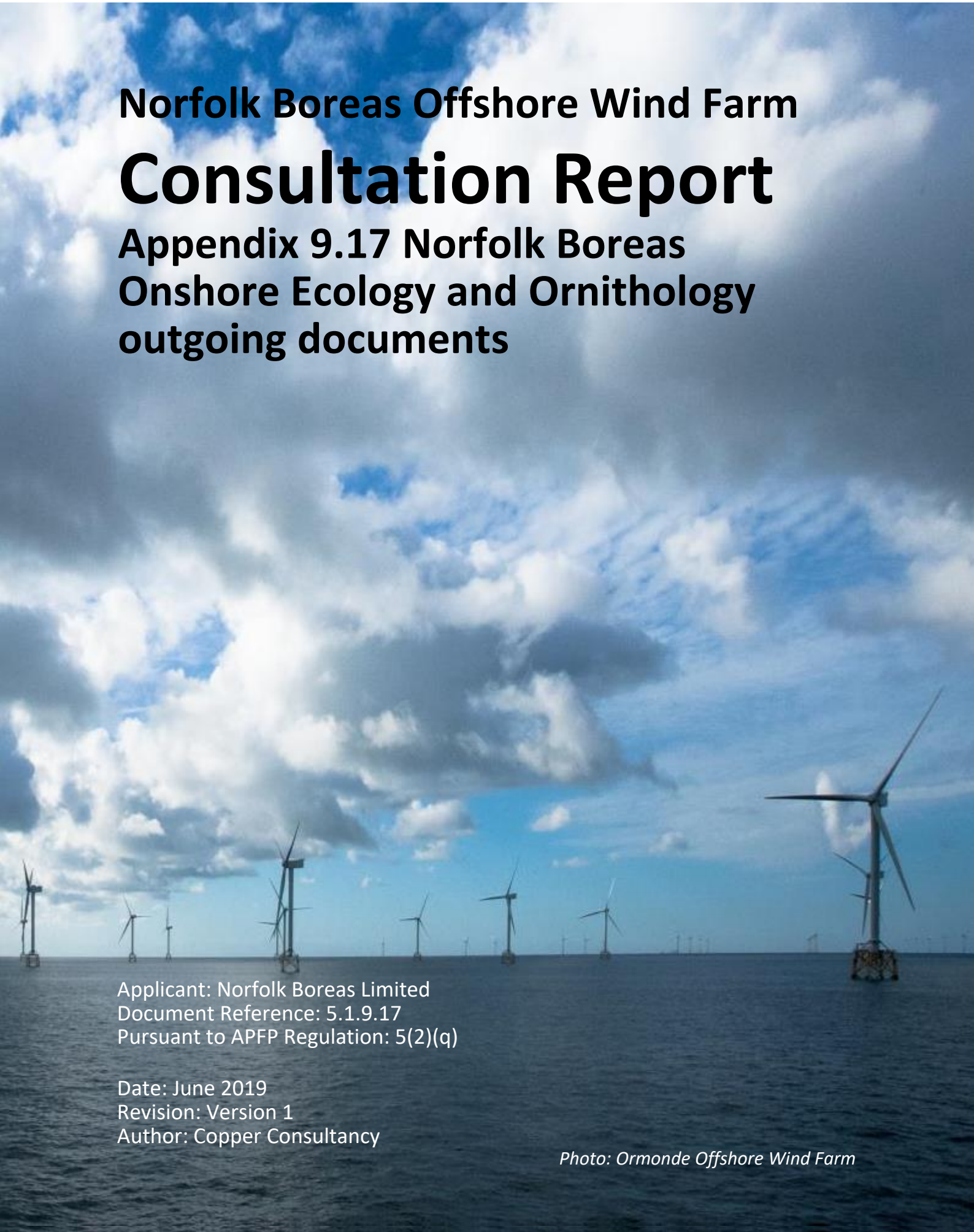
Royal HaskoningDHV
Enhancing Society Together

VATTENFALL

Norfolk Boreas Offshore Wind Farm

Consultation Report

Appendix 9.17 Norfolk Boreas Onshore Ecology and Ornithology outgoing documents



Applicant: Norfolk Boreas Limited
Document Reference: 5.1.9.17
Pursuant to APFP Regulation: 5(2)(q)

Date: June 2019
Revision: Version 1
Author: Copper Consultancy

Photo: Ormonde Offshore Wind Farm

This page is intentionally blank.

Royal HaskoningDHV
Enhancing Society Together

VATTENFALL

Norfolk Boreas Offshore Wind Farm

Environmental Impact Assessment

Onshore Ecology and Ornithology Method Statement

Document Reference: PB5640-004-005

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

IEMA
Transforming the world to sustainability
- EIA -

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
10/11/2017	01D	Internal draft for review	GC	DT	AD
13/11/2017	02D	Second Draft	GC	DT	
20/11/2017	03D	Draft provided to Vattenfall for review	GC	DT	JL
19/02/2018	01F	Issue to consultees	GC	CD	JL
30/01/2018	02F	Removed reference to agreement on *odonata* surveys in section 1.2.3.	GC	CD	CD

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 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 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.

Table of Contents

Figures

Glossary of Acronyms

AA	Appropriate Assessment
AIS	Air Insulated Switchgear
APIS	Air Pollution Information System
BAP	Biodiversity Action Plan
BCT	Bat Conservation Trust
BoCC4	Birds of Conservation Concern 4
CBS	Cement Bound Sand
CEMP	Construction and Environmental Management Plan
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CRS	Cable Relay Station
CWS	County Wildlife Sites
dB	Decibel
DCO	Development Consent Order
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
ESA	Ecosystem Services Assessment
ETG	Expert Topic Group
GIS	Gas Insulated Switchgear
ha	Hectares
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HRA	Habitats Regulations Assessment
HSI	Habitat Suitability Index
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
Hz	Hertz
IAQM	Institute of Air Quality Management
IEMA	Institute of Environmental Assessment
ILE	Institute for Lighting Engineers
IROPI	Imperative Reasons of Overriding Public Interest
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
km	Kilometre
km/h	Kilometre per hour
kV	Kilovolt
LBAP	Local Biodiversity Action Plan

LNR	Local Nature Reserve
LSE	Likely Significant Effect
m	Metre
MCZ	Marine Conservation Zone
mph	Miles per hour
NBIS	Norfolk Biodiversity Information Service
NERC Act	National Environment and Rural Communities
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NSER	No Significant Effects Report
NVC	National Vegetation Classification
O&M	Operation and Maintenance
OLEMS	Outline Landscape and Environmental Management Strategy
p/h	per hour
pCWS	Proposed County Wildlife Site
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PMA	Primary Mobilisation Area
RNR	Roadside Nature Reserves
SAC	Special Area of Conservation
SPA	Special Protection Area
SPL	Sound Pressure Level
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
TN	Target notes
UKHPI	UK Habitat of Principal Importance
VWPL	Vattenfall Wind Power Limited
ZOI	Zone of influence

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 ecology and onshore ornithology 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 Ecology and Ornithology Expert Topic Group (ETG), which 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 (link to Scoping Opinion provided below), responses to the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b) and consultation undertaken through the Norfolk Vanguard EPP.

4. Information provided in this method statement is a draft for stakeholder consultation only and is provided in confidence. It is recognised that Norfolk Vanguard ETG meetings are being 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, Norfolk Boreas must 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.

5. Although this method statement covers both onshore ecology and onshore ornithology two separate chapters will be provided within the PEIR, one to cover each of these topics.

1.1 Background

6. 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

7. 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

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

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 Norfolk Boreas Evidence Plan Process Programme

9. 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 completed and anticipated activity:

- Agreement of Terms of Reference - Q3 2017 (complete)
- Agreement was reached with Natural England on 19/10/2017 that the wintering bird survey effort, and data collected, for Norfolk Vanguard is sufficient and relevant for Norfolk Boreas. - Q3 2017 (complete)
- Post-scoping ETG meetings / correspondence - Q1 2018
    - Discuss method statements and Project Design
- ETG and Steering Group meetings as required - 2018
    - To be determined by the relevant groups based on issues raised
- PEI Report (PEIR) ETG and Steering Group meetings - Q4 2018/ Q1 2019
    - To discuss the findings of the PEI (before or after submission)
- Pre-submission ETG 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

1.2.3.1 Norfolk Vanguard Evidence Plan Program

10. Norfolk Boreas is the sister project to Norfolk Vanguard (see section 2 for details). A programme of consultation has already been undertaken for Norfolk Vanguard

which is also of relevance to the onshore ecology and ornithology aspect for Norfolk Boreas. This is summarised below:

- Submission of Onshore Winter / Passage Bird Survey Scoping Report - 15/09/16
  - Agreement reached with Natural England on scope for wintering bird surveys required for October 2016 – March 2017.
- Detailed EIA Scoping Request submission made to PINS - 03/10/16
- Receipt of Scoping Opinion (comments in Scoping Opinion subsequently addressed and incorporated into PEIR, where appropriate) - 11/11/16
- Steering Group meeting - 21/03/16
- Steering Group meeting - 20/09/16
- Post-scoping ETG meeting - 24/01/17
  - Agreed method statements and discussed Project Design Statement
  - Agreed scope for Extended Phase 1 Habitat Survey programmed for February 2017
- Issued scope for 2017 ecological survey programme - 17/03/17
  - Agreement reached on scope for 2017 ecological surveys for Norfolk Vanguard, including scope for
    i. Breeding bird surveys
    ii. Bat activity surveys
    iii. Bat emergence / re-entry surveys
    iv. Great crested newt surveys
    v. Water vole surveys (including otter surveys)
    vi. Reptile surveys
    vii. Botanical (National Vegetation Classification (NVC)) survey
    viii. Desmoulin's whorl snail survey
- ETG meeting to discuss data collection and impact assessment conducted to date - 18/07/17
  - Agreement reached on:
    i. Quality and validity of data collected to date (following issue of *PB4476.003.044_Norfolk Vanguard Bat Surveys Methodology Update_02F* on 20/09/17)
    ii. Sites screened into onshore Habitats Regulations Assessment (HRA) Screening for Likely Significant Effect

- PEIR Submission - 07/11/17
- PEIR responses received - 13/12/17

11. 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 effect the proposed methodology for the Norfolk Boreas EIA.

1.2.3.2 Norfolk Boreas Scoping Opinion

12. This method statement has been produced following a full review of the EIA Scoping Opinion provided by the Planning Inspectorate. The comments in the Norfolk Boreas Scoping Opinion relating to Onshore Ecology and Ornithology are summarised in **Table 1.1**. This table includes only those comments which apply to Norfolk Boreas.

Table 1.1 Scoping opinion responses

Consultee	Comment	Response
Secretary of State (SoS)	The Applicant is strongly advised to consider the advice from NE and the EA on the potential risks associated with the use of Horizontal Direct Drilling (HDD) under the River Wensum (see Appendix 3 of this report) and how these might be minimised.	Ongoing discussion on the impacts of trenchless techniques on the River Wensum has been undertaken during the Norfolk Vanguard EPP. Further surveys are proposed within this method statement in relation to the River Wensum SAC / SSSI to build on data already collected.
SoS	It is not entirely clear from the Scoping Report whether effects on the River Wensum SAC/SSSI will be covered in the onshore ecology section of the ES or in the section dealing with water resources and flood risk. Given the statutory ecological designations covering the River Wensum the SoS recommends that the ecological effects are reported in the onshore ecology chapter with appropriate cross referencing to the water resources chapter.	The River Wensum SAC / SSSI will be considered within the Onshore Ecology chapter of the PEIR / ES, although this section will be prepared in discussion with the water resources assessment.
Environment Agency	Whilst HDD is the preferred method for routing cable under sensitive features, risk of bentonite leaks as described would not be acceptable where risk of a leak can be appropriately managed to ensure this doesn't happen. As with any directional drilling operation there is the potential for the drilling fluid to leak up through the fissures and gravels into the river which could cause considerable turbidity. This can have severe consequences for fish, their eggs and also for plants and invertebrates as the effects of deposited drilling fluids being similar to the effects of sediment deposition, i.e. it can result in direct burial of eggs and larvae of fish or benthic invertebrates or can change bed material composition and cause increased compaction. Drill fluids can also carry a considerable distance downstream before it settles out. Given the risk of drill fluid release into sensitive receptors the following measures be factored into the Environmental Statement and construction method statements: Where HDD is proposed, soils of the site must be fully assessed to understand the potential risk of fluid release into sensitive receptors. The drill path must be kept sufficiently deep to reduce the potential of drilling fluid releases reaching a receptor Access pits are dug a suitable distance back from waterbodies, whilst taking into account the potential effects that this may have on the surrounding area. Operatives to monitor drilling fluid pressure and the volume of drilling fluid returns, to detect losses. A contingency plan is produced in case of drilling fluid pressure decreases The ground surface above the drilling path must be inspected for evidence of inadvertent drilling fluid releases The sensitive receptor must be monitored for evidence of inadvertent drilling fluid releases. This risk can be minimised using best	An assessment of the risk to watercourses from the trenchless techniques being considered will be included within the Water Resources chapter of the PEIR / ES. The potential effect on fish will be subsequently considered with the Onshore Ecology chapter of the PEIR / ES.

Consultee	Comment	Response
	practice and ensuring that the drilling occurs at sufficient depth below the river/ground surface. Clean-up materials and equipment, such as straw bales, sandbags, silt traps etc. must be present on site during the drilling operations.	
Forestry Commission	We would expect the environmental statement to consider how these techniques impact on any woodland to which they are applied: the likely impacts of disturbance, dust, water table effects and lighting . This should also encompass how the recommended '15 metre buffer' between any development and Ancient Woodland described in the Standing Advice for Ancient Woodland (from the canopy edge and not from the trunks of trees) will be applied as a protective measure.	Indirect effects upon woodland habitats, including those effects listed in the Standing Advice for Ancient Woodland, will be considered within the PEIR / ES. The 15m buffer has been incorporated into the embedded mitigation for the project (i.e. no works will take place within 15m of and ancient woodland).
Natural England	Norfolk Valley Fens SAC and component SSSIs: The area along the cable route includes several sites that form part of the Norfolk Valley Fens SAC. These sites, along with many of the locally designated sites in the area, form a complex network of hydrologically linked sites which are very sensitive to changes in water levels or flow. Some of the sites that form part of this network and may be affected by the cable route are Alderford Common, Swanningate Upgate Common, Booton Common and Potter and Scarning Fens East Dereham SSSIs (though this list is not exhaustive); we recommend that a desk study is carried out to ensure that all SSSIs associated with this SAC that may be affected by the cable route are scoped into the assessment. We advise that the Environmental Statement considers in detail how the placement of the route will affect surface water flow across any of the sites that are components of the Norfolk Valley Fens SAC, along with any County Wildlife sites with a hydrological focus.	Norfolk Valley Fens SAC / constituent SSSIs will be considered within the PEIR / ES and HRA (SAC only).

2 PROJECT DESCRIPTION

2.1 Introduction

13. 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 project substations.

14. The Norfolk Vanguard project is approximately 12 months ahead of Norfolk Boreas 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.

15. 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.

16. However, Norfolk Boreas needs to consider the possibility that the Norfolk Vanguard project may not be constructed. In order for Norfolk Boreas to stand up as an independent project, this scenario must be provided for within the Norfolk Boreas DCO. Thus, 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.

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

18. 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

19. 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 ETG. Details of the site selection process are provided in Chapter 4 of the Norfolk Vanguard Preliminary Environmental Information Report (Royal HaskoningDHV, 2017b) with a summary provided below:

2.2.1 Landfall Zone

20. 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.

21. 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 ETGs in June and July 2017 and in the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b).

22. Happisburgh South 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

23. 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 only. No cable relay station would be required 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.

24. 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 of 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.

25. 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 to be delivered in Q4 2018.

2.2.3 Onshore Cable Route

26. 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 and other key environmental constraints where possible.

27. 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**).

2.2.4 Onshore Project Substation

28. 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 for Norfolk Boreas. Although the onshore project substation location is now well defined 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**).

29. A Norfolk Boreas onshore project substation temporary construction compound area has not yet been identified, however a defined location will be determined and presented within the Norfolk Boreas PEIR to be delivered during Q4 2018.

2.2.5 Extension to the Existing Necton National Grid substation

30. The Norfolk Boreas Scoping report presented a National Grid substation extension zone. Since the publication of that report further work has been undertaken 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).

31. 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. 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 Chapter 4 of the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b).

2.3 Indicative Worst Case Scenarios

32. The following section provides a summary of the project description and the current predicted worst case scenarios for Onshore Ecology and Ornithology. A summary only is provided here, however should further information be sought, a detailed description of the project predicted worst case scenarios are provided **Appendix 2**. The Norfolk Boreas PEIR and the ES will also provide further detail on the Project Description. The ES will describe the final project design envelope for the DCO application.

33. 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.

34. 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.

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 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 infrastructure are considered within this method statement:

- 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);
- 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. A summary of the key elements of each of these parameters is provided in **Table 2.1** below.

38. As outlined in section 2.1, not all of the infrastructure listed above are required for each scenario. In the summary of infrastructure provided below, explanation of which elements are required for Scenario 1 or Scenario 2 is included in the text and summarised at the end of the section. For full detail of what is considered in Scenario 1 and what is considered in Scenario 2, please see **Appendix 2**.

39. 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.

40. The location of all elements of the onshore infrastructure described in **Table 2.1** are shown on the figures presented in **Appendix 1**.

Table 2.1 Infrastructure parameters

Infrastructure element	Scenario	Worst case scenario parameters

Landfall (Horizontal Directional Drilling (HDD) and associated compounds);	Scenario 1 and 2	**HDD:**
		• The HDD exit point would either be:
		  • On the beach, above the level of mean low water spring (classified as "short HDD");or
		  • At an offshore location, seaward the beach (up to 1,000m in drill length) (classified as "long HDD").
		• 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.
		Other key infrastructure parameters at landfall include:
		• Installation of a temporary construction compound to accommodate the drilling rig, ducting and associated materials and welfare facilities (fully reinstated upon completion of the landfall works).
		• 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.
		• Temporary footprint of works would be up to 3,000m2 per compound (up to six compounds).
		• Duration: For a drill length of 500m, it is anticipated that site establishment, drilling of up to six ducts and demobilisation will take approximately 30 weeks when considering 12 hour (7am-7pm), 7 day shifts. 24 hour operation could be employed for drilling activities, subject to planning and environmental restrictions, and could reduce the installation to approximately 20 weeks. Cable pulling would be undertaken subsequent to the duct installation.
		• Noise from HDD sites is generally associated with generators at the location with a noise emission of 77 dB LAeq at 10m. At 50m distance from an average HDD site the noise level is 63dB(A) and at 100m is typically 57dB(A).
		• Lighting: 24 hour lighting of the temporary footprint would be required throughout construction.

Cable relay station (required for HVAC only);	Scenario 1 and 2	**Infrastructure summary:** 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). Each reactor would be installed in concrete bunds to contain oil leakage and prevent damage to the environment. Within the Cable Relay Station, cables which enter from the landfall exit towards the onshore project substation would be laid in concrete troughs and terminated at the GIS. **Other key infrastructure parameters** at the cable relay station include: • The maximum **height** of the reactor and associated GIS equipment would be 8m. • The **total cable relay station fenced area** would be 73m x 135m (9,855m^2), with a perimeter **fence height** of 2.4m. External to the perimeter fence would be a small control building with associated parking with combined

Infrastructure element	Scenario	Worst case scenario parameters
		dimensions of 31m x 18m (558m^2). • There would be an additional **temporary construction area** with a maximum temporary footprint of 15,000m2 during construction of the cable relay station. • Construction activities would be conducted during **working hours** of 7am-7pm. Evening or weekend working may be required to maintain programme progress and for specific time critical activities such as transformer oil filling and processing; however these would be kept to a minimum. Perimeter and site **lighting** would be required during working hours and a lower level of lighting will remain overnight for security purposes. • **Surface water drainage** requirements for the onshore project substation would be dictated by the final drainage study. • The **construction programme** for the cable relay station would be 18 months.
Cable corridor (with associated trenchless crossing technique areas, construction compounds and mobilisation areas);	Scenario 1	**Infrastructure summary:** Norfolk Vanguard would install cable ducts and undertake supporting 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, the ducts would be installed and ground reinstated by Norfolk Vanguard. **Other key infrastructure parameters** for the cable corridor works (Scenario 1) include: • Approximately 20% (12km) of the Norfolk Vanguard **running track** would need reinstatement to facilitate cable pulling operations. • **Duration:** The cable pulling and jointing process would take approximately six weeks per 1km of cable length, including installing and removing any temporary hard standing and delivering the cables to the jointing pits. However any one jointing pit could be open for up to 12 weeks. Jointing pits would be required at every 800m, and would have a footprint of 15m x 10m x 5m and be excavated to a depth of 1.2m.
	Scenario 2	**Infrastructure summary:** Norfolk Boreas would be responsible for installing all onshore cable route infrastructure required for the project, including installing ducts along the entire cable route (including at crossing points) and reinstating land. Under this scenario the cable route 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. The main cable installation method would be through the use of open cut trenching with HDPE ducts installed, backfilled and cables pulled though the pre-laid ducts. **Other key infrastructure parameters** for the cable corridor works (Scenario 2) include: **Overall route:**

Infrastructure element	Scenario	Worst case scenario parameters

		• **Route length:** The cable route would be approximately 60km in length. The total cable easement width for Norfolk Boreas would involve the following parameters (under a 'worst case' HVAC scenario):
		  ◦ **Temporary strip width** (total land requirement to install the cables (i.e. cable route width)) = 50m
		  ◦ **Permanent strip width** (total ongoing land requirement of the installed cables) = 17m
		  ◦ **Running track / ongoing right of access strip width** (temporary area required to be reserved for access for future repair or maintenance activities) = 8m
		• **Hedgerows:** The total temporary strip can be reduced down to 25m at sensitive locations, e.g. hedgerow crossings.
		• **Duration:** The cable pulling and jointing process would take approximately six weeks per 1km of cable length, including installing and removing any temporary hard standing and delivering the cables to the jointing pits. However any one jointing pit could be open for up to 12 weeks. Jointing pits would be required at every 800m, and would have a footprint of 15m x 10m x 5m and be excavated to a depth of 1.2m.
		Crossing installation methods:
		• **Temporary damming and diverting:** Where small scale watercourses such as field drains, which are shallower than 1.5m are to be crossed, temporary damming and diverting of the watercourse could be employed.
		• **Culverting or cable bridges:** Where larger watercourses such as field drains are deeper than 1.5m, culverting or cable bridges could be used. Full details of these techniques and under what circumstances they would be proposed are set out in **Appendix 2**.
		• **Trenchless installation methods:** Trenchless 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 would be employed at the River Wensum Special Area of Conservation (SAC) and Sites of Special Scientific Interest (SSSI), other major watercourse crossings, major infrastructure and sensitive habitat areas such as semi-natural broadleaved woodland, to minimise the impact to the feature being crossed. The locations of these are shown in **Appendix 1** (termed 'trenchless crossing techniques').
		• 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. 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 (2,500m^2) for the reception site and 100m x 50m (5,000m^2) on the launch site, adjacent to the onshore cable route.

Infrastructure element	Scenario	Worst case scenario parameters
		Temporary construction compounds: • Primary and secondary mobilisation areas would be required to store equipment and provide welfare facilities. These areas would be covered with hardstanding. • The primary and secondary mobilisation areas would typically have **footprints** of 100m x 100m (10,000m^2) and 40m x 40m (1,600m^2) respectively. • **Site lighting** and secure fencing around the perimeter of the mobilisation area would be put in place for safety and security purposes.
Onshore project substation;	Scenario 1 and 2	**Key infrastructure parameters** for the onshore project substation include: • The maximum **height** of any element of equipment would be 10m for HVAC (transformers), and 25m for HDVC (lightning protection masts). The largest equipment within the HVDC onshore substation would be the reactor halls with an approximate height of 19m. All other equipment would not exceed a height of 6m (HVAC) or 10m (HVDC). • **Permanent footprint:** The total land requirement for the HVAC or HVDC onshore substation to the perimeter fence is 250m x 300m (75,000m^2). • During construction of the onshore project substation, a **temporary construction compound** would be established to support the works. In Scenario 1, this access would be shared with the onshore project substation for Norfolk Vanguard; in Scenario 2, the access would need to be constructed as part of Norfolk Boreas. **Temporary footprint:** The compound would be would be formed of hard standing and be of dimensions 200m x 100m and would accommodate construction management offices, welfare facilities, car parking, workshops and storage areas. • Construction activities would be conducted during **working hours** of 7am-7pm. Evening or weekend working may be required to maintain programme progress and for specific time critical activities such as transformer oil filling and processing; however these would be kept to a minimum. Perimeter and site **lighting** would be required during working hours and a lower level of lighting will remain overnight for security purposes. • **Surface water drainage** requirements for the onshore project substation would be dictated by the final drainage study. • The **construction programme** for the cable relay station would be 18 months.
Extension to the existing Necton National Grid Substation, including	Scenario 1	**Infrastructure summary:** All extension enabling works would be completed to facilitate both Norfolk Vanguard and Norfolk Boreas including access roads, earthworks, foundations, buildings, civil works and overhead line modifications under the Norfolk Vanguard consent. Electrical busbar extensions and other electrical equipment required for Norfolk Boreas only would be constructed under

Infrastructure element	Scenario	Worst case scenario parameters
overhead line modification.		the Norfolk Boreas consent. Five further Air Insulated Switch (AIS) bays would be constructed for Norfolk Boreas within the Norfolk Vanguard Necton National Grid Substation Extension footprint. **Other key infrastructure parameters** for the extension to the existing Necton National Grid Substation (Scenario 1) include: • Construction activities would be conducted during **working hours** of 7am-7pm. Evening or weekend working may be required to maintain programme progress. Perimeter and site lighting would be required during working hours and a lower level of lighting would remain overnight for security purposes. • The **construction programme** for the Necton National Grid substation extension works is 18 months (although will be less than under Scenario 2).
	Scenario 2	**Infrastructure summary:** All Necton National Grid substation extension works including access roads, earthworks, foundations, buildings, civil works and overhead line modifications would be completed under the Norfolk Boreas consent. **Other key infrastructure parameters** for the extension to the Necton National Grid Substation (Scenario 2) include: • 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). Two new overhead line towers would be required in close proximity to the existing corner tower (to the north east of the existing Necton Substation) with a maximum height of 67m. • Two **temporary construction compounds** would be established to support the works, of dimensions 300m x 150m and 200m x 150m respectively. The compounds would accommodate construction management offices, welfare facilities, car parking, workshops and storage areas. The compounds would likely be tarmacked with some concrete hard standing for heavier plant and equipment. • Construction activities would be conducted during **working hours** of 7am-7pm. Evening or weekend working may be required to maintain programme progress. Perimeter and site lighting would be required during working hours and a lower level of lighting would remain overnight for security purposes. • **Noise:** Cranes, excavators and potentially piling equipment would be the main equipment required to construct the towers and extend the substation with sound levels in the order of 90 dB LAeq at 10m. • The **construction programme** for the Necton National Grid substation extension and overhead line modification works is 18 months.

2.3.2 Construction Programme

41. Currently it is expected that the Norfolk Boreas project would be constructed in one, two or three phases. **Table 2.2** 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.

2.3.3 Operation and Maintenance (O&M) Strategy

42. 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. 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 maintenance activities only.

43. There is no ongoing requirement to maintain the onshore cables following installation. Periodic access to installed link boxes (which may be buried or above ground (see **Appendix 2**) may be required for inspection, estimated to be annually. These link boxes will be accessible from ground level and will not require excavation works.

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

45. Peak noise levels at the cable relay station will be produced by the oil immersed reactors with an unmitigated noise level of approximately 112 dB Sound Pressure Level (SPL) across a frequency spectrum up to 8 kHz.

46. Peak operational noise levels at the onshore project substation would be produced by autotransformers with an unmitigated noise level of approximately 97dB(A) SWL , static synchronous compensators (STATCOM/ phase reactors) with an unmitigated noise level of approximately 80dB(A) SWL, harmonic filter reactors with an unmitigated noise level of approximately 86dB(A) SWL, and oil immersed shunt reactors with an unmitigated noise level of approximately 112dB(A), all across a frequency spectrum of up to 8kHz.

47. Operational noise levels at the Necton National Grid substation extension are not anticipated to change from existing levels due to the nature of the extension works.

48. There would be no operational noise at landfall or along the onshore cable corridor.

Table 2.2 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				

2.3.4 Decommissioning

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

2.3.5 Cumulative Impact Scenarios

2.3.5.1 Norfolk Vanguard

50. 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, further detail is provided in section 5.4.

2.3.5.2 Other projects

51. The assessment would 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.

52. Potential projects may include offshore wind farms, coastal defence projects (such as the Bacton sandscaping scheme) road or large infrastructure projects (including the dualling 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 and cumulative effects.

53. 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. CIA screening will be undertaken in consultation with stakeholders.

3 BASELINE ENVIRONMENT

3.1 Existing Baseline

54. This section sets out the existing data sources which are proposed to be used to inform the Norfolk Boreas EIA and includes a summary of the onshore ecology and ornithology baseline that has been identified in these sources.

3.1.1 Available Data

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

56. The data sources listed in **Table 3.1** include desk and field survey data that has been gathered for the Norfolk Vanguard project. The desk and field survey data collected for the Norfolk Vanguard project includes the footprint of the Norfolk Boreas onshore infrastructure. As shown in **Table 3.1**, this data has been collected during 2016 and 2017. Given the spatial overlap between the onshore infrastructure for these two projects, and the fact that the field data has been collected within the last 12 months, the data sources listed in **Table 3.1**, are considered to be valid for use for the Norfolk Boreas project EIA. Agreement was reached with Natural England in October 2017 that this was indeed the case for wintering bird survey data and that no further data collection was required (see section 1.2.3)

Table 3.1 Data sources

Data source	Date	Data contents	Coverage	Status
Desk study data				
Joint Nature Conservation Committee (JNCC)	July 2016	European designated sites (Special Protection Areas (SPA), SAC, Ramsar sites)	Onshore infrastructure plus a 2km buffer	Data obtained
JNCC Natural England	July 2016	UK designated sites (SSSI, National Nature Reserve (NNR), Local Nature Reserve (LNR), Ancient Woodland)	Onshore infrastructure plus a 2km buffer	Data obtained
JNCC	July 2016	UK Habitats of Principal Importance	Onshore infrastructure plus a 50m buffer	Data obtained
Norfolk Biodiversity Information Service (NBIS)	July 2016	Locally designated sites (County Wildlife Sites (CWS), Roadside Nature Reserves (RNR))	Onshore infrastructure plus a 2km buffer	Data obtained
NBIS	July 2016	Protected and notable species records including: • Wildlife & Countryside Act 1981 Schedules 1,5, 8 & 9; • The Conservation of Habitats & Species Regulations 2010 Schedules 2 & 5; • Protection of Badgers Act 1992; • Bonn Convention Appendix 1 & 2; • Bern Convention Annex 1 & 2; • Habitats Directive Annex 2, 4 & 5; • National Environment and Rural Communities (NERC) Act 2006 Section 41 species; • National (England) priority species (under Section 41 of the Natural Environment and Rural Communities Act 2006) and local Biodiversity Action Plan (BAP) species; • Birds of Conservation Concern (BoCC4) Red and Amber list species (Eaton et al., 2015); • Veteran trees; International Union for Conservation of Nature (IUCN) Red List Species;	Onshore infrastructure plus a 2km buffer (5km for bats)	Data obtained

Data source	Date	Data contents	Coverage	Status
		• Nationally Notable species; • Locally Rare species.		
NBIS	March 2017	Norfolk 'Living Map' remote sensing habitat mapping data	Onshore infrastructure plus a 50m buffer	Data obtained
Norfolk Barbastelle Study Group	June 2017	Barbastelles *Barbastella barbastellus*: • Radiotracking data for maternity colonies, to show roost locations and home ranges; • Barbastelle roosts (summer and winter), commuting routes (at hedgerow level as far as possible), core foraging areas; • Additional acoustic data for later summer/autumn. Other bat species: • Roosts, species, type and counts; and • Acoustic records.	Radiotracking data and other species roost data: Onshore infrastructure plus a 5km buffer Commuting routes and acoustic data: onshore infrastructure plus 50m buffer	Data obtained
Norfolk Local Biodiversity Action Plan (LBAP)	June 2017	Lists of Norfolk priority habitat and species. Information on Norfolk's ecological networks.	Onshore infrastructure plus a 50m buffer	Data obtained
Natural England	August 2016	Sensitivity maps for the following Broadland SPA species[1] from 1986/87 to 2012/13: • Bewick's Swan *Cygnus columbianus bewickii*; • Whooper swan *Cygnus cygnus*; and • Pink-footed goose *Anser brachyrhynchus*	10km buffer around Broadland SPA	Data obtained
Natural England	March 2017	Location of sand martin *Riparia riparia* nests at Happisburgh coastline.	Happisburgh	Data obtained
Field survey data				
Extended Phase 1 Habitat Survey	February 2017	An Extended Phase 1 Habitat Survey following 'Extended Phase 1' methodology as set out in *Guidelines for Baseline Ecological Assessment* (Institute of Environmental Assessment (IEMA), 1995). Habitats were classified and mapped following JNCC's *Handbook for Phase 1 habitat survey: A technique for environmental audit* (2010).	Great crested newts: Onshore infrastructure plus 250m buffer (temporary works) and	Full survey results available

[1] These species are those which have the greatest foraging ranges of those overwintering qualifying features of the Broadland SPA and Ramsar site.

Data source	Date	Data contents	Coverage	Status
		Included a search for: • Field signs of badgers *Meles meles*; • Assessment of roost suitable of trees and structures for bats; • Assessment of commuting / foraging suitability of all linear features for bats; • Field signs of otter *Lutra lutra*; • Assessment of suitability of watercourse to support water voles *Arvicola amphibius*; • Habitats suitability assessment of all standing water bodies for ability to support great crested newts *Triturus cristatus*; • Assessment of suitability of habitats to support reptiles; • Assessment of suitability of habitats to notable invertebrates; and • Evidence of non-native invasive species (flora and fauna).	500m buffer (permanent works) All other habitats and species: Onshore infrastructure plus a 50m buffer) Coverage of approx. 50% of survey area.	
Wintering bird surveys	October - March 2017	A survey of ex situ habitats of the Broadland SPA, and of those SSSI within 1km of the cable route which support wintering bird interest features. This includes surveys of the following areas: • Agricultural fields in North Walsham District; • Dereham Rush Meadows SSSI; • Hundred Stream; and • North Norfolk Coast between Eccles-on-Sea and Paston.	Habitats within 300m of the onshore infrastructure and 5km of the Broadland SPA; SSSI within 300m of the onshore infrastructure.	Full survey results available
Breeding bird survey	April - August 2017	A breeding bird surveys of the following areas: • Booton Common SSSI; • Dillington Carr SSSI; • Dereham Rush Meadows SSSI; • Land South of Dillington Carr CWS; • Coastal floodplain grazing marsh habitat has been identified along the habitats adjacent to the river within the survey area; and • Pigney's Wood LNR.	Statutory and non-statutory designated sites with ornithological interest features within 1km of the onshore infrastructure. Coverage of approx. 50% of survey area achieved.	Full survey results available
Great Crested Newt Survey	March - June 2017	A great crested newt presence / likely absence survey of those standing water bodies identified during the Extended Phase 1 Habitat Survey as providing 'average', 'good' or 'excellent' habitat suitability to supporting breeding populations of great crested newts.	Onshore infrastructure plus a 250m (temporary works) and 500m (permanent works)	Full survey results available

Data source	Date	Data contents	Coverage	Status
			buffer Coverage of approx. 30% of survey area.	
Water Vole Survey	May - June 2017	A water vole presence / absence and population estimate survey of those watercourses identified as suitable to support water voles during the Extended Phase 1 Habitat Survey. Field signs of otters were also searched for during this survey.	Onshore infrastructure plus a 50m buffer Coverage of approx. 75% of survey area (including all major watercourses)	Full survey results available
Reptile Presence/ Absence Survey	April-September 2017	A reptile presence / absence survey of all habitat mosaics identified during the Extended Phase 1 Habitat Survey as providing suitable habitat for common reptile species.	Onshore infrastructure plus a 50m buffer	Full survey results available
Bat Emergence / Re-entry Surveys	May - September 2017 (data analysis in progress)	Bat emergence / re-entry surveys of all trees and structures identified during the Extended Phase 1 Habitat Survey as providing moderate or high suitability to support roosting bats.	Onshore infrastructure plus a 50m buffer	Data analysis in progress. No results available yet.
Bat Activity Surveys	May - October 2017	Bat activity surveys of all linear features (hedgerows, watercourses scrub patches and woodland edges, coastline) identified during the Extended Phase 1 Habitat Survey as providing moderate or high suitability to support commuting or foraging bats.	Onshore infrastructure plus a 50m buffer	Data obtained
Aquatic Invertebrate Survey	July 2017	A survey for the Desmoulin's whorl snail *Vertigo moulinsiana* within floodplain habitats adjacent to the River Wensum.	Floodplain habitats of the River Wensum	Full survey results available
Odonata Transect Survey	July 2017	A transect survey for the Norfolk hawker *Anaciaeschna isoceles* (adult stage) along two drainage ditch networks (NH01 and NH02) adjacent to the River Bure (see **Figure 1** for survey locations).	Drainage ditches of the River Bure floodplain	Full survey results available
Botanical NVC Survey	July 2017	A NVC survey searching for the qualifying flora species (Stream water-crowfoot *R. penicillatus ssp. Pseudofluitans*, thread-leaved water-crowfoot *R. trichophyllus* and fan-leaved water-crowfoot *R. circinatus*) of the River Wensum SAC.	Floodplain habitats of the River Wensum	Full survey results available

3.1.2 Summary of Existing Baseline

3.1.2.1 Onshore ecology

57. The ecological receptors that will potentially be affected by the Norfolk Boreas project include:

- Statutory designated sites;
- Non-statutory designated sites;
- Terrestrial habitats;
- Legally protected or notable species; and
- Habitats susceptible to the spread of invasive species.

58. A study area has been established to identify onshore ecology designated sites which could be affected by the Norfolk Boreas project. The study area includes a 2km buffer around all onshore project infrastructure, which includes the landfall zone, onshore cable corridor, mobilisation zones, cable relay station search zones, onshore project substation search zone and National Grid temporary works (all shown in **Appendix 1**).

Statutory designated sites

59. A total of 37 statutory designated sites for nature conservation are located within the onshore ecology study area. These are:

- Three SACs (all of which are also designated as SSSIs);
- One NNR (which is also designated as a SSSI);
- 10 SSSIs;
- Three LNRs; and
- 21 ancient woodlands.

60. One of these sites, the River Wensum SAC and SSSI, is also located directly within the boundaries of the onshore infrastructure. The remainder are located within 2km of the onshore infrastructure.

Non-statutory designated sites

61. There are a total of 97 non-statutory designated sites (CWS) and RNR within the study area.

62. Five of these sites (Wendling Carr CWS (No. 1013), Land South of Dillington Carr CWS (No. 1025), Marriott's Way CWS (No. 2176), Paston Way and Knapton Cutting CWS (No. 1175) and Kerdiston pCWS) are located directly within the boundaries of the onshore infrastructure.

Terrestrial habitats

63. The key designated habitats located within the onshore infrastructure boundaries (shown in **Appendix 1**) are provided in **Table 3.2**.

Table 3.2 Key designated habitats within the onshore infrastructure

Habitat type	Area (ha)	Habitat designation
Lowland Mixed Deciduous Woodland	7.0	UK Habitat of Principal Importance (UKHPI), Norfolk LBAP
Broadleaved woodland - semi-natural	5.2	UKHPI, Norfolk LBAP
Broadleaved Parkland/scattered trees	0.2	UKHPI, Norfolk LBAP
Coastal and Floodplain Grazing Marsh	0.7	UKHPI, Norfolk LBAP
Standing water	0.4	UKHPI, Norfolk LBAP
Running water	1.1	UKHPI
Intertidal - sand	8.6	UKHPI
Coastal Sand Dunes	0.0	Norfolk LBAP
Maritime Cliff and Slopes	0.1	UKHPI, Norfolk LBAP
Cultivated/disturbed land - arable	1413.0	(NB: cereal field margins are a UKHPI and Norfolk LBAP habitat)
Habitat	**Length (m)**	**Habitat designation**
Hedgerow or Field Margin	56720	Norfolk LBAP
Intact hedge - native species-rich	2911	Norfolk LBAP
Intact hedge - species-poor	10241	Norfolk LBAP
Defunct hedge - native species-rich	1690	Norfolk LBAP
Defunct hedge - species-poor	2173	Norfolk LBAP
Hedge with trees - native species-rich	13810	Norfolk LBAP
Hedge with trees - species-poor	8890	Norfolk LBAP

Legally protected or notable species

64. The following legally protected or notable species have been recorded within the boundaries of the onshore infrastructure:

- Badgers;
- Bats, including:
    - Barbastelle *Barbastella barbastellus*
    - Serotine *Eptesicus serotinus*
    - Brandt's *Myotis brandtii*

- Daubenton's bat *Myotis daubentonii*
- Whiskered bat *Myotis mystacinus*
- Natterer's *Myotis nattereri*
- Lesser noctule *Nyctalus leisleri*
- Nathusius's pipistrelle *Pipistrellus nathusii*;
- Common pipistrelle *Pipistrellus pipistrellus*
- Soprano pipistrelle *Pipistrellus pygmaeus*
- Brown long-eared *Plecotus auritus*.

- Water voles;
- Great crested newts;
- Common UK reptile species (grass snake *Natrix natrix* and slow worm *Anguis fragilis*); and
- Norfolk Hawker dragonfly

Invasive species present within the project footprint

65. The following non-native invasive species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) have been recorded within the boundaries of the onshore infrastructure:

- Signal crayfish *Pacifastacus leniusculus;*
- Japanese knotweed *Fallopia japonica; and*
- Giant hogweed *Heracleum mantegazzianum.*

3.1.2.2 Onshore ornithology

66. A study area has been established to identify onshore ornithology designated sites which could be affected by the Norfolk Boreas project. The study area includes a 5km buffer around all onshore project infrastructure.

International statutory designated sites

67. A total of four international statutory designated sites for nature conservation are located within the onshore ornithology study areas. These are:

- The Broadland SPA, SAC and Ramsar site;
- Paston Great Barn SAC;
- River Wensum SAC; and
- Norfolk Valley Fens SAC.

68. One of these sites, the River Wensum SAC, is also located directly within the boundaries of the onshore infrastructure.

National statutory designated sites

69. A total of six national statutory designated sites for nature conservation notified or designated in part due to the breeding or wintering bird species they support are located within the study area. These six sites are:

- River Wensum SSSI;
- Dereham Rush Meadow SSSI;
- Dillington Carr, Gressenhall SSSI;
- Cawston and Marsham Heaths SSSI;
- Booton Common SSSI; and
- Pigney's Wood LNR.

Non-statutory designated sites

70. The non-statutory designated sites described in section 3.1.2.1 also form the baseline for onshore ornithology

Terrestrial habitats

71. The terrestrial habitats described in section 3.1.2.1 also form the baseline for onshore ornithology.

Wintering / on passage bird species

72. Wintering / on passage bird species survey data were collected for the period October 2016 to March 2017 for the following areas:

- **Agricultural land** within 5km of the **Broadland SPA and Ramsar site**, and also within – or within a precautionary 1km disturbance buffer of – the onshore infrastructure;
- **Coastal habitats** within 5km of the **Broadland SPA and Ramsar site**, and also within – or within a precautionary 1km disturbance buffer of – the onshore infrastructure;
- **Lowland fen, rivers and lakes and lowland heathland habitats of the Hundred Stream** within 5km of the **Broadland SPA and Ramsar site**, and also within – or within a precautionary 1km disturbance buffer of – the onshore infrastructure; and
- **Habitats** within the boundaries of the **Dereham Rush Meadows SSSI**.

73. At all sites, the counts of waterbirds recorded during the survey are not of a scale to be of national (or greater) importance (i.e. less than 1% of the Great Britain or international population) or to be a significant component of the Broadland SPA or its constituent SSSIs, or the Dereham Rush Meadow SSSI (i.e. less than 1% of the SPA / component SSSI population).

Breeding bird species

74. **Table 3.3** summarises the results of the breeding bird survey conducted during 2017.

Table 3.3 Interim Breeding Bird Survey results (Visit 1)

Location	Total number of species recorded (holding territories)	Notable species recorded holding territories (Species value[2])
Rush Meadows BB01	35 (21)	Bullfinch (BOCC, Amber), Dunnock (BOCC, Amber) Reed bunting (BOCC, Amber; LBAP), Reed warbler (SSSI), Song thrush (BOCC, Red; LBAP), Willow warbler (BOCC, Amber)
Dillington Carr BB02	47 (30)	Coot (SSSI), Cuckoo (BOCC, Red), Dunnock (BOCC, Amber), Gadwall (BOCC, Amber; SSSI), Great-crested Grebe (SSSI), Little Grebe (SSSI), Mallard (BOCC, Amber), Mistle Thrush (BOCC, Red), Moorhen (SSSI) Mute Swan (BOCC, Amber; SSSI)), Reed Bunting (BOCC, Amber; LBAP), Song Thrush (BOCC, Red; LBAP), Stock Dove (BOCC, Amber)
Booton Common BB03	29 (21)	Dunnock (BOCC, Amber), Marsh Tit (BOCC, Red) Song Thrush (BOCC, Red; LBAP)
Pigney's Wood BB04	38 (26)	Cuckoo (BOCC, Red), Dunnock (BOCC, Amber), Mute swan (BOCC, Amber), Reed bunting (BOCC, Amber; LBAP) , Song thrush (BOCC, Red; LBAP), Stock dove (BOCC, Amber)
Land to the south of Dillington Carr BB05	41 (29)	Bullfinch (BOCC, Amber), Cuckoo (BOCC, Red) Dunnock (BOCC, Amber), Kingfisher (BOCC, Amber; Schedule 13), Linnet (BOCC, Red), Song Thrush (BOCC Red; LBAP), Spotted Flycatcher (BOCC, Red; LBAP), Willow warbler (BOCC, Amber), Yellowhammer (BOCC, Red)
Wensum Floodplain BB06	42 (33)	Barn Owl (Schedule 1; SSSI; LBAP), Bullfinch (BOCC, Amber), Cuckoo (BOCC, Red), Dunnock (BOCC, Amber), Kestrel (BOCC, Amber), Linnet (BOCC, Red) Mallard (BOCC, Amber), Mute Swan (BOCC, Amber) Reed Bunting (BOCC, Amber; LBAP), Skylark (BOCC, Red; LBAP), Song Thrush (BOCC, Red; LBAP), Stock Dove (BOCC, Amber)

75. The following species have also been recorded within the study area during other surveys:

- Woodcock (a BoCC4 Red List species);

[2] **BOCC, Amber** – Listed on the on BoCC4 'Amber List'
BOCC, Red – Listed on the on BoCC4 'Red List'
Schedule 1 – Listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and therefore subject to special protections
SSSI – List of the citation of the relevant SSSI
LBAP – A Norfolk BAP priority species

- Woodpecker sp. (lesser woodpecker is a BoCC4 Red List species); and
- Barn owl (A species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended)).

3.2 Planned Data Collection (should it be required)

3.2.1 Priority areas

76. Field surveys to inform the Norfolk Vanguard EIA were undertaken during 2017. These surveys covered only areas for which landowner access permission had been granted at the time of survey. The survey coverage achieved during the Norfolk Vanguard ecological surveys varied by receptor, between approximately 75% of the survey area for suitable water vole habitats to 30% for suitable great crested newt breeding ponds (details of coverage achieved for each receptor is set out in **Table 3.1**). Furthermore, for some receptors, all those areas identified as suitable to support an ecological receptor were surveyed during the Norfolk Vanguard ecological surveys (e.g. surveys for breeding birds). For those areas where survey access was not possible, desk-based data including the Norfolk Living Map were used to supplement the field data.

77. For the 2018 survey window and prior to DCO submission for Norfolk Boreas, further landowner access permission have become available for the onshore infrastructure and the study areas surrounding it. Where landowner access has become available, additional surveys of these areas are planned to be undertaken in 2018, should it be agreed with the onshore ecology ETG that these are required. If undertaken these surveys would further enable the baseline environment to be characterised.

78. In order to ensure that, as far as possible, the 2018 survey effort addresses key data gaps identified within the dataset collected during 2017, these surveys would focus on a series of 'priority areas'. Each priority area focuses on the onshore infrastructure where either:

- the proposed onshore infrastructure at this location is anticipated to give rise to effects of a greater magnitude than in other areas; or
- it has been anticipated that, using the data obtained during the 2017 surveys and the desk-based review including aerial imagery and the Norfolk Living Map, the area may be ecologically sensitive due to:
    - its designation as a statutory or non-statutory site for nature conservation;
    - the presence of sensitive habitats, including habitats designated as UKHPI or other habitats identified as potentially sensitive due to their high ecological value; or

- the potential for presence of legally protected or notable species due to the presence of suitable habitats and/or desk study information indicating that legally protected or notable species are present in the local area.

79. These priority areas and their reason for selection are summarised in **Table 3.4** and shown on **Figure 2**.

Table 3.4 Priority areas for surveys in 2018

Area ref.	Priority area (*in order from landfall to substation*)	Reason for identification as a 'priority area'
1	Cable Relay Station (CRS) Option 6a	Location of permanent infrastructure
2	CRS Option 5a	Location of permanent infrastructure
3	Drains at Ridlington Street	Sensitive habitats - drainage network and wet grassland Potential to support legally protected species, including potentially barbastelle bats of Paston Great Barn
4	HDD receptor site at Witton	Location of trenchless crossing receptor sites Boundary features identified within desk study as supporting commuting barbastelle bats
5	Knapton Way and Paston CWS	Non-statutory designated site for nature conservation
6	HDD receptor site at Cromer Road	Location of trenchless crossing receptor sites
7	HDD receptor site at King's Beck	Location of trenchless crossing receptor site Sensitive habitats - watercourses associated with the King's Beck
8	HDD receptor site and floodplain habitats at River Bure	Location of trenchless crossing receptor site Sensitive habitats - floodplain grazing marsh (undesignated)
9	Sensitive habitat (woodland) at Salle Park	Sensitive habitat – woodland Potential to support legally protected species, including common reptile species
10	Sensitive habitat (drain) North of Reepham	Sensitive habitat – drain
11	Kerdiston CWS	Non-statutory designated site for nature conservation
12	Marriott's Way CWS	Non-statutory designated site for nature conservation
13	HDD receptor site adjacent to R. Wensum	Location of trenchless crossing receptor site Sensitive habitats – coastal / floodplain grazing marsh UKHPI Potential to support legally protected species, including qualifying features of the River Wensum SAC
14	HDD receptor site adjacent to Dillington	Location of trenchless crossing receptor site Potential to support legally protected species, including water voles; great crested newts
15	Wendling Carr CWS	Non-statutory designated site for nature conservation

80. The 2018 surveys of these 'priority areas' would include an initial Extended Phase 1 Habitat Survey in order to identify the habitats and protected species potential of the priority areas, followed by species-specific Phase 2 surveys (where required) to determine the presence / likely absence of selected species. A description of what the 2018 surveys of the priority areas would entail (if conducted) is set out below.

3.2.2 Extended Phase 1 Habitat Survey

81. An Extended Phase 1 Habitat Survey for the priority areas of the onshore infrastructure would be undertaken during February 2018, in order to record the habitats within the onshore infrastructure and to identify the presence / likely presence of legally protected and notable species. The findings of the 2018 Extended Phase 1 Habitat Survey would be shared through consultation with the ETG.

3.2.2.1 Survey Area

82. The Extended Phase 1 Habitat Survey would include all areas shown on **Figure 2**. For each priority area, this would include the area within the project onshore infrastructure plus a 50m buffer either side. In addition, all water bodies within 250m of the temporary works, and 500m of the permanent works at each priority area would be included (as discussed below). Collectively, this comprises the 2018 survey.

3.2.2.2 Methodology

83. The Extended Phase 1 Habitat Survey would follow the 'Extended Phase 1' methodology as set out in *Guidelines for Baseline Ecological Assessment* (Institute of Environmental Assessment, 1995). This method of survey would provide information on the habitats within the survey area and assesses the potential for legally protected species to occur on or adjacent to the survey area. Habitats would be recorded within the surveyed area using the system set out within the JNCC *Handbook for Phase 1 habitat survey: A technique for environmental audit* (2010).

84. All of the habitats within the survey area would be mapped and Target notes (TN) would be used to provide details of characteristic habitats and species composition, and highlight any features of ecological interest.

85. Following the *Guidelines for Baseline Ecological Assessment*, the habitat survey would be 'extended' to record the potential legally protected and notable species presence. Specifically the following will also be searched for:

Birds

86. A search for all habitats with suitability to support breeding birds. In particular, habitats with the suitability to support birds listed on Schedule 1 of the Wildlife and Countryside Act and IUCN 'Red' and 'Amber' List species. These habitats would include trees, hedgerows, water bodies, grazing marsh / fen, lowland heath and agricultural land.

Badger

87. A search for signs of badger activity within and up to 50m from the survey area boundaries will be undertaken. Signs such as setts, tracks, hairs, bedding and spoil heaps, snuffle holes and latrines, would be checked for.

88. If active setts are found, they would be classified using the following categories (adapted from Scottish Natural Heritage *Best Practice Badger Survey Guidance Note* (2004):

- **Main sett** (Several holes with large spoil heaps and obvious paths emanating from and between sett entrances);
- **Annexe sett** (Normally less than 150m from main sett, comprising several holes. May not be in use all the time, even if main sett is very active).
- **Subsidiary sett** (Usually at least 50m from main sett with no obvious paths connecting to other setts. May only be used intermittently.
- **Outlier sett** (Little spoil outside holes. No obvious paths connecting to other setts and only used sporadically. May be used by foxes and rabbits).

Bats

89. All trees, buildings and structures would be assessed for their potential to support roosting bats. All trees, buildings and structures would be classified as providing negligible, low, moderate or high suitability to support roosting bats following the guidelines set out in Table 4.1 of the Bat Conservation Trust's (BCT) *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd ed.)* (2016).

90. All trees, waterbodies and hedgerows would also be assessed for their potential to provide commuting and foraging habitat for bats following the same guidelines.

Water vole and otter

91. Standing and running water bodies within the survey area would be assessed for their suitability to support water voles and otters.

92. During the Extended Phase 1 Habitat Survey, all water bodies would be assessed as to whether they provide optimal or sub-optimal habitat for water voles and/or

otters. Those assessed as being sub-optimal would be excluded from any further surveys and/or assessment. Sub-optimal water bodies are typically those with artificial banks, strong evidence of pollution, those which no longer support running water in any season, or field signs of mink observed during the survey (Strachan, Moorhouse and Gelling, 2011). Those water bodies assessed as providing optimal habitat for water voles and/or otters will be subject to further surveys; however these surveys would not be undertaken during the Extended Phase 1 Habitat Survey.

93. The margins of all water bodies within the survey area would be searched for field signs of otter, specifically holts, couches, spraints, tracks, feeding remains and slides (Natural England, 2014).

Great crested newt

94. Standing water bodies which are identified to be within 250m of the onshore electrical infrastructure temporary works (i.e. the landfall and onshore cable corridor) and within 500m of the onshore electrical infrastructure permanent works (i.e. the cable relay station and substation) would be subject to a Habitat Suitability Index (HSI) assessment (following Oldham et al., 2000), to assess their potential to support great crested newts.

Reptiles

95. Areas of potential reptile habitat would be identified during the Extended Phase 1 Habitat Survey. Specifically, habitat mosaics will be recorded i.e. where a collection of suitable habitats for reptile hibernation, basking, and foraging occur together. Habitats comprising habitat mosaics which may support reptiles include habitats transitions (ecotones), rank grassland, lowland heath, piles of debris (hibernacula), or bare ground (Edgar, P., Foster, J. and Baker, J. 2010)).

Invertebrates

96. High quality and diverse habitats considered to provide suitable opportunities for terrestrial invertebrates will be recorded. In particular (following consultation feedback during the project scoping phase), identification of suitable habitats for supporting the Desmoulin's land snail would be included.

Invasive non-native species

97. Where present, the location and extent of invasive non-native species would be recorded during the Extended Phase 1 Habitat Survey. Due to the many invasive non-native species being present in the UK, the field survey would focus on the species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). Following consultation feedback during the project scoping phase, particular

attention would be paid to aquatic invasive species including invasive crayfish species, Chinese mitten crab, killer shrimp and Himalayan balsam.

Hedgerows

98. An assessment of all hedgerows within the survey area would be undertaken. Each hedgerow would be assessed and determined whether it is considered to be 'importance' under the Hedgerow Regulations 1997. The ecological criteria for classifying an important hedgerow would be undertaken in accordance with Schedule 1 of the Hedgerow Regulations 1997.

3.2.3 Species-specific Phase 2 Surveys

99. The Extended Phase 1 Habitat Survey will, if it is agreed that it is required, identify the potential for legally protected species to be present within or adjacent to the survey area. The findings of the Extended Phase 1 Habitat Survey will determine what Phase 2 surveys will be required, and in what locations.

100. Given that the 'priority areas' have been identified, it is possible to ascertain the potential Phase 2 survey effort that may be required in order to adequately define the ecological baseline. This realistic maximum possible Phase 2 survey scope is set out below.

101. Following the findings of the Extended Phase 1 Habitat Survey, the survey effort may be reduced or modified from the scope set out below.

3.2.3.1 Great crested newt presence / absence and population estimate surveys

Survey area

102. There are a total of 23 unsurveyed water bodies located within the priority area survey areas, as identified using aerial mapping and the Norfolk Living Map. All 23 of these water bodies could require further surveys to determine great crested newt presence / likely absence, depending on the findings of the Habitat Suitability assessments undertaken during the proposed 2018 Extended Phase 1 Habitat Survey. The location of these water bodies is shown in **Table 3.5** below.

Table 3.5 Water bodies which may require great crested newt presence / likely absence survey in 2018 (see Figure 2 for priority area locations)

Area ref.	Priority area	No. of unsurveyed water bodies
1	CRS Option 6a	1
2	CRS Option 5a	3
3	Drains at Ridlington Street	1
4	HDD receptor site at Witton	1
5	Knapton Way and Paston CWS	1
6	HDD receptor site at Cromer Road	1

Area ref.	Priority area	No. of unsurveyed water bodies
7	HDD receptor site at King's Beck	2
8	HDD receptor site and floodplain habitats at River Bure	3
9	Sensitive habitat (woodland) at Salle Park	-
10	Sensitive habitat (drain) North of Reepham	3
11	Kerdiston CWS	1
12	Marriott's Way CWS	-
13	HDD receptor site adjacent to R. Wensum	1
14	HDD receptor site adjacent to Dillington	4
15	Wendling Carr CWS	1
Total no. unsurveyed water bodies		23

Methodology

103. The great crested newt presence / absence surveys would follow the protocol set out in the Great Crested Newt Mitigation Guidelines (English Nature, 2001). Each standing water body scoped into the survey would be subject to four survey visits between mid-March and mid-June, with at least two visits during the peak season (mid-April to mid-May). During each visit, each standing water body would be subject to three survey methods, including torching and bottle-trapping, and one of netting or egg-searching. Each survey method would be used to record number, sex, life-stage of all great crested newt founding during the surveys. All other amphibians found would be recorded also. If great crested newt presence is found during survey visits 1-4, two further survey visits are required in order to provide a water body population estimate. The same survey methods are required for these subsequent visits.

104. Torching surveys would be conducted using 500,000 candle torches. Bottle trapping should be conducted placing traps two-metres apart around pond perimeter. For netting surveys, at least 15 minutes of netting per 50m of shoreline.

105. Weather conditions would be recorded during each visit. No surveys would be conducted if temperatures are <5°C, there is strong wind or heavy rain.

106. All surveyors would operate under a Great Crested Newt Survey Class Licence (Level 1) during presence / absence surveys.

3.2.3.2 Water vole / otter surveys

Survey area

107. There are a total of nine unsurveyed watercourses located within the priority area survey areas, as identified using aerial mapping and the Norfolk Living Map. All nine of these watercourses could require water vole / otter surveys, depending on the

findings of the proposed 2018 Extended Phase 1 Habitat Survey. The location of these watercourses is shown in **Table 3.6** below.

Table 3.6 Watercourses which may require water vole survey in 2018 (see Figure 2 for priority area locations)

Area ref.	Priority area	No. of unsurveyed watercourses
1	CRS Option 6a	-
2	CRS Option 5a	-
3	Drains at Ridlington Street	2
4	HDD receptor site at Witton	-
5	Knapton Way and Paston CWS	-
6	HDD receptor site at Cromer Road	-
7	HDD receptor site at King's Beck	1
8	HDD receptor site and floodplain habitats at River Bure	
9	Sensitive habitat (woodland) at Salle Park	1
10	Sensitive habitat (drain) North of Reepham	1
11	Kerdiston CWS	1
12	Marriott's Way CWS	1
13	HDD receptor site adjacent to R. Wensum	1
14	HDD receptor site adjacent to Dillington	-
15	Wendling Carr CWS	1
Total no. unsurveyed watercourses		9

Methodology

108. The water vole surveys would follow the protocol for Environmental Assessment Surveys set out in the Water Vole Conservation Handbook (3rd Ed.) (Strachan, Moorhouse and Gelling, 2011) and as modified by The Water Vole Mitigation Handbook (Dean et al., 2016). Surveys would be conducted on one bank for the full length of each optimal watercourse within the survey area (i.e. within the project area, plus 50m upstream and 50m downstream). Each watercourse would be assessed in 100m sections. Each 100m section would be walked by an ecologist, and all field signs of water vole would be recorded. This would include sightings, burrows, latrines, feeding stations, lawns, nests, footprints and runways. The field sign and its location would be recorded. In additional to all water vole field signs, field signs of other aquatic mammals (rats, otter and mink) would be recorded. The survey would involve one visit during mid-April – June.

109. Habitat information would have already been obtained for these watercourses during the Phase 1 field survey, and this data would be referred to during the water vole survey. Weather conditions will be recorded during the survey.

3.2.3.3 Bat emergence / re-entry surveys

Survey areas

110. A review of aerial mapping and the Norfolk Living Map has identified a number of isolated tress, hedgerows and woodland blocks as well as isolated structures which may contain potential bat roost features. Based on this, it has been estimated that these features identified will correspond to approximately 37 trees or structures located within the priority area survey areas, which may require bat emergence / re-entry surveys. Further surveys of these features would be determined the proposed 2018 Extended Phase 1 Habitat Survey. The location of these features is shown in **Table 3.7** below.

Table 3.7 Trees / structures which may require water vole survey in 2018 (see Figure 2 for priority area locations)

Area ref.	Priority area	No. of unsurveyed water bodies
1	CRS Option 6a	2
2	CRS Option 5a	-
3	Drains at Ridlington Street	3
4	HDD receptor site at Witton	5
5	Knapton Way and Paston CWS	3
6	HDD receptor site at Cromer Road	-
7	HDD receptor site at King's Beck	-
8	HDD receptor site and floodplain habitats at River Bure	3
9	Sensitive habitat (woodland) at Salle Park	5
10	Sensitive habitat (drain) North of Reepham	3
11	Kerdiston CWS	2
12	Marriott's Way CWS	5
13	HDD receptor site adjacent to R. Wensum	3
14	HDD receptor site adjacent to Dillington	-
15	Wendling Carr CWS	3
Total no. unsurveyed potential bat roosts		37

Methodology

111. The emergence / re-entry surveys would be undertaken in accordance with the methodology outlined in the BCT's Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Ed.) (2016). For each tree/structure, two survey visits (i.e. one dusk emergence survey and one dawn re-entry survey) would be required. Each dusk emergence survey would commence 15 minutes before sunset, and cease 1.5-2 hours after sunset; whereas the dawn re-entry survey would commence 1.5-2 hours before sunrise, and cease 15 minutes after sunrise. The surveys would be at least two weeks apart, and would be undertaken between May and September with one survey visit between May and August.

112. Bat detectors (any type) and recording equipment to record any echolocation calls would be used for each survey. Laboratory sound-analysis would be used to identify the calls of any bat species picked up using the bat detectors. Species, timing, and activity will be noted for each bat picked up during the survey.

113. Weather conditions including temperature, wind speed and precipitation, would be recorded at the start and end of each survey visit. Surveys would not be carried out when the temperature is below 10°C at sunset, or during heavy rain or strong wind unless justified by the surveying ecologist.

114. All surveyors would hold BCT Professional Training Standard Level One, as set out in the BCT's *Professional Training Standards for Ecological Consultants* (2012). All surveyors would also adhere to the CIEEM's Professional Code of Conduct.

3.2.3.4 Bat activity surveys

Survey areas

115. There are a total of 10 unsurveyed commuting / foraging features located within the priority area survey areas, as identified using aerial mapping and the Norfolk Living Map. All 10 of these commuting / foraging features could require bat activity surveys, depending on the findings of the proposed 2018 Extended Phase 1 Habitat Survey. The location of these features is shown in **Table 3.8** below.

Table 3.8 Commuting / foraging features which may require bat activity surveys in 2018 (see Figure 2 for priority area locations)

Area ref.	Priority area	No. of unsurveyed watercourses
1	CRS Option 6a	1
2	CRS Option 5a	-
3	Drains at Ridlington Street	-
4	HDD receptor site at Witton	1
5	Knapton Way and Paston CWS	1
6	HDD receptor site at Cromer Road	1
7	HDD receptor site at King's Beck	-
8	HDD receptor site and floodplain habitats at River Bure	1
9	Sensitive habitat (woodland) at Salle Park	1
10	Sensitive habitat (drain) North of Reepham	1
11	Kerdiston CWS	-
12	Marriott's Way CWS	-
13	HDD receptor site adjacent to R. Wensum	-
14	HDD receptor site adjacent to Dillington	1
15	Wendling Carr CWS	1
Total no. unsurveyed commuting / foraging features		10

Methodology

116. The bat activity surveys would be undertaken in accordance with the BCT's Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Ed.) (2016). All features identified as providing suitability to support commuting or foraging bats would be grouped into 'habitat networks', where it is considered likely that bats are using the wider network as a single commuting or foraging resource. These habitat networks (or simply 'habitats'), would be then subject to bat activity surveys.

117. For all habitats scoped into the assessment, bat activity transect surveys and static detector surveys would be undertaken. Transect surveys would involve walking at a constant speed along each linear bat habitat (or the one edge of the two-dimensional bat habitat) recording observations such as number of bats, flight direction, flight height, behaviour, appearance and relative speed. Static detector surveys would involve placement of a static detector at locations identified as suitable through judgement of the surveying ecologist whilst on site. Data from these surveys would be recorded and subject to laboratory sound-analysis to identify species and pass numbers following the survey. Each habitat scoped into the survey assessed as providing moderate suitability for commuting or foraging bats would be subject to one transect survey visit per month from April to October (i.e. eight visits), including one dusk and pre-dawn survey within a 24-hour period, and static bat detector surveys at two locations within each habitat collected on five consecutive nights per month. Each habitat scoped into the survey assessed as providing high suitability for commuting or foraging bats would be subject to two survey visit per month from April to October (i.e. 16 visits), including one dusk and pre-dawn survey within a 24-hour period, and static bat detector surveys at three locations within each habitat collected on five consecutive nights per month. The transect surveys would commence at sunset, and cease 2-3 hours after sunset; static detector surveys would commence 30 minutes before sunset, and cease 15 minutes after sunrise.

118. The surveyors would use bat detectors (any type) and recording equipment to record any echolocation calls picked up during the survey. The same model of detector would, wherever possible, be used for all surveys. Laboratory sound-analysis would be used to identify the calls of any bat species picked up using the bat detectors.

119. Weather conditions including temperature, wind speed and precipitation, would be recorded for at the start and end of each survey visit. Surveys would not be carried out when the temperature is below 10°C at sunset, or during heavy rain or strong wind, unless justified by the surveying ecologist.

120. All surveyors would hold BCT Professional Training Standard Level One, as set out in the BCT's *Professional Training Standards for Ecological Consultants* (2012).

3.2.3.5 Reptile presence / absence surveys

Survey areas

121. There are a total of 10 unsurveyed potential reptile habitat mosaics located within the priority area survey areas, as identified using aerial mapping and the Norfolk Living Map. All 10 of these potential reptile habitat mosaics may require reptile presence / likely absence surveys, depending on the findings of the proposed 2018 Extended Phase 1 Habitat Survey. The location of these potential reptile habitat mosaics is shown in **Table 3.9** below.

Table 3.9 Potential reptile habitat mosaics which may require reptile presence / absence survey in 2018 (see Figure 2 for priority area locations)

Area ref.	Priority area	No. of unsurveyed watercourses
1	CRS Option 6a	-
2	CRS Option 5a	-
3	Drains at Ridlington Street	1
4	HDD receptor site at Witton	1
5	Knapton Way and Paston CWS	1
6	HDD receptor site at Cromer Road	-
7	HDD receptor site at King's Beck	-
8	HDD receptor site and floodplain habitats at River Bure	1
9	Sensitive habitat (woodland) at Salle Park	1
10	Sensitive habitat (drain) North of Reepham	1
11	Kerdiston CWS	1
12	Marriott's Way CWS	1
13	HDD receptor site adjacent to R. Wensum	1
14	HDD receptor site adjacent to Dillington	-
15	Wendling Carr CWS	1
Total no. unsurveyed potential reptile habitat mosaics		10

Methodology

122. The reptile presence / absence surveys would follow the protocol set out in the JNCC's Herpetofauna Worker's Manual (2003). The survey would involve an artificial refuge survey at each suitable habitat location. Refuge tiles would be placed in optimal locations, in groups of 3-4, within each habitat area. Tiles would cover the majority of each habitat mosaic. During each survey visit, all tiles would be lifted and the space beneath checked for the presence of reptiles. Seven survey visits in total would be required. These visits would be undertaken during April, May and September. At least 48 hours would be left between each survey visit.

123. Weather conditions would be recorded during each visit. The surveys would be undertaken during the morning and later afternoon, in order to coincide with the

optimal temperature window (10-17°C). These timings would be from 9am-11am, and from 4pm-7pm.

124. Refuge tiles (e.g. carpet tiles, roofing felt, or metal sheeting) of 0.5m by 0.5m would be used.

125. All surveys would be undertaken by experienced ecologists, preferably members of the CIEEM. No species licences are required for these surveys.

3.2.3.6 Aquatic invertebrates survey

Survey areas

126. Following consultation with Natural England conducted as part of the Norfolk Vanguard EPP, an invertebrate survey is required in relation to the wet grassland and field drain habitats associated with River Wensum. This survey is required to determine presence / absence of the Desmoulin's snail *Vertigo moulinsiana*, an Annex II species present as a qualifying feature, but not a primary reason for site selection for the River Wensum SAC.

127. All ditches along the right (i.e. southern) bank of the River Wensum were surveyed during 2017. It is proposed that the single ditch located on the left (i.e. northern) bank of the River Wensum would be surveyed during the 2018 survey effort.

Methodology

128. This invertebrate survey would follow the protocol set out in Killeen and Moorkens' (2003) *A Monitoring Protocol for Desmoulin's Whorl Snail,* Vertigo moulinsiana. Each watercourse / ditch scoped into the survey (i.e. one ditch) would be subject to sampling at five locations along a 20m length. A sub-sample would consist of one minute of vegetation beating over a white tray. The survey sample would be sorted in the field, and presence / absence of *V. moulinsiana* recorded. Samples of any terrestrial gastropod molluscs (*Pupilloidea*) would be taken back to the laboratory for confirmation of identification. Ground moisture level, vegetation class and average sward height will be recorded at each sample point.

129. The invertebrate survey would take place during August, when the snails are most active.

130. All surveys would be undertaken by ecologists with experience in aquatic invertebrate surveys, ideally members of CIEEM. No species licences are required for these surveys.

3.2.3.7 Botanical (NVC) survey

Survey areas

131. Following consultation with Natural England conducted as part of the Norfolk Vanguard EPP, a detailed assessment of the habitat associated with the River Wensum was recommended to ensure that the potential effects of proposed horizontal directional drilling under the River Wensum upon the quantifying features of the River Wensum SAC and the notified features of the River Wensum SSSI were fully understood. As a consequence a botanical survey would be undertaken to characterise the habitats of the semi-improved grassland found adjacent to the River Wensum during the field survey. This botanical survey would also involve a systematic search of the site in order to check the wet grassland habitats for the presence of springs and seepages, in order to characterise the water environment within the River Wensum floodplain.

132. All floodplain grazing marsh UKHPI of the River Wensum located within the onshore infrastructure is proposed to be surveyed for interest features of the SAC. Floodplain grazing marsh located on the right (i.e. southern) bank of the River Wensum was surveyed during 2017. It is proposed that land located within the boundaries of the floodplain grazing marsh UKHPI located on the left (i.e. northern) bank of the River Wensum is scoped into the 2018 survey effort.

Methodology

133. The botanical survey would follow the methodology set out in *National Vegetation Classification: Users' handbook* (Rodwell, 2006). The survey would cover all semi-improved and wet grassland areas adjacent to the River Wensum within the survey area. Quadrat sampling would be used within delineated sub-communities, and those species found within each quadrat identified. An NVC communities map would be drawn up following the results of the survey, and the precise location of all notable species recorded.

134. The following aquatic plant species, for which the habitat is given its SAC status, would be given particular attention:

- pond water-crowfoot *Ranunculus peltatus;*
- stream water-crowfoot *R. penicillatus ssp. pseudofluitans*; and
- river water-crowfoot *R. fluitans*.

135. The optimal surveying window for the botanical survey is between April and June.

136. The survey would be undertaken by experienced NVC surveyors, ideally members of CIEEM. No species licences are required for this survey.

3.2.4 Surveys scoped out of 2017

137. The followings species-specific surveys were undertaken during the 2017 survey effort, therefore they are not deemed necessary for the priority areas during the 2018 effort:

Breeding bird surveys

138. The priority areas cover one statutory designated site for nature conservation, the River Wensum SSSI, which is in part designated for the breeding birds it supports. Breeding birds supported by the SSSI can be found within the SSSI boundaries and within the floodplain grazing marsh adjacent to the SSSI boundaries.

139. Breeding bird surveys undertaken for the Norfolk Vanguard project incorporated the southern bank of the River Wensum within the floodplain grazing habitat within the onshore infrastructure area. These surveys also included observations of the northern bank of the River Wensum, and the survey transect approached within 100m of all floodplain grazing marsh located on the north bank within the survey area. As a consequence it is considered that the breeding bird surveys conducted in 2017 are sufficient and valid to characterise the breeding bird population present within the priority area north of the River Wensum, and further breeding bird surveys are not considered to be required for the Norfolk Boreas survey effort.

3.2.5 Survey programme

140. The proposed onshore ecological survey programme for 2018 is set out in **Table 3.10**. This programme applies if it is agreed through the ETG that these surveys are required and it access agreements are in place to make these surveys possible during the periods set out in the table. The survey durations and need for surveys will remain under review as the project progresses.

Table 3.10 Survey programme (provisional)

Survey	Survey dates	Notes
Extended Phase 1 Habitat Survey	February 2018	Survey will include search for badger field signs, otter field signs and presence of invasive species (no Phase 2 surveys for these species are recommended for 2018)
Great crested newt presence / absence surveys	April – June 2018	Two of the four survey visits will be within the mid-April and mid-May window (Natural England 2015)
Bat emergence / re-entry surveys	April 2018	
Bat activity surveys	April – October 2018	
Water vole presence / absence surveys	Mid-April – June 2018	
Reptile presence / absence surveys	April – May 2018	
Desmoulin's whorl snail survey	August 2018	
Botanical (NVC) survey	April – June 2018	

3.2.6 Approach to data gaps

141. All efforts have been made to ensure that the baseline is characterised as fully as possible through the existing and proposed desk and field based data collection set out above. However, in some instances, data cannot be obtained for certain receptors in certain parts of the survey area, most commonly due to lack of field survey access permission. All efforts have been made to ensure that the maximum possible amount of data is available for the Norfolk Boreas EIA, but for some parts of the survey area data collection is simply not possible.

142. Where certain 2017 field surveys have only achieved partial coverage of the survey area, this is set out within **Table 3.4**. The Norfolk Boreas PEIR submission will also include full details of survey coverage achieved during the proposed 2018 field surveys.

143. Where only partial survey coverage has been achieved, for the purposes of the Norfolk Boreas EIA it will be assumed that ecological receptors may be potentially present within these unsurveyed areas, if suitable habitat is present (presence of suitable habitat will be determined using the Norfolk Living Map habitat data). The draft OLEMS provided with the Environmental Statement (see section 5.5) will include full details of proposed mitigation both for those ecological receptors identified during the desk-based assessment and field surveys and for those which may potentially be present within the unsurveyed areas.

144. All unsurveyed areas where ecological receptors may be present will require pre-construction surveys, post-consent (if granted).

4 IMPACT ASSESSMENT METHODOLOGY

4.1 Defining Impact Significance

4.1.1 Approach to the Ecological Impact Assessment (EcIA)

145. The EcIA methodology proposed in relation to onshore ecology and ornithology is based on the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd Ed.)* by the Chartered Institute of Ecology and Environmental Management (CIEEM) (2016). These guidelines aim to predict the residual impacts on important ecological features affected, either directly or indirectly by a development, once all the appropriate mitigation has been implemented.

146. The approach to determining the significance of an impact will follow a systematic process for all impacts. This will involve identifying, qualifying and where possible quantifying the sensitivity, value and magnitude of all ecological receptors which have been scoped into this assessment. Using this information, a significance of each potential impact will be determined. Each of these steps is set out in the remainder of this section.

147. The EcIA will use professional judgement to ensure the assessed significance level is appropriate for each individual receptor, taking account of local values for biodiversity to avoid a subjective assessment wherever possible as per the CIEEM guidelines. As a result, the assessed significance level may not always be directly attributed to the guidance matrix detailed below.

4.1.2 Importance

148. The first stage of an EcIA is determining the 'importance' of ecological features or 'receptors'. CIEEM identifies the importance ecological features as those key sites, habitats and species which have been identified by European, national and local governments and specialist organisations as a key focus for biodiversity conservation in the UK. This includes:

- Statutory and non-statutory designated sites for nature conservation;
- Species occurring on national biodiversity lists;
- UK Habitats of Principal Importance; and
- Red listed, rare or legally protected species.

149. Importance is also qualified by the geographic context of an ecological receptor, i.e. a species may be not recognised on a national biodiversity list but is locally in decline, and therefore its local importance is greater.

150. For this EcIA, the guidelines outlined in **Table 4.1** will be followed to provide the relative importance of different ecological features.

Table 4.1 Definitions of the different levels of importance of onshore ecological receptors

Importance	Definition
High	• An internationally designated site or candidate site or an area which the statutory nature conservation organisation has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified; • A nationally designated site or a discrete area, which the statutory nature conservation organisation has determined meets the published selection criteria for national designation (e.g. SSSI selection guidelines) irrespective of whether or not it has yet been notified; • A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat which are essential to maintain the viability of a larger whole; or • A viable area of a UK Habitat of Principal Importance or smaller areas of such habitat which are essential to maintain the viability of a larger whole; • A European protected species listed in The Conservation of Habitats and Species Regulations 2010; • A regularly occurring, nationally significant population / number of any internationally important species.
Medium	• County Council / Unitary Authority designated sites and other sites which the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on defined ecological criteria and Wildlife Trust sites; • Viable areas of habitat identified in a County BAP; • Semi-natural woodland greater than 0.5ha which is considered to be in 'good condition'. • Any regularly occurring population of a nationally important species which is threatened or rare in the region; • A regularly occurring, locally significant number of a species identified as important on a regional basis.
Low	• Semi-natural woodland greater than 0.25ha which is considered to be in 'good condition' or greater than 0.5ha in unfavourable condition; • Network of inter-connected hedgerows including some species-rich hedgerows; • Individual Important hedgerows or other ancient-countryside linear features; • Viable areas of habitat identified in a sub-county (District / Borough) BAP; • Any regularly occurring population of a nationally important species which is not threatened or rare in the region or county; • Sites / features that are scarce within the District / Borough or which appreciably enrich the District / Borough habitat resource; or • Other features identified as wildlife corridors or migration routes.
Negligible	• Features of value to the immediate area only e.g. within the site.

151. In addition to the features listed in **Table 4.1**, ecological features which play a key functional role in the landscape or are locally rare. The importance of such features is to be determined by professional judgement.

152. CIEEM places the emphasis on using professional judgement when considering importance of ecological receptors, based on available guidance, information and expert advice. Different aspects of ecological importance should be taken into account, including designations, biodiversity value, potential value, secondary or supporting value, social value, economic value, legal protection and multi-functional features.

4.1.3 Magnitude

153. The magnitude of the impact is assessed according to:

- The extent of the area subject to a predicted impact;
- The duration the impact is expected to last prior to recover or replacement of the resource or feature;
- Whether the impacts are reversible, with recovery through natural or spontaneous regeneration, or through the implementation of mitigation measures or irreversible, when no recovery is possible within a reasonable timescale or there is no intention to reverse the impact; and
- The timing and frequency of the impact, i.e. conflicting with critical seasons or increasing impact through repetition.

154. **Table 4.2** summarises the definitions of magnitude for onshore ecology.

Table 4.2 Example definitions of the magnitude levels for ecological receptors

Magnitude	Definition
High	Major impacts on the feature / population, which would have a sufficient effect to alter the nature of the feature in the short to long term and affect its long-term viability. For example, more than 20% habitat loss or damage.
Medium	Impacts that are detectable in short and long-term, but which should not alter the long-term viability of the feature / population. For example, between 10 - 20% habitat loss or damage.
Low	Minor impacts, either of sufficiently small-scale or of short duration to cause no long-term harm to the feature / population. For example, less than 10% habitat loss or damage.
Negligible	A potential impact that is not expected to affect the feature / population in any way, therefore no effects are predicted.

4.1.4 Significance

155. Following the identification of receptor importance and magnitude of the effect, it is possible to determine the significance of the impact.

156. Ecologically significant impacts are defined as:

157. '*…impacts on structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution)*' (CIEEM 2016).

158. Impacts are unlikely to be significant where features of low importance are subject to small scale or short-term impacts. If an impact is found not to be significant at the level at which the resource or feature has been valued, it may be significant at a more local level.

159. CIEEM recommend that the follow factors are taking into account when determining significance for selected ecological receptors:

Designated/defined sites and ecosystems

- **Designated sites** – is the project and associated activities likely to undermine the site's conservation objectives, or positively or negatively affect the conservation status of species or habitats for which the site is designated, or may it have positive or negative effects on the condition of the site or its interest/qualifying features?
- **Ecosystems** – is the project likely to result in a change in ecosystem structure and function?

Habitats and species

- **Habitats** – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area.
- **Species** – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area. (CIEEM 2016)

160. Following the identification of receptor importance and magnitude of the effect, the significance of the impact will be considered using the matrix presented in **Table 4.3** below and knowledge of the ecological features affected.

161. The assessment of potential impacts will be undertaken assuming implementation of embedded mitigation and commitments for the project. Residual impacts will include any additional mitigation measures required. An assessment will then be made of residual impacts, after assuming implementation of additional mitigation measures where required, i.e. the significance of the effects that are predicted to remain after the implementation of all committed mitigation measures.

Table 4.3 Impact Significance Matrix

Importance		Negative magnitude				Beneficial magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
	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 Impact Significance Definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore no change in receptor condition.

162. Note that for the purposes of the EIA, **major** and **moderate** impacts are usually deemed to be significant. In addition, whilst **minor** impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

163. Embedded mitigation will be referred to and included in the initial assessment of impact. If the impact does not require mitigation (or none is possible) the residual impact will remain the same. If however, mitigation is required there will be an assessment of the post-mitigation residual impact.

4.2 Habitats Regulations Assessment (HRA)

4.2.1 HRA process

164. A HRA will be conducted for the Norfolk Boreas project and will inform the Norfolk Boreas EIA. The HRA will follow the following process (as described in Planning Inspectorate Advice Note 10 (Planning Inspectorate, 2016):

- Stage 1 –Screening for Likely Significant Effect (LSE);
    - European and Ramsar sites are screened for LSE, both effects from the project alone and in combination with other projects. The Planning Inspectorate advises that for those projects where no LSE is predicted then that should be reported in the form of a No Significant Effects Report (NSER) and the Stage 2 assessment is not carried out (the Planning Inspectorate, 2016).
- Stage 2 - Appropriate Assessment (AA);
    - For those sites where LSE on a European or Ramsar site cannot be excluded at Stage 1, then further information to inform the assessment will be prepared and the test applied to determine whether the project alone or in-combination could adversely affect the integrity of the site in view of its conservation objectives. This assessment stage will be reported in the form of a HRA AA Report and the results of the assessment summarised in the form of a series of matrices.

165. In those cases where the conclusion of the HRA AA Report is that an adverse effect on the integrity of a European or Ramsar site has been identified then the assessment proceeds to two further stages:

- Stage 3 - Assessment of Alternatives;
    - The alternatives that have been considered will be assessed. The Planning Inspectorate advises that alternative solutions can include a proposal of a different scale, a different location and an option of not having the scheme at all – the 'do nothing' approach.
- Stage 4 – Assessment of Imperative Reasons of Overriding Public Interest (IROPI).
- If it is demonstrated that there are no alternative solutions to the proposal that would have a lesser effect or avoid an adverse effect on the integrity of the site(s), then a justified case will be prepared that the scheme must be carried out for IROPI.

166. If the conclusion of Stages 3 and 4 is that there is no alternative and that the project has demonstrated clear Imperative Reasons of Overriding Public Interest (IROPI) then the project may proceed with a requirement that appropriate compensatory measures are delivered.

167. An in-combination assessment will also be undertaken as part of the HRA.

4.2.2 HRA Stage 1: Screening process

168. The screening process will involve an assessment of whether or not the interest features of a European and Ramsar sites are likely to be subject to effects which are created by the Norfolk Boreas project.

169. In order to identify relevant European and Ramsar sites that have the potential to be affected by the project, a 5km buffer zone around the onshore infrastructure will be applied.

170. The assessment of LSE will be comprised expert assessment of the likely effects of the project during both the construction, operational and decommissioning phases of the Norfolk Boreas project. This includes the analysis of the maximum distance over which potential impacts could occur (known as the 'zone of influence' (ZOI)) for specific environmental parameters associated with the construction and operational phases of the project. This screening exercise will consider whether the project ZOIs overlap with either of the following footprints:

- The European and Ramsar site boundaries; and
- Ex-situ habitats of the qualifying features of European and Ramsar sites.

171. Ex-situ habitats are those which support qualifying features of the European or Ramsar site but are located outside of the designated site boundary.

172. The ZOI for different environmental parameters is summarised **Table 4.5**. These ZOIs have been determined using expert judgement. An explanation of how each ZOI is derived is set out in **Table 4.5**.

Table 4.5 The ZOI of potential effects for relevant environmental parameters

Environmental parameter	ZoI of potential effect	Explanation
Noise	1km from the **onshore project area**.	**A precautionary buffer based on the sensitivity of ornithological receptors to noise disturbance (Whitfield, Ruddock & Bullman, 2008).**
Air quality	50m from the **onshore project area** for construction dust. 1km from the **onshore project area** for project emissions.	**Precautionary buffers based on the anticipated dispersion distances of emissions generated by the project (IAQM guidance considers receptors within 500m of a pollution source (IAQM, 2014)).**

Environmental parameter	ZoI of potential effect	Explanation
Light	50m from the **onshore project area**, the zone of potential (controlled) light spill.	**Buffer based on the potentially effects of light upon sensitivity ecological features (e.g. bat commuting / foraging routes).**
Visual disturbance	500m from the **onshore project area**.	**A precautionary buffer based on the sensitivity of ornithological receptors to noise disturbance (Whitfield, Ruddock & Bullman, 2008).**
Geology and land contamination	500m from the **onshore project area**.	**A precautionary buffer based on the assumed maximum extent of release of contaminated material caused by the project.**
Groundwater and Hydrology	**Generally taken to be 1km from the onshore project area, although this could be larger where a groundwater connection exists.**	**A precautionary buffer based on the maximum extent of groundwater bodies' functional connectivity with a designated site.**

4.2.3 Sites to be considered during the HRA screening

173. A HRA Screening for Likely Significant Effect was conducted for the Norfolk Vanguard project in October 2017. This HRA screening identified four European sites and one Ramsar site within 5km of the onshore infrastructure. These are shown in **Table 4.6**

Table 4.6 European and Ramsar sites within 5km of the onshore infrastructure

European / Ramsar site	Closest point to the onshore infrastructure
River Wensum SAC	Lies within the onshore project area
Paston Great Barn SAC	2.9km (located north-east of the onshore project area)
Norfolk Valley Fens SAC	570m (located south of the onshore project area)
Broadland SPA and Ramsar site	3.6km (located south of the onshore project area)

174. As no new sites have been designated within 5km of the onshore infrastructure, it is proposed that these sites will also be considered for the Norfolk Boreas project.

175. Natural England have requested via PEIR response that information be supplied as to the reasoning for not including The Broads SAC within the Norfolk Vanguard HRA Screening for Likely Significant Effect. This information will therefore be included within the Norfolk Boreas HRA Screening for Likely Significant Effect.

4.3 Ecosystem Services Assessment

4.3.1 ESA Process

176. An Ecosystem Services Assessment (ESA) will be undertaken to inform the Norfolk Boreas EIA. The principal aim of the ESA will be to determine the ecosystem services

which may be affected by the construction, operation and decommissioning phases of the project.

177. The approach to identifying ecosystem services and the potential impacts of the project are summarised in **Table 4.7** and listed below**:**

Table 4.7 ESA process

Stage	Description of work elements
A – Establishing the baseline (Screening and Scoping)	• **Identify and categorise ecosystems and their services – this can be habitat led, service led or place led.** • **Consider the extent, condition, connectivity and diversity of the ecosystem.** • **Consider the scale of the service – is it local, regional, national or international?** • **Show data sources identifying any gaps or uncertainty.** • **Screen those services present within the study area.** • **Scope those services which may be potentially affected by the project, to provide a shortlist of services which will be taken forward for assessment in Stage B.**
B – Evaluating the Ecosystem Services	• **Review which impacts may occur against identified baseline.** • **Consider spatial scale of the ecosystem (and therefore of the impacts).** • **Determine whether the alteration to the service is likely to be measurable / quantifiable and of a scale that is unlikely to fall within the natural dynamics of the system.** • **Consider interaction of the services and show where cumulative or synergistic effects to services arise.**
C – Quantifying impacts	• **Determine extent of ecosystem service and how it is affected. Use expert judgement where necessary and identify data gaps.** • **Complexity introduced by supporting services that are not directly consumed but are of value – they are assessed indirectly.** • **Avoid double counting impacts.**

4.3.2 Ecosystems services screened in to the ESA

178. An ESA was conducted with respect to the Norfolk Vanguard project during 2017. The following sites were screened into assessment for the Norfolk Vanguard project, and are proposed to be screened into assessment for the Norfolk Boreas project:

- Food – managed (cereal crops, vegetables, livestock, game, fish, honey);
- Food – wild (mushrooms, nuts, wild fruits, fish);
- Cultivated produce (fibre crops, willow beds, wool, timber, paper);
- Fuel (bio-fuel, wood fuel, charcoal);
- Genetic resources (animal breeding);
- Biochemicals (herbs and botanicals);
- Ornamental resources (compost, wildflowers, shells, natural stone);
- Drinking water (aquifers);
- Air quality regulation (dry deposition);

- Climate regulation (carbon sequestration);
- Water regulation – land cover (habitat/land use type);
- Water regulation – water storage (wetlands);
- Pest regulation (crop pests, livestock pests);
- Erosion regulation – land cover (habitat/land use type);
- Erosion regulation – waterbodies (waterbody characteristics);
- Water purification and waste treatment (reedbeds);
- Pollination (wildflowers);
- Cultural heritage (religious assets, social interactions/leisure facilities, traditions, designated sites/structures, non-designated sites, wildlife (habitats and species));
- Recreation and tourism (rambling, freshwater angling, coastal angling, scuba diving, surfing, windsurfing, kitesurfing, canoeing, rowing, sailing, bird watching/wildlife watching, horse riding, game shooting, cycling);
- Aesthetic value (physical landscape/townscape/seascape, heritage assets);
- Soil formation;
- Primary production;
- Nutrient cycling;
- Water cycling; and
- Photosynthesis.

5 POTENTIAL IMPACTS

179. The following section describes the potential impacts anticipated to arise during the construction, operation and maintenance and decommissioning phases of Norfolk Boreas. The impacts described below have been determined based on our knowledge of the project and the nature of the habitats and species likely to be present. The detailed impacts will be determined once the location, extent and sensitivity of the ecological receptors have been refined through data collection undertaken during 2018.

180. The EIA will be undertaken against Scenario 1 and Scenario 2 separately in order to be able to clearly identify the potential impacts which each scenario will likely give rise to during its construction, operation and maintenance and decommissioning phases. The 'approach to assessment' detailed in the remainder of this section sets out how the approach to EIA will differ under the two scenarios being considered for the Norfolk Boreas project. The differences between the two scenarios are set out in full in **Appendix 2**.

5.1 Potential Impacts during Construction

5.1.1 Impact: Impacts to statutory and non-statutory designated sites

181. The site selection process for the location of the onshore electrical infrastructure for the Norfolk Boreas considered the location of statutory designated sites for nature conservation (i.e. National Parks, SACs, SPAs, Ramsar sites and SSSIs) and Ancient Woodland habitat. The location of the onshore electrical infrastructure selected has therefore avoided all statutory designated sites. As such, direct impacts upon statutory designated sites will not occur.

182. The following indirect impacts upon statutory designated sites may still occur during construction, and will be considered during the EcIA:

- Changes to hydrological processes which underlie statutory designated sites.
- Impacts upon interest features of the statutory designated sites which may be present in habitats immediately surrounding each site (functionally-linked land).
- Spread of invasive species.
- Disturbance caused by works at the substation, cable route, landfall and cable relay station due to activities which generate fugitive emissions (i.e. noise and dust).

183. The following direct and indirect impacts upon non-statutory designated sites will be considered within the EcIA:

- Direct impacts upon Norfolk CWS arising through location of the onshore electrical infrastructure within a CWS.
- Indirect impacts upon Norfolk CWS due to activities which generate fugitive emissions (i.e. noise and dust), activities which may alter the local drainage patterns and activities which result in changes in land use type adjacent to statutory and non-statutory designated sites.

5.1.1.1 Approach to assessment

Scenario 1 only

184. Direct impacts arising from the reinstatement of access routes upon those non-statutory designated sites located within onshore infrastructure will be considered. These impacts will cover the same footprint as the access routes for Norfolk Vanguard, but the duration of the impact at these locations will be extended.

185. Changes to hydrological processes which underlie statutory designated sites (e.g. at the River Wensum) will not be considered for Scenario 1, as the excavation required for duct installation will already have been undertaken by the Norfolk Boreas Project.

Scenario 2 only

186. The desk-based assessment has identified the location of all non-statutory designated sites for nature conservation within and up to 2km from the survey area. This information will subsequently be used to identify where direct and indirect impacts may occur.

187. The results of the botanical (NVC) survey of the River Wensum trenchless crossing receptor site location (as described in section 3.2.3.7) will be used inform the EcIA in relation to potential indirect impacts upon the River Wensum SAC due to changes in hydrological processes as a result of the cable route construction activities, and to microsite the trenchless crossing receptor site location away from sensitive areas.

Both Scenarios

188. Indirect impacts upon statutory non-statutory designated sites will be considered within the assessment. The outputs of the air quality, noise and vibration, lighting assessment and water resources assessments will inform the assessment of indirect impacts upon designated sites.

189. The predicted air pollution outputs arising from the construction phase will be assessed against the UK Air Pollution Information System (APIS) database of critical loads to ensure the critical loads for sensitive habitats located within statutory

designated sites are not exceeded. Where exceedances are identified, mitigation measures will be proposed which will be included within the contractor's Construction and Environmental Management Plan (CEMP).

190. The predicted construction noise levels as determined by the noise assessment will be used to determine the potential indirect effects upon interest features of statutory and non-statutory designated sites.

191. The predicted light levels during construction determined by the lighting assessment will be used to identify the potential lighting effects caused by the construction activities. The BCT and Institute for Lighting Engineers (ILE)'s *Bats and Lighting in the UK* guidelines (BCT and ILE, 2009) will be used to inform the assessment of the indirect impacts of construction lighting upon bats associated with statutory and non-statutory designated sites.

192. An assessment of the sensitivity habitats of statutory and non-statutory designated sites to changes in the water resources predicted by the water resources assessment will be used to identify the indirect impacts upon these habitats.

193. All proposed mitigation measures will be captured in a project draft Outline Landscape and Environmental Management Strategy (OLEMS).

5.1.2 Impact: Impacts to habitats

194. The site selection process for the location of the onshore electrical infrastructure for Norfolk Boreas considered the location of Ancient Woodland habitat. The selected location of the onshore electrical infrastructure has avoided all areas of Ancient Woodland. Therefore direct impacts will not occur.

195. Impacts upon UK Habitats of Principal Importance and Norfolk LBAP habitats will be considered within the EcIA. Impacts upon these habitats have been avoided during the site selection process where possible. The following remaining impacts will be considered:

- Direct permanent loss of sensitive habitats located beneath the footprint of the cable relay station and substation.
- Direct temporary loss of sensitive habitats located beneath the footprint of the onshore cable route (including temporary works areas) and landfall site.
- Temporary habitat fragmentation of linear habitats during construction of the onshore cable route (including temporary works areas) and landfall site.
- Indirect damage to sensitive habitats arising from nitrogen deposition.

5.1.2.1 Approach to assessment

Both Scenarios

196. The location of UK Habitats of Principal Importance identified from the desk-based assessment and 2017 surveys will be assessed against the proposed location of the footprint of the permanent above-ground onshore electrical infrastructure. For habitats that will be permanently lost as a result of the footprint of the electrical infrastructure, new habitat will be created as part of the OLEMS.

197. The location of habitats listed on the Norfolk LBAP as recorded during the 2017 Extended Phase 1 Habitat Survey (and the proposed 2018 Extended Phase 1 Habitat Survey) will be assessed against the proposed location of the footprint of the permanent above-ground onshore electrical infrastructure.

198. The location of any habitat fragmentation (e.g. sections of temporary hedgerow loss) will be assessed against the species data collected during the 2017 and 2018 surveys. In particular, this will include bat activity survey data for hedgerows which will be subject to temporary hedgerow loss. Mitigation measures will be proposed to manage the impact of any temporary hedgerow loss, and these will be included within the OLEMS.

199. The outputs of the air quality and water resources assessment conducted as part of the Norfolk Boreas Offshore Wind Farm EIA will inform the assessment of indirect impacts upon sensitive habitats.

200. The predicted air pollution outputs arising from the construction phase will be assessed against the UK APIS database of critical loads to ensure the critical loads for sensitive habitats located within statutory designated sites are not exceeded. Where exceedances are identified, mitigation measures will be proposed which will be included within the contractor's CEMP.

201. An assessment of the sensitivity of habitats to changes in the water resources predicted by the water resources assessment will be used to identify the indirect impacts upon these habitats.

202. All proposed mitigation measures will be captured in a project draft OLEMS.

5.1.3 Impact: Impacts to legally protected and notable species

203. Impacts upon all legally protected species will be considered within the EcIA. Impacts upon legally protected species have been avoided during the design process where possible. The following remaining potential impacts will be considered:

- Direct impacts upon wintering and breeding birds through direct killing or injuring and indirect impacts through disturbance and habitat loss.
- Direct impacts upon great crested newt through direct killing or injuring and indirect impacts through terrestrial and aquatic habitat loss and fragmentation.
- Direct impacts upon reptiles (in particular common lizard *Zootoca vivipara* and slow worm *Anguis fragilis*) through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon otter through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon water vole through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon badgers through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon bats (in particular Western Barbastelle *Barbastella barbastellus*, Serotine *Eptesicus serotinus*, *Myotis spp*., Daubenton's Bat *Myotis daubentonii*, Natterer's Bat *Myotis nattereri*, Lesser Noctule *Nyctalus leisleri*, Noctule Bat *Nyctalus noctula*, Pipistrelle *Pipistrellus pipistrellus*, Nathusius's Pipistrelle *Pipistrellus nathusii*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Long-eared Bat species *Plecotus spp*., and Brown Long-eared Bat *Plecotus auritus*)) through direct killing or injuring and indirect impacts through habitat loss and fragmentation.

Scenario 1 only impacts

- Direct impacts upon qualifying plant species of the Riven Wensum SAC.
- Direct impacts upon terrestrial and aquatic invertebrates (including the Desmoulin's land snail and Norfolk Hawker dragonfly) and indirect impacts through habitat loss and fragmentation.

5.1.3.1 Approach to assessment

Scenario 1 only

204. The impact assessment will consider potential impacts upon the following legally protected or notable species within the onshore electrical infrastructure:

- **Qualifying plant species of the Riven Wensum SAC** – impacts to all suitable habitat within the floodplain of the River Wensum SAC.
- **Terrestrial and aquatic invertebrates** (the Desmoulin's land snail and Norfolk Hawker dragonfly) – impacts to all suitable habitat within or adjacent to an identified invertebrate population.

205. An assessment of the sensitivity habitats of statutory and non-statutory designated sites to changes in the water resources predicted by the water resources assessment will be used to identify the indirect impacts upon species support by these habitats (e.g. the Desmoulin's whorl snail).

Both Scenarios

206. As detailed in section 3.2, this assessment will be based on the results of the 2017 ecological surveys and on an additional programme of field surveys is planned to commence in 2018.

207. Where legally protected or notable species have been recorded within or adjacent to the onshore electrical infrastructure, Natural England's Standing Advice with respect to protected species will be adhered to when assessing the potential impacts for the project upon individual species.

208. The impact assessment will consider potential impacts upon individual legally protected or notable species within the following areas of the onshore electrical infrastructure:

- **Wintering and breeding birds** – impacts to all suitable terrestrial and aquatic breeding, roosting and foraging habitat.
- **Great crested newt** – impacts to all suitable aquatic habitat or suitable terrestrial habitat within 250m of an identified breeding pond.
- **Reptiles** – impacts to all suitable habitat within or adjacent to an identified reptile population.
- **Otter** – impacts to all suitable aquatic habitat (in any location – otter have large ranges (up to 30km), or any land within 30m of an active holt / couch.
- **Water vole** – impacts to all suitable terrestrial and aquatic habitat within 50m of an active water vole burrow.
- **Badgers** – impacts to all suitable habitat within 30m of an active badger sett.
- **Bats** – impacts to all suitable habitat identified as a commuting habitat or land within 30m of an active roost.

209. Where construction activities are likely to take place within these areas, the impact assessment methodology outlined in section 4 will be followed to determine the significance of the impact.

210. For any identified significant impacts, potential micro-siting of infrastructure will be considered in the first instance. Where this is not possible, species-specific mitigation will be designed in order to mitigate impacts. The relevant species specific guidance will be adhered to when assessing impacts and determining mitigation measures in relation each individual species.

211. The outputs of the noise and vibration, lighting assessment and water resources assessment conducted as part of the Norfolk Boreas Offshore Wind Farm EIA will inform the assessment of indirect impacts upon legally protected and notable species.

212. The predicted construction noise levels as determined by the noise assessment will be used to determine the potential indirect effects upon legally protected and notable species.

213. The predicted light levels during construction determined by the lighting assessment will be used to identify the potential lighting effects caused by the construction activities. The BCT and ILE's *Bats and Lighting in the UK* guidelines (BCT and ILE, 2009) will be used to inform the assessment of the indirect impacts of construction lighting upon bats.

214. All proposed mitigation measures will be captured in a project draft OLEMS.

5.1.4 Impact: Spread of invasive species

215. The construction activities have the potential to cause the spread of non-native invasive species, if present, as construction vehicles and personnel will be operating in a number of locations across a large area of Norfolk.

5.1.4.1 Approach to assessment

Both scenarios

216. Records of non-native invasive species provided by the desk-based assessment will be used to identify areas where non-native invasive species may present a risk. The findings of the Extended Phase 1 Habitat Survey will also indicate the location of non-native invasive flora.

217. A comprehensive Invasive Species Management Plan will be produced which will include best practice measures to be implemented to minimise the risk of construction activities spreading non-native invasive species. Mitigation measures including biosecurity protocols in the Invasive Species Management Plan will be carried across to the CEMP.

5.2 Potential Impacts during O&M

5.2.1 Impact: Temporary loss of habitats and disturbance of fauna during maintenance activities

218. There is no ongoing requirement to maintain the onshore cables following installation. As such, potential impacts arising during operation and maintenance activities will be minimal.

219. Routine maintenance of the substation and cable relay station will take place, involving small local vehicles, which may give rise to localised disturbance effects during operation.

5.2.1.1 Approach to assessment

Both scenarios

220. Consideration of the vehicles numbers required for operation and maintenance will be given in order to determine the potential disturbance effects of operational activities.

5.2.2 Impact: Disturbance of fauna due to operational lighting

221. Site lighting for the substation and cable relay station will be required for operation and maintenance only. Potential impacts may arise due to light disturbance during operation and maintenance.

5.2.2.1 Approach to assessment

Both scenarios

222. The outputs of the operational lighting assessment conducted as part of the Norfolk Boreas Offshore Wind Farm EIA will inform the assessment of indirect impacts upon legally protected and notable species. Mitigation measures to limit the effect of operational lighting will be included within the OLEMS.

5.3 Potential Impacts during Decommissioning

Both scenarios

223. No decision has been made regarding the final decommissioning plans for the substation, as it is recognised that industry best practice, rules and legislation change over time.

224. A full EIA will be carried out ahead of any decommissioning works being undertaken. The programme for decommissioning is expected to be similar in duration to the construction phase of 18 months.

5.4 Potential Cumulative Impacts

Both scenarios

225. Any other project with the potential to result in impacts that may act cumulatively with Norfolk Boreas will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

226. The assessment would 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.

227. Cumulative impacts as a result of the Dudgeon offshore wind farm, the proposed Hornsea Project 3 Offshore Wind Farm and the Bacton coastal defences scheme will be considered as part of the assessment.

228. Cumulative impact assessment will consider construction, operation and decommissioning phases of the project based on the known worst case scenarios for the projects identified for inclusion within the CIA.

Scenario 1 only

229. Cumulative impacts as a result of the proposed Norfolk Vanguard project will be considered as part of the Norfolk Boreas assessment.

5.5 Supplementary documentation

230. A draft OLEMS will be provided with the Norfolk Boreas DCO application. This document, submitted alongside the final ES, will be the primary document detailing the ecological mitigation measures required in order to ensure that all potential impacts identified within this EcIA are reduced to a non-significant level. The document will encapsulate those mitigation measures proposed for individual ecological receptors within this EcIA and will set out how they will fit into the wider approach to managing landscape impacts during construction and operation of the project.

6 REFERENCES

Bat Conservation Trust and Institute of Lighting Engineers (2009) Bats and Lighting in the UK: Bats and the Built Environment Series, May 2009.

Bat Conservation Trust's (BCT) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd ed.).

Chartered Institute of Ecology and Environmental Management (CIEEM) (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester

Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series). Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

Eaton, M.A., Aebischer, N.J., Brown, A.F., Hearn, R.D., Lock, L., Musgrove, A.J., Noble, D.G., Stroud, D.A. and Gregory, R.D. (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108, 708–746. Available online at: britishbirds.co.uk/wp-content/uploads/2014/07/BoCC4.pdf

Edgar, P., Foster, J. and Baker, J. (2010). Reptile Habitat Management Handbook. Amphibian and Reptile Conservation, Bournemouth

English Nature (2001) Great Crested Newt Mitigation Guidelines

Institute of Air Quality Management (IAQM) (2014). IAQM Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management, London. www.iaqm.co.uk/text/guidance/construction-dust-2014.pd

Institute of Environmental Assessment (1995) Guidelines for Baseline Ecological Assessment

Joint Nature Conservation Committee (JNCC) (2003) Herpetofauna Worker's Manual

Joint Nature Conservation Committee (JNCC) (2010) Handbook for Phase 1 habitat survey: A technique for environmental audit.

Killeen, I.J. and Moorkens, E.A. (2003) A Monitoring Protocol for Desmoulin's Whorl Snail, Vertigo moulinsiana. Conserving Natura 2000 Rivers Monitoring Series No. 6. English Nature, Peterborough.

Natural England (2014) Otters: surveys and mitigation for development projects. Natural England Standing Advice

Natural England (2015) Great crested newts: surveys and mitigation for development projects

Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M. (2000). Evaluating the suitability of habitat for the Great Crested Newt (*Triturus cristatus*). Herpetological Journal 10 (4), 143-155.

Royal HaskoningDHV (2017a) Norfolk Boreas Offshore Wind Farm: Evidence Plan Terms of Reference. [*Unpublished – Live Document*]

Royal HaskoningDHV (2017b) Norfolk Vanguard Offshore Wind Farm Preliminary Environmental Information Report. Available at https://corporate.vattenfall.co.uk/projects/wind-energy-projects/vattenfall-in-

norfolk/norfolkvanguard/documents/preliminary-environmental-information-report/

Scottish Natural Heritage (2004) Best Practice Badger Survey Guidance Note

Strachan, Moorhouse and Gelling (2011) Water Vole Conservation Handbook 3rd Edition. Wildlife Conservation Unit, University of Oxford.

Whitfield DP, Ruddock M & Bullman R (2008) Expert opinion as a tool for quantifying bird tolerance to human disturbance, Biological Conservation, 141 (11), pp. 2708-2717.