Norfolk Boreas Offshore Wind Farm

Appendix 22.10

Ecosystem Services Assessment

As produced for Norfolk Vanguard

Environmental Statement

Volume 3

Applicant: Norfolk Boreas Limited
Document Reference: 6.3.22.10
RHDHV Reference: PB5640-006-2210
Pursuant to APFP Regulation: 5(2)(a)

Date: June 2019
Revision: Version 1
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm

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Norfolk Vanguard Offshore Wind Farm

Ecosystem Services Assessment

Environmental Statement

Document Reference: PB4476-005-02210

June 2018

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
01/05/18	01D	First draft for Norfolk Vanguard Limited review	BD	ST / GC	JA
25/05/18	01F	Final for ES submission	BD	ST / GC	JA

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Glossary

AfL	Agreement for Lease
AONB	Area of Outstanding Natural Beauty
APIS	Air Pollution Information System
BISE	Biodiversity Information System for Europe
CWS	County Wildlife Site
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESA	Ecosystem Services Assessment
ETG	Expert Topic Group
EU	European Union
ha	hectares
HDD	Horizontal Directional Drilling
IBTS	International Bottom Trawl Survey
JNCC	Joint Nature Conservation Committee
LNR	Local Nature Reserve
m	metres
MAES	Mapping and Assessment of Ecosystem Services
NBIS	Norfolk Biodiversity Information Service
NBN	National Biodiversity Network
NCC	Norfolk County Council
NE	Natural England
NNR	National Nature Reserve
NPP	Net Primary Productivity
NSIP	National Significant Infrastructure Project
NWT	Norfolk Wildlife Trust
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Assessment Report
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UK BAP	UK Biodiversity Action Plan
UK NEA	United Kingdom National Ecosystem Assessment
UN CBD	United Nations Convention on Biological Diversity
WFD	Water Framework Directive

Terminology

Cable Relay Station	Primarily comprised of an outdoor compound containing reactors (also called inductors, or coils) and switchgear to increase the power transfer capability of the cables under the HVAC technology scenario as considered in the PEIR. This is no longer required for the project as the HVDC technology has been

	selected.
Landfall	Where the offshore cables come ashore at Happisburgh South
Mobilisation area	Areas approx. 100 x 100m used as access points to the running track for duct installation. Required to store equipment and provide welfare facilities. Located adjacent to the onshore cable route, accessible from local highways network suitable for the delivery of heavy and oversized materials and equipment.
Mobilisation zone	Area within which the mobilisation area will be located.
National Grid new / replacement overhead line tower	New overhead line towers to be installed at the National Grid substation.
National Grid overhead line modifications	The works to be undertaken to complete the necessary modification to the existing 400kV overhead lines
National Grid substation extension	The permanent footprint of the National Grid substation extension
National Grid temporary works area	Land adjacent to the Necton National Grid substation which would be temporarily required during construction of the National Grid substation extension.
Necton National Grid substation	The existing 400kV substation at Necton, which will be the grid connection location for Norfolk Vanguard
Onshore cable corridor	200m wide onshore corridor within which the onshore cable route would be located as submitted for PEIR.
Onshore cable route	The 45m easement which will contain the buried export cables as well as the temporary running track, topsoil storage and excavated material during construction.
Onshore cables	The cables which take the electricity from landfall to the onshore project substation
Onshore project area	All onshore electrical infrastructure (landfall; onshore cable route, accesses, trenchless crossing technique (e.g. Horizontal Directional Drilling (HDD)) zones and mobilisation areas; onshore project substation and extension to the Necton National Grid substation and overhead line modification)
Onshore project substation	A compound containing electrical equipment to enable connection to the National Grid. The substation will convert the exported power from HVDC to HVAC, to 400kV (grid voltage). This also contains equipment to help maintain stable grid voltage.
Onshore project substation temporary	Land adjacent to the onshore project substation which would be temporarily required during construction of the onshore project substation.

construction compound	
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure

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22 ECOSYSTEM SERVICES ASSESSMENT

22.1 Introduction

1. This report presents the results of the Ecosystem Services Assessment (ESA) of the Norfolk Vanguard Offshore Wind Farm (herein referred to as the 'project'). The principal aim is to determine the ecosystem services which may be affected by the construction, operation and decommissioning phases of the project, evaluate their likelihood to be subject to significant change, and quantify any potential impacts.

2. Please refer to Chapter 5 Project Description for detail on the infrastructure associated with the project and the location of the onshore and offshore project areas.

22.1.1 Purpose of the ESA

3. This assessment has been undertaken in order to consider the potential effects of the project upon the ecosystem services which are present within the project. This report presents the findings of the screening and scoping stages of the ESA, where potential ecosystem services within a defined study area have been identified. The scoping assessment has identified no potential significant changes to any ecosystem services which may arise as a result of the construction or operation of the project. As a consequence of the scoping assessment, it is proposed that all ecosystem services are scoped out of further assessment and detailed consideration of the potential impacts of the project upon ecosystem services is not required. For completeness, this report provides a detailed methodology of the evaluation and impact stages that would have been undertaken had any ecosystem services been scoped in for further assessment. Full details of the approach to the ESA are provided in section 22.2.

4. Ecosystems[1] provide a range of services and resources which benefit society either directly or indirectly - these are known as ecosystem services. Ecosystem services influence society daily, delivering cultural, economic and environmental benefits to individuals, organisations or society as a whole. The Millennium Ecosystem Assessment defined these services and categorised them into four groups (Millennium Ecosystem Assessment, 2005):

   - Provisioning services – supplying materials, food and water;
   - Regulating services – controlling feedback loops including climate, air/water quality;

[1] Defined as a biological community of interacting organisms and their physical environment.

- Cultural services – providing education, recreation and aesthetic experiences; and
- Supporting services – habitat provision or nutrient cycling which add to the above.

5. Ecosystem services are the indicators used to measure, plan and monitor the ecosystem approach (promoted by the United Nations Convention on Biological Diversity (UN CBD)). The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The key elements of the approach involve considering any interactions between an ecosystem and the human environment at an ecosystem scale, and considering the full range of ecosystem benefits and services which are present within an area and considering the interactions between ecosystems and anthropogenic systems, not simply focussing on selected ecosystem services of interest. Use of this approach ensures that all ecosystem interactions and services are fully considered as part of any assessment process.

6. The ecosystem approach recognises that conventional economic analysis and decision making / option development overlooks many of the benefits (particularly regulatory, cultural, and supporting) within an area and its associated ecosystems. Consequently, ESA is a multi-stage method, ensuring first that all relevant benefits of the ecosystems within a spatial area are identified and quantified, and second that, if appropriate, economic values for these ecosystem services are developed in order to inform the decision making process.

22.1.1.1 Policy and legislative context for ESA

7. Directive 2014/52/EU of the European Parliament and of the Council (herein 'the 2014 EIA Directive') (amendment to the 2011 Directive) includes a provision concerning compliance with the European Union's (EU's) responsibilities under the UN CBD and the EU's commitment under the Convention to 'halting biodiversity loss and the degradation of ecosystem services by 2020 and restoring them where feasible'. Although there is no explicit requirement within the 2014 EIA Directive, where possible and if appropriate, consideration of the degradation of ecosystem services should therefore be considered for certain development projects. The 2014 EIA Directive was transposed into to UK law via the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the 'EIA Regulations').

22.2 ESA Approach and Methodology

22.2.1 Study Area

8. For the purposes of the onshore assessment, the study area is the onshore project area plus a 1km buffer (onshore project area is shown on Figure 22.1, Chapter 22 Onshore Ecology). A 1km buffer is considered to be the maximum zone of influence of the project upon environmental receptors which provide ecosystem services. This buffer has been determined based on professional judgement of the likely maximum extent of potential effects arising from changes to ground and surface water, air quality emissions, noise emissions, groundwater and light emissions and visual disturbance[2].

9. For the purposes of the offshore assessment, the study area is the offshore project area and offshore cable corridor plus the wider southern North Sea. The wider southern North Sea is considered to be the maximum potential zone of influence of the project upon environmental receptors which provide offshore ecosystem services (based on the worst case scenario of underwater noise impacts, see Figure 12.8, Chapter 12 Marine Mammals).

22.2.2 ESA Methodology

10. This ESA has been undertaken based on an adaptation of the methodological framework set out in *An introductory guide to valuing ecosystem services* (Defra, 2007).

11. The approach to identifying ecosystem services and the potential impacts of the project are summarised in Table 22.1 and listed below:

- Establish baseline;
- Identify and provide qualitative assessment of potential impacts on ecosystem services; and
- Quantify the impacts on specific ecosystem services.

Table 22.1 ESA process

Stage	Description of work elements
A – Baseline	• 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?

[2] Further details on the determination of buffer zones used for screening and scoping potential effects upon biodiversity and ecosystem services are provided in the Information to Support Habitats Regulation Assessment Report (Document Reference: PB4476-006-001), submitted as part of the DCO.

Stage	Description of work elements
	• 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 – Qualitative assessment	• Initial checklist approach proposed scoring likely impacts against the baseline (see example) • Consider spatial scale of the ecosystem and therefore 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.

22.2.3 Stage A – Establishing the Baseline

12. This stage involves identifying the existing baseline for ecosystem services, screening those ecosystem services, and then scoping in any services which have the potential to be affected by the project.

22.2.3.1 Screening

13. Using the list of ecosystem services presented in the UK National Ecosystem Assessment (NEA) (UK NEA, 2011), those which may be present or are confirmed as present within the onshore project area and offshore project area have been identified. Drawing on previous work and published examples, this stage identifies ecosystem services using a toolbox of environmental, social, and economic assets as well as from standard listings of the regulatory, cultural, and supporting services in this field.

22.2.3.2 Scoping

14. Following the screening stage, the nature of the physical, chemical and biological changes likely to arise from the project are identified, and any ecosystem services where no change is expected are scoped out. Where it is unlikely that an ecosystem service is present or provided for, or where it is present in a negligible quantity, the service is excluded from further assessment.

15. All ecosystems services identified as likely to experience a quantifiable impact as a result of the project are then carried forward to the next stage of assessment.

22.2.4 Stage B – Evaluating the Ecosystem Services

16. For ecosystem services identified as likely to experience a quantifiable impact as a result of the project, the importance of those where a significant (measurable / quantifiable) change is likely is assessed. Their importance is evaluated within their national context, using existing studies and reports. This stage also highlights where there are any shortcomings in data or research with respect to valuing the services. Constraining and sensitive services are identified and considered.

22.2.5 Stage C – Quantifying Impacts

17. This stage provides an initial appraisal of the options with respect to the ecosystem services, identifying positive and adverse effects, and significance weighting. This details any quantified impacts (where possible) upon ecosystem services.

18. Where ecosystem services are scoped out of further assessment during Stage A, as is the case for the project, Stages B and C are not undertaken.

22.2.6 Consultation

19. Consultation is a key driver of the Environmental Impact Assessment (EIA) and Environmental Statement, and is an ongoing process throughout the lifecycle of the project, from the initial stages through to consent and post-consent. Table 22.2 provides a summary of consultation responses that were collected and taken into consideration. Full details of consultation for the project are provided in Chapter 7 Technical Consultation and Chapter 22 Onshore Ecology.

20. It should be noted that Table 22.2 contains a summary of all those comments made in relation to the project to date which are relevant to this ESA.

Table 22.2 Selected comments of ecology consultation responses

Consultee	Date/Document	Comment	Response
Natural England	Preliminary Environmental Information Report (PEIR) Response December 2017	We note that survey data has not been provided for onshore ecological receptors and we are thus unable to provide detailed comments about the adequacy of the surveys and assess impacts at this stage. It is likely that a key impact may arise from changes to the hydrology of wetland sites, either directly or indirectly, during construction and operation. In addition to international features of River Wensum SAC and Norfolk Valley	Mitigation for potential impacts upon these sites is reported within the HRA Report and within section 22.7.6.2 of Chapter 22 Onshore Ecology.

Consultee	Date/Document	Comment	Response
		Fens SAC, the impacts on their component SSSI features should also be assessed in detail. It is likely that there will be an impact on bat species using Great Paston Barn SAC. Mitigation needs to be provided for impacts on foraging areas and commuting routes in advance of construction works taking place. There is unlikely to be an effect on the purposes of designation of the protected landscapes of the Broads National Park and Norfolk Coast AONB.	
Natural England	PEIR Response December 2017	An area of particular concern is the hydrological impact of the construction affecting ground and surface water flows. This will need to be assessed according to the specific hydrological regime at individual locations where there is habitat linked to and dependant on the water regime. Small scale local disruptions can significantly affect important habitats and communities such as seepages and springs.	This is assessed in Chapter 19 Ground Conditions and Contamination.
Natural England	PEIR Response December 2017	Mitigation needs to be designed to account for impacts on bats, e.g. linear features need to be reinstated; hedges should be double-planted with grassland strips on both sides so there is always a leeward side to forage. Trees should be planted where possible as well as native shrubs.	Mitigation measures proposed with respect to hedgerows are presented within section 22.7.6.5 of Chapter 22 Onshore Ecology and captured within the OLEMS (document reference 8.7).
Natural England	PEIR Response December 2017	Works will interrupt core bat foraging areas as well as commuting routes; mitigation should be in place for these. In order to be effective, the mitigation should be in place before the disruption works are carried out. Working on sensitive sections e.g. severing commuting routes, should ideally be carried out in winter, when the bats are	Mitigation measures proposed with respect to hedgerows are presented within section 22.7.6.5 of Chapter 22

Consultee	Date/Document	Comment	Response
		dormant, so the bats can adapt to the change before the pupping season is underway.	Onshore Ecology and captured within the OLEMS (document reference 8.7).
Norfolk County Council	PEIR Response December 2017	(c) Loss of Ponds In Chapter 22: section 22.7.3.8.3 (Paragraph 314) it states "The cable route works will result in a temporary loss of approximately 40 ponds (approximately 0.4ha) during the cable ducting element of the construction phase (approximately two years) and for a further 16 weeks during the three year cable pull element of the construction phase." The County Council is unclear what the 'temporary loss' means in this context.	The potential impacts on ponds during construction is presented and the term 'temporary loss' explained within section 22.7.6.8 of Chapter 22 Onshore Ecology.
Environment Agency	PEIR Response December 2017	22.7.3.4.3 Impact 4. Woodland trees and scrub: Point 282. We support the use of trenchless crossing techniques (HDD) for any area of mixed deciduous woodland. We would encourage the applicant to consider the potential for creating woodland corridors to increase habitat continuity and create net overall habitat gain. Woodland provides multiple benefits including an essential role in reducing flooding in upper catchments and reducing soil erosion and sediment flow into watercourses.	Acknowledged.
Environment Agency	PEIR Response December 2017	22.7.3.5.1 Impact 5. Hedgerows - Point 292. The Onshore Cable corridor (ONC) work stands to result in the loss of approximately 6.3 km of hedgerow, which is a viable area of UKHPI and Norfolk BAP habitat. Hedgerows are essential in reducing soil erosion, reducing sediment runoff and removal, even temporarily, will have adverse effects on nearby waterbodies. The proposal includes a replanting element, however we would expect a further survey to differentiate between species rich hedgerow (ancient hedgerow) and species poor hedgerow. Where ancient hedgerow is identified, we would support the use of HDD	Hedgerows have been surveyed to this level of detail during the Extended Phase 1 Habitat Survey. This information is presented in Appendix 22.1.

Consultee	Date/Document	Comment	Response
		techniques. Further information on surveying hedgerows can be found through The Norfolk Wildlife Trust and Natural England.	
Environment Agency Environment Agency	PEIR Response December 2017	Control measures for non-native and invasive species should be in place	Mitigation measures to prevent the spread of invasive species is set out in section 22.7.6.19 of Chapter 22 Onshore Ecology.
Environment Agency	PEIR Response December 2017	Fish species - no assessment on bullhead, brown trout, brook lamprey (Annex II)	Data on these species has been provided by the Environment Agency and is included in section 22.6.5.9 of Chapter 22 Onshore Ecology. Impacts on these species and any required mitigation measures is set out in section 22.7.6.17 of Chapter 22 Onshore Ecology.
The Wildlife Trusts	PEIR Response December 2017	HDD is only preferred at a small number of designated watercourses and the PEIR makes the assessment that "Given the extent of these habitats within the wider environment, this effect is anticipated to be of low magnitude." (para 22.7.3.8.3). In our view HDD should be the preferred option at the great majority of watercourses and wetland habitats adjacent to watercourses. This will not only serve to give direct protection to habitats but will mitigate for potential	Impacts to watercourses is set out in Chapter 20 Water Resources and Flood Risk and summarised in section 22.7.6.8 of Chapter 22 Onshore Ecology.

Consultee	Date/Document	Comment	Response
		impacts of pollution and silt run-off, whilst also improving biosecurity.	
North Norfolk District Council	PEIR Response December 2017	In terms of long term and permanent effects on the landscape, there will be a need to provide appropriate landscape mitigation particularly where open cut trenches affect field boundaries and landscape features such as mature trees. Vattenfall has indicated they will seek to do this but this would need to be set out within the mitigation strategy. Where possible, the District Council would expect Horizontal Directional Drilling (HDD) to be used if routes through sensitive woodlands or landscapes cannot be avoided.	Woodlands have been avoided by the project during the design process. Mitigation for locations where hedgerow removal is required is presented in section 22.7.6.5 of Chapter 22 Onshore Ecology.
North Norfolk District Council	PEIR Response December 2017	In terms of delivering wider public benefits, there may be opportunities for Vattenfall to fund wider landscape mitigation to repair historical damage to field boundaries resulting from modern agricultural practices and to enhance local landscape character. This would also have the added benefit of helping improve biodiversity. Wider landscape enhancement could also improve the quality of walking and cycling opportunities in the countryside and enhance tourism to the benefit of the wider economy.	Landscape-scale habitat connection is considered within the landscape proposals in Chapter 29 Landscape and Visual Impact Assessment.

21. An initial ESA was produced and submitted as part of the PEIR in 2017. No comments were received in relation to the This document represents updated ESA for submission as part of the Norfolk Vanguard Environmental Statement, and contains new information in light of the revised onshore cable route.

22.3 Stage A - Baseline Environment

22. To determine the baseline environment, information from a range of available data sources was reviewed in order to provide a narrative description of the extent and nature of all the ecosystem services present within the study area.

22.3.1 Data Sources

23. This ESA has been informed by the findings from a desk-based exercise and field survey data that has been collected from July 2016 onwards, collected as part of the EIA. The following data sources were used to identify the baseline:

- Onshore ecosystem services (please see Chapter 22 Onshore Ecology for further detail of data sources used):
  - Air Pollution Information System (APIS);
  - Aerial photography (Bing Maps);
  - Biodiversity Information System for Europe (BISE) 'Mapping and Assessment of Ecosystem Services' (MAES) tool;
  - Defra's MAGIC website;
  - Environment Agency 'What's In Your Backyard?';
  - Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017);
  - Joint Nature Conservation Committee;
  - National Biodiversity Network (NBN) Gateway;
  - Natural England; and
  - Norfolk Biodiversity Information Service (NBIS).
- For offshore ecosystem services, data presented within the Environmental Statement has been used to inform this ESA. For details of the data sources which have informed the individual chapters of the Environmental Statement, please see the following chapters:
  - Marine Geology, Oceanography and Physical Processes (Chapter 8);
  - Marine Water and Sediment Quality (Chapter 9);
  - Benthic and Intertidal Ecology (Chapter 10);
  - Fish and Shellfish Ecology (Chapter 11);
  - Marine Mammals (Chapter 12);
  - Offshore Ornithology (Chapter 13);
  - Commercial Fisheries (Chapter 14);
  - Offshore and Intertidal Archaeology and Cultural Heritage (Chapter 17);
  - Infrastructure and Other Users (Chapter 18);
  - Water Resources and Flood Risk (Chapter 20);
  - Air Quality (Chapter 26); and
  - Tourism and Recreation (Chapter 30).

22.3.2 Provisioning Services

22.3.2.1 Onshore

22.3.2.1.1 Managed food

24. Managed food types, including cereal crops and vegetables, as well as livestock and game such as grouse and pheasant, are assumed to be present within the study area due to presence of arable farmland and woodland, as shown in Table 22.3. The total area of suitable habitat within the onshore project area for providing these managed food types is approximately 209.64ha. This information is shown in Figure 4, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report). In addition, the BISE digital atlas tool, 'MAES' - which is an interactive map of ecosystems synthesised from a pool of European, national and subnational data - supports this classification and distribution of habitat across the onshore project area. Other managed food types, such as allotments, are not likely to be present in the study area following the site selection process, which sought to avoid sensitive locations (see Chapter 4 Site Selection and Assessment of Alternatives); no amenity land in the form of gardens or registered allotments is present within the onshore project area.

Table 22.3 Areas and lengths of habitat type within the onshore project area recorded during the 2017 Extended Phase 1 Habitat Survey (Royal HaskoningDHV, 2017)

Habitat	Area (hectares (ha))
Woodland (all types)	5.13
Open water	0.59
Arable	202.26
Improved/Semi-improved grassland	6.05
Marsh/marshy grassland	8.07
Grassland (all types)	15.54
Hedgerow (all types)	3.3km (length)

22.3.2.1.2 Wild food

25. Wild food types are likely to be provided by selected habitats identified during the 2017 Extended Phase 1 Habitat Survey. Semi-improved and marshy grassland areas collectively account for 12.29ha of the onshore project area and offer favourable habitat conditions for mushrooms. The 2017 Extended Phase 1 Habitat Survey also identified 3.3km of hedgerow and 5.13ha of woodland habitat. These habitats are considered likely habitats for hedge or tree species bearing nuts or wild fruit. The same areas also provide suitable habitat for game such as deer, rabbit, grouse and pheasant.

26. Open water covers 0.59ha of the onshore project area, principally where the River Bure and River Wensum dissect the onshore cable route. Online maps published by the NBN synthesise hundreds of data sets from multiple data partners to illustrate the presence and distribution of species. These maps show European eel *Anguilla anguilla* are abundant across Norfolk and within the rivers that intersect the onshore project area. However, maps representing the distribution of Atlantic salmon *Salmo salar* show no sightings of salmon within or near to the onshore project area (NBIS, 2017).

22.3.2.1.3 Cultivated produce

27. This desk-based study could not determine whether fibre crops or wool are present in either the study or onshore project area, and, from analysis of aerial maps and the results of the 2017 Extended Phase 1 Habitat Survey, there are no plant nurseries for cut flowers or plants, thatch beds for thatch, or tanneries for leather provision (Bing Maps, 2017). However, there is suitable habitat for willow beds, such as at Wendling Carr and adjacent to the River Bure, and timber and paper production from several plantations, namely Salle (Bing Maps, 2017; Royal HaskoningDHV, 2017).

22.3.2.1.4 Fuel

28. Bio-fuel, charcoal and wood were identified as possible fuel types being produced within the onshore project area from the analysis of aerial maps (Bing Maps, 2017). These ecosystem services may be provided from arable land and woodland, totalling 207.39ha within the onshore project area. However, no peat is present, as observed from the 2017 Extended Phase 1 Habitat Survey and visual data.

22.3.2.1.5 Genetic resources

29. Genetic resources may be present in areas of improved grassland within the onshore project area, as this habitat is assumed to be used for pastoral agriculture purposes. This suggests that genetic resources are maintained through the selective breeding of livestock and cattle across 1.83ha of the onshore project area.

22.3.2.1.6 Medicinal and ornamental resources

30. Medicinal resources could not be determined from the desk-based study. However, ornamental resources including compost, wild flowers, shells and natural stones have been identified in the onshore project area within areas of grassland, woodland and coastal habitat, as evidenced in the Extended Phase 1

Habitat Survey and by analysing aerial maps (Royal HaskoningDHV, 2017; Bing Maps, 2017). Quarries are absent from the study area, so mined stone has been scoped out of any further consideration.

22.3.2.1.7 Freshwater

31. Environment Agency records confirm that drinking water is abstracted from aquifers/groundwater sources across the onshore project area and the wider region (Environment Agency, 2017a).

22.3.2.2 Offshore

22.3.2.2.1 Food

32. Wild food (i.e. capture fisheries) is present within the study area. Commercially important demersal species present include sole, plaice, cod and seabass. Commercially important pelagic species present include herring *Clupea harengus* and sprat *Sprattus sprattus*; however, herring represents less than 4% of the recorded fish landings total. Commercially important shellfish species such as brown (edible) crab *Cancer pagurus*, whelk *Buccinum undatum*, lobster *Hommarus gammarus* and brown shrimp *Crangon* sp. are also present in the study area (see Chapter 14 Commercial Fisheries).

33. In addition, diadromous species which may be fished either recreationally or commercially may transit through the study area and/or its vicinity during the marine phase of their cycle. Diadromous species include European eel *Anguilla anguilla*, Atlantic salmon *Salmo salar* and sea trout *Salmo trutta*. However, none of these species were recorded during site specific fish and shellfish surveys carried out at Norfolk Vanguard and East Anglia THREE. If present in the area, these species would be expected in coastal areas, i.e. inshore areas in the proximity of the export cable corridor.

34. Managed food types, such as aquaculture, marine seaweed harvesting and shellfish water protected areas, are not present within the study area (Ellis *et al*., 2012; Defra, 2016). These are therefore not considered further.

22.3.2.2.2 Raw materials

35. There are no aggregate dredging areas within the Norfolk Vanguard offshore project area; however, there are aggregate dredging licences approximately 27km south west of Norfolk Vanguard West and 42km south west of Norfolk Vanguard East (The Crown Estate, 2017). These are therefore not considered further.

22.3.2.2.3 Biomass fuel

36. There is no biological material derived from living organisms (both plant and animal) within the study area that serves as a source of energy. Biomass fuel generated from onshore resources is included within the onshore ESA.

22.3.2.2.4 Freshwater

37. Inland bodies of water, ground water, rainwater and surface waters for household, industrial and agricultural uses falls outwith the scope of the offshore assessment.

22.3.2.2.5 Genetic resources

38. The fauna and flora associated with the offshore project area contain a variety of genetic resources. Effects on this resource could be assessed through consideration of the impact assessment for the various ecological receptors as a proxy although it is not possible to quantify effect.

22.3.2.2.6 Biochemicals, natural medicines and pharmaceuticals

39. There is potential for the fauna and flora associated with the offshore project area to provide currently unidentified biochemical, medicinal and pharmaceutical resources. Effect on this resource could be assessed through consideration of the impact assessment for the various ecological receptors as a proxy although it is not possible to quantify effect. However, ornamental resources including shells and natural stones have been identified in the offshore project area within areas of coastal habitat, as evidenced in the Extended Phase 1 Habitat Survey and intertidal report and by analysing aerial maps (Royal HaskoningDHV, 2017a; Royal HaskoningDHV 2017b; Bing Maps, 2017).

22.3.3 Regulating Services

22.3.3.1 Onshore

22.3.3.1.1 Regulation of air quality

40. Air quality has a current compliance rating of good to very good within the onshore project area (Environment Agency, 2017b), with dry deposition of ammonia and nitrogen regulated by areas of woodland, grasslands and marshlands in the vicinity (APIS, 2016). Sulphur dioxide is also regulated by these and arable habitats. The total area within the onshore project area responsible for delivering air-quality regulation ecosystem services is 231ha (Table 22.3).

22.3.3.1.2 Regulation of climate

41. Woodland and hedgerows in the onshore project area offer climate regulation services through sequestering carbon from the atmosphere. The total area of habitats capable of carbon sequestration is 5.13ha, plus an additional 92.6km of hedgerow (Table 22.3).

22.3.3.1.3 Regulation of water

42. Water regulation is provided through woodland, grassland and marshland habitats as well as ditches, whilst water storage and retention is provided by wetlands. Woodland, grassland, marshland, dunes and ditches, totalling 29.57ha, regulate the quality of the water (Royal HaskoningDHV, 2017). Marshy areas account for 8.07ha of the onshore project area and are responsible for reducing flow-rates and storing the water (see Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)).

22.3.3.1.4 Regulation of natural hazards

43. There is no discernible regulation of natural hazards in the onshore project area. No evidence of a saltmarsh has been observed from aerial maps or the 2017 Extended Phase 1 Habitat Survey. The only identified feature resembling any natural defence system is a narrow sand beach along the coastline.

22.3.3.1.5 Regulation of pests and diseases

44. Pest regulation could not be determined from this desk based study. Vectors of disease, including mosquitos, ticks and other insects, may be supported by the current riparian habitats. Therefore, disease may be regulated within the onshore project area. Likely habitats include marshland, open water and ditches, which amass to an area of 8.66ha within the onshore project area.

22.3.3.1.6 Regulation of erosion

45. Erosion regulation services are likely to be present within the onshore project area, particularly within watercourses or where intensive farming is practised. Soil erosion is attributed to arable farmland, which accounts for 202.26ha, whilst semi-improved grassland that is assumed to be pastoral grazing land (improved and semi-improved grassland) totals 6.05ha of the onshore project area. In addition, rivers intersecting the onshore cable route account for 0.35ha of the onshore project area Figure 5, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report).

22.3.3.1.7 Regulation of water quality

46. Natural water purification and waste treatment may be delivered by marshland located within the onshore project area. This habitat accounts for 8.07ha of the onshore cable route (Royal HaskoningDHV, 2017). However, water purification and waste treatment is not delivered by peat bogs, as this type of habitat is not present in the onshore project area.

22.3.3.1.8 Pollination

47. Pollination potential has been identified, using the MAES tool, as 'low' at a county scale (MAES, 2015) based on the broad-scale habitats found within the county. However, this ecosystem service is present so will be further investigated during the scoping phase to ascertain the impacts and their associated magnitude from the development.

22.3.3.2 Offshore

22.3.3.2.1 Regulation of air quality

48. As agreed by the Planning Inspectorate in the Scoping Opinion (Planning Inspectorate, 2017), the direct impact study area for air quality is limited to the boundary of onshore construction impacts only, and is included in the onshore assessment (see Chapter 26 Air Quality). This is therefore not considered further in the offshore assessment.

22.3.3.2.2 Regulation of climate

49. The marine environment plays a key role in climate regulation services, by carbon sequestration, therefore part buffering the effects of increasing greenhouse gases in the atmosphere. The total area of the offshore project area is 828km^2, within which the infrastructure will have a relatively small surface footprint and limited effect on the surface area of marine habitat capable of carbon sequestration.

22.3.3.2.3 Regulation of water quality, timing and flows

50. The majority of pollutants enter the southern North Sea through the direct discharges of effluents or terrestrial run-off. Water quality regulation is provided through some onshore wetland habitats, as described in the onshore assessment. There are no coastal wetlands of relevance to the project.

51. The project is located within an area of seabed that is subject to a micro-tidal regime, with an average spring tidal range of up to 1.5m. With progression west along the offshore cable corridor, the tidal range increases. At the Happisburgh

landfall, the tidal range is approximately 2.6m on mean spring tides (see Chapter 8 Marine Geology, Oceanography and Physical Processes). The predominant waves at the study area arrive from the south-west. Tidal currents generally flow north to south on the flooding tide and south to north on the ebbing tide. Tidal currents are the main driving force of sediment transport and, due to the tidal asymmetry, move sediments in a northerly direction. Across the majority of the study area, water depths are likely to be sufficient to limit the effect of wave action on seabed sediments, apart from during exceptionally stormy seas or over shallower areas.

22.3.3.2.4 Erosion control

52. The coast of north-east Norfolk is exposed and therefore very dynamic. Rapid cliff erosion is occurring in places including at Happisburgh South, and foreshore steepening is an issue. Severe storm events can rapidly change beach levels and the degree of exposure of the natural or defended coastline (see Chapter 8 Marine Geology, Oceanography and Physical Processes). The shoreline management plan (AECOM, 2012) states that the intended erosion control at Happisburgh South is Managed Realignment over the next 100 years, meaning that beach and cliff erosion will be allowed to occur but in a controlled manner (i.e. minimising the rate of coastal erosion in the short term using appropriate temporary measures with a view to allowing time for measures to be introduced to allow people to adapt to the changes in the medium and long term).

22.3.3.2.5 Water purification and waste treatment

53. Natural water purification and waste treatment may be delivered by wetland located within the onshore project area, as described in the onshore ecosystem services assessment. This is not considered further for this offshore assessment.

22.3.3.2.6 Regulation of pests and diseases

54. Pests and diseases may be regulated within the onshore project area, for example, within riparian habitats, as described in the onshore assessment. This is not considered further for this offshore assessment.

22.3.3.2.7 Regulation of natural hazards

55. There is no discernible regulation of natural hazards in the project area. There are no coastal wetlands of relevance to the project. The only identified feature resembling any natural defence system is a narrow sand beach along the coastline.

22.3.4 Cultural Services

22.3.4.1 Onshore

22.3.4.1.1 Cultural heritage

56. Cultural heritage and cultural services present within the study areas includes heritage assets, wildlife and social interaction opportunities. Whilst several conservation zones intersect the onshore project area, there are no designated heritage assets in the onshore project area, which may be impacted by the project (Chapter 28 Onshore Archaeology and Cultural Heritage). Furthermore, 177 non-designated heritage assets were found within the onshore project area. However, designated iconic landscapes such as Areas of Outstanding Natural Beauty (AONB) are absent; therefore, the onshore project area's aesthetic value is of regional/local importance only, despite the cultural and aesthetic contribution of heritage assets. Traditions are indeterminable from the available data sources used in the environmental baseline. The presence of natural wildlife within statutory designation River Wensum SAC and SSSI, four County Wildlife Sites (CWS) and Pigney's Wood LNR, as recorded in (Chapter 22 Onshore Ecology), offers a degree of cultural importance within the onshore project area (MAGIC, 2017; Royal HaskoningDHV, 2017).

22.3.4.1.2 Recreation and tourism

57. Recreational activities derived from ecosystems within the onshore project area include rambling, freshwater and coastal angling, bird watching, wildlife watching, horse riding and cycling. The onshore cable route dissects 4 cycle paths, 35 footpaths, 3 public and 3 restricted bridleways. The landscape within the cable route is not conducive for other recreational pursuits such as climbing, gardening or golf as cliffs, gardens and golf courses were not identifiable in any aerial maps. Game shooting was indeterminable from the available resources referred to in this study, although the identified habitats would be suitable for the wildlife to facilitate the sport.

22.3.4.2 Offshore

22.3.4.2.1 Recreation and tourism

58. Recreational activities derived from ecosystems within the offshore project area include coastal angling, scuba diving, surfing, windsurfing, kitesurfing, canoeing, rowing, sailing, bird watching and wildlife watching (see Chapter 30 Tourism and Recreation).

59. As the site of the wind farm is 47km offshore (to the nearest point of Norfolk Vanguard West), recreational and tourism related activities at the wind farm site

are limited, with only some sailing and sea angling taking place nearby. From The Wash around to Lowestoft there are nine sailing clubs. Eight of these sail dinghies close to the shore on the Broads. One at Lowestoft has the facilities for yachts that would be capable of travelling far enough out to sea to interact with the wind farm. The marine traffic survey recorded limited recreational vessel activity in the study area during summer period, and recorded only one sailing vessel in Norfolk Vanguard West during the winter period.

60. There are no known dive sites in the offshore wind farm (OWF) sites (covering both Norfolk Vanguard East and West), with diving in Norfolk focused on gullies and wreck sites off Blakeney, Sheringham and West Runton in North Norfolk. There are no hire facilities for other marine activities (such as kayaking, jet skiing, or dinghy sailing) in close proximity to the landfall. Sea Palling has a jet ski and boat launching facility which includes the launch of dive vessels (Beach Rock Leisure, 2015). There are no scheduled boat trips which cross the OWF sites.

61. The OWF sites are of a distance offshore to avoid effects on coastal tourism through visual impact or marine activities through physical interaction. There is however potential for some interaction with coastal activities during construction along the offshore cable corridor and at the landfall, although the Norfolk coast does not have a high density of sailing clubs or other marine activity centres.

62. There are eight designated bathing waters within the Water Framework Directive (WFD) water body. The WFD bathing waters in closest proximity to the landfall are Mundesley and Sea Palling, which are located 3.1km to the north and 3.5km to the south respectively. Both bathing waters have been classified as having excellent bathing water quality since 2013 (Environment Agency, 2017).

22.3.4.2.2 Educational and inspirational values

63. There is potential for the habitats and cultural heritage features of the offshore project area to provide the basis for intellectual development, culture, art, design and innovation although this is not possible to quantify.

22.3.5 Supporting Services

22.3.5.1 Onshore

22.3.5.1.1 Soil formation, nutrient cycling, water cycling and primary production

64. Soil formation occurs across the entirety of the onshore project area. Primary production is present, with the majority of land in the onshore project area listed as habitat of principal importance (MAES, 2015). Nutrient cycling will be present

within the onshore project area as there is good soil coverage throughout. Water cycling is present in the onshore project area where the River Bure and River Wensum drain the catchment (Bing Maps, 2017). Photosynthesis is certainly present as there is good vegetative cover throughout the onshore project area (Bing Maps, 2017).

22.3.5.2 Offshore

22.3.5.2.1 Habitats and species

65. The following biotopes are present within the study area:

- Circalittoral coarse sediment - SS.SCS.CCS
- Circalittoral mixed sediment - SS.SMx.CMx (nearshore)
- *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel - SS.SCS.CCS.MedLumVen
- *Sabellaria spinulosa* on stable circalittoral mixed sediment - SS.SBR.PoR.SspiMx
- *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand - SS.SCS.CCS.Pkef (nearshore)
- Circalittoral fine sand - SS.SSa.CFiSa
- Circalittoral muddy sand - SS.SSa.MuSa

66. There are two habitat types listed in Annex I of the Habitats Directive that occur in the former East Anglia Zone and potentially within the offshore project area: sandbanks and biogenic reefs.

67. Habitat loss during wind farm operation will occur from placement of structures on the seabed and scour protection associated with the structures and cables. Direct habitat loss would occur where foundations (including scour protection) as well as cable protection are placed for the duration of the operational phase of the project (30 years). Within the offshore cable corridor direct habitat loss would occur where cable protection is placed, primarily around cable crossings.

68. It is likely that the new infrastructure will become colonised by some of the receptors affected by a loss of habitat.

69. As discussed in the relevant chapters of the Environmental Statement, the offshore project area provides a habitat and foraging areas for mobile species including birds, fish and marine mammals (Chapters 11 Fish and Shellfish, 12 Marine Mammal Ecology and 13 Offshore Ornithology).

70. Abundant species with high biomass such as sandeels (Ammodytidae) and clupeids (e.g. herring and sprat) play an important functional role in North Sea

food web dynamics. Such species represent an important food web link because they occupy intermediate trophic levels, are significant predators of zooplankton and represent a key dietary component of a variety of aquatic and terrestrial predators. Both landings data and the results of the International Bottom Trawl Surveys (IBTS) indicate that these species groups are present in the study area. Grey gurnard *Eutrigla gurnardus*, lesser weever *Echiichthys vipera*, solenette *Buglossidium luteum* and Gobiidae spp. are present throughout the study area and may also represent possible prey items for fish, seabird and marine mammal species.

22.3.5.2.2 Nutrient cycling

71. Nutrient cycling will be present within the offshore project area. For example, bioturbation by marine worms, mainly through burrowing in the sediment, moves nutrients from deep sediment layers to the surface and vice versa. Nutrient cycling is also maintained through processes such as ingestion and excretion of materials by organisms, for example, fish mineralise nitrogen and phosphorus through excretion (Gruber, 2008).

22.3.5.2.3 Primary production

72. Primary production is present in the onshore project area, with marine net primary production (NPP) by phytoplankton fuelling the marine food web. The majority of NPP in the sea is generated by photosynthesis by phytoplankton.

22.3.5.2.4 Water cycling

73. Water cycling is present in the onshore project area where the River Bure and River Wensum drain the catchment, therefore included in the onshore ecosystem services assessment. Water cycling in the offshore project area includes run-off/flow from the terrestrial environment, and water evaporation into the atmosphere.

22.3.6 Data Gaps and Uncertainties

22.3.6.1 Onshore

74. Given the high level nature of the information outlined in this document, there are likely to be a range of uncertainties about specific aspects of food production (due to likely rotation and changes over time), as well as social aspects and individual uses of the area. The presence and absence of the following ecosystem services were indeterminable in the screening stage of assessment:

- Honey;
- Fibre crops;

- Wool;
- Medical raw materials;
- Cut flowers;
- Crop and livestock pests;
- Religion; and
- Tradition.

22.3.6.2 Offshore

75. Given the high level nature of the information outlined in this document, there are likely to be a range of uncertainties about specific aspects of offshore ecosystem services. For example, food resources (due to likely changes over time), as well as social aspects and individual uses of the area. The presence and absence of the following ecosystem services were indeterminable in the screening stage of assessment:

- Genetic resources;
- Biochemicals, natural medicines and pharmaceuticals;
- Ethical and spiritual values; and
- Education and inspirational values.

22.4 Screening and Scoping of Onshore Ecosystem Services

76. This section summarises the results of the ecosystem services screening and scoping stages for the onshore project area.

22.4.1 Screening the ESA

77. Following a review of the available baseline data, screening was undertaken to identify the provision of ecosystem services within the onshore project area. The outcome of this process is a list of ecosystem services to be subjected to further assessment regarding the magnitude of impact and importance of the asset. The ecosystem services which have been screened in to this assessment are listed below. The full screening assessment, which includes an explanation for screening decisions, is presented in Annex 22.5.1.

- 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.

22.4.2 Scoping the ESA

78. Using professional judgement of the likely physical, chemical and biological interactions and impacts, and applying these to the different components of the project, a high level scoping of the effects on the present or potentially present ecosystem services and assets was undertaken. The completed scoping matrix is available to view in Annex 22.5.2, and illustrates the potential positive or negative impacts on each present ecosystem service each project component will cause. A summary is presented in Table 22.4. Where no impact from a project component is predicted for a specific ecosystem service, these have been omitted from the table.

Table 22.4 Ecosystem services scoping matrix - onshore

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension
Provisioning services					
Food - managed	Cereal Crops	x	x	x	x
	Vegetables	x	x	x	x
	Livestock (meat and dairy)	o	o	x	o
	Game	o	o	x	o
	Honey	x	x	x	x
Food - wild	Mushrooms	o	x	x	o
	Nuts	o	x	x	o
	Wild fruit	o	x	x	o
	Fish	o	o	x	o
Cultivated produce	Fibre crops	o	o	x	o
	Wool	o	o	x	o
	Timber	o	o	x	o
	Paper	o	o	x	o
	Willow beds	o	o	x	o
Fuel	Wood fuel	o	o	x	o
	Charcoal	o	o	x	o
	Bio-fuel	x	x	x	x
Genetic resources	Animal breeding	o	o	x	O
Ornamental resources	Compost	x	x	x	x
	Wild flowers	o	o	x	o
	Shells	o	o	o	o
	Stones	o	o	o	o
Regulating services					
Air-quality regulation	Dry deposition of pollutants	x	x	x	x
Climate regulation	Carbon sequestration	o	x	x	o

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension
Water regulation	Land cover	o	x	x	x
	Water storage	o	o	x	o
Pest regulation	Crop and livestock pests	o	o	x	o
Disease regulation	Mosquitos	o	o	+	o
Erosion regulation	Land cover	o	x	x	o
Water purification and waste regulation	Clean water	o	o	x	o
Pollination		o	o	x	o
Cultural services					
	Social interaction	x	o	x	o
	Location/ heritage asset	x	x	x	x
	Wildlife (habitats and species)	o	x	x	o
Recreation and tourism	Rambling	x	o	x	o
	Freshwater angling	o	o	x	o
	Coastal angling	x	o	o	o
	Bird watching/ wildlife watching	x	o	x	o
	Horse-riding	x	o	x	o
	Sailing	x	o	o	o
	Windsurfing	x	o	o	o
	Surfing	x	o	o	o
	Kite surfing	x	o	o	o
	Canoeing	o	o	x	o
	Rowing	o	o	x	o
	Scuba diving	x	o	o	o

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension
	Game shooting	o	o	x	o
	Cycling	o	o	x	o
Aesthetic value	Heritage assets	x	x	x	x
Supporting services					
Soil formation		x	x	x	x
Primary production		x	x	x	x
Nutrient cycling		x	x	x	x
Water cycling		o	x	x	o
Photosynthesis		x	x	x	x

Key:
'++' significant positive impact
'+' potential positive impact
'O' neutral/no impact
'x' potential negative impact
'xx' significant negative impact

NB: Complete matrix presented in Annex 22.5.2

79. The scoping assessment has identified no potential significant changes to any ecosystem services which may arise as a result of the construction or operation of the project. This is largely due to the scale of the potential effects which may be caused by the construction and operation of the project. Provision of ecosystem services typically operate at an ecosystem (i.e. regional, or greater) scale, and the effects of the construction and operation phases of the project in this instance operate at a local scale. Full details of the scoping assessment for each ecosystem service screened in for assessment is presented in Annex 22.5.2. As a consequence of the scoping assessment, it is proposed that all ecosystem services are scoped out of further assessment and detailed consideration of the potential impacts of the project upon ecosystem services (Stage B and Stage C in section 22.2) is not required.

22.5 Screening and Scoping of Offshore Ecosystem Services

80. This section summarises the results of the ecosystem services screening and scoping stages for the offshore project area.

22.5.1 Screening the ESA

81. Following review of the available baseline data, screening was undertaken to identify provision of ecosystem services within the offshore project area. The outcome of this process is a list of ecosystem services to be subjected to further assessment regarding the magnitude of impact and importance of the asset, as presented in Appendix 22.5.3. The ecosystem services which have been screened in to this assessment are listed below:

- Food – wild (commercial fisheries);
- Biological raw materials;
- Genetic resources;
- Biochemicals, natural medicines and pharmaceuticals;
- Ornamental resources (shells and natural stone);
- Climate regulation (carbon sequestration);
- Erosion regulation;
- Recreation and tourism (coastal angling, scuba diving, sailing, bird watching/wildlife watching);
- Ethical and spiritual value (religion, social interaction, traditions, wildlife (habitats and species));
- Educational and inspirational value (iconic landscape, designated sites/structures, non-designated sites);
- Habitats and species;
- Primary production;
- Nutrient cycling; and
- Water cycling.

22.5.2 Scoping the ESA

82. Using professional judgement of the likely physical, chemical and biological interactions and impacts, and applying these to the different components of the project, a high level scoping of the effects on the present or potentially present ecosystem services and assets was undertaken. A summary is presented in Table 22.5, which illustrates the potential positive or negative impacts on each present ecosystem service each project component will cause and further information is provided in Annex 22.5.4.

Table 22.5 Ecosystem services scoping matrix - offshore

Type of services	Sub category	Offshore wind farm sites	Offshore cable corridor
Provisioning services			
Food (wild)	Commercial fisheries	x	x
	Non-commercial fish species	x	x
	Diadromous species	o	x
Biological raw materials	Aggregates	o	o
Genetic resources		x	x
Biochemicals, natural medicines and pharmaceuticals		x	x
Ornamental resources	Shells	o	o
	Natural stones	o	o
Regulation services			
Climate regulation	Carbon sequestration	o	o
Erosion control		o	o
Cultural services			
Recreation and Tourism	Coastal angling	o	x
	Scuba diving	x	x
	Sailing	x	x
	Bird/wildlife watching	o	x
Ethical and spiritual value	Religion	o	o
	Social interaction	x	x
Educational and inspirational value		x	x
Supporting services			
Habitats and species		x	x
Nutrient cycling		x	x
Primary production		x	x
Water cycling		x	x

Key:
‘++’ significant positive impact
‘+’ potential positive impact
‘O’ neutral/no impact
‘x’ potential negative impact
‘xx’ significant negative impact

83. The scoping assessment has identified no potential significant changes to any ecosystem services which may arise as a result of the construction or operation of the project. This is largely due to the scale of the potential effects which may be caused by the construction and operation of the project offshore infrastructure. Provision of ecosystem services typically operate at an ecosystem (i.e. regional, or greater) scale, and the effects of the construction and operation phases of the offshore infrastructure typically operate at a local scale. As a consequence of the scoping assessment, it is proposed that all ecosystem services are scoped out of further assessment and detailed consideration of the potential impacts of the project upon ecosystem services (Stage B and Stage C in section 22.2) is not required.

22.6 Next Steps

84. As all ecosystem services have been scoped out of further assessment at this stage, no other next steps are proposed.

22.7 Conclusion

85. This assessment has identified the ecosystem services located within the onshore and offshore project areas and considered which of those services may be potentially affected by construction and operation of the project and should therefore be scoped into further assessment. The outcome of this process was to determine that no ecosystem services are likely to be subject to significant change due the construction and operation of the project and therefore all ecosystem services are proposed to be scoped out of further assessment. This report will now be reviewed alongside the Norfolk Vanguard Environmental Statement in accordance with the DCO examination process.

22.8 References

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22.9 Annexes

Annex 22.5.1: Onshore ESA Screening Assessment

86. Presented below is the complete screening matrix of ecosystem services within the onshore project area, detailing whether each ecosystem service has been identified as present (yes/no), and which data sources were consulted.

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source	Additional data source
Provisioning					
Food - managed	Cereal Crops		Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Vegetables		Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Fruit (including orchards)		N	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Allotments		N	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Livestock (meat and dairy)		Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Game	Pheasant/grouse	Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
		Deer	Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
		Waterfowl	Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Fish	Salmon	N	NBN	Chapter 14 Commercial Fisheries
		Trout	Y	NBN	Chapter 14 Commercial Fisheries
		Fishing Lakes	Y	Bing maps	Chapter 14 Commercial Fisheries
		Oyster beds	N	EP1HS	Chapter 14 Commercial Fisheries
		Mussel beds	N	EP1HS	Chapter 14 Commercial Fisheries

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source	Additional data source
		Sea Fishing	N	EP1HS	Chapter 14 Commercial Fisheries
	Honey		Y	EP1HS	
Food - wild	Mushrooms		Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Nuts		Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Wild fruit		Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Fish		Y	NBN	Chapter 14 Commercial Fisheries
Cultivated produce	Fibre crops		?	Cannot determine	
	Willow beds		Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Wool		?	Cannot determine	
	Flowers and plants		N	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Thatch		N	EP1HS	Bing maps, Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Leather		N	Bing maps	OS Maps
	Timber		Y	Bing maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report
	Paper		Y	Bing maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report
Fuel	Bio-fuel		Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Peat		N	MAES	
	Wood fuel		Y	Bing maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report
	Charcoal		Y	Bing maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source	Additional data source
Genetic resources	Genetic resources	Animal breeding	Y	Bing maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report
Biochemicals, natural medicines, pharmaceuticals	Medical raw materials	Herbs	?	Cannot determine	
Ornamental resources	Compost		Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Flowers	Cut flowers	N	Bing maps	
		Wild flowers	Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Shells		Y	EP1HS	Bing Maps
	Stone	Quarried	N	Bing maps	OS Maps
		Natural	Y	Bing maps	
Fresh water	Drinking water		Y	Environment Agency	EP1HS
Regulation Services					
Air-quality regulation	Dry deposition of pollutants		Y	EP1HS	OS Maps, Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Climate regulation	Carbon sequestration	Woods	Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Water regulation	Land cover	Habitat/land use type	Y	EP1HS	Bing Maps
	Water Storage	Peat Bogs	N	Bing Maps	
		Reservoirs	N	Bing Maps	
		Wetlands	Y	EP1HS	Bing Maps, Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Natural hazard regulation	Natural Defences	Saltmarsh	N	MAES	
Pest regulation	Crop and livestock pests		?	Bing Maps	

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source	Additional data source
Disease regulation	Mosquitos	Waterbodies	Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
		Wetlands	Y		
Erosion regulation	Land cover	Habitat/land use type	Y	Bing Maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report
	Waterbodies	Waterbody characteristics	Y	Bing Maps	Appendix 22.1 Extended Phase 1 Habitat Survey Report
Water purification and waste treatment	Clean water	Peat bogs	N	EP1HS	
		Reedbeds	Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Pollination		Wildflowers	Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Cultural services					
Cultural heritage	Religion		?	Bing aerial maps	
	Social interaction		Y	Chapter 30 Tourism and Recreation	
	Traditions		?	Cannot determine	
	Landscape	Iconic landscape	N	MAGIC	
	Location/ heritage asset	Designated sites / structures	Y	Chapter 28 Onshore Archaeology and Cultural Heritage	
		Non-designated sites	Y	Chapter 28 Onshore Archaeology and Cultural Heritage	
	Wildlife (habitats and species)	Cultural value	Y	MAGIC	NBIS, Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Recreation and tourism	Rambling		Y	Chapter 30 Tourism and Recreation	

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source	Additional data source
	Climbing		N	Bing maps	
	Freshwater angling		Y	Bing maps	
	Coastal angling		Y	Bing maps	
	Scuba diving		Y	Bing maps	
	Surfing		Y	Bing maps	
	Windsurfing		Y	Bing maps	
	Kitesurfing		Y	Bing maps	
	Canoeing		Y	Bing maps	
	Rowing		Y	Bing maps	
	Sailing		Y	Bing maps	
	Bird watching/ wildlife watching		Y	Bing maps	
	Horse riding		Y	Bing maps	Chapter 30 Tourism and Recreation
	Gardening		N	Bing maps	
	Game shooting		Y	Bing maps	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
	Cycling		Y	Chapter 30 Tourism and Recreation	
	Golf		N	Bing maps	
Aesthetic value	Physical landscape/ townscape/ seascape	Local importance	Y	MAGIC	Bing Maps, Chapter 22 Onshore Ecology, Chapter 28 Onshore Archaeology and Cultural Heritage
		National/International importance	N	Magic	Chapter 28 Onshore Archaeology and Cultural Heritage
	Heritage asset	177 non-designated assets within onshore project area	Y	Chapter 28 Onshore Archaeology and Cultural Heritage	
Supporting services					
Soil formation			Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source	Additional data source
Primary production			Y	MAES	
Nutrient cycling			Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)
Water cycling			Y	EP1HS	Chapter 22 Onshore Ecology
Photosynthesis			Y	EP1HS	Figure 3, Annex 22.1.1 (Appendix 22.1 Extended Phase 1 Habitat Survey Report)

87. Scoping matrix of impacts each onshore project component presents on each ecosystem service identified as present within the project onshore electrical infrastructure footprint. The significance of each impact is indicated using the symbols below:

'++'	significant positive impact
'+'	potential positive impact
'O'	neutral/no impact
'x'	potential negative impact
'xx'	significant negative impact

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
Provisioning services						
Food - managed	Cereal Crops	x	x	x	x	Temporary loss of arable land for all elements of onshore project area and permanent loss at onshore substation may occur. Maximum permanent loss of 7.5ha of arable land (onshore substation) and temporary loss of 383ha of arable land (up to 2 years). This represents a permanent and temporary loss of 0.0001% and 0.01% of the UK's arable land resource respectively. These impacts on an ecosystem scale are therefore not significant.
	Vegetables	x	x	x	x	As per cereal crops.
	Livestock (meat and dairy)	O	O	x	O	Temporary loss of pastoral land along the cable route may occur. Maximum temporary loss of 15.5ha of pastoral land (up to 2 years). This represents a temporary loss of 0.0005% of the UK's pastoral land resource. These impacts on an ecosystem scale are therefore not significant.
	Game	O	O	x	O	Temporary loss of habitats which may support game along the cable route may occur. Maximum temporary loss of up 5ha of plantation woodland habitat which has the potential to support game bird and deer, 0.3ha of floodplain grazing marsh which supports wildfowl along the cable route. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
	Honey	x	x	x	x	Temporary loss of habitats which may support natural honey provision along the cable route may occur. Maximum temporary loss of up 5ha of plantation habitat which has the potential to support beehives

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						along the cable route. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Food - wild	Mushrooms	O	x	x	O	Temporary loss of grassland habitat suitable for mushroom provision along the cable route may occur. Maximum temporary loss of 15.5ha of arable land (up to 2 years). This represents a temporary loss of 0.0005% of the UK's grassland resource respectively. These impacts on an ecosystem scale are therefore not significant.
	Nuts	O	x	x	O	Temporary loss of habitats which may support nut provision along the cable route may occur. Maximum temporary loss of up 5ha of plantation woodland habitat and 3.3km of hedgerow along the cable route and 610m of hedgerow at the onshore substation. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
	Wild fruit	O	x	x	O	As per nuts.
	Fish	O	O	x	O	Temporary impacts on potential fishing areas along 0.3ha of running water along the cable route. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Cultivated produce	Fibre crops	O	O	x	O	Temporary impacts on willow scrub providing potential fibre provision along the cable route. Maximum temporary loss of up 5ha of plantation habitats along the cable route. This represents a negligible loss of this resource at the UK level. These impacts on an ecosystem

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						scale are therefore not significant.
	Wool	O	O	x	O	Temporary loss of pastoral land along the cable route may occur. Maximum temporary loss of 15.5ha of arable land (up to 2 years). This represents a temporary loss of 0.0005% of the UK's pastoral land resource respectively. These impacts on an ecosystem scale are therefore not significant.
	Timber	O	O	x	O	Temporary loss timber resource along the cable route may occur. Maximum temporary loss of up 5ha of plantation habitat may occur along the cable route. This represents a temporary loss of <0.0001% of this resource at the UK level. These impacts on an ecosystem scale are therefore not significant.
	Paper	O	O	x	O	As per timber.
	Willow beds	O	O	x	O	As per fibre crops.
Fuel	Wood fuel	O	O	x	O	As per timber.
	Charcoal	O	O	x	O	As per timber.
	Bio-fuel	x	x	x	x	As per cereal crops.
Genetic resources	Animal breeding	O	O	x	O	As per livestock (meat and dairy).
Biochemicals, natural medicines, pharmaceuticals	Medical raw materials	O	O	O	O	Due to the absence of non-anthropogenic landscapes within the study area, the natural medicine potential of the study is minimal.
Ornamental resources	Compost	x	x	x	x	Organic material is present within all areas of the onshore project area. The contribution of the organic material within the onshore project area in negligible in

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						the context of the UK compost provision. There are no areas with notable high levels of organic material (e.g. peatlands) within the onshore project area.
	Wild flowers	O	O	x	O	Temporary loss of land with the potential to support wildflower assemblages (semi-improved and marshy grassland) along the cable route may occur. Maximum temporary loss of 16.2ha of arable land (up to 2 years). This represents a temporary loss of 0.001% of the UK's semi-natural grassland resource. This impact on an ecosystem scale is therefore not significant.
	Shells	O	O	O	O	Negligible areas of coastal habitats (<0.1ha) occur with the landfall which may provide ornamental shells. These will be avoided by the use of trenchless drilling techniques.
	Stones	O	O	O	O	As per shells.
Regulating services						
Air-quality regulation	Dry deposition of pollutants	x	x	x	x	Temporary loss of woodland, hedgerows, grassland and arable land, all of which perform an air quality regulation function, may occur within all areas of the onshore project area. Maximum permanent loss of 7.5ha of these habitats land (onshore substation) and temporary loss of approximately 383ha of these habitats (up to 2 years) may occur. This represents a permanent and temporary loss of 0.0005% of the UK's habitats which can provide an air quality regulation function. Furthermore, as air quality regulation is primarily a local function, these habitats are also widely spread the area surrounding the onshore project area. These impacts on an ecosystem scale are therefore not significant.

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
Climate regulation	Carbon sequestration	O	x	x	O	Temporary loss of habitats which sequester carbon along the cable route may occur. Maximum temporary loss of up 5ha of plantation woodland habitat and 3.3km of hedgerow along the cable route and 610m of hedgerow at the onshore substation. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Water regulation	Land cover	O	x	x	x	Permanent loss of permeable land cover of a total of 7.5ha at the onshore substation will occur. This represents a permanent loss of a negligible area of permeable land cover in the context of the catchments in which the onshore project area is located.
	Water storage	O	O	x	O	Temporary loss of marshy grassland habitat suitable for water storage along the cable route may occur. Maximum temporary loss of 8ha of arable land (up to 2 years). This represents a temporary loss of a negligible area of habitat suitable for water storage. These impacts on an ecosystem scale are therefore not significant.
Pest regulation	Crop and livestock pests	O	O	x	O	The majority of the habitat types within the onshore project area are monocultures and are not key habitats providing pest regulation. There will be a temporary loss of approximately 9.3ha of biodiverse grasslands, woodland and coastal habitats along the cable route. This represents a temporary loss of a negligible area of habitat suitable for providing pest regulation, particularly as biodiverse habitat e.g. semi-natural woodland have been avoided during the project embedded mitigation. These impacts on an ecosystem

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						scale are therefore not significant.
Disease regulation	Mosquitos	O	O	+	O	Data on the ecosystem service provision of mosquito regulation is weak, however the temporary loss of approximately 5 standing water bodies (0.05ha) along the cable route represents a negligible loss of mosquito-breeding habitat. This impact on an ecosystem scale is therefore not significant.
Erosion regulation	Land cover	O	x	x	O	Land covers types not subject to cropping provide erosion regulation, especially hedgerows, woodland areas and grasslands. Temporary loss of these habitats along the cable route and onshore substation may occur. Maximum temporary loss of 22ha and 3.3km of these habitats (up to 2 years) along the cable route, and permanent loss of 610m of hedgerow at the onshore substation. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
	Waterbody characteristics	O	O	O	O	The main rivers within the study area (the River Wensum, North Walsham and Dilham Canal, King's Beck, River Bure and the Wendling Beck) are heavily modified but all have natural floodplain habitat offering erosion regulation. All main rivers are to be crossed by trenchless techniques and so no change upon these watercourses will occur.
Water purification and waste regulation	Clean water	O	O	x	O	Temporary loss of marginal habitat suitable for water purification along the cable route may occur. Maximum temporary loss of 0.1ha of marginal vegetation land (up to 2 years). This represents a temporary loss of a negligible area of

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						habitat suitable for water purification. These impacts on an ecosystem scale are therefore not significant.
Pollination		O	O	x	O	Temporary loss of land with the potential to support pollinators (semi-improved and marshy grassland) along the cable route may occur. Maximum temporary loss of 9.3ha of arable land (up to 2 years). This represents a temporary loss of 0.0005% of the UK's semi-natural grassland resource. This impact on an ecosystem scale is therefore not significant.
Cultural services						
Cultural heritage	Religion	O	O	O	O	There are no known religious sites located within the ecosystems within the onshore cable route. As such no impact pathway has been identified.
	Social interaction	x	O	x	O	All public open spaces provide areas for social interaction. The only public open spaces provided within the study area are public access routes. Public access routes are located adjacent to the landfall and in multiple areas within the cable route. Temporary diversion of public access routes may be required during construction. As now loss of space for social interaction will occur, the impact on an ecosystem scale is not significant.
	Traditions	O	O	O	O	No impact pathways between the project and local traditions have been identified.
	Location/ heritage asset	x	x	x	x	No designated and up to 177 non-designated heritage assets are located within the onshore project area. The assets are located throughout the onshore project area. The setting of these assets may be temporarily affected during the construction phase (up to 2 years). The setting effects on these assets are small in relation to

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						the provision of heritage assets on a national scale. These impacts on this scale are therefore not significant.
	Wildlife (habitats and species)	O	x	x	O	A component of the cultural value of wildlife is its existence value. A temporary loss of suitable habitats for supporting legally protected and notable species will occur at the onshore substation and along the cable route where maximum temporary loss of 100.8ha and 3.3km of hedgerows, woodland areas and semi-improved grasslands (up to 2 years) along the cable route, and permanent loss of 610m of hedgerow at the onshore substation. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Recreation and tourism	Rambling	x	O	x	O	This service is available in any location where public access routes occur. Public access routes are located adjacent to the landfall and in multiple areas within the cable route. No county or national-level public access routes will be directly affected by the onshore project area. These impacts on an ecosystem scale are therefore not significant.
	Freshwater angling	O	O	x	O	The main rivers located along the cable route may potentially provide angling opportunities. All main rivers are to be crossed by trenchless techniques and so no change upon these watercourses will occur. There is the potential for effects on bankside habitats used for angling during the construction phase (up to 2 years). These impacts on an ecosystem scale are therefore not significant.
	Coastal	x	O	O	O	The landfall may provide opportunities for coastal

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
	angling					angling along approximately 650m of coastline. This will be subject to temporary disturbance during the construction phase (up to 2 years). This temporary disturbance is negligible in the context of the available coastal angling provision with the local area, the county and on a national scale. This impact on an ecosystem scale is therefore not significant.
	Bird watching/ wildlife watching	x	O	x	O	This service is available in any location where public access and suitable habitats to support notable species occur. Public access routes are located adjacent to the landfall, and there is the potential for notable ornithology to be observed in agricultural fields and offshore adjacent to these areas. Multiple public access routes are located within the cable route. None of these public access routes coincide with designed wildlife recreational assets (e.g. Wildlife Trust sites). As such the impacts are localised and are therefore not significant.
	Horse-riding	x	O	x	O	This service is available in any location where public bridleways occur. Public bridleways are located adjacent to the landfall and in multiple areas within the cable route. Temporary indirect effects upon users of these bridleways may occur for the duration of the construction phase (up to 2 years). These impacts on an ecosystem scale are therefore not significant.
	Sailing	x	O	O	O	The landfall may provide opportunities for cast-off for watersports along approximately 650m of coastline. This will be subject to temporary disturbance during the construction phase (up to 2 years). This temporary disturbance is negligible in the context of the available cast-off provision with the local area, the county and on

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						a national scale. This impact on an ecosystem scale is therefore not significant.
	Windsurfing	x	O	O	O	As per sailing.
	Surfing	x	O	O	O	As per sailing.
	Kite surfing	x	O	O	O	As per sailing.
	Canoeing	O	O	x	O	As per freshwater angling.
	Rowing	O	O	x	O	As per freshwater angling.
	Scuba diving	x	O	O	O	As per sailing.
	Game shooting	O	O	x	O	As per game (managed food).
	Cycling	O	O	x	O	This service is available in any location where public cycling routes occur. Cycling routes are located in multiple areas within the cable route including routes 30, 33, 1 and 13. The routes will be subject to temporary disturbance during construction (up to 2 years). They will be subject to diversions during this time. In light of this, these impacts are therefore not significant.
Aesthetic value	Heritage assets	x	x	x	x	As per location / heritage assets.
Supporting services						
Soil formation		x	x	x	x	Soil formation occurs throughout the onshore project area, with the key areas being woodland areas and grasslands. Temporary loss of these habitats along the cable route may occur. Furthermore temporary disruption to existing soils will occur within all areas of onshore project area. Maximum temporary loss of

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						22.1ha of these habitats (up to 2 years) along the cable route. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Primary production		x	x	x	x	Primary production occurs throughout the onshore project area, with the key areas being woodland areas and grasslands. Temporary loss of these habitats along the cable route may occur. Furthermore temporary disruption to arable primary production will occur within all areas of onshore project area. Maximum temporary loss of 22.1ha of these habitats (up to 2 years) along the cable route. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Nutrient cycling		x	x	x	x	Nutrient cycling occurs throughout the onshore project area, with the key areas being woodland areas and grasslands. Temporary loss of these habitats along the cable route may occur. Furthermore temporary disruption to existing soils will occur within all areas of onshore project area affecting the nutrient cycling process. Maximum temporary loss of 22.1ha of these habitats (up to 2 years) along the cable route. This represents a temporary loss of <0.0001% of these resources at the UK level. These impacts on an ecosystem scale are therefore not significant.
Water cycling		O	x	x	O	Permanent loss of permeable land cover of a total of 7.5ha at the onshore substation will occur. Due to the use of trenchless techniques, no watercourses will be directly affected by the onshore project infrastructure.

Type of services	Sub category	Landfall	Onshore project substation	Onshore cable route	National Grid substation extension	Initial assessment
						This represents a permanent and temporary loss of a negligible area of permeable land cover in the context of the catchments in which the onshore project area is located.
Photosynthesis		x	x	x	x	As per primary production.

88. Presented below is the complete screening matrix of ecosystem services within the offshore project area, detailing whether each ecosystem service has been identified as present (yes/no), and which data sources were consulted.

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source
Provisioning Services				
Food (managed)	Aquaculture		N	Ellis *et al*. 2012
	Seaweed harvesting		N	
	Shellfish water protected areas		N	DEFRA, 2016
Food (wild)	Commercial fisheries	Demersal	Y	Chapter 11 Fish and Shellfish Ecology; Chapter 14 Commercial Fisheries
		Pelagic	Y	Chapter 11 Fish and Shellfish Ecology; Chapter 14 Commercial Fisheries
		Shellfish	Y	Chapter 11 Fish and Shellfish Ecology; Chapter 14 Commercial Fisheries
	Fish		Y	Chapter 11 Fish and Shellfish Ecology; Chapter 14 Commercial Fisheries
Biological Raw Materials	Aggregates		Y	Chapter 18 Infrastructure and Other Users
Biomass fuel	Bio-fuel		N	

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source
Freshwater	Drinking water		N	N/A - terrestrial
Genetic resources	Genetic resources		Y	Chapter 10 Benthic and Intertidal Ecology; Chapter 11 Fish and Shellfish Ecology; Chapter 12 Marine Mammals; Chapter 13 Offshore Ornithology
Biochemicals, natural medicines, pharmaceuticals	Medical raw materials		Y	Chapter 10 Benthic and Intertidal Ecology; Chapter 11 Fish and Shellfish Ecology; Chapter 12 Marine Mammals; Chapter 13 Offshore Ornithology
Ornamental resources	Shells and natural stones		Y	Bing Maps
Regulating Services				
Air quality regulation	Pollutants		N	Chapter 26 Air Quality; Planning Inspectorate, 2017
Climate regulation	Carbon sequestration		Y	
Water regulation			N	Chapter 8 Marine Geology, Oceanography and Physical Processes; Chapter 20 Water Resources and Flood Risk
Erosion control			Y	Chapter 8 Marine Geology, Oceanography and Physical Processes
Water purification and waste treatment	Clean water		N	N/A - terrestrial
Pest and disease regulation			N	N/A - terrestrial
Soil regulation			N	N/A - terrestrial

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source
Pollination			N	N/A - terrestrial
Natural hazard regulation	Natural Defences		Y	Chapter 8 Marine Geology, Oceanography and Physical Processes; Chapter 20 Water Resources and Flood Risk
Cultural Services				
Recreation and ecotourism	Coastal angling		Y	Chapter 30 Tourism and Recreation
	Scuba diving		Y	Chapter 30 Tourism and Recreation
	Surfing		N	Chapter 30 Tourism and Recreation
	Windsurfing		N	Chapter 30 Tourism and Recreation
	Kitesurfing		N	Chapter 30 Tourism and Recreation
	Canoeing		N	Chapter 30 Tourism and Recreation
	Rowing		N	Chapter 30 Tourism and Recreation
	Sailing		Y	Chapter 30 Tourism and Recreation
	Bird watching/ wildlife watching		Y	Chapter 30 Tourism and Recreation
Ethical and spiritual value	Religion		?	

Type of services	Sub category	Identifying asset	Present (Y/N)	Data source
	Social interaction		Y	Chapter 30 Tourism and Recreation
	Traditions		?	
	Aesthetic		N	Chapter 30 Tourism and Recreation
	Wildlife (habitats and species)	Cultural value	Y	Chapter 30 Tourism and Recreation
Educational and inspirational value	Landscape	Iconic landscape	?	Chapter 17 Offshore and Intertidal Archaeology and Cultural Heritage
	Location/ heritage asset	Designated sites / structures	?	Chapter 17 Offshore and Intertidal Archaeology and Cultural Heritage
		Non-designated sites	?	Chapter 17 Offshore and Intertidal Archaeology and Cultural Heritage
Supporting Services				
Habitat			Y	Chapter 10 Benthic and Intertidal Ecology; Chapter 11 Fish and Shellfish Ecology; Chapter 12 Marine Mammals; Chapter 13 Offshore Ornithology
Nutrient cycling			Y	Gruber, 2008
Primary production			Y	
Water cycling			Y	

Type of services	Sub category	Offshore wind farm	Offshore cable corridor	Scoping Assessment
Provisioning services				
Food (wild)	Commercial fisheries	x	x	Adverse impacts on commercially harvested fish and shellfish populations may result in behavioural changes or declines in abundance, which could indirectly affect the productivity of the fishery. However, adverse impacts on commercially exploited species during the construction, operational and decommissioning phases of Norfolk Vanguard are assessed fully within Chapter 11 Fish and Shellfish Ecology and are not expected to exceed minor adverse significance. Consultation with fishermen highlighted that loss of fishing ground is the principal concern of fishermen and their representatives. However, adverse impacts due to loss of fishing ground during the construction, operational and decommissioning phases of Norfolk Vanguard are assessed fully within Chapter 11 Fish and Shellfish Ecology and are not expected to exceed minor adverse significance. It is not expected there will be any significant effects of loss of fishing area during the operational phase. It is therefore unlikely that there is any potential for displacement effects to occur with the result that the magnitude of displacement is assessed to be negligible. As none of the receptor groups have been assessed to have sensitivities above moderate, the resultant displacement impacts for all categories would also be of negligible significance. Impacts on an ecosystem scale are therefore not significant.
	Non-commercial fish species	x	x	As described in Chapter 11 Fish and Shellfish Ecology, potential impacts include: physical disturbance and temporary/permanent loss of habitat, increased suspended

Type of services	Sub category	Offshore wind farm	Offshore cable corridor	Scoping Assessment
	Diadromous species	o	x	sediment concentrations (SSCs) and sediment re-deposition, underwater noise, electromagnetic fields (EMFs). The total area disturbed under the worst case scenario for both OWF sites would be 15.7km^2. This accounts for a very small proportion of the area of each OWF site: 4.5% of the Norfolk Vanguard West area and 2.8% of the Norfolk Vanguard East area. Similarly, the maximum area of disturbance associated with the installation of export cables would also be relatively small (13km^2). The majority of fish species are highly mobile and able to make use of suitable undisturbed areas in the vicinity of the construction works, resulting in an impact of minor adverse significance for commercial fish species. However, it is recognised that sandeels, herring and shellfish species depend on specific substrates for burrowing or spawning. These species have been assessed further within Chapter 11 Fish and Shellfish Ecology and the impact of physical disturbance and temporary loss of habitat is also assessed to be of minor adverse significance for these species. As described in Chapter 11 Fish and Shellfish Ecology, due to the small spatial and temporal extents of increased suspended sediments and deposition associated with construction activities, the magnitude of the impact is considered to be low. In general terms, adult and juvenile fish, being mobile, would be expected to rapidly redistribute to undisturbed areas within their habitat range, and are therefore considered receptors of low sensitivity. This, in combination with the low magnitude of the effect associated with the Project, would result in an impact of minor adverse significance. It is recognised that species and life stages of relatively low mobility and those highly dependent on the presence of specific substrates, e.g. sandeels, herring and shellfish species, may have increased sensitivity to the impact of SSCs and sediment deposition. These species have been assessed further within Chapter 11 Fish and Shellfish Ecology and the impact of physical disturbance and temporary loss of habitat is also assessed to be of minor adverse significance for these species. The potential impact of noise on fish and shellfish may vary depending on the hearing sensitivity of each particular species. Fish species in which the swim bladder is involved

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				in hearing are the most sensitive to impacts of piling noise. However, adverse impacts of underwater noise are assessed fully within Chapter 11 Fish and Shellfish Ecology and are not expected to exceed minor adverse significance. Adverse impacts due to electromagnetic fields are assessed fully within Chapter 11 Fish and Shellfish Ecology and are not expected to exceed minor adverse significance. Impacts on an ecosystem scale are therefore not significant.
Biological raw materials	Aggregates	o	o	The closest aggregate dredging licences to the offshore project area are approximately 27km south west of Norfolk Vanguard West and 42km south west of Norfolk Vanguard East; therefore impacts on an ecosystem scale are not significant.
Genetic resources		x	x	None of the impacts assessed in the EIA would suggest a major adverse impact upon any species or stock which would affect it at a population scale. It is considered that therefore there is no pathway for impact upon the ecosystem service.
Biochemicals, natural medicines and pharmaceuticals		x	x	There is potential for currently unidentified resources / resource uses to be present within the offshore project area. However, as none of the ecological impact assessed within the EIA are considered significant at the population scale, it is considered that there is no pathway to impact future potential resources.
Regulation services				
Climate regulation	Carbon sequestration	o	o	Temporary loss of habitats which sequester carbon may occur. The total footprint of Norfolk Vanguard and therefore the maximum surface area of marine habitat capable of carbon sequestration is 828 km^2 – however the footprint of infrastructure within this would be minimal and de minimis when considering the Southern North Sea as a whole. Therefore impacts on an ecosystem scale are not significant.
Erosion control		o	o	Rapid cliff erosion is occurring in places including at Happisburgh South, and foreshore steepening is an issue. The shoreline management plan (AECOM, 2012) states that the intended erosion control at Happisburgh South is Managed Realignment over the next 100 years, meaning that beach and cliff erosion will be allowed to occur but in a controlled manner. The offshore cable route landfall is located at Happisburgh South;

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				however, the landfall installation will use horizontal directional drilling (HDD) to limit further erosion, therefore impacts on an ecosystem scale are not significant.
Cultural services				
Recreation and Tourism	Coastal angling	o	x	The landfall may provide opportunities for coastal angling along approximately 650m of coastline. This will be subject to temporary disturbance during the construction phase (up to 2 years). This temporary disturbance is negligible in the context of the available coastal angling provision with the local area, the county and on a national scale. This impact on an ecosystem scale is therefore not significant.
	Scuba diving	x	x	There are no known dive sites in the OWF, with diving focused on gullies and wreck sites off Blakeney, Sheringham and West Runton in North Norfolk. As such no impact pathway has been identified.
	Sailing	x	x	From The Wash around to Lowestoft there are nine sailing clubs. Eight of these sail dinghies close to the shore on the Broads. One at Lowestoft has the facilities for yachts that would be capable of travelling far enough out to sea to interact with the wind farm. The marine traffic survey recorded limited recreational vessel activity in the study area during summer period, and recorded only one sailing vessel in Norfolk Vanguard West during the winter period. As such the impacts are localised and are therefore not significant on an ecosystem scale.
	Bird/wildlife watching	o	x	This service is available in any location where public access and suitable habitats to support notable species occur. Public access routes are located adjacent to the landfall, and there is the potential for notable ornithology to be observed on the beach and in agricultural fields and offshore adjacent to these areas. Multiple public access routes are located within the cable route. None of these public access routes coincide with designed wildlife recreational assets (e.g. Wildlife Trust sites). As such the impacts are localised and are therefore not significant.
Ethical and spiritual value	Religion	o	o	There are no known religious sites located within the ecosystems within the offshore project area. As such no impact pathway has been identified.
	Social interaction	x	x	All public open spaces provide areas for social interaction. As no loss of space for social interaction will occur, the impact on an ecosystem scale is not significant.

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Educational and inspirational value		x	x	A component of the cultural value of wildlife is its existence value. A loss of suitable habitats for supporting legally protected and notable species will occur within the study area. However, as none of the ecological impact assessed within the EIA are considered significant at the population scale, it is considered that impacts on an ecosystem scale are not significant. There is potential for impacts upon known and unknown cultural heritage, however mitigation and management measures will ensure either that impact is avoided or that artefacts are recorded and input to the wider knowledge base. There would therefore be either no impact or an insignificant positive impact.
Supporting services				
Habitats and species		x	x	Habitat loss will occur from placement of structures on the seabed. The worst case habitat loss from Norfolk Vanguard is 13.4 km^2. This area is very small (2.3% of the OWF site) in relation to the habitat available within the wider Southern North Sea; therefore impacts on an ecosystem scale are not significant. Given the minimal impact upon habitats (and species such as fish) it is not considered that there will be any effects upon food webs within the offshore project area.
Nutrient cycling		x	x	Nutrient cycling occurs throughout the offshore project area. Temporary loss of these habitats may occur. The worst case habitat loss from Norfolk Vanguard is 15.7 km^2. This area is very small (2% of the OWF site) in relation to the habitat available within the wider Southern North Sea; therefore impacts on an ecosystem scale are not significant.
Primary production		x	x	Primary production occurs throughout the offshore project area, however the key primary producers will be phytoplankton which will not be affected by the installation and operation of infrastructure – there will be no footprint excluding phytoplankton and indeed shallow foundation structures may support the growth of algae. Therefore impacts on an ecosystem scale are not significant.
Water cycling		x	x	Water cycling occurs throughout the offshore project area largely in the form of evaporation. This process will not be affected by the installation and operation of

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				infrastructure, therefore there will be no impact on the ecosystem service.

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