Trenching and soil storage

Scenario 1

58. No trenching and soil storage would be required under this scenario for Norfolk Boreas as these works would have been completed under Norfolk Vanguard.

Scenario 2

59. Norfolk Boreas would be responsible for duct installation requiring trenching and storage for topsoil and subsoil. The main duct installation method would be through the use of open cut trenching with HDPE ducts installed, soil backfilled and land reinstated. Cables would then be pulled though the pre-laid ducts at a later stage.

60. The ducts would be installed in a flat formation (each cable core installed alongside each other) to a depth of 1.05m (to top of duct), in a trench of approximate 1m width.

61. Where the cable route crosses major transport routes or waterways the standard open cut trenching installation technique might not be suitable. The cable burial depth might increase at these crossing locations or an alternative trenchless method may be used. Further details of crossing methodologies are provided below. Where open cut trenching is employed in these locations and associated locations such as hedgerows, the working width could be reduced to the running track and cable trenching areas only (e.g. 25m for HVAC) with soil storage areas retained immediately before and after the feature crossing.

62. Topsoil would be stripped from the entire width of the onshore cable route. The cable trenches would then be excavated, typically utilising tracked excavators.

63. Alternatively, a tracked trenching machine could be used which allows ducting installation to be achieved without excavation. This method will be dependent on soil conditions and other detailed design aspects to be reviewed at the time of construction design.

2.3.1.3.3 Running track

64. A would provide safe access for construction vehicles within the onshore cable route and could be up to 6m wide.

Scenario 1

65. Under Scenario 1 approximately 20% of the Norfolk Vanguard running track would need to be retained or reinstated for the cable pulling phases.

Scenario 2

66. Under Scenario 2 running track would be installed along the entire length of the cable route (approximately 60km) to allow safe access from mobilisation areas to the duct installation sites.

67. Following topsoil stripping, the running track would be formed of protective matting, temporary metal road or permeable gravel aggregate dependant on the ground conditions, vehicle requirements and any necessary protection for underground services.

68. At larger road and water course crossings, temporary bridges could be employed to allow continuation of the running track. At railway and main river crossings where a trenchless crossing solution would be used, the running track would not be continuous. These locations would be 'stop ends' to the construction work fronts.

69. Following construction completion, the running track would be removed and the topsoil reinstated although rights would be retained to access the running tracks location should repairs of the cables be required during the lifetime of the project.

2.3.1.3.4 Cable Pulling Process

70. Under either scenario the onshore cables would be pulled through the installed ducts later in the construction programme in a staged approach, as offshore generating capacity came online. Cable pulling would not require the trenches to be reopened, with the cables pulled through the preinstalled ducts between the jointing pits located along the onshore cable route.

71. Access to and from the jointing pits would be required to facilitate the works during this phase of the project. This would be achieved through access to the onshore cable jointing pits directly from the highways network (at crossing locations) or existing local access routes where possible.

72. Under Scenario 1 in some locations, small sections of the running track would be required to be instated to allow access to more remote jointing bay locations (assuming that the entire running track required for the Norfolk Vanguard Project would have been removed). It is considered as a worst case scenario this would require approximately 20% of the running track to be reinstated to facilitate access to jointing pits.

73. Under Scenario 2, approximately 20% of running track present would be left in place from the duct installation works, or required to be reinstated to allow access to more remote jointing bay locations.

2.3.1.3.5 Jointing pits

74. Jointing pits would be required along the onshore cable route to allow cable pulling and jointing of two sections of cable. Under both Scenario 1 and 2, the jointing pits would be installed by Norfolk Boreas for pulling cables through.

75. The jointing pits would typically be located at 800m intervals, the maximum cable length which can be delivered, although site specific constraints may result in shorter intervals where necessary. The jointing pits will be of a similar design and installed in a similar approach to the transition jointing pits detailed in section 2.3.1.1

76. Access to and from jointing pits would be required for the cable pull through. These would be retained or reinstated from those used by Norfolk Vanguard in Scenario 1, and would be retained or reinstated from the duct installation phase in Scenario 2. Under either scenario the land on which the access route has been established would be reinstated.

2.3.1.3.6 Link boxes

77. Link boxes are required for a HVAC connection arrangement to enable the cables to work as efficiently as possible and installation would be the same for each scenario. These would typically be installed in close proximity (within 10m) to jointing pit locations.

78. There are two options being considered for Link Box installation: Either a box with dimensions 1.5m x 1.5m, per circuit, would be buried to ground level within an excavated pit, providing access via a secured access panel or, an above ground link box cabinet with a footprint of 1.0m x 0.5m and a height of 1.0m could be utilised.

2.3.1.3.7 Crossing installation methods

Scenario 1

79. Under this scenario all necessary crossing installation would have been completed by Norfolk Vanguard. No additional works would be required by Norfolk Boreas.

Scenario 2

80. Under this scenario all crossings would be consented and installed by Norfolk Boreas. When crossing some features along the onshore cable route, alternative or amended installation approaches would be required to minimise the impact on the feature or obstacle being crossed as much as reasonably practicable. Features of relevance with respect to onshore archaeology and cultural heritage include hedgerows; regarded as an integral aspect of the Historic Landscape Character of an area.

81. When crossing hedgerows, the width of the cable route would be reduced to the running track and cable trenches only to minimise the amount of hedgerow removal. Using this technique, the hedgerow removal would be reduced to a maximum of 25m width. In order to ensure a hedgerows pre-construction condition and character is replicated, any hedgerow removed will be replanted with hedgerow types matching the existing as part of reinstatement works where possible. The restoration of hedgerows will further minimise any alteration to the nature of and impact upon the Historic Landscape Character.

82. Trenchless installation methods such as HDD, micro tunnelling or auger boring are likely to be used where open cut trenching is not suitable due to the crossing width or the feature being crossed. Trenchless methods will be employed at the River Wensum and River Bure (Special Area of Conservation – SAC, Site of Special Scientific Interest – SSSI) and major infrastructure such as Network Rail to minimise the impact

to the feature being crossed. The locations of these are shown in **Appendix 1** (termed trenchless crossing techniques).

83. With trenchless methods, the depth at which the ducts are installed depends on the topology and geology at the crossing site. Typically, for a river crossing, HDD ducts would be installed 5 to 15m below the floodplain, and at least 2m below the river bed.

84. Where trenchless drilling activities are to be conducted, a temporary work area would be required to store drilling equipment, welfare facilities, ducting and water for the drilling process. The trenchless drilling compounds would typically be of dimensions 50m x 50m for the reception site and 100m x 50m on the launch site, adjacent to the onshore cable route. A temporary bridge might be included to allow continuation of the running track and allow access to both sides of the crossing. Alternatively, a stop end would be used, requiring the inclusion of a turning area for vehicles within the temporary work area.

2.3.1.3.8 Temporary construction compounds

Scenario 1

85. Under Scenario 1 no primary and secondary mobilisation areas would be required as materials will be delivered directly to jointing pits locations.

Scenario 2

86. Primary and secondary mobilisation areas would be required to store equipment and provide welfare facilities. Indicative locations for these are provided in **Appendix 1**.

87. The primary mobilisation areas would typically be of 100m x 100m dimensions (or 150m x 100m if combined with a trenchless drilling compound) and the secondary mobilisation areas would be approximately 40m x 40m with specific sizing and dimensions for each location based on site constraints and land boundaries.

88. Hardstanding would likely comprise of permeable gravel aggregate to a depth of 0.3m underlain by geotextile or other suitable material would be employed to allow safe storage and movement of vehicles within the area and maintain required drainage. Site lighting and secure fencing around the perimeter of the mobilisation area would be put in place for safety and security purposes. Following installation of the ducts, the mobilisation areas would be removed and the land reinstated.

2.3.1.3.9 Cable route side access

89. Small temporary access routes would be required to facilitate the safe ingress and egress from the public highways to the construction locations termed side accesses.

The current proposed locations for these are displayed in **Appendix 1** and would be used to for the following:

- To gain access to jointing pit locations during cable pulling and jointing phase;
- To gain to access link boxes, and
- To gain access to cables to make repairs during operational phase.

90. Not all of the side accesses would be used for the all of the above a sub set would be used for each of three activities. In general terms, the access strategy incorporated a preference for utilising and upgrading existing accesses where possible, although new accesses were required in some instances.

Scenario 1

91. Under Scenario 1 some of the side accesses to the cable route would be retained or reinstated from the Norfolk Vanguard project. For the purposes of this method statement the worst case scenario would be the reinstatement of these accesses. Detailed traffic and transport assessments are ongoing to refine which side accesses would need to be reinstated under Scenario 1.

Scenario 2

92. Under Scenario 2 side accesses to the cable route would need to be constructed and would be left in place for three years to provide for cable pulling phases before being removed and land reinstated. Detailed traffic and transport assessments are ongoing to refine exactly where these side accesses would be required and which would need to be retained from the duct installation process

2.3.1.4 Onshore Project Substation

93. The Norfolk Boreas onshore project substation would consist of either an HVAC substation or HVDC substation[1], dependant on the electrical solution utilised. Only one project substation (HVAC or HVDC) would be required for Norfolk Boreas. The proposed onshore project substation location is presented in **Appendix 1**, with dimensions as detailed below.

94. The location of the onshore project substation was determined by an optioneering process undertaken for both Norfolk Vanguard and Norfolk Boreas which is explained in Chapter 4 site selection and alternatives of the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b).

[1] Also referred to as a HVDC converter station. For the purposes of consistency both HVAC and HVDC solutions will be referred to as the onshore project substation.

95. The largest equipment within the HVAC onshore project substation would be the 400/220kV transformers with an approximate height of 10m, all other equipment would not exceed a height of 6m. The total land requirement for the HVAC onshore substation to the perimeter fence is 250m x 300m.

96. The largest equipment within the HVDC onshore project substation would be the reactor halls with an approximate height of 19m. The tallest structure would be the lightning protection masts at a height of 25m. All other equipment would not exceed a height of 10m. The total land requirement for the HVDC onshore substation to the perimeter fence would be 250m x 300m.

97. During construction of the onshore project substation, a temporary construction compound would be established to support the works. The compound would be formed of hard standing.

98. At this stage it is not known whether the foundations would be ground-bearing or piled based on the prevailing ground conditions. Piling would represent the worst case foundation type with respect to onshore archaeology and cultural heritage. If required, the maximum number of piles (worst case) installed for the onshore project substation would be 360 piles (inclusive of a 20% contingency). Should it be required, the depth of piling will depend on ground investigation data.

99. The construction programme for the onshore project substation is 18 months. The enabling works for the onshore project substation would differ between scenarios as outlined below:

Scenario 1

100. Under Scenario 1, a number of enabling works would be undertaken by Norfolk Vanguard. These include:

- Landscaping to reduce visual impacts;
- Access roads; and
- Site drainage infrastructure.

101. In Scenario 1, the access road would be shared with the onshore project substation for Norfolk Vanguard.

Scenario 2

102. Under Scenario 2, all enabling works would be undertaken by Norfolk Boreas. The access road would be up to 6m in width and 2,000m in length.

2.3.1.5 Necton National Grid Substation Extension

103. The existing Necton National Grid substation would be required to be extended to accommodate the Norfolk Boreas and Norfolk Vanguard connection points. The proposed footprint of this extension is provided in **Appendix 1.** Under Scenario 1 the majority of these works, including modifications to overhead lines, would be undertaken by Norfolk Vanguard for both projects. Under Scenario 2, the extension would be undertaken to accommodate Norfolk Boreas only, and would form part of the Norfolk Boreas DCO application.

104. In addition to the Necton National Grid substation itself, modifications to the existing overhead lines in parallel to the substation would be required to provide a double turn-in arrangement.

Scenario 1

105. Under Scenario 1 all extension enabling works would be completed to facilitate both Norfolk Vanguard and Norfolk Boreas including access roads, earthworks, foundations, buildings and civil works under the Norfolk Vanguard DCO. All overhead line modification would also have been carried out under the Norfolk Vanguard project.

106. However the electrical busbar extensions and other electrical equipment required for Norfolk Boreas would be installed under Norfolk Boreas consent.

Scenario 2

107. Under Scenario 2 all extension works to the Necton National Grid Substation and overhead line modification would be undertaken by Norfolk Boreas.

108. The outdoor busbar would be extended in an east and west direction to an estimated total length of approximately 340m with seven air-insulated switchgear bays installed along the busbar extension required to accommodate Norfolk Boreas.

109. The maximum height of the outdoor busbar and bays at the substation is estimated to be 15m. The total substation area is estimated to be 150m x 370m (inclusive of existing substation operational area). No additional land is anticipated for the overhead line modifications with existing towers being replaced with new towers.

110. Two new overhead line towers would be required in close proximity to the existing corner tower (to the north east of the existing Necton National Grid Substation) with a maximum height of 67m.

111. The substation extension and overhead line modification works will be conducted within the areas identified within **Appendix 1** as National Grid Overhead Line Works, National Grid substation extension and National Grid temporary works.

112. During construction of the Necton National Grid Substation, two temporary construction compounds would be established to support the works with an overall temporary works footprint of 444,709m^2 (including extension and overhead line modification).

113. The larger compound would be of dimensions 300m x 150m and the smaller compound 200m x 150m. The site would be soil stripped and graded as required by the final design. Excavations and laying of foundations, trenches and drainage will commence after grading is complete. At this stage it is not known whether the substation foundations would either be ground-bearing or piled based on the prevailing ground conditions. Piling would represent the worst case foundation type with respect to onshore archaeology and cultural heritage.

114. For the overhead line modifications, up to three temporary towers (maximum height 45m) would be constructed in close proximity to the existing towers and the existing circuits transferred over to the temporary towers. The existing towers would be removed and replaced with new towers, each up to 50m in height (or alternatively the existing towers would be modified if possible). The circuits would then be transferred from the temporary towers which would then be removed along with their foundations.

115. The tower foundations could be piled or excavated and cast, dependant on the ground conditions and structural requirements. It is anticipated that the footprint of the towers would be unchanged from the existing towers; however the orientation and design of the towers may change to allow for the double turn in arrangement. These works would be undertaken within the National Grid temporary works are displayed in **Appendix 1**.

116. The construction programme for the Necton National Grid substation extension and overhead line modification works is 18 months and would be conducted primarily during working hours of 7am to 7pm. Further detail on construction programmes is provided below in section 2.3.2.

2.3.2 Construction Programme

117. Currently it is expected that the Norfolk Boreas project would be constructed in one, two or three phases. **Table 2.1** summarises the main construction activities and sequence associated with installation of the Norfolk Boreas project onshore infrastructure under a 'three-phased' approach (as this represents the worst-case scenario in terms of duration of impact). Separate time lines are discussed for both Scenario 1 and 2.

Table 2.1 Construction programme

Date	Scenario 1		Scenario 2	
2022			**Pre-construction works** • Road modifications • Hedge and tree removal (season dependant) • Ecological preparations (e.g. displacement of water voles, fencing of areas for newts, etc.) • Preconstruction drainage (at cable relay station and substation locations)	
2023				
2024	**Pre-construction works** (*landfall, cable relay station and onshore project substation only*) • Ecological preparations (e.g. displacement of water voles, fencing of areas for newts, etc.) • Preconstruction Drainage at cable relay station and substation locations	**Substation and Cable Relay Station Construction** • Main works (drainage, foundations and buildings)	**Main duct installation works** • Enabling works • Duct installation • Reinstatement works	**Substation and Cable Relay Station Construction** • Main works (drainage, foundations and buildings)
2025				
2026			**Cable installation** • Installed in three phases (2026, 2027 & 2028)	**Substation and Cable Relay Station Construction** • Plant installation (to tie in with cable pull)
2027	**Cable pulling** • Installed in three phases (2027, 2028 & 2029)	**Substation and Cable Relay Station Construction** • Plant installation (to tie in with cable pull)		
2028				
2029				

2.3.3 Operation and Maintenance (O&M) Strategy

118. The cable relay station, onshore project substation and overhead line modification area would not be manned, however access would be required periodically for routine maintenance activities, estimated at an average of one visit per week.

119. Periodic access to installed link boxes (which may be buried or above ground, see section 2.3.1.3) may be required for inspection, estimated to be annually. These link boxes will be accessible from ground level and will not require excavation works.

120. Access to the cable easement would be required to conduct emergency repairs if necessary.

121. The operational emissions from the substation and cable relay station are restricted to light and noise. During operation, it is not anticipated for the cable relay station and onshore substation to be illuminated under normal operating conditions. Site lighting will be provided during operations and maintenance activities only.

2.3.4 Decommissioning

122. 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. The detailed activities and methodology would be determined later within the project lifetime, but are expected to include:

- Dismantling and removal of outside electrical equipment from sites located outside of the onshore project substation/cable relay station buildings;
- Removal of cabling from site;
- Dismantling and removal of electrical equipment from within the onshore project substation/cable relay station buildings;
- Removal of main onshore project substation/cable relay station building and minor services equipment;
- Demolition of the support buildings and removal of fencing;
- Landscaping and reinstatement of the site (including land drainage); and
- Removal of areas of hard standing.

123. It is expected that the onshore cables will be removed from ducts and recycled, with the jointing 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.

2.3.5 Cumulative Impact Scenarios

2.3.5.1 Norfolk Vanguard

124. VWPL are seeking to minimise cumulative impacts between Norfolk Boreas and Norfolk Vanguard through the alignment of onshore cable route and the preference for Norfolk Vanguard to pre-install ducts and undertake other enabling works for Norfolk Boreas. Cumulative impacts between the two sister projects will be assessed within the Norfolk Boreas EIA.

2.3.5.2 Other projects

125. The assessment will also consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage.

126. Potential projects may include offshore wind farms, coastal defence projects (such as the Bacton sandscaping scheme) road or large infrastructure projects (including the duelling of the A47, Sizewell Nuclear Power Station and the Norwich Northern Distributor Road) which have a potential to act together with the construction, operation or decommissioning phases of Norfolk Boreas in a cumulative way. In particular, VWPL are committed to working with Ørsted (formally DONG Energy) on identifying the potential interactions between the Norfolk Boreas and Norfolk Vanguard onshore cable corridor with the Hornsea Project 3 Offshore Wind Farm onshore cable route, and assessing and mitigating any potential cumulative effects.

127. Construction and commissioning of the substation for the Dudgeon Offshore Wind Farm is complete and operation commenced in 2017. The cumulative impacts during construction are therefore likely to be minimal, however this will be considered further in the CIA.

128. CIA screening will be undertaken in consultation with stakeholders. A proposed list of projects for inclusion in the CIA is provided in section 5.4

3 BASELINE ENVIRONMENT

3.1 Desk Based Review

129. A full and comprehensive Archaeological Desk Based Assessment (DBA) has been undertaken as part of the Norfolk Vanguard EIA (Royal HaskoningDHV 2017b, Appendix 28.1), feeding into the PEIR and ES. Given the spatial overlap and timeframe between the Norfolk Vanguard and Norfolk Boreas projects, the archaeological DBA prepared for Norfolk Vanguard is considered to be valid for use during the Norfolk Boreas project. Any additional and relevant data acquired since the DBA submission reported on and incorporated into the Norfolk Boreas PEIR and ES.

130. The DBA was carried out by Royal HaskoningDHV on behalf of VWPLin strict adherence to a Written Scheme of Investigation (WSI) for DBA (Royal HaskoningDHV, 2017c). The WSI was prepared in agreement with the Heritage Steering Group (Norfolk County Council Historic Environment Service and Historic England).

131. The onshore archaeology and cultural heritage baseline environment will be developed to reflect each scenario under consideration. Under Scenario 1, the baseline environment developed for Norfolk Boreas will incorporate any changes, where relevant, to the environment following the consent of the Norfolk Vanguard project. Under Scenario 2, alterations to the baseline environment will be confined to pre-consent activities/surveys, where relevant.

3.1.1 Available Data

132. **Table 3.1** summarises the data sources which will be used to inform the Norfolk Boreas EIA.

Table 3.1 Data sources

Data Source	Data	Coverage	Date	Status
Desk based data				
Norfolk Historic Environment Record (NHER)	Non-designated heritage assets and Historic Landscape Characterisation Data	Onshore infrastructure plus a 500m buffer	May 2017	Data obtained
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/	Designated heritage assets	Onshore infrastructure plus a 1km buffer	June 2017	Data obtained
Local Authority Resources (North Norfolk, Broadland and Breckland District Councils)	Heritage Conservation Areas	North Norfolk, Broadland and Breckland Districts	January – June 2017	Digitised from the available Local Authority Resources on-line. No digital data received to date.
Various published literature	Regional, Local and Period Archaeological Studies and Journals	Project area and wider region	January – June 2017	Data obtained
The Archaeology Data Service	Archaeological research projects and grey literature	Project area and wider region	January – June 2017	Data obtained
The Ancient Human Occupation of Britain (AHOB) and Pathways to Ancient Britain (PAB) Projects	Evidence-based research based on available known archaeological / palaeoenvironmental data for Britain that document early hominin occupation	Archaeological investigations on data for key Pleistocene sites in Britain that document early hominin occupation in north-western Europe.	January – June 2017	Data obtained
The Environment Agency's removal of failed sea defences – archaeological evaluation report re: Happisburgh (Birks, 2016)	Results of a targeted assessment of archaeological monitoring and borehole survey at Happisburgh	Archaeological investigation with a focus on the wider	June 2017	Data obtained

Data Source	Data	Coverage	Date	Status
		vicinity of the Happisburgh South Landfall.		
Various published literature	Documentary sources relevant to the archaeological and historical background	Project area and wider region	January – June 2017	Data obtained
Norfolk County Council's Historic Map Explorer; and the Norfolk Vanguard specific Envirocheck Report	Cartographic sources (historic mapping)	Project area	June 2017	Data obtained
Norfolk Record Office (and other relevant repositories)	Pre-enclosure maps	Project area	Anticipated 2018	Planned
Survey data				
Air Photo Services Ltd (Norfolk Vanguard Project)	Aerial photographic data	Norfolk Vanguard study area	April – June 2017	Data obtained
	Light Detection and Ranging (LiDAR)	LiDAR Data, available over *c.* 75% of the Norfolk Vanguard study area.	April 2017	Data obtained
Norfolk Vanguard project geotechnical survey data assessment (Phase 1)	Existing and available geotechnical data acquired and assessed as part of the Norfolk Vanguard project.	Norfolk Vanguard project area: Focussed on possible landfall sites at the coast and at seven key crossing locations	July 2017	Survey complete. Draft report obtained, full results pending.
Norfolk Vanguard project geotechnical survey data assessment (Phase 2)	Existing and available geotechnical data acquired and assessed as part of the Norfolk Vanguard project	Norfolk Vanguard project area: Focussed on the North Walsham and Dilham Canal crossing, Kings Beck crossing, Wooden Copse (north of Bacton Wood)	November 2017	Survey underway/ongoing.

Data Source	Data	Coverage	Date	Status
		crossing, Wendling Beck crossing.		
Norfolk Vanguard project geophysical survey data assessment	Geophysical survey data	Key areas of targeted priority archaeological geophysical survey on a project-wide basis	Anticipated Q4 2017/Q1 2018	Survey underway/ongoing.
LVIA tool kits	LVIA tool kits, such as ZTVs and photomontages, taken from heritage-specific viewpoints (agreed with Historic England, Norfolk County Council's Historic Environment Service and Conservation Officers at North Norfolk and Breckland District Councils) and will be reviewed to inform the settings assessment, where relevant	Key areas/assets targeted, particularly in relation to above ground onshore infrastructure	Anticipated late Q4 2017 / Q1 2018	Underway / ongoing
Field reconnaissance survey site walkover and site visit observations	Heritage-specific site walkovers and site visits have been undertaken to inform the settings assessment	Landfall and cable relay station targeted to date. Further site visits are anticipated in the vicinity of the onshore project substation, and additional cable relay station related site visits	Initial site visits – April 2017. Subsequent site visits – anticipated late Q4 2017 / Q1 2018	Underway/ongoing

133. **Table 3.1** lists the desk based and survey data acquired for the Norfolk Vanguard project, which includes the footprint of the Norfolk Boreas onshore infrastructure. Given both the spatial overlap of the two projects and the recent data acquisition of the source material, the data sources listed in **Table 3.1** are considered to be valid for use during the Norfolk Boreas project.

134. In order to provide a fully integrated assessment of various elements of the historic environment with respect to the proposed development, the Onshore Archaeology and Cultural Heritage assessment undertaken for the Norfolk Boreas project will correlate with the Offshore and Inter-tidal Archaeology and Cultural Heritage assessment and the Landscape and Visual Impact Assessment (LVIA), as appropriate. In particular, with the LVIA this will include the assessment of photomontages at heritage specific viewpoints generated as part of the Norfolk Vanguard application in order to support the settings assessment.

135. Assessments and surveys both anticipated and undertaken to date will be / have been carried out 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>
- Department for Communities and Local Government (2014). Planning Practice Guidance: Conserving and enhancing the historic environment. Available at: <http://planningguidance.communities.gov.uk/blog/guidance/conserving-and-enhancing-the-historic-environment>
- Department of Culture, Media and Sport, Scheduled Monuments: Identifying, protecting, conserving and investigating nationally important archaeological sites under the Ancient Monuments and Archaeological Areas Act (1979), Department for Culture, Media and Sport, 2010
- Historic England (2007). Geoarchaeology: Using earth sciences to understand the archaeological record
- Historic England (2007). Understanding the Archaeology of Landscapes: A guide to good recording practice
- Historic England (2008). Geophysical Survey in Archaeological Field Evaluation

- Historic England (2008). Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment
- Historic England (2011).Environmental Archaeology: A guide to the theory and practice of methods, from sampling and recovery to post-excavation (second edition)
- Historic England (2016). Preserving Archaeological Remains: Decision taking for sites under Development
- 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. (2003). Standards for Field Archaeology in the East of England, in East Anglian Archaeology, Occasional Papers 14
- Historic England (2015). The Historic Environment in Local Plans: Historic Environment Good Practice Advice in Planning Note 1. Available at: <https://content.historicengland.org.uk/images-books/publications/gpa1-historic-environment-local-plans/gpa1.pdf>
- Historic England (2015). Managing Significance in Decision-Taking in the Historic Environment: Historic Environment Good Practice Advice in Planning Note 2. Available at: <https://content.historicengland.org.uk/images-books/publications/gpa2-managing-significance-in-decision-taking/gpa2.pdf>
- Historic England (2015). The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3. Available at: <https://content.historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/gpa3.pdf>
- Historic England (2015). The Management of Research Project in the Historic Environment (MoRPHE)
- Historic England, (2015). Metric Survey Specifications for Cultural Heritage
- 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 Data Handling

136. Of the desk-based and survey data acquired for the Norfolk Vanguard project (see section 3.1.1), those with spatial data will be incorporated into a project geographic information system so that they can be spatially analysed. The data will subsequently be compiled into gazetteers specific to the Norfolk Boreas project design parameters, and appended to the PEIR and subsequent ES. Gazetteers may be separated according to the following divisions:

- Designated Heritage Assets; and
- Non-Designated Heritage Assets.

3.1.3 Designated Heritage Assets

137. An approach consistent with the Norfolk Vanguard project will be adopted in relation to designated assets, whereby those within 1km of the project footprint will be under consideration as part of the PEIR and ES (**Figure 1**). This approach will be agreed with the Heritage Steering Group.

138. The proposed project area has been defined so as to avoid designated heritage assets. As such, direct impacts upon designated heritage assets arising as a result of the project are considered to be negligible. Designated heritage assets will therefore be considered from an indirect impacts perspective, particularly in respect to potential settings impacts. A settings assessment will be undertaken (and is underway and ongoing) in line with that recommended in The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3 (Historic

England, 2015) and will be supplemented by site visits conducted as part of the Norfolk Vanguard project. Where appropriate, the settings assessment will tie-in with the Landscape and Visual Impact Assessment (LVIA) process and tool kits such as Zones of Theoretical Visibility (ZTVs) and photomontages.

3.1.4 Non-Designated Heritage Assets

139. An approach consistent with the Norfolk Vanguard project will be adopted in relation to non-designated assets, whereby those within 500m of the project footprint will be under consideration as part of the PEIR and ES. Consideration will also be given to non-designated heritage assets recorded immediately beyond 500m parameters on the basis that their true extent may extend beyond their recorded location. This is particularly relevant with respect to heritage assets represented by point data, whose actual extent may encroach upon the Non-Designated Heritage Asset study area.

140. In addition to those records held by the NHER (Royal HaskoningDHV 2017b, Chapter 28, Figure 28.2), a review of non-designated heritage assets will also take into account data for potential sub-surface and above ground remains, where relevant, as attained from the aerial photographic and LiDAR data assessment (Royal HaskoningDHV 2017b, Appendix 28.1; Annex 28.1.3) and the priority geophysical survey assessment (underway, results forthcoming), undertaken as part of the Norfolk Vanguard project.

141. Non-designated heritage assets will be considered from a direct and indirect impacts perspective. Assessment will include a consideration of above ground extant remains and potential buried remains. This assessment will take into account the priority geophysical survey data results undertaken for Norfolk Vanguard, which will serve as an indication for the potential for buried archaeological remains to be present within the project area.

3.2 Planned Data Collection

142. 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 3.2**.

143. **Table 3.2** outlines the various elements of the data collection survey programme relevant to the Norfolk Boreas project. Where survey programmes have been undertaken or are anticipated under the Norfolk Vanguard project application, this has been stated. Survey elements undertaken as part of the Norfolk Vanguard

application are anticipated to occur variously both pre- and post-consent. **Table 3.2** thereby refers to the programme of works in relation to Scenarios 1 and 2 (see section 2).

144. The methodology for each of the survey approaches outlined in **Table 3.2** (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). All surveys are highly dependent on landowner access, as well as specific programme requirements and associated project risk.

Table 3.2: Onshore Archaeology Data Collection

Data Collection Method	Details	Scenario 1	Scenario 2
Non-Intrusive and Intrusive Evaluation			
Archaeological Geophysical Survey	A standard detailed magnetometry technique will be utilised with the aim of identifying anomalies representing archaeological sites and features across the projected onshore project area. The archaeological assessment of survey results will aid in the understanding of the presence, perceived absence, character and extent of any sub-surface archaeological remains within the survey area. Survey data will contribute directly to informing archaeological trial trench locations and positioning. Survey results may also inform route refinement and micrositing, where necessary. There are currently no plans for the application of alternative geophysical survey techniques. Alternative survey techniques will however be considered on a case-by-case basis where magnetometry was not found to be appropriate to the circumstances of a given anomaly or potential sub-surface feature and will only be employed where required on a case by case basis, in a manner that is both proportionate and required.	A pre-consent priority archaeological geophysical survey (magnetometry) is being undertaken as part of the **Norfolk Vanguard application**, the results of which will be incorporated into the Norfolk Boreas PEIR and ES, where relevant. Requests for additional access may be made as part of the **Norfolk Boreas application** for any areas identified for priority geophysics, where relevant to the Norfolk Boreas project area, that were not surveyed as part of the Norfolk Vanguard project due to for example access restrictions and / or field conditions or any areas that a solely related to Norfolk Boreas. However, the current assumption is that the data gathering programme under Norfolk Vanguard with respect to geophysical survey will be sufficient for Norfolk Boreas. Additional programmes of geophysical survey undertaken as part of the Norfolk Boreas application will only be considered where a clear case can be made that such data is required.	As in Scenario 1.
Archaeological Watching Brief / Geoarchaeological Monitoring of Site Investigation Works (targeted).	A programme of geoarchaeological monitoring of ground investigation works for the proposed onshore cable route corridor including (landfall and key trenchless crossing technique (e.g. HDD) locations) began in the	Undertaken pre-consent for the Norfolk Vanguard application. Data will feed into a palaeoenvironmental assessment, the results of which will be incorporated into the Norfolk	As in Scenario 1.

Data Collection Method	Details	Scenario 1	Scenario 2
	week commencing on the 3rd July 2017 (phase 1). The investigation comprised the monitoring of coring activity and assessment of boreholes logs, with a focus on possible landfall sites at the coast and at seven key crossing locations, where the proposed current onshore cable corridor intersects major transport routes or waterways where trenchless crossing techniques (e.g. Horizontal Directional Drilling – HDD) methods will be required. The investigation also examined ground conditions in two locations at the proposed Happisburgh South landfall. Phase 2 of geoarchaeological monitoring of ground investigation works commenced in November 2017, focussing on the North Walsham and Dilham Canal crossing, the Kings Beck crossing, the Wooded Copse (north of Bacton Wood) crossing and the Wendling Beck crossing.	Boreas PEIR and ES, where relevant. The current assumption is that the data gathering programme under Norfolk Vanguard with respect to geotechnical survey will be sufficient for Norfolk Boreas. However, should any Site Investigation works be undertaken specific to the Norfolk Boreas project, additional targeted geoarchaeological monitoring may be required, where fully justified.	
Field Reconnaissance Survey / Site Visits (targeted)	An initial targeted 'heritage specific' site walkover and site visits have been undertaken at the landfall and cable relay station areas. Subsequent re-visits and site visits in the vicinity of the onshore project substation are anticipated in Q4 2017 / Q1 2018.	A pre-consent settings assessment is currently in process under the **Norfolk Vanguard application**, the results of which will be incorporated into the Norfolk Boreas PEIR and ES, where relevant.	As in Scenario 1.
Archaeological Metal Detecting Survey (targeted, only if required). TBC as this may now only happen post consent.	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.	May be required for the **Norfolk Vanguard application** at three separate areas along the cable corridor. Anticipated to be post-consent, access permitting. Results will be incorporated into the Norfolk Boreas PEIR and ES if collected in time, where relevant. Requests for	Assuming metal detecting is undertaken pre-consent as part of the Norfolk Vanguard application, the same will apply as set out in Scenario 1. Should such surveys be anticipated post-consent as part of the Norfolk Vanguard project, under Scenario 2, metal detecting may be required

Data Collection Method	Details	Scenario 1	Scenario 2
		additional access may be made as part of the **Norfolk Boreas application** for any areas identified for metal detecting survey, where relevant to the Norfolk Boreas project area, that were not surveyed as part of the Norfolk Vanguard project due to for example access restrictions.	under the **Norfolk Boreas application**.
Archaeological Fieldwalking Survey (targeted, only if required). TBC.	Methodical walking of targeted areas of the onshore project area, to recover and map archaeological material on the field surface, and to identify potential archaeological sites below or within the modern plough zone.	Not anticipated to be a requirement at this stage.	Not anticipated to be a requirement at this stage.
Earthwork Condition (GPS/topographic) Survey (targeted, only if required). TBC.	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).	Anticipated to be undertaken post-consent.	Anticipated to be undertaken post-consent.
Geoarchaeological Assessment / Palaeoenvironmental Survey (scheme wide approach, but targeted).	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	Anticipated to be post-consent, especially the fieldwork elements, as required.	Anticipated to be post-consent, especially the fieldwork elements, as required.

Data Collection Method	Details	Scenario 1	Scenario 2
	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.		
Archaeological Trial Trenching (scheme-wide approach, but targeted, predominantly on the geophysical survey results and a sample of apparent 'blank' areas). TBC.	A programme of ground intrusive evaluation, 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 (see below).	Required for the **Norfolk Vanguard application.** 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.	Likely to be required for the **Norfolk Boreas application.** 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.
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).	Likely to be a condition of consent for the Norfolk Vanguard and Norfolk Boreas projects.	
Preservation in-situ (avoidance/micrositing/re-routing/HDD).	TBC (in advance of, at and during construction).		
Strip, Map and Record (or	TBC (at / during construction).		

Data Collection Method	Details	Scenario 1	Scenario 2
Sample) Excavation. Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate).			
Watching Brief (targeted and general). Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate).	TBC (at / during construction).		

3.2.1 Survey Programme

145. The onshore archaeology and cultural heritage survey programme (**Table 3.3**) sets out the survey programme anticipated in relation to the Norfolk Vanguard application. It's envisaged that it will be necessary to undertake a number of surveys (in part or in full) during the post-consent / pre-construction window. Should the Norfolk Vanguard project not be granted consent, a number of these survey programmes are likely to be proposed as part of the Norfolk Boreas application. The timings of surveys (non-intrusive and intrusive) will be discussed with the Heritage Steering Group as the Norfolk Vanguard and Norfolk Boreas projects progress.

Table 3.3: Onshore Archaeology Programme

Survey/ Data Review	Programme
Non-Intrusive and Intrusive Evaluation:	
• Priority Archaeological Geophysical Survey c. 45 % of the onshore project area (although ultimately anticipated to be largely a scheme-wide requirement). **Under Norfolk Vanguard application**.	- Q4 2017 / Q1 2018.
• Archaeological Metal Detecting Survey (targeted, only if required). Three possible areas currently identified, however this may occur post consent.	- Q1 2018 (TBC).
• Archaeological Fieldwalking Survey (targeted, only if required).	- TBC. Not anticipated to be a requirement at this stage.
• Earthwork Condition (GPS/topographic) Survey (targeted, only if required).	- TBC. Post-consent.
• Geoarchaeological Assessment / Palaeoenvironmental Survey (scheme wide approach, but targeted).	- TBC. Any field work elements are proposed to be undertaken post-consent.
• Archaeological Trial Trenching (scheme-wide approach, but targeted, predominantly on the geophysical survey results and a sample of apparent 'blank' areas).	- TBC. Proposed to be undertaken post-consent.
• Archaeological Watching Brief / Geoarchaeological Monitoring of Site Investigation Works (targeted). **Under Norfolk Vanguard application**.	- Q3/Q4 2017.
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).

Survey/ Data Review	Programme
• 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).
• Geoarchaeological coring (targeted) (where appropriate).	TBC

4 IMPACT ASSESSMENT METHODOLOGY

146. 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. Impacts of a development can also effect below ground deposits over a much wider area. For example, groundworks may result in hydrological changes which could ultimately result in the desiccation and drying of wetland deposits and preserved waterlogged archaeological remains. As such, impacts on potential geoarchaeological / palaeoenvironmental remains potentially indicative of former land surfaces will also be considered.

147. 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.

148. 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).

149. 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).

150. 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.

151. The potential for impacts to occur upon the onshore archaeological and cultural heritage resource may differ according to the scenario in question. As such, this will have repercussions on the way in which the impact assessment is implemented, as described in the examples set out below In order to fully assess the impacts of Scenarios 1 and Scenario 2, each potential impact within the Archaeology and Cultural Heritage ES chapter will be divided into two sections, one for each Scenario. The worst case scenario assessment will therefore include reference to each.

Scenario 1

152. Should Scenario 1 occur, the potential impact of the various elements of the Norfolk Boreas project will be confined works associated with the HDD at landfall, jointing and transition pits, onshore project substation, cable relay station and the installation of cables in the ducts through a process of cable pulling.

Scenario 2

153. If Scenario 2 were to occur, potential impacts arising from Norfolk Boreas project would span the extent of the proposed project area, involving the construction and installation of all onshore infrastructure necessary for a viable project.

4.1 Defining Impact Significance

4.1.1 Heritage significance (importance)

154. The sensitivity of a receptor (heritage asset) is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. However, while impacts to a heritage asset's setting or character can be temporary, impacts which result in damage or destruction of the assets themselves, or their relationship with their wider environment and context, are permanent. Once destroyed a heritage asset cannot recover. For this reason, the sensitivity of heritage assets is determined by their heritage significance (archaeological importance). The heritage significance of an asset, the determination of which is outlined below, can therefore be regarded as equating to its sensitivity.

155. 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.

156. 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 project (NPPF paragraph 128, 2012).

157. The initial indicative (outline) criteria for determining the heritage significance of any relevant heritage assets are described in **Table 4.1** below. This criteria provides 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. However, due to the nature of the archaeological record, it is often the case that information regarding individual assets may, at times, be limited. As such, the categories and definitions of heritage significance do not necessarily reflect a definitive level of importance of an asset. Instead they should be regarded as providing a preliminary or likely heritage significance based on information available to date. The heritage significance of an asset can therefore be amended or revised as more information comes to light. Archaeological survey and assessment that may alter the perceived heritage significance of an asset may be undertaken pre- and/or post-consent and include non-intrusive and intrusive survey programmes.

158. 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.

159. 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

160. 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)

161. 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.

162. 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.

163. 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 project and the sensitivity with which the landscape is re-instated subsequent to decommissioning / demolition, if applicable.

164. 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

165. 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 Significance of an impact resulting from each combination of receptor sensitivity (heritage significance) and the magnitude of the effect

		Negative magnitude				Beneficial magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 4.4 Indicative Impact Significance Categories

Impact Significance	Definition
Major (Substantial)	May equate to substantial harm or total loss of the value of a designated heritage asset (or asset worthy of designation) such that development may not be consented unless substantial public benefit is delivered by the project. Effective/acceptable mitigation options may still be possible, to offset and/or reduce residual impacts to satisfactory levels.
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 project to determine consent. Effective/acceptable mitigation options are likely to be possible, to offset and/or reduce residual impacts to satisfactory levels.
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.

166. 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).

167. 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.

5 POTENTIAL IMPACTS

168. 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.

5.1 Potential Impacts during Construction

169. It is proposed that the onshore archaeology and cultural heritage EIA will assess the construction impacts identified in sections 5.1.1 to 5.1.4

170. Each impact section will be assessed in a manner consistent with the impact assessment methodology (see section 4) and divided into Scenarios 1 and 2 so that potential impacts arising from each scenario can be assessed. Within each scenario, reference will be made to various elements of the project infrastructure and associated works, where relevant.

5.1.1 Impact: Direct impact on (permanent change to) buried archaeological remains

171. Activities undertaken as part of construction for the project have the potential to directly impact heritage assets in the form of sub-surface remains, resulting in their loss or disturbance to the relationships between assets and their wider surroundings. Impacts resulting in these potential effects as part of construction work are those associated with intrusive groundworks.

172. 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. However, all direct impacts to archaeological heritage assets are considered permanent. Once archaeological deposits and material, and the relationships between deposits, material and their context have been damaged or disturbed, it is not possible to reinstate or reverse those changes. As such, direct impacts to the fabric or physical setting would represent a total loss of an asset, or part of it, and the character, composition or attributes of the asset would be fundamentally changed or lost from the site altogether.

5.1.1.1 Approach to Assessment

173. Baseline environment data will be assessed as part of a staged approach, based on the results of the Archaeological Desk Based Assessment undertaken for the Norfolk

Vanguard project, alongside the results of any subsequent survey programmes (see Section 3.2) undertaken as part of the Norfolk Vanguard application.

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

174. Construction activities undertaken as part of the project have the potential to directly impact potential heritage assets in the form of above ground remains, resulting in their loss or disturbing relationships between assets and their wider surroundings. Above ground remains may be represented by earthworks or field boundaries or may comprise non-designated built heritage structures. Impacts resulting in these potential effects as part of construction works are those associated with intrusive groundworks. 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.

175. Extant earthworks and field boundaries are an integral part of the Historic Landscape Character (HLC) of the wider area, and any loss of such features therefore has the potential to impact upon the HLC of the study area.

5.1.2.1 Approach to assessment

176. Baseline environment data will be assessed as part of a staged approach, based on the results of the Archaeological Desk Based Assessment undertaken for the Norfolk Vanguard project, alongside the results of any subsequent survey programmes (see Section 3.2) undertaken as part of the Norfolk Vanguard application.

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

177. Activities undertaken as part of construction works for the project have the potential to impact designated and non-designated heritage assets in an indirect (non-physical) manner, related to the setting of heritage assets. Indirect impacts, where present, are likely to arise 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, created during the construction phase could have an impact upon heritage assets and their settings.

5.1.3.1 Approach to assessment

178. Settings assessment following Historic England guidance has been conducted as part of the Norfolk Vanguard application, and reported on within the relevant Archaeological DBA and PEIR chapter in support of this application. This assessment is ongoing. Due to the proximity of the proposed elements of the Norfolk Boreas

project, the results of this assessment will be incorporated within the Norfolk Boreas PEIR / ES. This assessment will be supplemented using LVIA type tools such as ZTVs and photomontages generated for the Norfolk Boreas project, particularly in relation to above ground infrastructure such as the cable relay station, onshore project substation and the Necton National Grid extension.

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

179. Activities undertaken as part of the project as part of construction works have the potential to 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. Impacts resulting in these potential effects as part of construction works are those associated with intrusive groundworks.

5.1.4.1 Approach to assessment

180. Baseline environment data will be assessed as part of a staged approach, based on the results of the ADBA undertaken for the Norfolk Vanguard project, alongside the results of any subsequent survey programmes (see section 3.2). This will include the results of a programme of monitoring and ground investigation works undertaken for the Norfolk Vanguard application. The results of further geoarchaeological assessment / palaeoenvironmental surveys, as required, may further inform upon this assessment.

5.2 Potential Impacts during Operation and Maintenance

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

181. 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.

5.2.1.1 Approach to assessment

182. Settings assessment following Historic England guidance has commenced as part of the Norfolk Vanguard application, and reported on within the relevant Archaeological DBA and PEIR chapter in support of that application. This assessment is ongoing. Due to the proximity of the proposed elements of the Norfolk Boreas project, the results of this assessment will be incorporated within the Norfolk Boreas PEIR / ES. This assessment will be supplemented using LVIA type tools such as ZTVs and photomontages generated for the Norfolk Boreas project, particularly in relation

to above ground infrastructure such as the Cable Relay Station and Substation options.

183. This section will consider Scenario 2 only. Impacts arising as a result of Scenario 1 will be considered as part of the CIA (see section 5.4).

5.3 Potential Impacts during Decommissioning

5.3.1 Impact: Direct impact on (permanent change to) buried archaeological remains

184. 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 Norfolk Vanguard 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.

5.3.1.1 Approach to assessment

185. No decision has been made regarding the final decommissioning policy for the onshore cables, as it is recognised that industry best practice, rules and legislation change over time.

186. In relation to the onshore project substation and cable relay station, the programme for decommissioning is expected to be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the project lifetime.

187. Whilst details regarding the decommissioning of the onshore project substation/cable relay station are currently unknown, considering the worst case scenario which would be the removal and reinstatement of the current land use at the site, it is anticipated that the impacts would be similar to those during construction.

188. The decommissioning methodology would need to be finalised nearer to the end of the lifetime of the project so as to be in line with current guidance, policy and legislation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works could be subject to a separate licencing approach which may require EIA.

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

189. Settings impacts may 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.

5.3.2.1 Approach to assessment

190. During decommissioning it is expected that the level of plant use and associated activity will be similar but lower than during construction. As such, it is anticipated that the impacts would be similar to those during construction. However, as stated above, the decommissioning methodology would need to be finalised nearer to the end of the lifetime of the project so as to be in line with current guidance, policy and legislation at that point. Any such methodology would be agreed with the relevant authorities and statutory consultees. The decommissioning works could be subject to a separate licencing approach which may require EIA.

5.4 Potential Cumulative Impacts

191. Projects which have the potential to act cumulatively with Norfolk Boreas will be identified and assessed as part of the CIA and are therefore scoped into the assessment. Such projects include those that are existing, consented or at application stage, where relevant. The current proposed list of projects to be considered under the CIA assessment include:

- The proposed Norfolk Vanguard project (under a Scenario 1);
- The proposed Hornsea Project Three Offshore Wind Farm,
- Dudgeon Offshore Wind Farm,
- The approved Bacton Gas terminal extension and coastal protection projects and the approved Bacton Coastal Protection Scheme.

192. Other projects with the potential to impact upon the onshore historic environment may come to light as the project progresses and these will be agreed in consultation with local authorities.

193. Potential cumulative impacts arising from the proposed project will be considered in line with the EIA Methodology. Potential impacts will be identified and assessed in terms of significance and magnitude using the same methodology outlined in the impact assessment. Where appropriate, potential mitigation measures will be outlined.

5.5 Supplementary documentation

194. The project will submit a project-specific draft (outline) WSI as part of the DCO application which will outline a commitment to undertake additional programmes of

survey and evaluation post-consent. The WSI will be prepared and agreed in consultation with Historic England and Norfolk County Council.

195. The methodology for any additional forms of pre-consent survey work required for the project will also be subject to 'survey-specific' WSIs and agreed in consultation with Historic England and Norfolk County Council.

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