Norfolk Boreas Offshore Wind Farm

Chapter 20

Water Resources and Flood Risk

Environmental Statement

Volume 1

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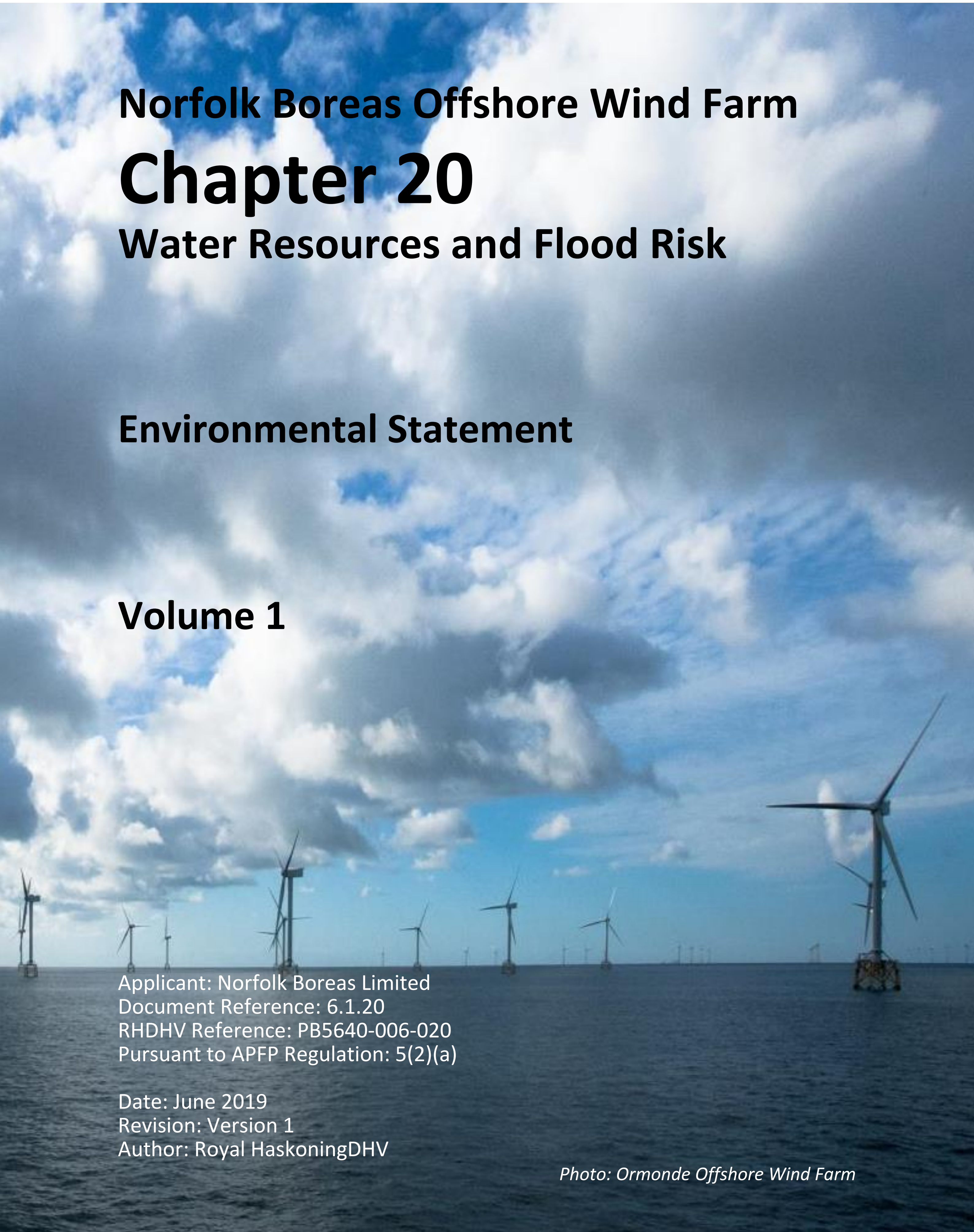

Photo: Ormonde Offshore Wind Farm

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Table of Contents

Tables

Figures (Volume 2)

Appendices (Volume 3)

Glossary of Acronyms

CoCP	Code of Construction Practice
CIA	Cumulative Impact Assessment
CIRIA	Construction Industry Research and Information Association
CMS	Construction Method Statement
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for Environment, Food & Rural Affairs
DMRB	Design Manual for Roads and Bridges
EC	European Commission
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act
GEP	Good Ecological Potential
GES	Good Ecological Status
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IDB	Internal Drainage Board
LNR	Local Nature Reserve
NCC	Norfolk County Council
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPS	National Policy Statement
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
RBD	River Basin District
RBMP	River Basin Management Plan
RIGS	Regionally Important Geological Site
SAC	Special Area of Conservation
SNCI	Site of Nature Conservation Interest
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
VWPL	Vattenfall Wind Power Limited
WCS	Worst Case Scenario
WFD	Water Framework Directive
WMA	Water Management Alliance

Glossary of Terminology

Cable pulling	Installation of cables within pre-installed ducts from jointing pits located along the onshore cable route.
Ducts	A duct is a length of underground piping, which is used to house electrical and communication cables.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and information to support the HRA.
Interconnector cables	Offshore cables which link offshore electrical platforms within the Norfolk Boreas site
Jointing pit	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	Where the offshore cables come ashore at Happisburgh South.
Landfall compound	Compound at landfall within which HDD drilling would take place
Link boxes	Underground chambers or above ground cabinets next to the cable trench housing low voltage electrical earthing links.
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 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 grid connection location for Norfolk Boreas and Norfolk Vanguard
Onshore 400kV cable route	Buried high-voltage cables linking the onshore project substation to the Necton National Grid substation
Onshore cable corridor	A 100m wide corridor presented at Scoping within which the onshore cable route has now been defined.
Onshore cable route	The up to 35m working width within a 45m wide corridor 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 power and communications from landfall to the onshore project substation
Onshore project area	The area of the onshore infrastructure (landfall, onshore cable route, accesses, trenchless crossing zones and mobilisation areas; onshore project substation and extension to the Necton National Grid substation and overhead line modifications).

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.
Running track	The track along the onshore cable route which the construction traffic would use to access workfronts.
The Applicant	Norfolk Boreas Limited
The project	Norfolk Boreas Wind Farm including the onshore and offshore infrastructure.
Transition pit	Underground structures that house the joints between the offshore export cables and the onshore cables.
Trenchless crossing zone (e.g. HDD)	Areas within the onshore cable route which will house trenchless crossing entry and exit points.
Water Management Alliance	A group of 5 Internal Drainage Boards (IDBs) operating in the Anglian Region. WMA members include Broads IDB, East Suffolk IDB, King’s Lynn IDB, Norfolk Rivers IDB and South Holland IDB.
Workfront	A length of onshore cable route within which duct installation works will occur, approximately 150m.

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20 WATER RESOURCES AND FLOOD RISK

20.1 Introduction

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the Norfolk Boreas Offshore Wind Farm (hereafter 'the project') on water resources and flood risk. The chapter provides an overview of the existing baseline where the onshore project area is proposed, followed by an assessment of the potential impacts and associated mitigation for the construction, operation, and decommissioning of the project.

2. Vattenfall Wind Power Limited (VWPL) (the parent company of Norfolk Boreas Limited) is also developing Norfolk Vanguard, a 'sister project' to Norfolk Boreas. In order to minimise impacts associated with onshore construction works for the two projects, Norfolk Vanguard are seeking to obtain consent to undertake enabling works for both projects at the same time. However, Norfolk Boreas needs to consider the possibility that Norfolk Vanguard may not proceed to construction.

3. The Environmental Impact Assessment (EIA) will therefore be undertaken using the following two alternative scenarios (further details are presented in Chapter 5 Project Description) and an assessment of potential impacts has been undertaken for each scenario:

   - **Scenario 1** – Norfolk Vanguard proceeds to construction and installs ducts and other shared enabling works for Norfolk Boreas.
   - **Scenario 2** – Norfolk Vanguard does not proceed to construction and Norfolk Boreas proceeds alone. Norfolk Boreas undertakes all works required as an independent project.

4. The assessment also considers cumulative impacts of other proposed projects. The proposed methodology adhered to for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) is discussed in section 20.8.

5. Figures which accompany the text in this chapter are provided in Volume 2 Figures.

6. This chapter should also be read in conjunction with Chapter 22 Onshore Ecology and Chapter 19 Ground Conditions and Contamination due to the close association between water resources and flood risk, onshore ecology and ground conditions.

7. Additional information to support the assessment of impacts on water resources and flood risk is provided separately in the following appendices:

   - Appendix 20.1 Flood Risk Assessment (FRA);
   - Appendix 20.2 Water Framework Directive (WFD) Compliance Assessment; and
   - Appendix 20.3 Geomorphological Walkover Survey.

20.2 Legislation, Guidance and Policy

8. There are a number of pieces of legislation, policy and guidance applicable to water resources and flood risk. The following sections provide detail on key pieces of international and UK legislation, policy and guidance which are relevant to water resources and the FRA as it has influenced the sensitivity of receptors and requirements for mitigation or the scope and/or methodology for the ES.

9. Further detail on legislation and policy in relation to the wider project is provided in Chapter 3 Policy and Legislative Context.

20.2.1 International

20.2.1.1 Water Framework Directive (2000 / 60 / EC)

10. The Water Framework Directive (WFD) (Council Directive 2000/60/EC establishing a framework for community action in the field of water policy) was adopted by the European Commission (EC) in December 2000.

11. The WFD requires that all European Union (EU) Member States must prevent deterioration and protect and enhance the status of aquatic ecosystems. This means that Member States must ensure that new schemes do not adversely impact upon the status of aquatic ecosystems, and that historical modifications that are already impacting it need to be addressed.

12. Unlike the EU Birds and Habitats Directives (European Commission (EC) Directive on the Conservation of Wild Birds (2009/147/EC) and EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC), respectively), which apply only to designated sites, the WFD applies to all water bodies (rivers, lakes, estuaries, coastal waters and groundwater) including those that are man-made.

20.2.2 National

20.2.2.1 Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

13. The WFD was transposed into national law in the UK by means of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. These regulations were updated by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The Regulations provide for the implementation of the WFD, from designation of all surface waters (rivers, lakes, estuarine waters, coastal waters and ground waters) as water bodies, and set objectives for the achievement of Good Ecological Status (GES) or Good Ecological Potential (GEP).

20.2.2.2 Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015

14. The standards used to determine the ecological or chemical status of a water body are provided in the WFD (Standards and Classification) Directions (England and Wales) 2015. This includes the thresholds for determining the status of the biological, hydromorphological, physico-chemical and chemical status of surface water bodies, and the quantitative and chemical status of groundwater bodies.

20.2.2.3 National Planning Policy Framework (2018) and supporting guidance

15. The National Planning Policy Framework (NPPF) sets out the UK Government planning policies for England. The NPPF seeks to ensure that flood risk is considered at all stages in the planning and development process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at risk of flooding.

16. The National Planning Practice Guidance (NPPG) on Flood Risk and Coastal Change supports the NPPF with additional guidance on flood risk vulnerability classifications and managing residual risks. The NPPG makes use of the concepts of Flood Zones, Vulnerability Classifications and Compatibility in order to assess the suitability of a specific site for a certain type of development.

17. The NPPF directs development away from areas at highest risk of flooding via the application of the Sequential Test. If, following application of the Sequential Test, it is not possible for the project to be located in zones with a lower probability of flooding; the Exception Test can be applied if appropriate.

20.2.2.4 National Policy Statements

18. The assessment of potential impacts upon water resources and flood risk has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to the project are:

- Overarching NPS for Energy (EN-1) (DECC, 2011a);
- NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

19. Chapter 3 Policy and Legislative Context provides further detail with regards to these NPSs. The specific assessment requirements for water resources and flood risk, as detailed in the NPSs, are summarised in Table 20.1, together with an indication of the section number of the ES chapter where each is addressed.

Table 20.1 NPS assessment requirements

NPS Requirement	NPS Reference	ES Reference
EN-1 Overarching NPS for Energy		
'Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Infrastructure Planning Commission (IPC) consider thoroughly the potential effects of a proposed project.'	Section 5.3	Existing environment is discussed in section 20.6. Impacts are set out in sections 20.7 and 20.8.
'Where a proposed development on land within or outside an SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), development consent should not normally be granted. Where an adverse effect, after mitigation, on the site's notified special interest features is likely, an exception should only be made where the benefits (including need) of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.'	Section 5.3	Impacts on surface water habitats which support SSSIs are set out in sections 20.7 and 20.8.
'Applications for energy projects of 1 hectare or greater in Flood Zone 1 in England or Zone A in Wales and all proposals for energy projects located in Flood Zones 2 and 3 in England or Zones B and C in Wales should be accompanied by a flood risk assessment (FRA). An FRA will also be required where an energy project less than 1 hectare may be subject to sources of flooding other than rivers and the sea (for example surface water), or where the EA, Internal Drainage Board or other body have indicated that there may be drainage problems. This should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account.'	Section 5.7	Impacts on flood risk are set out in sections 20.7 and 20.8, and Appendix 20.1.
'Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent. The ES should in particular describe: • the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing	Section 5.15	Impacts on surface and groundwater resources are set out in sections 20.7 and 20.8. Impacts under the WFD are assessed in Appendix 20.2.

NPS Requirement	NPS Reference	ES Reference
discharges, proposed new discharges and proposed changes to discharges; • existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies); • existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and • any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions.'		

20.2.2.5 Flood and Water Management Act 2010

20. The Flood and Water Management Act (FWMA) was passed in 2010. It aims to improve both flood risk management and the way we manage our water resources by creating clearer roles and responsibilities. This includes a new lead role for local authorities in managing local flood risk (from surface water, ground water and ordinary watercourses) and a strategic overview role of all flood risk for the Environment Agency. The implications of the FWMA provide opportunities for a more comprehensive, risk-based approach on land use planning and flood risk management by local authorities and other key partners.

20.2.3 Regional

20.2.3.1 Anglian River Basin District: River Basin Management Plan (2015)

21. The River Basin District Management Plan (RBMP) is a strategic document that sets out the objectives that have been set for implementation of the WFD at a regional (River Basin District (RBD)) level. The purpose of a RBMP is to provide a framework for protecting and enhancing the benefits provided by the water environment. To achieve this, and because water and land resources are closely linked, it also informs decisions on land-use planning.

22. The second RBMP for the Anglian RBD was finalised by Defra and the Environment Agency in December 2015 and published in February 2016. This document sets out the current state of the water environment according to WFD parameters, pressures affecting the water environment, environmental objectives for protecting and improving the waters, programme of measures to improve the water environment and deliver WFD objectives, actions needed to achieve the objectives, progress since

the 2009 RBMP, and also informs decisions on land-use planning because water and land resources are closely linked.

20.2.3.2 Preliminary and Strategic Flood Risk Assessments

23. The project onshore cable route is approximately 60km and as such falls within a number of local authority boundaries.

24. The onshore project area falls wholly under the jurisdiction of Norfolk County Council and the following local authorities:

- Breckland Council;
- Broadland District Council; and
- North Norfolk District Council.

25. Breckland Council produced its own updated Stage 1 Strategic FRA for its council area in February 2017, whilst North Norfolk District Council and Broadland District Council worked together and with others to produce a Partnership Strategic FRA in December 2007 covering both Districts. Norfolk County Council produced a Preliminary FRA for the entire county in July 2011.

20.2.3.3 Local Flood Risk Management Strategy

26. Norfolk County Council produced the Norfolk Local Flood Risk Management Strategy in 2015 which outlines the aims and objectives the council has as Lead Local Flood Authority and provides policies based on these aims. As Lead Local Flood Authority, Norfolk County Council sets flood risk policy and produces strategic documents that are relevant to the entire county. Local district councils produce more localised policies (specific to the flood risk posed to their geographical boundaries) that sit within the county wide strategy.

20.2.4 Local

27. Table 20.2 provides details of the local planning policy documents and the policies contained within these relevant to water resources and flood risk.

Table 20.2 Relevant local planning policies

Document	Policy/guidance	Policy/guidance purpose
North Norfolk District Council		
Local Development Framework, comprising a number of Development Plan Documents, including a Core Strategy and Development Management Policies document (North Norfolk District Council, 2012)	Development Management Policy EN10 – 'Development and Flood Risk'	"The sequential test will be applied rigorously across North Norfolk and most new development should be located in Flood Risk Zone 1. New development in Flood Risk Zones 2 and 3a will be restricted to the following categories: • Water compatible uses; • Minor development (xii);

Document	Policy/guidance	Policy/guidance purpose
		• Changes of use (to an equal or lower risk category in the flood risk vulnerability classification) where there is no operational development (xiii); and • 'Less vulnerable' uses where the sequential test has been passed."
	Strategic Policy	In addition, the adopted Core Strategy includes the following Strategic Policy, relevant for the project: "Renewable energy proposals will be supported and considered in the context of sustainable development and climate change, taking account of the wide environmental, social and economic benefits of renewable energy gain and their contribution to overcoming energy supply problems in parts of the District."
	Appendix B (North Norfolk Ecological Network) of North Norfolk District Council's Policy EN 9 on Biodiversity	The policy identifies the Rivers Wensum, Bure and Ant, their tributaries and floodplains as a core area for biodiversity, where protection, enhancement and expansion of the existing resource will be a priority. Chalk river BAP habitat in the Wensum and Bure is identified as being a particular priority in the county. The policy also sets out four objectives for river habitats: • Produce river restoration plans; • Create habitat ecotones from wet to dry habitat; • Buffer floodplains by encouraging low input agricultural systems or semi-natural habitats; and • Enhance connectivity through creating new wetland linkages and enhancing the matrix (land uses surrounding a wetland).
Breckland Council		
The Breckland Council Core Strategy and Development Control Policies Development Plan Document (2012)	Strategic Objectives (SO13).	This Core Strategy document highlights delivering development within sustainable locations that are "not at risk of flooding" as a priority, with the minimisation of the risk of flooding to existing and new developments.
	Strategic Objective 12 (SO12)	"Promote renewable energy to reduce carbon emissions."
Broadland District Council		
Broadland District Council Local Plan (Joint Core Strategy DPD for	Objective 1 of the Spatial Planning Objectives	This Strategy recognises flooding as a key concern, where it states:

Document	Policy/guidance	Policy/guidance purpose
Broadland, Norwich and South Norfolk District Councils (2014))		"New development will generally be guided away from areas with a high probability of flooding. Where new development in such areas is desirable for reasons of sustainability (e.g. in the city centre), flood mitigation will be required and flood protection will be maintained and enhanced."

20.3 Consultation

28. Consultation is a key driver of the EIA process, and is an ongoing process throughout the lifecycle of the project, from the initial stages through to consent and post-consent. To date, consultation regarding water resources and flood risk has been conducted through the Scoping Report (Royal HaskoningDHV, 2017), the Evidence Plan Process (EPP), namely the Water Resources and Flood Risk Method Statement (Royal HaskoningDHV, 2018, unpublished) and the Preliminary Environmental Information Report (PEIR) (Norfolk Boreas Limited, 2018). Feedback received during the process to date has been incorporated into this ES.

29. Further consultation has been undertaken through an Expert Topic Group (ETG) meeting held in February 2019, to discuss and agree feedback received on the PEIR.

30. As the majority of the onshore infrastructure for Norfolk Boreas and Norfolk Vanguard is co-located, the pre-application consultation undertaken for Norfolk Vanguard is relevant to both projects and has been used to inform the approach to this assessment. In addition, where possible any comment received as part of the Norfolk Vanguard examination process, up to Deadline 5 (20th March 2019) have also be considered. The Norfolk Vanguard responses considered are provided in Appendix 20.5.

31. A summary of the Norfolk Boreas consultation that has been undertaken to date with respect to water resources and flood risk is provided in Table 20.3.

Table 20.3 Norfolk Boreas Consultation Responses

Consultee	Document /Date	Comment	Response / where addressed in the ES
Secretary of State	Scoping Opinion June 2017	It is not entirely clear from the Scoping Report whether effects on the River Wensum SAC/SSSI will be covered in the onshore ecology section of the ES or in the section dealing with water resources and flood risk. Given the statutory ecological designations covering the River Wensum the SoS recommends that the ecological effects are reported in the onshore ecology	Ecological impacts on the River Wensum SAC/SSSI are considered within Chapter 22 Onshore Ecology. Impacts on the hydrology, geomorphology and water quality in the

Consultee	Document /Date	Comment	Response / where addressed in the ES
		chapter with appropriate cross referencing to the water resources chapter.	SAC/SSSI are assessed in section 20.7.
Environment Agency	Scoping Opinion June 2017	Question 1 Table 3.6 of the document confirmed that data has been obtained from our Flood Map for planning in 2012. Further modelling has been completed of the Bure and Yare Rivers since 2012, and the baseline data may therefore need updating as the flood map for planning may have been updated. The most recent data should be obtained from us prior to the writing of the Flood Risk Assessment.	The latest flood risk data has been obtained from the Environment Agency and included in the Flood Risk Assessment (Appendix 20.1).
Secretary of State	Scoping Opinion June 2017	Consideration should be given to the potential impacts on the coastal defence works proposed around Bacton, as noted within NE's response (see Appendix 3 of this Opinion).	The potential impacts on the coastal defence works proposed around Bacton are considered within section 20.8.
Secretary of State	Scoping Opinion June 2017	The SoS welcomes reference to the preparation of a draft drainage strategy at paragraph 1006 of the Scoping Report and recommends that this be provided with the ES. The location of any swales and/or attenuation basins used to mitigate flood risk should be identified. The assessment should consider potential effects of the Proposed Development on existing field drainage patterns and any potential inter-related effects on the quantity and quality of productive farmland. The SoS welcomes the proposal that all drainage systems would be fully reinstated in consultation with landowners and drainage contractors (paragraph 1081 of the Scoping Report). Advice from Norfolk County Council on a drainage strategy is provided in Appendix 3 of this Opinion.	Impacts on drainage are described in sections 20.7.4.4.1 and 20.7.5.1. Embedded drainage measures are described in section 20.7.1.
Secretary of State	Scoping Opinion June 2017	In relation to HDD activities, the ES should address potential risks to both groundwater resources and surface water bodies from leakage of drilling fluid and provide details of measures that will be implemented to address such risks and how they will be secured as part of the CoCP or otherwise in the DCO. The Applicant's attention is also	Potential risks to both groundwater resources and surface water bodies are assessed in section 20.7.

Consultee	Document /Date	Comment	Response / where addressed in the ES
		drawn to the consultation response from the Environment Agency in this regard (Appendix 3 of this Opinion).	
Secretary of State	Scoping Opinion June 2017	The Applicant is advised to consider the necessary responsibilities in relation to working over or crossing of main rivers including any permits or licences that may be required (for example Flood Risk Activity Permits under the Environmental Permitting regulations). References to any water resources licensing that may be required should be outlined as part of the ES, particularly where the residual effects reported in the ES are wholly or partly reliant on the grant of such licenses.	Norfolk Boreas Limited notes its responsibilities in relation to working over or crossing main rivers, and will obtain any permits or licences that may be required through consultation with the Environment Agency and other appropriate regulatory bodies.
Anglian Water	Scoping Opinion June 2017	Reference is made to an onshore cable corridor to be shared with Norfolk Vanguard and the construction of a cable relay station (if required). At this stage, it is unclear whether there is a requirement for potable water and wastewater services. The extent of proposed cable corridor is to be refined further by the applicant. Therefore, the extent to which existing water and water recycling assets would be affected will need to be defined with the assistance of Anglian Water.	The requirement for potable water and wastewater services is outlined in section 20.7.1. Potential impacts on buried services are assessed in Chapter 21 Land Use and Agriculture. Due to Norfolk Boreas's commitment to HVDC transmission, cable relay stations no longer form part of this project (Chapter 4 Site Selection and Assessment of Alternatives)
Anglian Water	Scoping Opinion June 2017	Reference is made to the evidence provided by the Environment Agency in relation to the risk of fluvial and surface water flooding. Anglian Water is responsible for managing the risks of flooding from surface water, foul water or combined water systems. Consideration should be given to all potential sources of flooding including sewer flooding.	Consideration has been given to all potential sources of flooding including sewer flooding in the Flood Risk Assessment (Appendix 20.1).
Anglian Water	Scoping Opinion June 2017	The Environmental Statement should include reference to Anglian Water's existing assets and any potential impacts from the above development. We would expect any requests for alteration or removal of foul sewers or	Requests for removal or alteration will be undertaken by Norfolk Boreas Limited in consultation with Anglian Water. Further

Consultee	Document /Date	Comment	Response / where addressed in the ES
		water mains to be conducted in accordance with the Water Industry Act 1991.	information on buried services is provided in Chapter 21 Land Use and Agriculture.
Public Health England	Scoping Opinion June 2017	When considering a baseline (of existing water quality) and in the assessment and future monitoring of impacts these: • should include assessment of potential impacts on human health and not focus solely on ecological impacts • should identify and consider all routes by which emissions may lead to population exposure (e.g. surface watercourses; recreational waters; sewers; geological routes etc.) • should assess the potential off-site effects of emissions to groundwater (e.g. on aquifers used for drinking water) and surface water (used for drinking water abstraction) in terms of the potential for population exposure • should include consideration of potential impacts on recreational users (e.g. from fishing, canoeing etc.) alongside assessment of potential exposure via drinking water	All potential human health impacts will be assessed, with all routes where emissions may lead to population exposure considered, and the potential offsite effects of emissions to groundwater and consideration of potential impacts on recreational users assessed. This will be assessed within the Chapter 27 Human Health.
Norfolk County Council	Method Statement, February 2018	Confirmed agreement on: baseline coverage, proposed methodology, use of the same survey data used to assess the impacts of Norfolk Vanguard in the assessment of the impacts of Norfolk Boreas, and the scope of impacts considered.	No response required.
Environment Agency	Method Statement, February 2018	No specific comments on baseline coverage, proposed methodology, coverage of potential impacts or the use of survey data used to assess the impacts of Norfolk Vanguard in the assessment of impacts of Norfolk Boreas.	No response required.
Water Management Alliance (Internal Drainage Board)	Method Statement, February 2018	No specific comments on baseline coverage, proposed methodology, coverage of potential impacts or the use of survey data used to assess the impacts of Norfolk Vanguard in the assessment of impacts of Norfolk Boreas.	No response required.

Consultee	Document /Date	Comment	Response / where addressed in the ES
Anglian Water	Method Statement, February 2018	No specific comments on baseline coverage, proposed methodology, coverage of potential impacts or the use of survey data used to assess the impacts of Norfolk Vanguard in the assessment of impacts of Norfolk Boreas.	No response required.
Natural England	Method Statement, February 2018	Confirmed agreement on baseline coverage, proposed methodology and use of survey data used to assess the impacts of Norfolk Vanguard in the assessment of impacts of Norfolk Boreas. Added that further clarification is required on whether HDD has the potential to affect the interaction between groundwater and surface water, and if so, what the nature and scale of this interaction is.	Further information on groundwater impacts is provided for Scenario 2 in section 20.7.4 and Chapter 19 Ground Conditions and Contamination.
Environment Agency	PEIR, October 2018	Requested that mitigation measures are considered post completion of works to help water bodies achieve 'Good' status under the WFD. Highlighted that, should work result in the raising of ground levels, local flood risk should be considered and compensated for. Requested that careful consideration of the impacts upon the watercourse should be made when applying for the open trench crossings, and recommended that assessments should demonstrate that impacts will be kept to a minimum and crossings will be kept to the original standard, ideally with enhancement. An environmental permit for flood risk activities will be required for works in, under, over or within 8m of a fluvial main river/any flood defence structure or culvert/16m from a tidal main river/from any flood defence structure or culvert. Potential risks associated with other sources of flooding should be considered.	Enhancements to water bodies directly affected by the project will be considered as part of the reinstatement process, although due to the restrictions associated with the DCO process these will be limited to within the project red line boundary. Considered in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1. Details are provided in Section 20.7.4.1 addressing trench techniques and impacts upon watercourses. This will be included in the CoCP for consideration during post-consent. Environmental Permits will be applied for post-consent. Considered in detail in Appendix 20.1.
Norfolk County Council	PEIR, October 2018	It has not been determined what method of discharging surface water will be utilised in the final design and	Site-specific methods for discharging surface waters will be

Consultee	Document /Date	Comment	Response / where addressed in the ES
		no assessment of the current or proposed runoff rates has been undertaken. NCC would wish to see that drainage strategies contain maintenance and management plans detailing the activities required and who will adopt and maintain the surface water drainage features for the lifetime of the development.	confirmed during the post-consent design stage through the development of a drainage strategy. The drainage strategy will include maintenance and management plans.
		The project should consider the flood risk it could introduce elsewhere as well as to the development. Risk to any nearby properties should also be considered.	Considered in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.
		There are many ordinary watercourses within the proposal area and these also have a flood risk associated with them (equivalent to flood zone 2 and 3) as defined by the Environment Agency online Flood Map for Planning. which are not shown on the EA map. This should be considered and all sources of flooding should be assessed.	Considered in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.
		Where the proposals involve works to any ordinary watercourse (temporary or permanent) a consent will be required. The number of these, where applicable, should be determined and applications for block, or phased consents should be made to the appropriate authority, including the flood and water management team at NCC or the Internal Drainage Board. Environmental permits/consents will likely be required for crossing points over ditches and watercourses.	Necessary permits and consents will be obtained post-consent in consultation with the Environment Agency, LLFA and IDB.
		The methodology for any temporary construction at crossing points shall be agreed with the EA and relevant Local Authority. Management techniques will be required to mitigate surface water flooding at the location of the National Grid substation extension.	A detailed methodology will be prepared during the post-consent design stage and agreed with the Environment Agency and LLFA.
		Original flow rates to be maintained to ensure flood risk is not increased during the temporary damming/re-routing of watercourses during onshore cable corridor construction.	Addressed in sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.

Consultee	Document /Date	Comment	Response / where addressed in the ES
		Confirmation of the minimum depth of cables beneath watercourses is required.	Minimum depth clarified in Sections 20.7.2 and 20.7.4.1. The cable will be a minimum of 2m below the bed at all trenchless crossings and minimum 1.5m below bed level at trenched crossings.
		Post-construction, watercourses should be reinstated to pre-construction channel depths and bank slopes.	The reinstated channel will have at least the same capacity as the pre-construction channel to prevent impacts on flood risk, although bank profiles may vary according to the agreed scope of environmental enhancements.
		Mitigation of the existing flood risk at key crossing points during the construction phase should be managed.	
		Construction work located within Flood Zone 2 or 3, or within proximity to an ordinary watercourse should undertake suitable risk assessments.	Addressed in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.
		Consideration regarding signing up to Met Office weather alerts required for Ordinary Watercourses.	Addressed in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.
		This risk of creating a 'conduit' should be considered when assessing any back-fill materials to the trench, and how this could affect the local flow routes. The surface water drainage requirements for the permanent compounds will be dictated by the final drainage study.	Addressed in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.
		There is no assessment of the current and proposed runoff rates to determine the surface water attenuation requirements for the sites in line with The SuDS Manual (2015), which should indicate that the flow rate discharged from the sites must not exceed that prior to the proposed development for the 1 in 1 year event; 1 in 30 year event; and 1 in 100 year event. The sites have not yet been assessed against a 'greenfield' baseline, assumed to be 100% permeable surfacing. Further information should be	Site-specific methods for discharging surface waters will be confirmed during the post-consent design stage through the development of a drainage strategy.

Consultee	Document /Date	Comment	Response / where addressed in the ES
		requested to be provided at design stage. At present, it has not been determined what method of discharging surface water will be utilised in the final design and no assessment of the current or proposed runoff rates has been undertaken. The County would also wish to see that any drainage strategies contain maintenance and management plans detailing the activities required and who will adopt and maintain the surface water drainage features for the lifetime of the development.	Addressed in Sections 20.7.4.4 and 20.7.5.1 and Appendix 20.1.
Burgh and Tuttington Parish Council	PEIR, October 2018	Concerns raised regarding changes in sediment levels in King's Beck or other factors which might affect its flow or flooding downstream, and the introduction of pollutants into King's Beck which pass downstream.	Impacts associated with increased sediment supply are discussed in Sections 20.7.4.2 and 20.8.2.2. Impacts associated with the release of contaminants are assessed in Sections 20.7.4.3 and 20.8.2.2. Impacts on flood risk are discussed in Sections 20.7.4.4 and 20.7.5.1, and Appendix 20.1.
Anglian Water	PEIR, October 2018	Reference is made to a number of groundwater source protection zones (SPZs) located within the onshore project area. It is essential to protect the aquifer and Anglian Water's existing assets from contamination from any activities that might cause pollution. Anglian Water are currently in dialogue with Vattenfall and their appointed consultants regarding the proposed crossings of groundwater Source Protection Zones which include public water supplies in Anglian Water's ownership within the onshore cable route. Anglian Water have previously requested that the Environmental Report for the above project includes reference to all potential sources of flooding including sewer flooding. We welcome the inclusion of reference to sewer flooding in the Flood Risk Assessment as part of the above report.	Potential impacts on groundwater and SPZs are considered in Section 20.7.4.3.

Consultee	Document /Date	Comment	Response / where addressed in the ES
		Reference is made to potential foul and surface water connections to public sewerage for the proposed substation site - a preferred option for the proposed method of drainage has yet to be identified. Anglian Water would welcome further discussion about any required connection(s) to the public sewerage network for the onshore project substation or as part of the construction phase. In relation to surface water disposal, regard should be had to Anglian Water's Surface Water Drainage Policy1 which specifies the circumstances in which we would agree a surface water connection to the public sewerage network. Anglian Water would wish to be involved in the development of proposed Surface Water Management Drainage Plan where it interacts with the public sewerage network.	Requirements for foul and surface water connections at the onshore project substation will be confirmed through consultation with Anglian Water during the post-consent design stage.
Canal & River Trust	PEIR, October 2018	The Trust has reviewed the proposals, and on the basis that they appear unlikely to have any impact on waterways under their jurisdiction they have no comment to make at this time.	No response required.
Expert Topic Group Meeting attended by Natural England, Environment Agency and Water Management Alliance	PEIR, February 2019	Meeting to discuss feedback on PEIR and agree approach to ES.	No response required.

20.4 Assessment Methodology

20.4.1 Impact Assessment Methodology

32. Chapter 6 EIA Methodology details the general impact assessment method, and the following sections describe more specifically the methodology used to assess the potential impacts of the project on water resources and flood risk. Separately, more detailed methodologies for the FRA and WFD Compliance Assessment can be found in Appendix 20.1 and Appendix 20.2, respectively.

33. Two key groups of impacts have been identified for the purpose of defining impact significance:

- Water resources: These are potential effects on the physical (including hydrology and geomorphology), biological or chemical character of surface waters or groundwater, potentially impacting on secondary receptors such as wetlands or abstractions, and WFD water body status; and

- Flood risk: These are the potential impacts of the project on site drainage, conveyance and surface water flooding.

34. Whilst there are clear links between the two impact groups, the assessment of receptor sensitivity and the magnitude of effect may differ. Definitions of receptor sensitivity, value, magnitude of effect and the resulting impact significance are provided in the paragraphs below. These definitions have been developed with reference to guidance provided by the Department of Transport (2015) and Highways Agency (2008).

35. The assessment methodology follows the four-level classification of receptor sensitivity and value and impact magnitude recommended by the Department of Transport (2015) (i.e. high, medium, low, negligible) rather than the five-level system recommended in Highways Agency (2008) (very high, high, medium, low, negligible) to ensure that it is consistent with the approach adopted in the other chapters of the ES. However, the Highways Agency (2008) guidance has been fully consulted and used to inform the definition of each key assessment term where appropriate.

36. The impact assessment was undertaken using the two alternative scenarios, as detailed in section 20.1 and an assessment of potential impacts will be undertaken for each scenario, using the worst case assumptions applicable to each scenario.

20.4.1.1 Sensitivity

37. Receptor sensitivity has been defined with reference to the adaptability, tolerance, recoverability and value of individual receptors. Table 20.4 provides the criteria for appraisal of the value and sensitivity for identified water resources and flood risk receptors based on professional judgement.

Table 20.4 Definitions of sensitivity for water resources and flood risk receptors

Sensitivity	Definition	Criteria
High	Receptor has no or very limited capacity to accommodate changes to hydrology, geomorphology, water quality or flood risk.	*Water resources* Controlled waters with an unmodified, naturally diverse hydrological regime, a naturally diverse geomorphology with no barriers to the operation of natural processes, and good water quality. Supports habitats or species that are highly sensitive to changes in surface hydrology, geomorphology or water quality. Supports Principal Aquifer with public water supply abstractions by provision of recharge. Site is within Inner or Outer Source Protection Zones.
		Flood risk Highly Vulnerable Land Use, as defined by NPPF PPG (DCLG, 2015). Land with more than 100 residential properties (after DMRB, 2009).
Medium	Receptor has limited capacity to accommodate changes to hydrology, geomorphology, water quality or flood risk.	*Water resources* Controlled waters with hydrology that sustains natural variations, geomorphology that sustains natural processes, and water quality that is not contaminated to the extent that habitat quality is constrained. Supports or contributes to habitats or species that are sensitive to changes in surface hydrology, geomorphology and/or water quality. Supports Secondary A or Secondary B Aquifer with water supply abstractions. Site is within a Catchment Source Protection Zone.
		Flood risk More Vulnerable Land Use, as defined by NPPF PPG (DCLG, 2015). Land with between 1 and 100 residential properties or more than 10 industrial premises (after DMRB, 2009).
Low	Receptor has moderate capacity to accommodate changes to hydrology, geomorphology, water quality or flood risk.	*Water resources* Controlled waters with hydrology that supports limited natural variations, geomorphology that supports limited natural processes, and water quality that may constrain some ecological communities. Supports or contributes to habitats that are not sensitive to changes in surface hydrology, geomorphology or water quality. Supports Secondary A or Secondary B Aquifer without abstractions.
		Flood risk Less Vulnerable Land Use, as defined by NPPF PPG (DCLG, 2015). Land with 10 or fewer industrial properties (after DMRB, 2009).
Negligible	Receptor is generally tolerant of changes to hydrology,	*Water resources* Controlled waters with hydrology that does not support natural variations, geomorphology that does not support natural processes, and water quality that constrains ecological communities.

Sensitivity	Definition	Criteria
	geomorphology, water quality or flood risk.	Aquatic or water-dependent habitats and/or species are tolerant to changes in hydrology, geomorphology or water quality. Non-productive strata that does not support groundwater resources.
		Flood risk Water Compatible Land Use, as defined by NPPF PPG (DCLG, 2015). Land with limited constraints and a low probability of flooding of residential and industrial properties (after DMRB, 2009).

20.4.1.2 Value

38. It should be noted that high value and high sensitivity are not necessarily linked with respect to a particular impact. A receptor could be of high value but have a low sensitivity to an effect. It is therefore important not to inflate the significance of an impact due to the value of the receptor. Instead, the value can be used as a modifier for the sensitivity assigned to the receptor. Definitions for the value of surface waters are provided in Table 20.5.

Table 20.5 Definitions of value levels for water resources and flood risk receptors

Value	Criteria
High Receptor is an internationally or nationally important resource with limited potential for offsetting / compensation.	*Water resources* • Supports or contributes to designated habitats or species of international importance (e.g. Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site)); and/or • Licensed potable abstractions (surface water and groundwater).
	Flood Risk • Nationally significant infrastructure; and/or • Internationally or nationally designated planning policy areas.
Medium Receptor is a regionally important resource with limited potential for offsetting / compensation.	*Water resources* • Supports or contributes to habitats with high biodiversity or species of national importance (e.g. Site of Special Scientific Interest (SSSI)); and/or • Licensed non-potable abstractions and unlicensed potable abstractions (surface water and groundwater).
	Flood Risk • Locally significant infrastructure; and/or • Local planning policy designated sites.
Low Receptor is a locally important resource.	*Water resources* • Supports or contributes to habitats or species of UK regional or local value (Local Nature Reserve (LNR), Site of Nature Conservation Interest (SNCI), Regionally Important Geological Site (RIGS)); • Unlicensed non-potable abstractions (surface water and groundwater).
	Flood Risk • Drainage that does not discharge to Critical Drainage Areas.
Negligible Receptor is not considered to be an important resource.	*Water resources* • Aquatic or water-dependent habitats and/or species are not sensitive to changes in hydrology, geomorphology or water quality. The waters are tolerant to the proposed changes; and/or • No abstractions (surface water and groundwater).
	Flood Risk • No significant infrastructure.

20.4.1.3 Magnitude

39. Receptor magnitude has been defined with consideration to the spatial extent, duration, frequency and severity of the effect. Impact magnitude is defined in Table 20.6.

Table 20.6 Definitions of magnitude of effect for water resources and flood risk receptors

Magnitude	Definition	Criteria
High	Permanent or large-scale change affecting usability, risk, or value over a wide area.	*Water resources* Permanent changes to geomorphology and/or hydrology that prevent natural processes operating. Permanent and/or wide scale effects on water quality or availability. Permanent loss or long-term degradation of a water supply source resulting in prosecution. Permanent or wide scale degradation of habitat quality.
		Flood risk Permanent or major change to existing flood risk. Reduction in on-site flood risk by raising ground level in conjunction with provision of compensation storage. Increase in off-site flood risk due to raising ground levels without provision of compensation storage. Failure to meet either sequential or exception test (if applicable).
Medium	Moderate permanent or long-term reversible change affecting usability, value, or risk, over the medium- term or local area.	*Water resources* Medium-term effects on water quality or availability. Medium-term degradation of a water supply source, possibly resulting in prosecution. Habitat change over the medium-term.
		Flood risk Medium-term or moderate change to existing flood risk. Possible failure of sequential or exception test (if applicable). Reduction in off-site flood risk within the local area due to the provision of a managed drainage system.
Low	Minor permanent change over the short-term or within the site boundary with minimal effect on usability, risk or value.	*Water resources* Short-term or local effects on water quality or availability. Short-term degradation of a water supply source. Habitat change over the short-term.
		Flood risk Short-term temporary or minor change to existing flood risk. Localised increase in on-site or off-site flood risk due to increase in impermeable area. Passing of sequential and exception test.
Negligible	Temporary change, undiscernible over the medium- to long-term, with no effect on usability, risk or value.	*Water resources* Intermittent impact on local water quality or availability. Intermittent or no degradation of a water supply source. Very slight local changes to habitat that have no observable impact on dependent receptors.
		Flood risk Intermittent or very minor change to existing flood risk. Highly localised increase in on-site or off-site flood risk due to increase in impermeable area.

20.4.1.4 Impact significance

40. The potential significance of an impact is a function of the sensitivity and value of the receptor and the magnitude of the effect. It should be noted that value and sensitivity are not necessarily linked with respect to a particular impact. A receptor could be of high value but have a low sensitivity to an effect. The value is therefore used as a modifier for the sensitivity assigned to the receptor.

41. The significance is derived using an impact significance matrix, as shown in Table 20.7. Definitions of each level of significance are provided in Table 20.8.

42. Assessment of impact significance is qualitative and reliant on professional experience, interpretation and judgement. The matrix should therefore be viewed as a framework to aid understanding of how a judgement has been reached, rather than as a prescriptive, formulaic tool. Note that impacts may be adverse or beneficial.

43. Effects that result in major or moderate impacts are considered to be 'significant' in EIA terms. Adverse significant impacts may require mitigation; beneficial significant impacts could contribute to the case in favour of the project.

Table 20.7 Impact significance matrix

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

Table 20.8 Impact Significance Definitions

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

Impact Significance	Definition
No change	No impact, therefore no changes in receptor condition.

20.4.2 Cumulative Impact Assessment

44. Chapter 6 EIA Methodology provides a general methodology with regards to the CIA.

45. The potential for cumulative effects has been considered for the construction, operation and decommissioning of the onshore project area cumulatively with the offshore project area as well as with other onshore projects.

46. Cumulative impacts are discussed where the project has the potential to overlap with similar effects arising from:

- Recent development, either built or under construction (which is not considered part of the baseline);
- Approved development, awaiting implementation; and
- Proposals awaiting determination within the planning process with design information in the public domain.

47. The onshore CIA involves consideration of whether impacts on a receptor can occur on a cumulative basis between the project and other activities, projects and plans for which sufficient information regarding location and scale exist.

48. The strategy recognises that data and information sufficient to undertake an assessment will not be available for all potential projects, activities, plans and/or parameters, and seeks to establish the 'confidence' which may be placed in the data and information available.

20.4.3 Transboundary Impact Assessment

49. There are no transboundary impacts with regards to water resources and flood risk as the onshore project area is not sited in proximity to any international boundaries. Transboundary impacts are therefore scoped out of this assessment and will not be considered further, as agreed with stakeholders during the scoping stage (Royal HaskoningDHV, 2017).

20.5 Scope

20.5.1 Study Area

50. The onshore project area and is shown on Figure 20.1. The onshore project area considered within this assessment includes the following elements:

- Landfall;

- Onshore cable route (including the running track reinstatement and jointing pits under Scenario 1 and duct installation, running track, trenchless crossings and mobilisation areas under Scenario 2);
- Onshore project substation; and
- Extension to the Necton National Grid substation (Scenario 1 and 2) and overhead line modification (Scenario 2 only).

51. A full description and associated information for the onshore project area is provided in Chapter 5 Project Description.

52. The study area for this assessment is defined on the basis of surface hydrological catchments, whereby catchments have been included in the study area if they contain or are hydrologically connected to (i.e. upstream or downstream where the potential for wider impacts have been identified), the onshore project area. The Environment Agency's WFD river water body catchments are based on surface hydrological catchments and have therefore been used to delineate the boundaries of the study area and define surface water receptors (Figure 20.1).

53. For the purposes of the WFD Compliance Assessment, the study area encapsulates all the surface (rivers, lakes, transitional and coastal water bodies) and groundwater bodies that are potentially hydrologically connected to both the onshore and offshore infrastructure associated with the project. This WFD Compliance Assessment study area is discussed further in Appendix 20.2.

20.5.2 Data Sources

54. The data sources used to inform the water resources and flood risk baseline, and the confidence levels associated with each data source, are listed in Table 20.9.

Table 20.9 Data sources

Data	Source	Year	Coverage	Confidence	Notes
Flood Map for Planning	Environment Agency	2018	Nationwide	High	N/A
Product 4 data	Environment Agency	2017	Landfall, onshore cable route, onshore project substation	High	Environment Agency Product 8 data was also requested, but this is unavailable in the area.
Risk of Flooding from Surface Water	Environment Agency	2018	Nationwide	High	N/A

Data	Source	Year	Coverage	Confidence	Notes
Risk of Flooding from Rivers and Sea	Environment Agency	2018	Nationwide	High	N/A
Catchment Data Explorer for WFD River Basin Districts Management Catchments, Operational Catchments and WFD water bodies	Environment Agency	2018	Nationwide	High	N/A
Classification of drains within the North Rivers and Broads IDB regions	Internal Drainage Board (IDB)	2017	Landfall, onshore cable route, onshore project substation	High	N/A

20.5.3 Assumptions and Limitations

55. This assessment is based on a range of publicly available information and data. Although it is considered that the individual datasets provided are robust, there is a level of uncertainty associated with their use in this impact assessment. For example, the known characteristics of the drainage network and watercourse specific attributes and conditions have been used as a proxy to assign value and sensitivity to the wider catchment. This represents a precautionary approach that ensures that value and sensitivity has not been under-assessed within the assessment.

56. The exact location of the running track to be reinstalled during cable pulling will be confirmed post-consent. To inform an assessment for Scenario 1 (where works along the onshore cable route will be limited to cable pulling and associated reinstalled running track), a review was undertaken to identify areas along the onshore cable route which could be inaccessible from the existing roads or tracks. As a worst case, it has been assumed that any watercourses within these areas would require a temporary crossing in order to reinstall the running track.

20.6 Existing Environment

20.6.1 Surface Water

20.6.1.1 Surface water drainage

57. The onshore project area is located within three main surface water catchments (Figure 20.2, which only labels the main drainage catchments, and not the tributaries):

- The River Bure catchment;
- The River Wensum catchment; and
- The River Wissey catchment.

58. The River Bure and several of its tributaries in the upper catchment, including the New Cut, East Ruston Stream, North Walsham and Dilham Canal (formerly known as the River Ant) and King's Beck would be crossed by the onshore cable route (Figure 20.2). The main river rises near Briston, from where it flows in an easterly direction until it reaches Aylsham. From here, it continues to flow to the south east until it enters the sea at Great Yarmouth. The downstream reaches of the river include a wide range of wetland features, including Hoveton Great Broad and Marshes, Woodbastwick Fens and Marshes, Bure Marshes and the Norfolk Broads. A small proportion of the cable route also crosses the northern part of the New Cut catchment.

59. The River Wensum and several of its tributaries, including the Wendling Beck and Blackwater Drain, would be crossed by the onshore cable route (Figure 20.2). The river rises near Whissonsett, from where it flows north towards Fakenham before continuing in a broadly south easterly direction towards Norwich. The River Wensum is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

60. The National Grid substation extension and onshore project substation are located within the headwaters of the River Wissey (Figure 20.2). The Wissey rises to the south of Dereham, from where it drains in a westerly direction towards Necton before eventually joining the River Great Ouse at Denver Sluice, near Downham Market.

61. The study area comprises a number of surface sub-catchments (Figure 20.3 and Table 20.10), which are analogous to the WFD water body catchments identified by the Environment Agency. These are themselves divided into a range of different watercourses.

62. There are also a number of Internal Drainage Board (IDB) channels of importance (as shown on Figure 20.4), which in general follow the main river catchments.

63. Furthermore, there are a large number of ordinary watercourses and agricultural drainage channels that are unnamed and due to the number within the study area cannot be individually listed here. These are shown on Figure 20.4.

Table 20.10 Surface water catchments

Catchment	Sub-catchment	Watercourse	Primary IDB Drains	WFD water body
Bure	New Cut	New Cut	-	New Cut
Bure	East Ruston Stream	Hundred Stream	BG1301	East Ruston Stream
Bure	North Walsham & Dilham Canal (Ant)	North Walsham & Dilham Canal	AG1216	N Walsham & Dilham Canal
Bure	North Walsham & Dilham Canal (Ant)	Unnamed (Brick Kiln Farm)	-	N Walsham & Dilham Canal
Bure	North Walsham & Dilham Canal (Ant)	Unnamed (Grammar School Farm)	-	N Walsham & Dilham Canal
Bure	King's Beck	Unnamed (Cooke's Bottoms)	-	King's Beck
Bure	King's Beck	Suffield Beck	Boundary Farm Spur (19a)	King's Beck
Bure	King's Beck	Blackwater Beck	Blackwater Beck	King's Beck
Bure	King's Beck	Blackwater Beck	Low Level Drain – Colby to Suffield Hall (18)	King's Beck
Bure	King's Beck	Unnamed (Colby Hall)	-	King's Beck
Bure	Mermaid Stream	Mermaid Stream	The Mermaid	Mermaid Stream
Bure	River Bure	River Bure	-	Bure (Scarrow-Horstead)
Bure	River Bure	Unnamed (Silvergate)	Blickling to Silvergate (28)	Bure (Scarrow-Horstead)
Wensum	Blackwater	Unnamed (Southgate)	MN 16 – Reepham	Blackwater Drain (Wensum)
Wensum	Blackwater	Booton Watercourse	MN 16 – Reepham	Blackwater Drain (Wensum)
Wensum	Blackwater	Unnamed (Bath Plantation)	-	Blackwater Drain (Wensum)
Wensum	Blackwater	Reepham Stream (east)	-	Blackwater Drain (Wensum)
Wensum	Blackwater	Unnamed (Kerdiston)	MN 16 – Reepham	Blackwater Drain (Wensum)
Wensum	Blackwater	Reepham Stream (west)	MN 16 – Reepham	Blackwater Drain (Wensum)
Wensum	Blackwater	Unnamed (Jordan Green)	-	Blackwater Drain (Wensum)
Wensum	Blackwater	Unnamed (Sparham House)	-	Blackwater Drain (Wensum)
Wensum	River Wensum	River Wensum	MN 25 – Bylaugh Meadows	Wensum us Norwich
Wensum	River Wensum	River Wensum	MN 12 – Swanton Morley	Wensum us Norwich
Wensum	Penny Spot Beck	Penny Spot Beck	MN 26 – Pennyspot Farm	Wensum us Norwich
Wensum	Penny Spot Beck	Unnamed (Frog's Hall)	-	Wensum us Norwich
Wensum	Wendling Beck	Wendling Beck	-	Wendling Beck
Wensum	Wendling Beck	Unnamed (Little Wood)	-	Wendling Beck
Wensum	Wendling Beck	Unnamed (Bushy Common)	-	Wendling Beck
Wensum	Wendling Beck	Unnamed (Bradenham)	-	Wendling Beck
Wissey	River Wissey	Upper Wissey	-	Wissey – Upper
Wissey	River Wissey	Unnamed (Lodge Farm))	-	Wissey – Upper

64. The WFD Compliance Assessment, Appendix 20.2, details the potential impacts upon the WFD quality elements of these water bodies. A summary of the main findings of the WFD Compliance Assessment is presented in section 20.7.7.

20.6.1.2 Geomorphology

65. A geomorphological survey of the accessible main river watercourses that would be crossed by the onshore cable corridor was undertaken in April 2017, as detailed in Appendix 20.3. This survey identified the main geomorphological characteristics, including flow conditions, channel form, floodplain characteristics and any evidence of channel modification, of the following watercourse crossing points:

- North Walsham and Dilham Canal at Little London;
- King's Beck at Colby Corner;
- River Bure at Abbot's Hall Farm, Drabblegate;
- Blackwater Drain at Salle Park;
- River Wensum at Old Hall Farm, Mill Street;
- Wendling Beck at Old Brigg, Gressenhall; and
- Wendling Beck at Bushy Common.

66. Table 20.11 below provides an overview of the geomorphological characteristics of each of these water bodies.

Table 20.11 Geomorphological overview of watercourse crossing locations

Water body	Geomorphological overview
North Walsham and Dilham Canal	The North Walsham and Dilham Canal is a heavily modified watercourse with a straight planform and uniformly graded banks. The channel is dominated by low energy glide flows and appears to support very little geomorphological diversity.
King's Beck	King's Beck is a uniform, incised channel that has been artificially straightened and resectioned. The channel is dominated by glide flows and there is extensive in-channel vegetation growth. In addition to the main channel, there are several connected channels that have similar characteristics. These are largely artificial, although some reaches may represent a resectioned historical course of the watercourse.
River Bure	The River Bure is a moderately sinuous watercourse that has been historically resectioned and enlarged. The channel has largely uniform banks and flow conditions are dominated by uniform glides. Evidence of lateral accretion (in the form of low berms within the resectioned bank line) suggests that the channel is naturally recovering from historical modifications.
Blackwater Drain	The Blackwater Drain is a narrow, meandering channel that supports a range of different flow types and geomorphological habitat niches. Exposed tree roots in the bed indicate that the channel has recently incised.
River Wensum	The River Wensum is a gently meandering chalk river, with a wide, deep channel and very shallow banks. Flows are dominated by uniform, low energy glides, and siltation appears to be the dominant geomorphological process. The channel is fringed by low embankments which may reduce floodplain connectivity but are likely to be frequently overtopped.

Water body	Geomorphological overview
Wendling Beck at Bushy Common	Wendling Beck is a gently meandering chalk river that has been historically straightened. The channel is shallow, with steep, low banks and swift flows. These maintain the natural coarse substrate along the majority of the reach, although there is evidence of fine sedimentation along the channel margins and upstream of a twin pipe culvert.
Wendling Beck at Old Brigg	Wendling Beck is a gently meandering channel with low energy glide flows and extensive siltation which obscures the coarse substrate that would typically be associated with chalk rivers. The deep, narrow channel has steep banks, and much of the watercourse is likely to have been historically resectioned.

20.6.1.3 Water quality

67. A review of the Environment Agency's Catchment Data Explorer WFD water quality data for the surface water bodies identified predominantly good physico-chemical and chemical water quality conditions across the main surface water catchments.

68. However, the East Ruston Stream (GB105034055670), which drains into the North Walsham and Dilham Canal, has low concentrations of dissolved oxygen. This is attributed by the Environment Agency (2016) to continuous sewage effluent discharges from a waste water treatment plant.

69. In addition, the Wissey – Upper (GB105033047890) water body has elevated levels of phosphate. This is attributed by the Environment Agency (2016) to inputs of phosphate fertilisers from agricultural areas via surface run-off draining into the watercourse.

20.6.1.4 Flood risk

70. Environment Agency flood zone maps (Environment Agency, 2012) (Figure 20.5) indicate that the majority of the study area is located within an area of low flood risk (Flood Zone 1). Flood Zone 1 is defined as land as having a less than 1 in 1,000 annual probability of river flooding (<0.1%). However, any onshore infrastructure located closer to the main rivers of the River Bure and the River Wensum and their tributaries (as identified above) have a higher risk of flooding (up to Flood Zone 3 – high risk of flooding).

71. The FRA, Appendix 20.1, provides a detailed description of the baseline flood risk of the study area. This demonstrates that all permanent above-ground infrastructure associated with the project will be located in Flood Zone 1.

20.6.2 Groundwater

20.6.2.1 Groundwater bodies

72. The Crag and the Chalk aquifers are classified as Principal Aquifers by the Environment Agency. The superficial deposits are classified as Secondary A, B and undifferentiated aquifers (Chapter 19 Ground Conditions and Contamination, Figure

19.4). The Environment Agency's groundwater vulnerability maps indicate the study area is located within an area of high groundwater vulnerability (overlying a permeable aquifer). This indicates soils which may be able to transmit a wide range of pollutants into any groundwater stored in the underlying strata.

73. The WFD defines groundwater bodies as distinct volumes of groundwater within an aquifer or aquifers. It requires that groundwater bodies are designated as drinking water protected areas (DrWPAs) based on their use for human consumption. Regionally, the principal groundwater body covering the majority of the onshore project area is the Broadland Rivers Chalk & Crag (Figure 20.6). The chalk bedrock is designated as a Principal Aquifer and a number of groundwater Source Protection Zone (SPZ) areas are identified within the study area, with both inner and outer zones of the SPZ areas extending across the eastern section of the onshore cable route. There are small sections of the onshore project area close to the coast, north of North Walsham that is underlain by the North Norfolk Chalk groundwater body. Some areas of the western extent of the project area are underlain by the North Norfolk Chalk and North West Norfolk Chalk groundwater bodies.

20.6.2.2 Groundwater abstractions

74. There are a number of licensed groundwater abstractions within the study area which are mostly associated with agriculture. Broadland District Council, North Norfolk District Council and Breckland Council were contacted in May 2017 to obtain information regarding private water supplies located within the study area. There are 101 private water supplies within the study area in the areas administered by North Norfolk District Council and Breckland Council. Broadland District Council does not hold records regarding private water supply and no information is available for this area. The precise location of private water supplies would be confirmed as part of the pre-construction works (e.g. through landowner consultation).

75. There are a number of groundwater SPZ areas within the onshore project area (Chapter 19 Ground Conditions and Contamination, Figure 19.5). Trenchless crossing techniques (e.g. Horizontal Directional Drilling, (HDD)) activities are proposed in the following areas:

- SPZ3 in the area of Scarning;
- SPZ2 and SPZ3 north of Dereham;
- SPZ1 and SPZ2 in the area of North Walsham;
- SPZ3 under the River Wensum;
- SPZ2 and SPZ3 north of Aylsham;
- SPZ3 under the Cromer Road (A149); and
- SPZ3 south of Edingthorpe.

76. Safeguard Zones (SgZs) are non-statutory WFD designations defined by the Environment Agency for potable abstractions where the water quality is poor and where additional measures are needed to bring about improvement. SgZs are typically based on existing SPZ1 and SPZ2 areas. SgZ designation means that there will be strict enforcement of existing measures for particular pollutants and activities, and possibly new voluntary measures. The study area does not cross any groundwater SgZs, and as such these receptors are therefore not considered further in this impact assessment.

20.6.3 Designated Sites

77. The River Wensum is designated as a SAC and SSSI on account of the water-dependent features and habitats that it supports.

78. The river was designated as a SSSI because it provides an exceptional example of an enriched, calcareous lowland river, supporting a diverse assemblage of plants and invertebrates. The SSSI is currently in unfavourable condition due to hydrological pressures, high phosphate concentrations, high turbidity and siltation-related issues.

79. The Wensum was also designated as a SAC because it supports Annex 1 habitats with river water-crowfoot (*Ranunculion fluitantis*) and *Callitricho-Batrachion* (water-starworts) vegetation communities. It also supports Annex II species such as white clawed crayfish (*Austropotamobius pallipes*), Desmoulin's whorl snail (*Vertigo moulinsiana*), brook lamprey (*Lampetra planeri*) and bullhead (*Cottus gobio*).

80. Further details regarding designated sites can be found within Chapter 22 Onshore Ecology, with designated sites shown in Figure 22.2.

20.6.4 Sensitivity and Value of Receptors

20.6.4.1 Surface water receptors

81. As described in section 20.5.1, there are three main surface water catchments in the study area, each composed of several sub-catchments and individual watercourses. A value and sensitivity has been set for each catchment and applied to all natural watercourses within that catchment. All parts of the permanent drainage network that are not included in Ordnance Survey datasets will therefore be considered to be part of the nearest downstream watercourse that is included in the dataset.

82. The sensitivity of these receptors has been defined at a sub-catchment level based on the geomorphological (i.e. physical habitat) characteristics observed at key points within each catchment (based on the results of the walkover survey presented in Appendix 20.3 and additional site observations made during the site surveys undertaken to inform Chapter 22 Onshore Ecology).

83. The value of each receptor has been identified with reference to Environment Agency fisheries data and ecological designations. The results of this process are shown in Table 20.12.

Table 20.12 Sensitivity and value of surface water resources

Catchment	Sub-catchment	Watercourse	Physical characteristics	Sensitivity	Protected species and ecological designations	Value
River Bure	New Cut	New Cut	Largely artificial, highly straightened channel	Low	Supports Calthorpe Broad and Priory Meadows, Hickling SSSI Drains into The Broads SAC and Broadland SPA	High
	East Ruston Stream	Hundred Stream	Naturally meandering channel with good geomorphological diversity	High	Potentially supports habitat for water voles	High
	North Walsham & Dilham Canal	North Walsham & Dilham Canal Unnamed (Brick Kiln Farm) Unnamed (Grammar School Farm)	Extensively modified channel with limited geomorphological diversity	Low	None recorded	Low
	King's Beck	Unnamed (Cooke's Bottoms) Suffield Beck Blackwater Beck Unnamed (Colby Hall)	Uniform resectioned channel with some geomorphological diversity	Medium	Supports habitats for brown trout Potentially supports habitat for water voles	High
	River Bure	River Bure Unnamed (Silvergate)	Modified channel with evidence of natural geomorphological recovery	Medium	Supports habitats for brown trout, brook lamprey and water voles	High
	Mermaid Stream	The Mermaid		Medium	Supports habitats for brown trout Potentially supports habitat for water voles	High
River Wensum	Blackwater	Unnamed (Southgate) Booton Watercourse Unnamed (Bath Plantation)	Predominantly natural meandering channel with good geomorphological diversity	High	Supports habitats for brown trout Potentially supports habitat for water voles	High

Catchment	Sub-catchment	Watercourse	Physical characteristics	Sensitivity	Protected species and ecological designations	Value
		Reepham Stream (east branch)			Supports habitats for bullhead Potentially supports habitat for water voles	
		Unnamed (Kerdiston)				
		Reepham Stream (west branch)				
		Unnamed (Jordan Green)			None recorded	
		Unnamed (Sparham House)			Supports habitats for bullhead. Potentially supports habitat for water voles	
	River Wensum	River Wensum	Gently meandering chalk river with uniform flows and extensive deposition over coarse substrates	High	Supports habitats for brown trout, brook lamprey, bullhead and water voles Designated SAC and SSSI	High
	Penny Spot Beck	Penny Spot Beck	Uniform, straightened chalk stream that retains natural substrate in places	High	Supports habitats for brown trout, bullhead and water voles	High
		Unnamed (Frog's Hall)			None recorded	
	Wendling Beck	Wendling Beck	Meandering chalk river with some modifications, but good geomorphological diversity	High	Supports habitat for brown trout, bullhead and water voles Supports Dillington Carr SSSI	High
		Wendling Beck (Little Wood)				
		Wendling Beck (Bushy Common)				
		Wendling Beck (Bradenham)				
River Wissey	River Wissey	Upper Wissey	Narrow incised channel with clean gravel substrate and some geomorphological diversity	Medium	Supports habitat for water voles	Medium
		Unnamed (Lodge Farm)				

20.6.4.2 Groundwater receptors

84. The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk groundwater bodies are all designated as Principal Aquifers and contain a number of groundwater SPZ areas (intended to protect potable water abstractions). The Principal Aquifer which underlies the superficial deposits beneath the whole study area is considered to be of high vulnerability. The sensitivity of groundwater receptors is therefore considered to be high.

20.6.5 Anticipated Trends in the Existing Environment

20.6.5.1 Surface waters

85. The baseline review presented in section 20.5.1 demonstrates that, although surface watercourses in the study area support large areas of high quality natural habitats, the geomorphology of many surface watercourses in the study area has been modified as a result of land drainage, flood risk management and navigation pressures. This section also demonstrates that surface water quality across the study area is predominantly good, although several watercourses are adversely affected by the supply of phosphate fertilisers and sewage effluent.

86. Ongoing initiatives by the Environment Agency and its partners to deliver the WFD and restore the River Wensum are likely to reduce the existing pressures on the geomorphology of the surface drainage network, and improve water quality. A steady improvement in the baseline condition of surface watercourses is therefore expected in the future.

87. Predicted climate changes are likely to result in wetter winters, drier summers and a greater number of convectional rain storms. This means that the hydrology of the surface drainage network could change, with higher winter flows, lower summer flows and a greater number of storm-related flood flows. This in turn could result in changes to the geomorphology of the river systems, with increased geomorphological activity (e.g. channel adjustment) occurring in response to storm events. This means that the surface drainage network is unlikely to remain stable, and when combined with the planned management changes outlined above, is likely to become more typical of the natural river types in the future.

20.6.5.2 Groundwater

88. Groundwater quality is affected by the combined pressures of intensive land use and highly permeable soils, which have resulted in substantial leaching of nitrate to groundwater. However, increased regulation of agricultural chemicals and catchment-wide initiatives to reduce pressures on groundwater to achieve compliance with the WFD suggest that baseline groundwater quality is likely to improve in the future. However, any improvements are likely to become apparent over long timescales.

89. As part of Defra’s Water Abstraction Plan (2017), the Environment Agency will review and amend all existing abstraction licenses by 2027. It is anticipated that abstraction will decrease and approximately 90% of surface water bodies and 77% of groundwater bodies will meet the required standards by 2021. Pressures on groundwater levels are therefore likely to decrease in the future.

20.6.5.3 Designated sites

90. The physical habitat characteristics of the River Wensum SAC and SSSI (section 20.6.3) could potentially be affected by the changes to the quantity and quality of surface and groundwaters described above.

91. The ongoing programme of river restoration and changes to catchment management that are being implemented by (among others) Natural England, the Environment Agency, the Norfolk Rivers Trust, the Water Level Management Alliance and local landowners are likely to result in a continued improvement of the physical habitats supported by the river. The geomorphology of the channel is likely to improve over time, as natural processes are restored within existing modified reaches. Furthermore, water quality is likely to improve as a result of a reduction in the supply of sediment, nutrients and other contaminants into the river system.

92. Further information regarding anticipated trends associated with the ecology of designated sites are provided in Chapter 22 Onshore Ecology.

20.7 Potential Impacts

93. This section details the impact assessment for the construction, operation and decommissioning phases of the project, based upon the interactions between the relevant worst case assumptions for the project and embedded mitigation with regards to receptor sensitivity and value, and the magnitude of the potential effect (as detailed in section 20.4.1).

94. The EIA is being undertaken for the following two alternative scenarios therefore an assessment of potential impacts has been undertaken for each scenario:

- **Scenario 1** – Norfolk Vanguard proceeds to construction, and installs ducts and other shared enabling works for Norfolk Boreas.
- **Scenario 2** – Norfolk Vanguard does not proceed to construction and Norfolk Boreas proceeds alone. Norfolk Boreas undertakes all works required as an independent project.

95. Where the assessment of the impact is different for Scenario 1 and Scenario 2 a separate assessment is presented under each impact heading.

20.7.1 Embedded Mitigation

96. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process.

97. The following sections outline the key embedded mitigation relevant for this assessment. These measures are presented in Table 20.13. Where embedded mitigation measures have been developed into the design of the project with specific regard to water resources and flood risk, these are described in Table 20.14. Any further mitigation measures identified within this chapter are therefore considered to be additional.

Table 20.13 Embedded mitigation

Parameter	Mitigation measures embedded into the project design	Notes
Project Wide		
Commitment to HVDC technology	Commitment to HVDC technology minimises environmental impacts through the following design considerations: • HVDC requires fewer cables than the HVAC solution. During the duct installation phase this reduces the cable route working width for Norfolk Boreas to 35m from the previously identified worst case of 50m. As a result, the overall footprint of the onshore cable route required for the duct installation phase is reduced from approx. 300ha to 210ha; • The width of permanent cable easement is also reduced from 25m to 13m; • Removes the requirement for a cable relay station as permanent above ground infrastructure; • Reduces the maximum duration of the cable pulling phase from three years down to two years; • Reduces the total number of jointing pits for Norfolk Boreas from 450 to 150; and • Reduces the number of drills needed at trenchless crossings (including landfall).	Norfolk Boreas Limited has reviewed consultation received and in light of the feedback, has made a number of decisions in relation to the project design. One of these decisions is to deploy HVDC technology as the export system.
Site Selection	The project has undergone an extensive site selection process which has involved incorporating environmental considerations in collaboration with the engineering design requirements. Considerations include (but are not limited to) adhering to the Horlock Rules (for explanation see Chapter 4 Site Selection and Assessment of Alternatives) for onshore project substations and Necton National Grid extension and associated infrastructure, a preference for the shortest route length (where practical) and developing construction methodologies to minimise potential impacts. Key design principles from the outset were followed (wherever practical) and further refined during the EIA process, including; • Avoiding proximity to residential dwellings; • Avoiding proximity to historic buildings; • Avoiding designated sites;	Constraints mapping and sensitive site selection to avoid a number of impacts, or to reduce impacts as far as possible, is a type of primary mitigation and is an inherent aspect of the EIA process. Norfolk Boreas Limited has reviewed consultation received to inform the site selection process (including from local communities, landowners and

Parameter	Mitigation measures embedded into the project design	Notes
	• Minimising impacts to local residents in relation to access to services and road usage, including footpath closures; • Utilising open agricultural land, therefore reducing road carriageway works; • Minimising requirement for complex crossing arrangements, e.g. road, river and rail crossings; • Avoiding areas of important habitat, trees, ponds and agricultural ditches; • Installing cables in flat terrain maintaining a straight route where possible for ease of pulling cables through ducts; • Avoiding other services (e.g. gas pipelines) but aiming to cross at close to right angles where crossings are required; • Minimising the number of hedgerow crossings, utilising existing gaps in field boundaries; • Avoiding rendering parcels of agricultural land inaccessible; and • Utilising and upgrading existing accesses where possible to avoid impacting undisturbed ground.	regulators) and in response to feedback, has made a number of decisions in relation to the siting of project infrastructure. The site selection process is set out in Chapter 4 Site Selection and Assessment of Alternatives.
Long HDD at landfall	Use of long HDD at landfall to avoid restrictions or closures to Happisburgh beach and retain open access to the beach during construction. Norfolk Boreas Limited have also agreed to not use the beach car park at Happisburgh South.	Norfolk Boreas Limited has reviewed consultation received and in response to feedback, has made a number of decisions in relation to the project design. One of those decisions is to use long HDD at landfall.
Scenario 1		
Strategic approach to delivering Norfolk Boreas and Norfolk Vanguard	Under Scenario 1, onshore ducts will be installed for both projects at the same time, as part of the Norfolk Vanguard construction works. This would allow the main civil works for the cable route to be completed in one construction period and in advance of cable delivery, preventing the requirement to reopen the land in order to minimise disruption. Onshore cables would then be pulled through the pre-installed ducts in a phased approach at later stages. In accordance with the Horlock Rules, the co-location of Norfolk Boreas and Norfolk Vanguard onshore project substations will keep these developments contained within a localised area and, in so doing, will contain the extent of potential impacts.	The strategic approach to delivering Norfolk Boreas and Norfolk Vanguard in order to minimise environmental impacts has been a consideration from the outset.
Scenario 2		
Duct Installation Strategy	Under Scenario 2, the onshore cable duct installation strategy is to install ducts in sections to minimise impacts. Construction teams would work on a short section (approximately 150m length) and once the cable ducts have been installed, the section would be back filled and the top	This has been a very early project commitment. Chapter 5 Project Description

Parameter	Mitigation measures embedded into the project design	Notes
	soil reinstated before moving onto the next section. This would minimise the amount of land being worked on at any one time and would also minimise the duration of works on any given section of the route.	provides a detailed description of the process.
Trenchless Crossings	Commitment to trenchless crossing techniques to minimise impacts to the following specific features; • Wendling Carr County Wildlife Site; • Little Wood County Wildlife Site; • Land South of Dillington Carr County Wildlife Site; • Kerdiston proposed County Wildlife Site; • Marriott's Way County Wildlife Site / Public Right of Way (PRoW); • Paston Way and Knapton Cutting County Wildlife Site; • Norfolk Coast Path; • Witton Hall Plantation along Old Hall Road; • King's Beck; • River Wensum; • River Bure; • Wendling Beck; • Wendling Carr; • North Walsham and Dilham Canal; • Network Rail line at North Walsham that runs from Norwich to Cromer; • Mid-Norfolk Railway line at Dereham that runs from Wymondham to North Elmham; and • Trunk Roads including A47, A140, A149.	A commitment to a number of trenchless crossings at certain sensitive locations was identified at the outset. However, Norfolk Boreas Limited has committed to certain additional trenchless crossings as a direct response to stakeholder requests.

Table 20.14 Topic specific embedded mitigation

Parameter	Mitigation measures embedded for water resources and flood risk	Notes
Scenario 1		
Surface drainage	Changes in surface water runoff as a result of the increase in impermeable area from the onshore project substation will be attenuated and discharged at a controlled rate, in consultation with the LLFA and Environment Agency. The controlled runoff rate will be equivalent to the greenfield runoff rate. An attenuation pond with a volume of 4,050m^3 (approximate dimensions of 58m x 58m x 1.2m) has been allowed for at the onshore project substation to provide sufficient attenuation to greenfield runoff rates into the closest watercourse or sewer connection. The full specification for the attenuation pond will be addressed as part of detailed design. Allowance for increased attenuation of surface water drainage (e.g. a new larger pond to replace the existing pond) at the Necton National Grid substation has also been included to accommodate additional impermeable ground associated with the National Grid substation extension for Norfolk Boreas.	n/a

Parameter	Mitigation measures embedded for water resources and flood risk	Notes
Foul drainage	During the construction phase, foul drainage at the onshore project substation will be collected through a mains connection to existing local authority sewer system (if available) or septic tanks located within the development boundary. During operation, foul drainage at the onshore project substation will be collected through a mains connection to the existing local authority sewer system (if a suitable connection is available) or collected in a septic tank located within the development boundary and transported off site for disposal at a licensed facility.	n/a
Scenario 2		
Sediment management	The area of open ground at any one time within one sub-catchment will be restricted, across a notional 5km length, to 2 working areas (configured as 35m x 300m strips), 50% of one mobilisation area, 50% of one set of trenchless crossing compounds and 25% of 5km running track. Topsoil would be stripped from the entire width of the onshore cable route for the length of the workfront (150m) and stored and capped to minimise wind and water erosion. Once all the trenching is completed and back-filled, the stored topsoil will be re-distributed over the area of the workfront, with the exception of the running track and any associated drainage. Temporary works areas (e.g. mobilisation areas and trenchless crossing areas) within the onshore project area will comprise hardstanding of permeable gravel aggregate underlain by geotextile, or other suitable material to a minimum of 50% of the total area to minimise the area of open ground.	These measures apply to the cable route only.
Watercourse crossings	Trenchless crossing techniques will be employed at the following major watercourses: River Wensum, River Bure, King's Beck, Wendling Beck (two crossing points), and the North Walsham and Dilham Canal. Stop ends would be employed on the running track at each of the trenchless crossing points outlined above, with the exception of the crossing of Wendling Beck at Bushy Common. Reinstatement of the channel would achieve the pre-construction depth of the watercourse, and the dams removed. The width of the running track at watercourse crossings will be minimised from 6m to 3m to limit the area of direct disturbance.	These measures apply to the cable route only.
Surface drainage	Changes in surface water runoff as a result of the increase in impermeable area from the substation will be attenuated and discharged at a controlled rate, in consultation with the LLFA and Environment Agency. The controlled runoff rate will be equivalent to the greenfield runoff rate. An attenuation pond with a volume of 4,050m^3 (approximate dimensions of 58m x 58m x 1.2m) has been allowed for at the onshore project substation to provide sufficient attenuation to	n/a

Parameter	Mitigation measures embedded for water resources and flood risk	Notes
	greenfield runoff rates into the closest watercourse or sewer connection. The full specification for the attenuation pond will be addressed as part of detailed design. Allowance for increased attenuation of surface water drainage (an extension to the existing pond or a new pond in proximity to the existing pond) at the Necton National Grid substation has also been included to accommodate additional impermeable ground associated with the National Grid substation extension for Norfolk Boreas. During construction, the onshore cable route will be bounded by drainage channels (one on each side) to intercept drainage from within the working corridor. Additional drainage channels will be installed to intercept water from the cable trench. Depending upon the precise location, water from the channels will be infiltrated or discharged into the surface drainage network.	
Foul drainage	During the construction phase, foul drainage at the onshore project substation and mobilisation areas will be collected through a mains connection to existing local authority sewer system (if available) or septic tanks located within the development boundary. Foul drainage from welfare facilities along the cable route will be collected in septic tanks and taken off site for disposal at a licensed site. During operation, foul drainage at the onshore project substation will be collected through a mains connection to the existing local authority sewer system (if a suitable connection is available) or collected in a septic tank located within the development boundary and transported off site for disposal at a licensed facility.	n/a

20.7.2 Worst Case

98. This section establishes the worst case assumptions for each key impact category under both Scenario 1 and Scenario 2, forming the basis for the subsequent impact assessment. For this assessment, this involves a consideration of the particular design parameters (such as the maximum construction footprint at the landfall) that define the project.

99. Full details of the range of project options being considered are provided within Chapter 5 Project Description. For the purpose of the water resources and flood risk chapter, only those design parameters with the potential to influence the level of impact to such receptors are identified. Therefore, if the design parameter is not described below, it is not considered to have a material bearing on the outcome of this assessment.

100. The realistic worse case assumptions identified in this section for both scenarios, as detailed in Table 20.15 and Table 20.16, are also applied to the CIA. When the worst case assumptions for the project in isolation do not result in the worst case for cumulative impacts, this is addressed within the cumulative impacts section of this chapter.

Table 20.15 Worst case assumptions Scenario 1

Worst case assumptions Parameter	Worst case criteria	Worst case definition	Notes
Landfall			
Construction	Method	Trenchless technique (e.g. HDD)	Horizontal Directional Drilling (HDD).
	HDD horizontal length (m)	1,000m	Indicative length
	Maximum temporary works duration	20 weeks	Based on 7am-7pm normal working hours. 7 days a week.
Landfall compounds	Maximum number and maximum land take for temporary landfall compounds	6,000m^2	Assumes two compounds at 3000m^2 (50m x 60m) to support parallel drilling rigs.
Onshore cable route			
Construction (cable pulling only)	Method	Pulling of cables through pre-installed ducts	Cables will be pulled through the ducts installed by Norfolk Vanguard
	Cable pull maximum footprint	85,500m^2	Cable pull footprints include the running track and jointing pits.
	Running track width and length	6m and 12,000m	Up to 20% of the running track utilised by Norfolk Vanguard will need to be reinstalled to facilitate cable pulling
	Excavated material for reinstalling running track	21,600m^3	Volume based on worst case assumption of reinstallation of 12km length of the running track, with a width of 6m and a depth of 0.3m
	Area of ground protection for running track	Assumes a maximum of 75% of the reinstated running track will be covered with aggregate, protective matting or temporary metal road surface.	
	Watercourse crossings	Temporary watercourse crossings to provide access during cable pulling	It has been assumed that any watercourses within areas which could be inaccessible from existing roads or tracks would require a temporary crossing.

Worst case assumptions			
Parameter	**Worst case criteria**	**Worst case definition**	**Notes**
Permanent jointing pits	Maximum number and required dimensions	Assume 150 at 90m^2 and 2m deep each	Dimension 6m (w) and 15m (l). Spaced approximately one per circuit per 800m cable.
Cable logistics area	Maximum number and required dimensions	Assumes one compound with an area of 4,188m^2	A cable logistics area has been identified for the storage of materials, welfare facilities, etc.
	Area of ground protection	100% existing hardstanding	
Decommissioning	Method	Jointing pits and ducts left in-situ	Where cables are in pre-installed ducts, cables may be extracted once de-energised.
Onshore project substation			
Construction	Maximum land take for all construction works area at the onshore project substation	95,000m^2	Operational area for Substation (250m x 300m) plus additional temporary construction compound (200 x 100m)
	Maximum land take for temporary works area at Spicers Corner	10,000m^2	Spicers Corner compound 100 x 100m
	Maximum duration	30 months	Indicative construction window 24 months
	Substation foundations	Piled	Assumes worst case there is piling as part of construction of foundations
Operation	Maximum land take for permanent footprint	75,000m^2	Operational footprint 250m x 300m
Decommissioning	No decision has been made regarding the final decommissioning policy for the onshore project substation, as it is recognised that industry best practice, rules and legislation change over time. However, the onshore project equipment will likely be removed and reused or recycled. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, for the purposes of a worst-case assumptions, impacts as for the construction phase are assumed.		
National Grid substation extension and overhead line extension			
Construction	Maximum land take for construction at substation extension	95,250m^2	Operational area (135m x 150m) plus temporary compound adjacent to eastern extension site (150m x 200m) and compound adjacent to the Norfolk Vanguard Extension (300m x 150m).
	Maximum duration	30 months	Indicative construction window 24 months

Worst case assumptions			
Parameter	**Worst case criteria**	**Worst case definition**	**Notes**
Operation	Maximum land take for substation extension permanent footprint	20,250m^2	Permanent eastern extension footprint approximately 135m length and 150m wide

Table 20.16 Worst case assumptions Scenario 2

Worst case assumptions			
Parameter	**Worst case criteria**	**Worst case definition**	**Notes**
Landfall			
Construction	Method	Trenchless technique (e.g. HDD)	Horizontal Directional Drilling (HDD).
	HDD horizontal in length (m)	1,000m	Indicative length
	Maximum temporary works duration	20 weeks	Based on 7am-7pm normal working hours. 7 Days a week.
Landfall compounds	Maximum number and maximum land take for temporary landfall compounds	Assumes 2 at 3,000m^2	Two compounds (50m x 60m) to support parallel drilling rigs.
Onshore cable route			
Construction – duct installation	Method	Open cut trenching and trenchless crossing methods	Where open cut trenching is employed at watercourses, the working width will be reduced to the running track and cable trenching areas only (13m) with soil storage areas retained immediately before and after the feature crossing.
	Maximum working width and length	35m and 60km	
	Onshore cable route maximum footprint	2,100,000m^2	60km length of cable route x 35m working width
	Minimum burial depth	1.05m to top of duct	Minimum 1.05m to top of ducts for 'normal' agricultural, 1.2m 'deep ploughing' agricultural to top of duct. Up to 20m at trenchless crossings.
	Depth of trench	1.5m	Trench depth and width are indicative depending on ground conditions
	Width of cable trench	1m	Trench per circuit so two separate trenches of 1m width
	Maximum area of disturbed ground	0.062 km^2 per 5km of cable	Maximum working area (workfront) for one team will be 0.011km^2 (35m x 300m).

Worst case assumptions			
Parameter	**Worst case criteria**	**Worst case definition**	**Notes**
			Assuming a maximum of two workfronts, one mobilisation area, one set of trenchless crossing compounds and 5km of running track per 5km of cable, the maximum area of disturbed ground would be 0.062 km2 per 5km of cable.
	Running Track width and length	6m and 60km	
	Running track excavated material	108,000m^3	Volume based on worst case assumption of installation of 60km length of the running track, with a width of 6m and a depth of 0.3m
	Area of ground protection for running track	Assumes a maximum of 75% of the reinstated running track will be covered with aggregate, protective matting or temporary metal road surface.	
Mobilisation areas	Maximum number and required dimensions	Assumes 14 at 10,000m^2	Including area at Spicers Corner
Trenchless crossing areas (e.g. HDD)	Locations required	Trenchless crossing of main watercourses: North Walsham & Dilham Canal, King's Beck, River Bure, Wendling Beck (downstream), Wendling Beck (upstream) and River Wensum.	With the exception of the Wendling Beck at Bushy Common, these watercourses will not be crossed by the running track.
	Trenchless reception sites. Maximum number and maximum land take	Assumes 16 pairs at 5,000m^2	Up to 100m x 50m if stop end employed
	Trenchless launch sites. Maximum number and maximum land take	Assumes 16 pairs at 7,500m^2	Up to 150m x 50m if stop end employed
Trenched watercourse crossings	Type of crossing	Where watercourses are shallower than 1.5m, temporary damming and diverting of the watercourse may be employed. Where watercourses are deeper than 1.5m, culverting may be employed.	All watercourses not specifically noted as being crossed using a trenchless technique will be crossed via trenched methods. Culverts will be used to allow the running track to cross all watercourses at trenched crossing points (including the

Worst case assumptions			
Parameter	Worst case criteria	Worst case definition	Notes
			Wendling Beck at Bushy Common but excluding all other trenched watercourse crossing locations).
Construction - cable pulling	Cable pulling maximum footprint	85,500m^2	Cable pull footprint includes the running track and jointing pits
Permanent jointing pits	Maximum number and required dimensions	Assumes 150 at 90m^2 and 2m deep each	Dimensions 6m (w) x 15m (l). Spaced approximately one per circuit per 800m cable.
Cable Logistics Area	Maximum number and required dimensions	Assumes one compound with an area of 4,190m^2	A cable logistics area has been identified for the storage of materials, welfare facilities, etc.
	Area of ground protection at cable logistics area	100% existing hardstanding	
Decommissioning	Method	Jointing pits and ducts left in-situ	Where cables are in pre-installed ducts, cables may be extracted once de-energised.
Onshore project substation			
Construction	Maximum land take for all temporary works area at the onshore project substation	95,000m^2	Operational area for Substation (250m x 300m) plus additional temporary construction compound (200m x 100m).
	Maximum duration	30 months	Indicative construction window 24 months.
	Substation foundations	Piled	Assumes worst case there is piling as part of construction of foundations
Operation	Maximum land take for permanent substation footprint	75,000m^2	The total land requirement for the onshore project substation to the perimeter fence is 250m x 300m
Decommissioning	No decision has been made regarding the final decommissioning policy for the onshore project substation, as it is recognised that industry best practice, rules and legislation change over time. However, the onshore project equipment will likely be removed and reused or recycled. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, for the purposes of a worst case assumptions, impacts as for the construction phase are assumed.		
National Grid substation extension and overhead line modification			
Construction	Maximum land take for temporary works area – substation extension	97,500m^2	Operational area (200m x 150m) plus temporary

Worst case assumptions Parameter	Worst case criteria	Worst case definition	Notes
			compounds (150m x 150m and 300m x 150m)
	Maximum duration	30 months	Indicative construction window 24 months.
	Maximum land take for temporary works area – overhead line	176,310 m^2	
	Tower foundations	Piled	4 piles required per tower (2 towers)
	Maximum land take for substation extension permanent footprint	30,000m^2	Permanent western extension footprint approx. 200m length and 150m wide
	Maximum land take for overhead line permanent footprint	Up to 1,000m^2	Two new permanent overhead line towers will be required.

101. Chapter 5 Project Description outlines the timings to be assessed in relation to the phasing of the works. In all cases for water resources; the two phase option, where cables are installed in two consecutive years to facilitate the commissioning of the offshore wind turbine planting, is assumed to be the worst case. This is due to the increased length of time that receptors will be potentially impacted by the project.

20.7.3 Monitoring

102. The development of the detailed design and Code of Construction Practice (CoCP) (DCO Requirement 20) will refine the worst-case impacts assessed in this ES. It is recognised that monitoring is an important element in the management and verification of the actual project impacts. The requirement for and appropriate design and scope of monitoring will be agreed with the appropriate stakeholders and included within the approved CoCP, and the Construction Method Statement (CMS) commitments prior to construction works commencing.

20.7.4 Potential Impacts during Construction

103. The following impacts consider all elements of the onshore cable route, onshore project substation, landfall and National Grid substation extension. The assessed mechanisms for impact (e.g. increased surface water runoff and flood risk) will not significantly differ in effect or magnitude in response to variations in the specific layout or positioning of components in each part of the development.

104. Furthermore, the alternative phasing options of the proposed development (over one or two years) are not considered separately in the impact assessment. The construction methodology means that the area of ground disturbed at any one time will be minimised to within a constrained working area at any given time. Any

differences in the phasing of works will not significantly affect the potential for impact, provided that this methodology is followed.

105. Impacts are considered for both Scenario 1 and Scenario 2, with any differences discussed separately.

20.7.4.1 Impact 1: Direct disturbance of surface water bodies

20.7.4.1.1 Description of impacts

106. Onshore construction activities have the potential to directly alter the geomorphology, hydrology and physical habitat value of surface water bodies as a result of the installation of cabling across surface watercourses.

107. The installation of cable trenches in Scenario 2 will directly disturb the bed and banks of the watercourse. This could potentially result in the direct loss of natural geomorphological features (and associated physical habitat niches) and geomorphological instability (e.g. due to enhanced scour and increased sediment supply). However, this would be a temporary impact provided that the bed and banks are reinstated to their original level, position, planform and profile. Note that subsequent cable pulling through the pre-installed ducting will not result in any further disturbance.

108. The installation of temporary culverts under Scenario 1 and permanent and temporary culverts under Scenario 2 would also directly disturb the bed and banks of the watercourse and result in the direct loss of natural geomorphological features within the footprint of the structure. This impact would be reversible once temporary culverts have been removed and the bed and banks reinstated, but would be permanent for permanent culverts under Scenario 2.

109. The presence of temporary dams (to allow watercourses to be crossed in dry conditions under Scenario 2) and culverts (used for the running track under both scenarios) could potentially result in reduced flow and sediment conveyance (particularly of coarse sediment), create upstream impoundment, affect patterns of erosion and sedimentation, impede river continuity, increase turbidity and potentially encourage fine sedimentation on the bed upstream. Changes to flow conditions could also result in a reduction in the dissolved oxygen concentrations supported in the watercourses upstream of the impoundment. These activities could therefore reduce the physical habitat value of the watercourse for species such as brown trout (*Salmo trutta*), bullhead and brook lamprey. The temporary dams could also act as a barrier to the movement of fish and other aquatic organisms. However, these impacts are considered to be temporary (i.e. confined to the duration of construction) and would be reversed once the temporary impounding structures were removed.

110. The presence of permanent culverts installed under Scenario 2 to allow the cable ducting to cross watercourses could result in the same suite of impacts on a permanent and irreversible basis.

111. For the purposes of this assessment, the magnitude of effect is assumed to be proportional to the total number of watercourse crossings within each sub-catchment (Table 20.17).

Table 20.17 Magnitude of effect resulting from watercourse crossings

Magnitude of effect	Number of crossings per sub-catchment
Negligible	1
Low	2-4
Medium	5-9
High	≥10

112. Note that potential impacts on groundwater receptors associated with trenchless watercourse crossings are assessed in section 20.7.4.3.

20.7.4.1.2 Scenario 1

113. As stated in section 20.7.2, under Scenario 1 the cable will be pulled through pre-installed ducts (installed as part of Norfolk Vanguard), which means that there will be no need to install any permanent culverts at watercourse crossing locations. Whilst this will not require the installation of cable ducts to cross surface watercourses, there will be a need for temporary culverts to be reinstalled so that watercourses can be crossed by the running track. The exact location of the running track, including the requirements for temporary watercourse crossings, to be reinstalled will be confirmed post-consent. However, the worst case number of watercourse crossings has been estimated on the assumption that any watercourses along the cable route within areas that are not directly accessible from the existing network of roads and tracks will need temporary crossings during cable pulling (see section 20.5.3). The number of temporary watercourse crossings potentially required within each sub-catchment is shown in Table 20.18 and locations are presented on Figure 20.1.4 in Appendix 20.1.

Table 20.18 Temporary watercourse crossings in surface water catchments (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Number of crossings
River Bure	New Cut	Low	High	0
	East Ruston Stream	High	High	2
	North Walsham & Dilham Canal	Low	Low	2
	King's Beck	Medium	High	1
	River Bure	Medium	High	5
	Mermaid Stream	Medium	High	0
			Total	**10**
River Wensum	Blackwater	High	High	1
	River Wensum	High	High	0
	Penny Spot Beck	High	High	2

	Wendling Beck	High	High	2
			Total	5
River Wissey	River Wissey	Medium	Medium	1
			Total	**1**

Impacts prior to mitigation

114. There are no temporary crossings within the New Cut, Mermaid Stream or main River Wensum sub-catchments. There is therefore no mechanism for watercourses within the catchment to be impacted.

115. For the remaining sub-catchments, there will be a need to reinstall some temporary culverts when reinstalling the running track. The impacts on each sub-catchment resulting from these temporary crossings are summarised in Table 20.20. Prior to mitigation the potential impacts range from **minor** to **major adverse**.

Additional mitigation measures

116. Potential impacts resulting from the use of temporary culverts at watercourse crossings along the running track would be mitigated through the additional measures in Table 20.19. These will be detailed in the COCP (DCO Requirement 20) and outline COCP (document reference 8.1) that has been produced and submitted with the DCO application.

Table 20.19 Additional mitigation measures for direct disturbance of surface water bodies from watercourse crossings during construction (Scenario 1)

Measures
Ensuring that the culvert is adequately sized to avoid impounding flows (including an allowance for potential increases in winter flows as a result of projected climate change).
Installing the culvert below the active bed of the channel, so that sediment continuity and movement of fish and aquatic invertebrates can be maintained.
Temporary bridges will be considered where appropriate (e.g. where installation of a temporary culvert is likely to have an impact on channel morphology and ecology).

Impacts following mitigation

117. Following implementation of the measures described in Table 20.19, the potential for impacts associated with temporary watercourse crossings for the running track would be reduced. The magnitude of effect following mitigation would be negligible and the resulting residual impact for each sub-catchment would be no greater than **minor adverse**, as shown in Table 20.20.

Table 20.20 Impacts resulting from the direct disturbance of surface water bodies (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	East Ruston Stream	High	High	Two temporary crossings required, one on the main watercourse and a second on a tributary. These will be in place for a maximum of two years.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham Canal	Low	Low	Two temporary crossings required, confined to small tributaries, not directly affecting the main channel.	Negligible	**Minor Adverse**	Negligible	**Negligible**
	River Bure	Medium	High	Five temporary crossings will be required in this sub-catchment. These crossings will each affect single tributaries for a maximum of two years, and will not directly impact upon the main river channel.	Medium	**Major adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High	Single crossing required for a maximum of two years.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wensum	Blackwater Drain	High	High	One temporary crossing for a maximum of two years.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High	Two temporary crossings will be required including one on the main river channel.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Penny Spot Beck	High	High	Two temporary crossings required on the watercourse and its tributaries.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	Single crossing of Upper Wissey ordinary watercourse.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**

20.7.4.1.3 Scenario 2

118. Unlike Scenario 1, Scenario 2 will require the installation of cable ducts between the landfall and onshore project substation. Table 20.21 summarises the number of watercourse crossings that will be required in each sub-catchment, with further information regarding the schedule of watercourse crossings provided in Appendix 20.4.

Table 20.21 Watercourse crossings in surface water catchments (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Number of crossings	
				Open cut	Trenchless
River Bure	New Cut	Low	High	0	0
	East Ruston Stream	High	High	2	0
	North Walsham & Dilham Canal	Low	Low	2	4
	King's Beck	Medium	High	4	5
	River Bure	Medium	High	5	2
	Mermaid Stream	Medium	High	0	0
			Total	**13**	**11**
River Wensum	Blackwater	High	High	10	1
	River Wensum	High	High	0	3
	Penny Spot Beck	High	High	5	2
	Wendling Beck	High	High	5	3
			Total	20	9
River Wissey	River Wissey	Medium	Medium	4	0
			Total	**4**	**0**

119. Trenchless crossing techniques (e.g. HDD) have been embedded within the scheme design to avoid impacts on the larger and most sensitive watercourses, including the main channels of the River Wensum, River Bure, King's Beck, Wendling Beck (two crossings) and the North Walsham and Dilham Canal (section 20.7.1). The cable will be installed at least 2m beneath the watercourse using a technique such as HDD, micro-tunnelling or auger boring (Chapter 5 Project Description). Although these techniques will cause some surface disturbance at the entry and exit points, there will be no direct disturbance of the surface watercourses. Furthermore, the running track will not cross any of the watercourses that will be crossed by trenchless techniques, with the exception of Wendling Beck at Bushy Common. There are therefore no direct mechanisms to impact upon the geomorphology, hydrology and physical habitats of surface watercourses associated with trenchless techniques, and no further mitigation is proposed at trenchless crossing locations.

120. Trenchless crossing techniques will be limited in use to the larger and most sensitive watercourse crossings, whereas open trench techniques will be used for the majority of crossings of smaller watercourses. Two potential trenched crossing techniques have been identified, depending upon the dimensions of the watercourse:

- Temporary dam and divert: For watercourses that are shallower than 1.5m, temporary dams (composed of either sand bags or straw bales and ditching clay) will be installed upstream and downstream of the cable crossing to allow works to be undertaken in dry conditions. A pump, temporary flume or bypass channel will be used to maintain flows downstream of the dams. Temporary culverts or bridges (with a width of up to 3m) may be required to allow the running track to cross the watercourse at these trenched crossing locations. Depending upon the location, it may be necessary for these to remain in place for up to 2 years during the duct installation works, with the potential for a further period during cable pulling; and
- Permanent culvert to allow the cable ducting to cross watercourses: For watercourses that are 1.5m or deeper, it may be possible to use the approach outlined above, however in some cases it may be necessary to install a pipe or box culvert.

121. In addition, temporary culverts will be required to allow the running track to cross surface watercourses as outlined for Scenario 1. These will be used at the majority of crossing locations, including Wendling Beck at Bushy Common but excluding all other watercourses crossed using trenchless techniques.

Impacts prior to mitigation

122. There are no crossings within the New Cut or Mermaid Stream sub-catchments. There is therefore no mechanism for watercourses within the catchment to be impacted.

123. For the remaining sub-catchments, there will be a need for watercourse crossings. The impacts on each sub-catchment resulting from the direct disturbance during construction are summarised in Table 20.23. Prior to mitigation the potential impacts range from **negligible** to **major adverse**.

Additional mitigation measures

124. In addition to the embedded measures described in section 20.7.1, the additional measures in Table 20.22 would be applied to reduce the impacts associated with watercourse crossings. These will be detailed in the COCP (DCO Requirement 20) and outline COCP (document reference 8.1) that has been produced and submitted with the DCO application.

Table 20.22 Additional mitigation measures for direct disturbance of surface water bodies from watercourse crossings during construction (Scenario 2)

Measure
Specific dam and divert method for larger watercourses will be agreed at detailed design with internal drainage boards and flood management agencies, as part of the relevant secondary consent processes.
Restrict the amount of time that temporary dams are in place, e.g. typically no more than one week.

Measure
Fish rescue undertaken in the area between the temporary dams prior to dewatering.
Ensure pumps, flumes (pipes) or diversion channels are appropriately sized to maintain flows downstream of the obstruction whilst minimising upstream impoundment.
Select technique that can allow fish passage to be maintained in watercourses which support migratory fish species such as brown trout, where appropriate.
Geotextiles or similar techniques used to line diversion channels and prevent sediment entering the watercourse.
Use adequately sized culverts to avoid impounding flows and ensure that there is no reduction in flow conveyance (including an allowance for potential increases in winter flows as a result of projected climate change).
Install culverts below the active bed of the channel, so that sediment continuity and movement of fish and aquatic invertebrates can be maintained.
In the case of temporary culverts for the running track, alternative techniques such as temporary bridges will be considered where appropriate (e.g. where culvert installation is likely to have an impact on channel morphology and ecology).
At trenched crossing locations, the cable will be buried a minimum of 1.5m below the bed level. This will ensure that there is sufficient thickness of natural bed substrates to prevent geomorphological impacts (e.g. bed scour and channel instability) and avoid exposure during periods of higher energy flow where the bed could be mobilised (allowing for climate-related increases in fluvial flows and erosion in the future). At trenchless crossings cable ducts will be installed a minimum of 2m below bed level. Installation depths at watercourse crossings will be confirmed with the relevant drainage authority post-consent.
Where possible, localised improvements to the geomorphology and in-channel habitats will be considered where they are crossed using open cut techniques e.g. by replacing resectioned banks with more natural profiles that are typical of the natural geomorphology of the watercourse. Note that any enhancements to directly affected watercourses would be limited to within the project red line boundary.

Impacts following mitigation

125. Following implementation of the measures described in Table 20.22, the potential for impacts associated with watercourse crossings along the cable route would be reduced. The magnitude of effect following mitigation and the resulting residual impact for each sub-catchment is shown in Table 20.23. In most sub-catchments the potential residual impact ranges from **negligible** to **minor adverse**. However, for the River Bure, King's Beck, Blackwater Drain, Wendling Beck and Penny Spot Beck sub-catchments there are potential **moderate adverse** residual impact s.

126. It is important to note that the moderate adverse residual impacts resulting from the proposed installation of multiple open cut crossings within the River Bure, King's Beck, Blackwater Drain, Wendling Beck and Penny Spot Beck sub-catchments reflect the worst case assumption that multiple permanent culverts could be constructed within each sub-catchment (which, in this case, are considered to have a greater potential to adversely impact on the hydrology and geomorphology of the surface watercourses than temporary disturbance during the installation of multiple temporary dams). However, the measures outlined in Table 20.22 would be highly effective in mitigating impacts on the geomorphology and hydrology of the

watercourse at each crossing location because they would allow the free movement of water and sediment to continue with minimal interference. Furthermore, the installation of each trenchless crossing is not considered to result in a significant effect when assessed individually.

127. It is also important to note that impacts resulting from the use of dam and divert techniques and temporary culverts would be largely restricted to the period in which the impounding structures are in place. Any changes to the condition of each watercourse would be reversible once the structures have been removed and the reinstatement measures described above have been implemented. The natural hydrology would recover immediately upon structure removal, and geomorphology and associated physical habitats are also expected to recover rapidly. The use of these techniques is therefore not considered to result in significant adverse effects.

Table 20.23 Impacts resulting from the direct disturbance of surface water bodies (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	East Ruston Stream	High	High	Two open cut crossings: one on the East Ruston Stream and one on a connected IDB drain.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham Canal	Low	Low	Four trenchless crossings: one on the North Walsham and Dilham Canal, one on the IDB drain, and two ordinary watercourses adjacent to it. The use of a trenchless technique to cross these watercourses will avoid any direct disturbance.	Negligible	**Negligible**	Negligible	**Negligible**
				Two open cut crossings on the unnamed watercourses at Brick Kiln Farm and Grammar School Farm.	Low	**Minor Adverse**	Negligible	**Negligible**
	River Bure	Medium	High	Two trenchless crossings: one on the main River Bure and one on the adjacent ordinary watercourse. The use of a trenchless technique to cross these watercourses will avoid any direct disturbance.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
				Five open cut crossings: Four on unnamed tributaries and one on an IDB drain near Silvergate.	Medium	**Major Adverse**	Low	**Moderate Adverse**
	King’s Beck	Medium	High	Five trenchless crossings; one on the Blackwater Beck IDB Drain and four on connected ordinary watercourses. The use of a trenchless technique to cross these watercourses will avoid any direct disturbance.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
				Several tributaries of the King’s Beck will be crossed using trenched techniques; one at Suffield Beck IDB drain, one on the unnamed ordinary watercourse near Cooke’s Bottoms and two on the unnamed ordinary watercourses near Colby Hall.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum	High	High	Three trenchless crossings; one at the main River Wensum, and two adjacent IDB drains.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
	Blackwater Drain	High	High	There will be a single trenchless crossing near Kerdiston.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
				Ten trenched crossings across the sub-catchment, including a trenched crossing of the main river at Sparham House.	High	**Major Adverse**	Low	**Moderate Adverse**
	Wendling Beck	High	High	Two trenchless crossings across Wendling Beck, and a third across the unnamed ordinary watercourse near Little Wood.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
				There will also be five crossings of unnamed tributaries of the Wendling Beck using an alternative trenched technique.	Medium	**Major Adverse**	Low	**Moderate Adverse**
	Penny Spot Beck	High	High	Two trenchless crossings across the watercourse.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
				Penny Spot Beck will be crossed at one location with a trenched technique. The headwaters of a small watercourse near Frog's Hall that drains into the beck will be crossed four times using a trenched technique.	Medium	**Major Adverse**	Low	**Moderate Adverse**
River Wissey	Upper River Wissey	Medium	Medium	Three trenched crossings of an unnamed ordinary watercourse near Lodge Farm and a single crossing of the Upper Wissey ordinary watercourse.	Low	**Minor Adverse**	Negligible	**Minor Adverse**

20.7.4.2 Impact 2: Increased sediment supply

20.7.4.2.1 Description of impacts

128. Construction activities in the onshore project area will involve earthworks and create temporary areas of bare ground by removing surface vegetation cover. The extent of these impacts will differ for Scenario 1 and Scenario 2. These construction activities could increase the potential for the erosion of soil particulates, resulting in an increase in the supply of fine sediment (e.g. clays, silts and fine sands) to surface watercourses through surface water runoff and the erosion of exposed soils.

129. Increased sediment supply could affect the geomorphology of the watercourse by increasing turbidity in the water column and encouraging enhanced deposition of fine sediment on the bed of the channel. Furthermore, increased sediment loads could potentially smother existing bed habitats, reduce light penetration and reduce dissolved oxygen concentration, adversely affecting stream biota (e.g. macrophytes, aquatic invertebrates and fish such as brown trout, bullhead and brook lamprey) and adversely affecting the quality of in-channel habitats.

130. Any impacts of increased sediment supply would be particularly pronounced in chalk river catchments (such as the River Wensum and its tributaries), which naturally have low suspended sediment loads and coarse bed substrates (i.e. gravels and cobbles) with a low proportion of fine sediment. Species such as brown trout, bullhead and spawning adult brook lamprey require these “clean” substrates and as such in-channel habitats for these species could become degraded as a result of increased sediment supply. Note that further discussion on the potential impacts of the development on aquatic ecology is provided in Chapter 22 Onshore Ecology.

131. Site preparation, ground excavations and other construction activities which have the potential to increase sediment supply will take place across the onshore project area. The scale of the potential impact at a sub-catchment level is proportional to the area of each catchment that would be disturbed during construction, and the scenario being assessed.

20.7.4.2.2 Scenario 1

Impacts prior to mitigation

132. Under Scenario 1, construction-stage activities in the River Bure and River Wensum catchments will be limited to pulling of cables through the pre-installed ducts, the construction of jointing pits (each with an area of 90m^2) and the reinstallation of limited areas of running track. The construction activities in the River Bure and River Wensum catchments are expected to be the same and the impacts on these two catchments have been assessed alongside each other.

133. For the purposes of this assessment, the number of jointing pits within each sub-catchment has been estimated based on the worst-case interval of 800m along the cable route, rounded up to the nearest whole number. Furthermore, it is also assumed that, as a worst case, it will be necessary to reinstall 20% of the running track and that this area will be unprotected i.e. exposed ground. The resulting worst case total area of ground disturbance within each sub-catchment is shown in Table 20.24. Any changes to sediment supply are unlikely to be of sufficient magnitude to significantly change the channel capacity and therefore will not alter flood risk.

Table 20.24 Area of disturbed ground in surface catchments (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Maximum total area of disturbed ground	
				km^2	%
River Bure	New Cut	Low	High	0.0068	0.03
	East Ruston Stream	High	High	0.0083	0.03
	North Walsham & Dilham Canal	Low	Low	0.0097	0.02
	King's Beck	Medium	High	0.0084	0.01
	River Bure	Medium	High	0.0088	0.02
	Mermaid Stream	Medium	High	0.0025	0.01
			Total	**0.0377**	**0.02**
River Wensum	Blackwater	High	High	0.0165	0.03
	River Wensum	High	High	0.0104	0.01
	Wendling Beck	High	High	0.0182	0.02
			Total	**0.0452**	**0.01**
River Wissey	River Wissey	Medium	Medium	0.1580	0.18
			Total	**0.1580**	**0.18**

134. The impacts on each sub-catchment associated with increased sediment supply during construction are summarised in Table 20.26. Prior to mitigation the potential impacts range from **negligible** to **minor adverse**.

Additional mitigation measures

135. The additional mitigation measures in Table 20.25 will be put in place to prevent the release of sediment into the watercourses during construction.

Table 20.25 Additional mitigation measures for increased sediment supply during construction

Measure
A CoCP (DCO Requirement 20) will be developed for the construction activities and will adhere to construction industry good practice guidance as detailed in the Environment Agency's Pollution Prevention Guidance (PPG) notes (including PPG01, PPG05, PPG08 and PPG21) (now revoked as regulatory guidance in England, but still provides a useful guide for best practice measures), and CIRIA's 'Control of water pollution from construction sites – A guide to good practice' (2001). Specific measures will include: • Subsoil exposure minimised and strips of undisturbed vegetation retained on the edge of the working area where possible; • On-site retention of sediment maximised by routing all drainage through the site drainage system; • Silt fences at the foot of soil storage areas to intercept sediment runoff at source. Where practicable, runoff will be routed into swales, which incorporate check dams to further intercept

Measure
sediment and/or attenuation ponds which incorporate sediment forebays. Suitable filters will be used to remove sediment from any water discharged into the surface drainage network; • Additional silt fences included in parts of the working area that are in close proximity to surface drainage channels; and • Soil and sediment not allowed to accumulate on roads. Traffic movements restricted to minimise the potential for surface disturbance.
Buffer strips will be retained adjacent to watercourses where possible. Where surface vegetation has been removed, it will be reseeded to prevent future runoff (excluding arable crops).

Impacts following mitigation

136. It is not expected that these additional mitigation measures will further reduce the magnitude of effect on the River Bure, Wensum and Wissey catchments, because they were classed as having a negligible magnitude prior to mitigation. However, the additional measures are an important and integral part of best practice construction methodology and will be adhered to for this project to help ensure that sediment supply is not increased.

137. As a result the residual impacts for each sub-catchment remain as **negligible** to **minor adverse**, as shown in Table 20.26.

Table 20.26 Impacts resulting from increased sediment supply (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	The total area of disturbed ground in each sub-catchment is very small, and accounts for a maximum of 0.03% of the total area of each sub-catchment. Given the small spatial extent of these activities and the minimal ground disturbance, they are unlikely to result in the generation of more than trace quantities of sediment.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham Canal	Low	Low		Negligible	**Negligible**	Negligible	**Negligible**
	River Bure	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	Embedded mitigation measures described in section 20.7.1 will control supply of sediment from construction activities.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**

20.7.4.2.3 Scenario 2

138. Under Scenario 2, the maximum total area that could potentially be disturbed in each catchment during construction is summarised in Table 20.27. Scenario 2 includes the duct installation for the onshore cable route and construction of the onshore project substation and National Grid substation extension, and as a result the area impacted is larger than under Scenario 1. However, as highlighted in Table 20.14 and Table 20.16, it is important to note that each active working area on the cable route at any one time will be restricted in spatial extent (0.011km^2) and duration (2 weeks). The worst case assumption is that, in a given 5km stretch of cable route, work at any one time will be restricted to a maximum of two workfronts (0.022km^2), one mobilisation area, one set of trenchless crossings and 5km of running track. These areas have been scaled according to the length of cable route in each sub-catchment, and the results are shown in Table 20.27. Note that, where a sub-catchment contains less than 5km of cable route, it is assumed that two workfronts, one mobilisation area and one set of trenchless crossings would still be worked on concurrently as a worst case (i.e. these elements have a fixed area and cannot be sub-divided).

139. Although in most cases the total working area at a single point in time could be considerably less (because it is unlikely that a large number of teams will be working in the same sub-catchment at the same time), these values have been presented as a worst case scenario on which to base this assessment (section 20.7.2).

Table 20.27 Area of disturbed ground in surface water catchments (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Maximum total area of disturbed ground km^2	Maximum total area of disturbed ground %	Maximum working area at any one time km^2	Maximum working area at any one time %
River Bure	New Cut	Low	High	0.1670	0.82	0.06	0.30
	East Ruston Stream	High	High	0.2020	0.81	0.07	0.29
	North Walsham & Dilham Canal	Low	Low	0.2370	0.44	0.08	0.16
	King's Beck	Medium	High	0.2048	0.29	0.07	0.10
	River Bure	Medium	High	0.2156	0.57	0.08	0.20
	Mermaid Stream	Medium	High	0.0606	0.29	0.04	0.20
			Total	**1.0868**	**0.52**	**0.41**	**0.20**
River Wensum	Blackwater	High	High	0.4060	0.62	0.14	0.22
	River Wensum	High	High	0.2534	0.13	0.09	0.05
	Wendling Beck	High	High	0.4480	0.56	0.16	0.20
			Total	**1.1074**	**0.33**	**0.39**	**0.12**
River Wissey	River Wissey	Medium	Medium	0.2614	0.30	0.2614	0.30
			Total	**0.2614**	**0.30**	**0.04**	**0.04**

Impacts prior to mitigation

140. The development will include a range of embedded mitigation measures to reduce the potential for an increase in the supply of fine sediment, including minimising the area of open ground, storing and reinstating topsoil and using hardstanding in mobilisation areas (section 20.7.1). This means that the working area will be restricted in each catchment at any one time (Table 20.27). It is important to note that any impacts will be short term, limited to the duct installation period (works will be undertaken in 150m sections, and the time from topsoil strip to reinstatement would typically be a maximum of two weeks in each 150m section), and reversible once activities have been completed.

141. As a result of the embedded measures, any changes to sediment supply are unlikely to be of sufficient magnitude to significantly change the channel capacity and therefore will not alter flood risk.

142. Based on the low proportion of the catchment affected (Table 20.27) and with embedded measures to minimise the working area in place, the impacts on each sub-catchment resulting from the increased sediment supply during construction range from **minor** to **moderate adverse** (Table 20.28.

Additional mitigation measures

143. As outlined for Scenario 1 the additional mitigation measures in Table 20.25 will be implemented to reduce the likelihood of sediment release into surface watercourses.

144. In addition, a Construction Surface Water and Drainage Plan (SWDP) (DCO Requirement 20(2)(i)) will also be developed and implemented to minimise water within the cable trench and ensure ongoing drainage of surrounding land. Where water enters the trenches during installation, this will be pumped via settling tanks, sediment basins or mobile treatment facilities to remove sediment, before being discharged into local ditches or drains via temporary interceptor drains to prevent increases in fine sediment supply to the watercourses.

Impacts following mitigation

145. Additional mitigation measures will reduce sediment supply from the working area and are an important and integral part of best practice construction methodology to help ensure that sediment supply is not increased. However, because the assessment has been undertaken on a worst case (sub-catchment) basis the additional mitigation measures are not considered to reduce the magnitude of effect on the River Bure and Wensum catchments. The most effective mitigation measures are considered to be those embedded in the project already including minimising the area of open ground, storing and reinstating topsoil and using hardstanding in mobilisation areas. However, these measures will collectively reduce the magnitude of effect in the River Wissey catchment, where activities are greater and focussed at

the onshore project substation and National Grid substation extension. The magnitude of effect following mitigation and the resulting residual impact for each sub-catchment is shown in Table 20.28. In most of the sub-catchments the potential residual impact would range from **negligible** to **minor adverse**. However, in the East Ruston Stream, River Bure, Blackwater Drain and Wendling Beck sub-catchments there are potential **moderate adverse** residual impacts.

146. It is important to note that the moderate adverse residual impacts predicted for the East Ruston Stream, River Bure, Blackwater Drain and Wendling Beck sub-catchments are based on a worst case scenario which reflects the cumulative impact of construction activities (e.g. cable trenching and watercourse crossings) within each sub-catchment, rather than the potential impacts on any individual watercourse. When assessed alone, potential impacts on the individual watercourses which make up each sub-catchment are not considered to give rise to significant effects.

Table 20.28 Impacts resulting from increased sediment supply (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	Because the proportion of the catchment area affected by a working area is minimised through embedded measures the overall magnitude of effect is assessed to be low for the East Ruston Stream and the main River Bure and negligible elsewhere within the catchment.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Low	**Moderate Adverse**	Low	**Moderate Adverse**
	North Walsham & Dilham Canal	Low	Low		Negligible	**Negligible**	Negligible	**Negligible**
	River Bure	Medium	High		Low	**Moderate Adverse**	Low	**Moderate Adverse**
	King's Beck	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High	Embedded mitigation measures will control sediment supply from construction works.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High	A greater area of these sub-catchments will be disturbed, therefore there is a greater potential for increased sediment to enter these watercourses.	Low	**Moderate Adverse**	Low	**Moderate Adverse**
	Wendling Beck	High	High		Low	**Moderate Adverse**	Low	**Moderate Adverse**
River Wissey	Upper River Wissey	Medium	Medium	A greater area of this sub-catchment will be disturbed, therefore there is a greater potential for increased sediment to enter the watercourse.	Medium	**Moderate Adverse**	Low	**Minor Adverse**

20.7.4.3 Impact 3: Accidental release of fuels, oils, lubricants, foul waters and construction materials

20.7.4.3.1 Description of impacts

147. There is the potential for the accidental release of lubricants, fuels and oils from construction machinery working in and adjacent to surface watercourses, through spillage, leakage and in-wash from vehicle storage areas after rainfall (during the main construction activities, including associated access to sites, and subsequent cable pulling). There is also the potential for accidental release of foul waters (from welfare facilities) and construction materials (including concrete and inert drilling fluids from trenchless crossings) into the aquatic system during construction.

148. If a significant leakage or spillage occurs, there is the potential for adverse impacts upon water quality if contaminants enter the surface drainage network or percolate into groundwater. Construction activities which disturb the ground (including excavation and piling at the onshore project substation) could therefore potentially introduce contaminants into the underlying groundwater bodies (particularly shallow aquifers). These activities could therefore adversely affect the quality of the underlying groundwater (including the Principal Aquifer and any secondary aquifers) and could potentially impact upon any licensed and unlicensed abstractions within it (including potable water abstractions protected by SPZ1 or SPZ2).

149. These water quality impacts have the potential to adversely affect ecology (particularly fish and macroinvertebrates; see Chapter 22 Onshore Ecology) if pollutant concentrations are sufficiently high.

150. The scale of the potential impact upon each receptor is likely to be proportional to the area of each catchment that would be affected during construction (i.e. the total footprint of construction activities). This is summarised in Table 20.24 for Scenario 1 and Table 20.27 for Scenario 2.

20.7.4.3.2 Scenario 1

Impacts prior to mitigation

151. Under Scenario 1, construction-stage activities in the River Bure and River Wensum catchments will be limited to pulling of cables through pre-installed ducts, the construction of joint pits and the reinstatement of the running track. The impacts on each receptor resulting from the accidental release of fuels, oils, lubricants, foul waters and construction materials are summarised in Table 20.29. Prior to mitigation the potential impacts range from **negligible** to **moderate adverse**.

Table 20.29 Impacts resulting from the accidental release of fuels, oils, lubricants, foul waters and construction materials (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	The scale of potential accidental release of fuels, oils, lubricants, foul waters and construction materials upon a sub-catchment is likely to be proportional to the area of each catchment that would be affected during construction. Under Scenario 1, construction-stage activities in the River Bure and River Wensum catchments will be limited to pulling of cables through pre-installed ducts, the construction of jointing pits and the reinstatement of the running track.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham Canal	Low	Low		Negligible	**Negligible**	Negligible	**Negligible**
	River Bure	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wissey	River Wissey	Medium	Medium	The embedded mitigation measure described in Section 20.7.1 will control the accidental release of foul waters, but will not prevent the release of other contaminants from construction activities.	Low	**Minor Adverse**	Negligible	**Minor Adverse**
Groundwater	Groundwater	High	High	The embedded mitigation measure described in section 20.7.1 will control the accidental release of foul waters, but will not prevent the release of other contaminants from construction activities at the compound and substation.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**

Additional mitigation measures

152. The potential for impacts associated with the accidental release of fuels, oils, lubricants, construction materials and other contaminants will be reduced by a range of additional measures, as set out in Table 20.30.

Table 20.30 Additional mitigation measures for impacts associated with the accidental release of contaminants during construction

Measure
A CMS (DCO Requirement 20(2)(g)) will be produced that adheres to construction industry good practice guidance. This will be informed by the Environment Agency's Pollution Prevention Guidance (PPG) notes (including PPG01, PPG05, PPG08 and PPG21) (now revoked as regulatory guidance in England, but still provides a useful guide for best practice measures), and CIRIA's 'Control of water pollution from construction sites – A guide to good practice' (2001). In addition to the sediment management measures set out in section 20.7.4.2, additional measures to prevent contamination will include the following: • Concrete and cement mixing and washing areas will be situated at least 10m away from the nearest watercourse. These will incorporate settlement and recirculation systems to allow water to be re-used. • All washing out of equipment will be undertaken in a contained area, and all water will be collected for off-site disposal. • All fuels, oils, lubricants and other chemicals will be stored in an impermeable bund with at least 110% of the stored capacity. Damaged containers will be removed from site. All refuelling will take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils will be used where possible. • Spill kits will be available on site at all times. Sand bags or stop logs will also be available for deployment on the outlets from the site drainage system in case of emergency spillages.
Suitable biosecurity protocols (such as those outlined by the Non-Native Species Secretariat (NNSS)) would be put in place during the works in order to minimise the risk of contamination and the spread of the invasive non-native species (INNS), including the spread of crayfish plague. This includes the implementation of strict biosecurity protocols such as stringent 'Check, Clean, Dry' working methodology for plant, equipment and construction crews. Further details with regards to mitigation measures implemented to prevent the spread and propagation of INNS are included in Chapter 22 Onshore Ecology.
Foul drainage (e.g. domestic waste from welfare facilities) at the onshore project substation (located in the Wissey catchment) will be collected through a mains connection to the existing local authority sewer system (if a suitable connection is available) or collected in a septic tank located within the development boundary and transported off site for disposal at a licensed facility. The specific approach will be determined during detailed design with consideration for the availability of mains connection and projected volumes of foul water to be generated (based on the number of visiting hours for site attendees during operation). Any requirements for potable water (e.g. for domestic use within welfare facilities) will also be confirmed during detailed design.
If works are required in a groundwater SPZ1 or SPZ2, the construction working methodology (for example a Construction Method Statement) will stipulate that the best available techniques (BAT) are used for any installations, in accordance with the Energy Network Association Guidance, and in agreement with the Environment Agency.

Impacts following mitigation

153. It is not expected that these additional mitigation measures will further reduce the magnitude of effect on the River Bure and River Wensum catchments. However, the additional measures are an important and integral part of best practice construction

methodology and will be adhered to for this project to help ensure that the supply of contaminants is not increased.

154. Following the implementation of the additional mitigation measures (including the measure to prevent the release of foul drainage from the onshore project substation and National Grid substation extension), the effect is expected to reduce to a negligible magnitude in the Wissey catchment and groundwater receptors.

155. The magnitude of effect following mitigation and the resulting residual impact for each receptor is shown in Table 20.29 and range from **negligible** to **minor adverse**.

20.7.4.3.3 Scenario 2

Impacts prior to mitigation

156. The scale of potential accidental release of fuels, oils, lubricants, foul waters and construction materials upon a sub-catchment is likely to be proportional to the area of each catchment that would be affected during construction. Under Scenario 2, construction-stage activities in the River Bure and Wensum catchments will include the construction of the cable route and associated infrastructure such as the running track. The River Wissey catchment will also include construction of the onshore project substation and National Grid substation extension.

157. The impacts on each receptor resulting from the accidental release of fuels, oils, lubricants, foul waters and construction materials are summarised in Table 20.31 Prior to mitigation the potential impacts range from **minor** to **major adverse**.

Additional mitigation measures

158. As outlined for Scenario 1 the mitigation measures detailed in Table 20.30 will be implemented in addition to the embedded mitigation measures to prevent the release of contaminants set out in section 20.7.1.

159. Furthermore, following consultation with the Environment Agency, cable excavations will be designed not to disturb groundwater in any significant manner. Excavations will be shallow (approximately 1.5m) and above the water table of the Principal Aquifer.

160. If works are required in the SPZ1 or SPZ2 areas or across the functional floodplain of the main watercourses, the construction working methodology (for example a Construction Method Statement) will stipulate that best available techniques (BAT) are used for any installations, in accordance with the Energy Network Association Guidance, and in agreement with the Environment Agency. Furthermore, a hydrogeological risk assessment in accordance with Groundwater Protection Principles and Practice (GP3) (Environment Agency, 2017), will be undertaken for any trenchless crossing locations in SPZ1 or SPZ2 areas (specifically the North Walsham

and Dilham Canal). If significant risks are identified, alternatives including alternative trenchless drilling techniques (other than HDD) to cross the SPZ area will be considered.

161. A break-out contingency plan will be drafted in case of break-out of drilling fluid during trenchless crossing construction. The details of this plan will be included in the CoCP (DCO Requirement 20).

Impacts following mitigation

162. Following the implementation of these additional mitigation measures, the potential for accidental release of contaminants from construction activities is reduced. The impacts on each receptor following mitigation and resulting residual impacts are shown in Table 20.31 and range from **negligible** to **minor adverse**.

Table 20.31 Impacts resulting from the accidental release of fuels, oils, lubricants, foul waters and construction materials (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	Overall, a greater proportion of the New Cut and East Ruston Stream sub-catchments will be affected than the other sub-catchments within the Bure catchment. It is important to note that this will be a short term impact, limited to the duct installation period (works will be undertaken in 150m sections, and the time from topsoil strip to reinstatement would typically be a maximum of two weeks in each 150m section), and reversible once activities have been completed.	Medium	**Major Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Medium	**Major Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham canal	Low	Low		Low	**Minor Adverse**	Negligible	**Negligible**
	River Bure	Medium	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High	Overall, a greater proportion of the Blackwater Drain and Wendling Beck sub-catchments will be affected than the other sub-catchments within the Wensum catchment. It is important to note that this will be a short term impact, limited to the duct installation period (works will be undertaken in 150m sections, and the time from topsoil strip to reinstatement would typically be a maximum of two weeks in each 150m section), and reversible once activities have been completed.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High		Medium	**Major Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High		Medium	**Major Adverse**	Negligible	**Minor Adverse**
River Wissey	River Wissey	Medium	Medium	The construction of the onshore substations will disturb a relatively small proportion of the overall River Wissey catchment.	Low	**Minor Adverse**	Negligible	**Minor Adverse**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
Groundwater	Groundwater	High	High	The groundwater receptors in the study area support abstractions for public water supply and are considered to have a high vulnerability.	Medium	**Major Adverse**	Negligible	**Minor Adverse**

20.7.4.4 Impact 4: Changes to surface water runoff and flood risk

20.7.4.4.1 Description of impacts

163. The initial site preparation and construction activities associated with the onshore project area have the potential to alter surface water flows and drainage patterns by:

- Altering existing flow paths and changing the distribution of surface drainage across development sites (e.g. through raising or lowering the existing land surface);
- Reducing infiltration and increasing surface runoff as a result of soil compaction by construction vehicles;
- Increasing the proportion of impermeable surfaces in a catchment and therefore reducing infiltration. The development of surface infrastructure also has the potential to change surface flows and infiltration rates as a result of changes to land use (i.e. by increasing the proportion of impermeable surfaces in a drainage catchment) and alter site runoff characteristics; and
- Installing structures (e.g. temporary watercourse crossings) across existing surface drainage features that constrain their capacity to convey flows downstream and increase localised flood risk.

164. The construction of the project therefore has the potential to increase surface water runoff, which could adversely affect the hydrology and geomorphology of the surface drainage network (e.g. as a result of increased discharge resulting in bed and bank scour, and the in wash of greater volumes of fine sediment due to increased surface runoff, as discussed in section 20.7.4.2). This could also affect in-channel habitats for species such as brown trout, bullhead and brook lamprey. Specific impacts upon fish species are discussed in Chapter 22 Onshore Ecology.

165. Any changes in surface flows could also increase flood risk in the onshore project area, particularly third-party land and property in areas within Flood Zones 2 or 3. The project passes largely through agricultural land, with some residential and agricultural buildings located in proximity to the onshore project area.

166. The area of direct impact within the construction footprint and, where appropriate, the number of open cut watercourse crossings (including temporary crossing locations) are used as a proxy for the assessment of potential changes to surface water runoff and flood risk within each sub-catchment.

167. It is important to note that the changes to surface water runoff and flood risk assessed in detail for each catchment below are expected to relatively localised, and would not be sufficient to cause a major accident or disaster. More detailed information regarding potential flood risk impacts are provided in to Appendix 20.1.

168. Note that potential additional impacts on surface water flows and flood risk associated with cable trenching under Scenario 2 are discussed in more detail in section 20.7.4.4.3.

20.7.4.4.2 Scenario 1

Impacts prior to mitigation

169. The impacts on each receptor resulting from changes to surface water runoff and flood risk are summarised in Table 20.33. Prior to mitigation the potential impacts range from **negligible** to **moderate adverse**.

170. It is important to note that, under Scenario 1, the project will not displace or increase flood risk off-site, therefore the risk to third-party land is considered negligible (see Appendix 20.1).

Additional mitigation measures

171. Potential impacts resulting from the use of temporary culverts at watercourse crossings along the running track would be mitigated by the additional measures set out in Table 20.32.

Table 20.32 Additional mitigation measures for impacts associated with changes to surface water runoff and flood risk during construction (Scenario 1)

Measure
The following measures would be implemented along the cable route: • Ensuring that the temporary culvert is adequately sized to avoid impounding flows (including an allowance for potential increases in winter flows as a result of projected climate change). • Installing the temporary culvert below the active bed of the channel, so that sediment continuity and movement of fish and aquatic invertebrates can be maintained. • Alternative techniques such as temporary bridges will be considered where appropriate (e.g. where installation of a temporary culvert is likely to have an impact on channel morphology and ecology).
The following measures would be implemented at the onshore project substation: • Surface water drainage requirements will be presented in the final Operational Drainage Plan (ODP) (DCO Requirement 32), an outline ODP (document reference 8.21) has been produced and submitted as part of the DCO application. The drainage scheme will be designed to meet the requirements of the NPPF and NPS EN-5, with runoff limited, where feasible, through the use of infiltration techniques which can be accommodated within the area of development. The drainage strategy will be developed according to the principles of the SuDS discharge hierarchy. Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable: i) into the ground (infiltration); ii) to a surface water body; iii) to a surface water sewer, highway drain or another drainage system; or iv) to a combined sewer. • A pre-construction drainage plan will be developed as part of the SWDP, agreed with regulators and implemented to minimise water within the working area and ensure ongoing drainage of surrounding land. • Existing land drains at the onshore project substation will be reinstated following construction. A local specialised drainage contractor will undertake surveys to locate drains and create drawings both pre- and post-construction, and ensure appropriate reinstatement. The pre-construction

Measure
drainage plan will include provisions to minimise water within the working area and ensure ongoing drainage of surrounding land.

Impacts following mitigation

172. Following application of these measures, the magnitude of effect would be reduced (where not already negligible). The impacts following mitigation and resulting residual impacts are summarised for each receptor in Table 20.33 and would be **minor adverse** in all sub-catchments.

Table 20.33 Impacts resulting from changes to surface runoff and flood risk (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	High	High	Up to 0.0068 km^2 (0.03%) of the New Cut sub-catchment would be directly affected by changes in surface water flow patterns, but there will not be any temporary watercourse crossings.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High	Up to 0.0083 km^2 (0.03%) of the East Ruston Stream sub-catchment would be directly affected by changes in surface water flow patterns, and there will be two temporary watercourse crossings.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham canal	Low	Low	Up to 0.0097 km^2 (0.02%) of the North Walsham and Dilham Canal sub-catchment would be directly affected by construction activities which could change surface flows, and there would be two temporary watercourse crossings.	Negligible	**Negligible**	Negligible	**Negligible**
	River Bure	Medium	High	Up to 0.0088 km^2 (0.01%) of the main River Bure would be directly affected by construction activities, and five temporary watercourse crossings would be required.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High	Up to 0.0084 km^2 (0.01%) of the King's Beck sub-catchment would be directly affected by construction activities, and one temporary watercourse crossing would be required.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High	Up to 0.0025 km^2 (0.01%) of the Mermaid Stream sub-catchment would be directly affected by construction activities, but no temporary crossings would be necessary.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Wensum	River Wensum & Penny Spot Beck	High	High	Up to 0.0104 km^2 (0.01%) of the main River Wensum (including Penny Spot Beck) sub-catchment would be directly affected by construction activities, and four temporary crossings would be required on the Penny Spot Beck.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High	Up to 0.0165 km^2 (0.03%) of the Blackwater Drain sub-catchment would be directly affected by construction activities, and there would be one temporary watercourse crossing.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High	Up to 0.0182 km^2 (0.02%) of the Wendling Beck sub-catchment would be directly affected by construction activities, and there would be five temporary watercourse crossings (including one on the main river channel).	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	A maximum of 0.1580km^2 (0.18%) of the Upper Wissey sub-catchment would be directly affected by the construction of the substation, National Grid extension and 400kV cable route.	Medium	**Moderate Adverse**	Low	**Minor Adverse**

20.7.4.4.3 Scenario 2

Additional impacts

173. In addition to the impacts that are described for both scenarios in section 20.7.4.4.1, the construction of the cable route under Scenario 2 could also impact upon surface water runoff and flood risk as a result of:

- Dewatering the cable trench and removal of the water through infiltration or discharge into the surface drainage network;
- Temporary changes to surface flows as a result of trenched watercourse crossings (see section 20.7.4.1 for details), particularly if the capacity of any pumps, flumes or diversion channels is exceeded; and
- Temporary changes to surface flows and flood risk resulting from temporary storage of spoil from the cable trenching within the floodplain of existing surface drainage features, which could constrain their capacity to convey flows downstream and increase localised flood risk.

174. These potential additional impacts are therefore considered alongside the impacts that are common to both scenarios in the subsequent sections.

175. The project will include embedded mitigation measures to control surface runoff during the construction phase, including the creation of drainage channels to intercept water from the cable trench and cable corridor. These measures, which are described in more detail in section 20.7.1, will help to control the release of surface waters from onshore construction works and prevent changes to surface runoff and flood risk.

Impacts prior to mitigation

176. The impacts on each receptor resulting from changes to surface water runoff and flood risk are summarised in Table 20.34. Prior to mitigation the potential impacts range from **minor** to **moderate adverse**.

Table 20.34 Impacts resulting from changes to surface runoff and flood risk (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	Up to 0.1670km^2 (0.82%) of the sub-catchment would be directly affected by construction activities, but the watercourse would not be crossed using an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High	Up to 0.2020km^2 (0.81%) of the sub-catchment could be directly affected by changes in surface water flow patterns, and there will be one open cut watercourse crossing.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham Canal	Low	Low	The onshore project area within the sub-catchment will be up to 0.2370km^2 (0.44%), and there would be one open cut watercourse crossing.	Low	**Minor Adverse**	Negligible	**Negligible**
	River Bure	Medium	High	Up to 0.2156km^2 (0.57%) of the sub-catchment would be directly affected by construction activities, and a single watercourse would be crossed with an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High	Up to 0.2048km^2 (0.29%) of the sub-catchment would be directly affected by construction activities, and four watercourses would be crossed with an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High	Up to 0.0606km^2 (0.29%) of the sub-catchment would be directly affected by construction activities, but the watercourse would not be crossed using an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High	Up to 0.2534km^2 (0.13%) of the sub-catchment would be directly affected by construction activities, and a single tributary of the Penny Spot Beck would be crossed using an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
	Blackwater Drain	High	High	Up to 0.4060km^2 (0.62%) of the sub-catchment would be directly affected by construction activities, and there would be sixteen watercourse crossings using an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High	Up to 0.0.4480km^2 (0.56%) of the sub-catchment would be directly affected by construction activities, and there would be four watercourse crossings using an open cut technique.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	A maximum of 0.2614km^2 (0.30%) of the Upper Wissey sub-catchment would be directly affected by construction activities and a single watercourse would be crossed using an open cut technique.	Medium	**Moderate Adverse**	Low	**Minor Adverse**

Additional mitigation measures

177. In addition to the embedded mitigation measures to intercept site drainage that are described in section 20.7.1, the potential for impacts associated with changes to surface water runoff and flood risk will be reduced by the additional measures described in Table 20.32 and Table 20.35. These measures will ensure that the project will not displace or increase flood risk off-site, therefore the risk to third-party land is considered negligible (see Appendix 20.1).

Table 20.35 Additional mitigation measures for impacts associated with changes to surface water runoff and flood risk during construction (Scenario 2)

Measure
Spoil storage areas along the cable route will be located at least 8m away from major surface watercourses (e.g. main rivers, IDB drains) and, wherever possible, outwith Flood Zone 3b (functional floodplain) to ensure that there is no loss of flood storage capacity within the functional floodplain.

Impacts following mitigation

178. Following the implementation of the additional mitigation measures outlined above, the potential for changes to surface water flows and flood risk is reduced and represents a negligible magnitude of effect on each sub-catchment.

179. The impacts following mitigation and resulting residual impacts are summarised for each receptor in Table 20.34 and range from **negligible** to **minor adverse**.

20.7.5 Potential Impacts during Operation

20.7.5.1 Impact 1: Increased surface water runoff, altered groundwater flows and changes to flood risk

20.7.5.1.1 Description of impacts

180. The permanent above-ground infrastructure, including the onshore project substation, National Grid substation extension and any new, permanent access track will result in permanent changes to land use. In most cases, the change in use from existing greenfield agricultural land use will create a permanent increase in impermeable area. Changes in land use are detailed further within Chapter 21 Land Use and Agriculture. Although permeable surface treatments will be used where possible, jointing pits along the onshore cable route, and the onshore project substation and National Grid substation extension are expected to comprise impermeable surfaces, with associated infrastructure such as roads also comprising impermeable surfaces.

181. An increase in the proportion of impermeable surfaces in a sub-catchment will result in a corresponding decrease in local infiltration and an increase in surface runoff. Furthermore, the presence of the buried cable ducting along the onshore cable route will introduce an impermeable barrier that has the potential to impact upon

subsurface flow routes and change the distribution of groundwater by changing subsurface flow patterns and forcing water to move upwards (i.e. towards the surface) or downwards (away from the surface). In addition, there is the potential for the cable route to act as a conduit for water during the operational phase as a result of differences in the hydraulic properties of the land disturbed during the trenching process and undisturbed ground surrounding it.

182. There is therefore potential for changes in surface water runoff resulting from the increase in impermeable areas and changes to subsurface flows. These could be sufficient to impact upon the hydrology (e.g. by increasing surface water volumes and flow velocities) of the surface water system and result in permanent changes to geomorphology by increasing rates of bed and bank erosion and encouraging geomorphological adjustment. Any geomorphological changes could also impact upon in-channel habitat conditions for aquatic species such as brown trout, bullhead and brook lamprey (specific impacts upon fish species are discussed in Chapter 22 Onshore Ecology). Impacts on geomorphology and in-channel habitats are likely to be particularly marked if drainage from a large area is discharged at a discrete location within the existing surface drainage network.

183. As well as impacts on geomorphology and in-channel habitats, changes to surface drainage patterns could potentially, if unmitigated, also increase flood risk to third party land and property, especially if the discharge of any drainage is not sufficiently controlled. Furthermore, watercourse crossing locations have the potential to increase flood risk elsewhere should they not be reinstated to pre-construction channel capacities (i.e. any reductions in channel capacity could increase local flood risk).

184. Any changes in the proportion of groundwater contained in surface waters (e.g. due to an increase in surface runoff, or an increase or decrease in groundwater upwelling) could potentially alter water chemistry and impact upon the quality of water-dependant habitats. There is also potential for the presence of the buried cable ducting throughout the onshore cable route to impact upon the level of recharge and the distribution of groundwater within the aquifers that underlie the onshore project area (including shallow aquifers and deeper Principal Aquifers).

185. The scale of the potential impact upon a sub-catchment is likely to be proportional to the area of permanent infrastructure in each catchment during operation. This is summarised in Table 20.36. The values quoted for Scenario 1 only include permanent above-ground infrastructure and jointing pits, because buried duct infrastructure will be installed as part of Norfolk Vanguard. The values quoted for Scenario 2 include above ground and below ground infrastructure, because both have the potential to alter existing flow patterns.

Table 20.36 Area of permanent infrastructure in surface water catchments

Catchment	Sub-catchment	Sensitivity	Value	Area of permanent infrastructure (Scenario 1)		Area of permanent infrastructure (Scenario 2)	
				ha	%	ha	%
River Bure	New Cut	Low	High	0.0030	0.00015	6.20	0.30
	East Ruston Stream	High	High	0.0045	0.00018	7.51	0.30
	North Walsham & Dilham Canal	Low	Low	0.0045	0.00008	8.81	0.16
	King's Beck	Medium	High	0.0045	0.00006	7.61	0.11
	River Bure	Medium	High	0.0045	0.00012	8.01	0.21
	Mermaid Stream	Medium	High	0.0015	0.00007	2.25	0.11
			Total	**0.0195**	**0.00009**	**34.18**	**0.16**
River Wensum	Blackwater	High	High	0.0075	0.00012	15.09	0.23
	River Wensum	High	High	0.0045	0.00002	9.42	0.05
	Wendling Beck	High	High	0.0090	0.00011	16.65	0.21
			Total	**0.0210**	**0.00006**	**41.15**	**0.12**
River Wissey	River Wissey	Medium	Medium	9.3632	0.1067	13.37	0.15
			Total	**9.3632**	**0.1067**	**13.37**	**0.15**

186. As detailed in section 20.7.1, the project will include embedded mitigation measures to reduce the potential for impact. This includes limiting discharge from the onshore project substation to the greenfield runoff rate, creation of a new attenuation pond at the onshore project substation and creation of increased storage volume at the Necton National Grid substation (either by extending the existing attenuation pond or creating a new feature).

20.7.5.1.2 Scenario 1

Impact prior to mitigation

187. The impacts on each receptor resulting from increased surface water runoff, altered groundwater flows and changes to flood risk under Scenario 1 are summarised in Table 20.37. Prior to mitigation the potential impacts range from **negligible** to **minor adverse**. However, it is important to note that appropriate control measures will be used to ensure that discharge of drainage will not displace or increase flood-risk to third party land. Further information is provided in Appendix 20.1.

Table 20.37 Impacts resulting from increased surface water runoff, altered groundwater flows and changes to flood risk (Scenario 1)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	As a result of the very limited spatial extent of permanent impermeable development along the cable route, the effect is considered to be of negligible magnitude in the River Bure and River Wensum catchments.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham Canal	Low	Low		Negligible	**Negligible**	Negligible	**Negligible**
	River Bure	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	Approximately 9.36ha (0.11%) of the Upper Wissey sub-catchment could potentially be impacted by changes to surface water runoff, groundwater flows and flood risk resulting from the permanent presence of the onshore project substation, Necton National Grid Extension and associated infrastructure.	Low	**Minor Adverse**	Negligible	**Negligible**
Groundwater	The Broadland Rivers Chalk & Crag, Cam	High	High	As a result of the very limited spatial extent of permanent impermeable development	Negligible	**Minor Adverse**	Negligible	**Negligible**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
	and Ely Ouse Chalk, and North Norfolk Chalk groundwater bodies			along the cable route, the effect on groundwater receptors is considered to be of negligible magnitude.				

Additional mitigation measures

188. The additional measures described in Table 20.38 will be applied to reduce the potential operational impacts of the onshore cable route.

Table 20.38 Additional mitigation measures for impacts associated with changes to surface water runoff and flood risk during operation

Measure
Existing land drains along the onshore cable route will be reinstated following construction so that they do not affect subsurface flows during the operational phase. A local specialised drainage contractor will undertake surveys to locate drains and create drawings both pre- and post-construction, and ensure appropriate reinstatement.
The reinstated channel at crossing locations will have at least the same capacity as the pre-construction channel to prevent impacts on flood risk.
Surface water drainage requirements for the permanent substation developments will be presented in the final ODP (DCO Requirement 32) and will be designed to meet the requirements of the National Planning Policy Framework (NPPF) and NPS EN-5, with runoff limited to greenfield rates. The drainage strategy will be developed according to the principles of the SuDS discharge hierarchy. Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable: i) into the ground (infiltration); ii) to a surface water body; iii) to a surface water sewer, highway drain or another drainage system; or iv) to a combined sewer. Requirements related to foul water discharge will be confirmed during the post-DCO design stage.

Impacts following mitigation

189. It is not expected that these additional mitigation measures will further reduce the magnitude of effect on sub-catchments within the River Bure and River Wensum catchments, because they were classed as having a negligible magnitude prior to mitigation. However, the measures are an integral part of best practice drainage design and will be adhered to for this project.

190. However, the additional measures described above will control drainage from operational activities at the onshore project substation and National Grid substation extension within the River Wissey catchment and prevent changes to surface runoff, groundwater flows and flood risk and further reduce the potential for impacts upon surface watercourses and groundwater.

191. The impacts following mitigation and resulting residual impacts are summarised for each receptor in Table 20.37 and range from **negligible** to **minor adverse**.

20.7.5.1.3 Scenario 2

Impacts prior to mitigation

192. The impacts on each receptor resulting from increased surface water runoff, altered groundwater flows and changes to flood risk under Scenario 2 are summarised in Table 20.39. Prior to mitigation the potential impacts range from **minor** to **moderate adverse**. However, it is important to note that appropriate control measures will be

used to ensure that discharge of drainage will not displace or increase flood-risk to third party land. Further information is provided in Appendix 20.1.

Additional mitigation measures

193. The additional measures described in Table 20.38 addition, on the cable route stabilised backfill (e.g. cement bound sand) will be used at the base of the cable route trench and then covered with excavated subsoil and then topsoil. This will be well compacted to prevent the cable corridor acting as a conduit for water.

Impacts following mitigation

194. The additional measures described above will control drainage from operation activities and prevent changes to surface runoff, groundwater flows and flood risk and further reduce the potential for impacts upon surface watercourses and groundwater. The impacts following mitigation and resulting residual impacts are summarised for each receptor in Table 20.39 and range from **negligible** to **minor adverse.**

Table 20.39 Impacts resulting from increased surface water runoff, altered groundwater flows and changes to flood risk (Scenario 2)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
River Bure	New Cut	Low	High	As a result of the limited spatial extent of permanent impermeable development along the cable route, the effect is considered to be of low magnitude in the River Bure and River Wensum catchments.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham canal	Low	Low		Low	**Minor Adverse**	Negligible	**Negligible**
	River Bure	Medium	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High		Low	**Moderate Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	Approximately 13.37ha (0.15%) of the Upper Wissey sub-catchment could potentially be impacted by changes to surface water runoff, groundwater flows and flood risk resulting from the permanent presence of the onshore project substation, Necton National Grid Extension, cable ducting and associated infrastructure.	Low	**Minor Adverse**	Negligible	**Negligible**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following mitigation	Residual impact
Groundwater	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk groundwater bodies	High	High	Although the buried cable ducting will create an impermeable barrier (1.05m to the top of the duct (typical), with two 260mm diameter (typical) ducts installed per trench, and one small duct for fibre cables), it is expected that subsurface (groundwater) flows will pass above or below the ducting and will not change significantly. As a result, although there will be some minor changes in the distribution of flows, there is unlikely to be a significant perturbation / change in overall flow directions and quantities. Furthermore, the size and shallow depth of the impermeable subsurface barrier created by the cable ducting in comparison to the size of the groundwater bodies which underlie the onshore project area comprises 0.001%, 0.003% and 0.0003% of the overall area of the North Norfolk Chalk, Broadland Rivers Chalk & Crag and Cam and Ely Ouse Chalk groundwater bodies respectively. This will result in an effect upon infiltration rates, groundwater flows, sub-surface flow routes and alterations in the distribution of groundwater of low magnitude.	Low	**Moderate Adverse**	Negligible	**Minor Adverse**

20.7.5.2 Impact 2: Supply of fine sediment and other contaminants

20.7.5.2.1 Description of impacts

195. The operation of the project, including planned and unplanned maintenance at the onshore project substation, National Grid substation extension and along the onshore cable route, could result in the supply of fine sediment, fuels, oils and lubricants from the road network and other impermeable surfaces. This could potentially affect the geomorphology and water quality in the surface drainage network.

196. There is potential for an increase in sediment supply to surface waters during operation via mechanisms such as enhanced surface runoff from the permanent above-ground development (see section 20.7.5.1), which could impact upon the geomorphology and surface water quality of the river water bodies, and consequently impact upon aquatic ecology.

197. Furthermore, there is potential for the supply of contaminants to surface waters during operation through surface runoff or accidental spillage or leakage of fuel oils or lubricants from vehicles during operational activities, which could impact upon surface water quality and that of connected groundwaters. This could have subsequent impacts upon aquatic ecology and the use of water resources for licensed and unlicensed abstractions.

198. As outlined in section 20.7.1, foul drainage at the onshore project substation (including the National Grid substation extension) will be collected through a mains connection to the existing local authority sewer system if available, or collected in a septic tank and transported off site for disposal at a licensed facility. The specific approach will be determined during detailed design with consideration for the availability of mains connection and the number of visiting hours for site attendees during operation.

199. The potential for the contamination of groundwaters will be significantly reduced by using inert solid plastic insulation within the cables, rather than historic oil insulated cables, therefore removing the potential for fluid leakage from the cables during operation.

20.7.5.2.2 Scenario 1 and Scenario 2

200. The area of above-ground infrastructure has been used as a proxy to indicate the extent to which operational activities may be required in each sub-catchment. Both scenarios have been assessed together for this operational impact, because the permanent operational-stage infrastructure and planned and unplanned maintenance activities will be almost identical. Although there may be marginal differences in the location of the onshore project substation and location and area of

National Grid substation extension (see Table 20.15 and Table 20.16), they are not considered to have a material impact upon the outcomes of the assessment.

Impacts prior to mitigation

201. The impacts on each receptor resulting from increased surface water runoff, altered groundwater flows and changes to flood risk under Scenario 1 and Scenario 2 are summarised in Table 20.40. Prior to mitigation the potential impacts range from **negligible** to **minor adverse**.

Table 20.40 Impacts resulting from the supply of fine sediment and other contaminants during operation (Scenarios 1 & 2)

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following investigation	Residual impact
River Bure	New Cut	Low	High	As a result of the limited spatial extent of permanent development along the cable route, and the fact that there is no requirement to undertake routine maintenance, the impact is considered to be of negligible magnitude in the River Bure and River Wensum catchments.	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	East Ruston Stream	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	North Walsham & Dilham canal	Low	Low		Negligible	**Negligible**	Negligible	**Negligible**
	River Bure	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	King's Beck	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Mermaid Stream	Medium	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wensum	River Wensum & Penny Spot Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Blackwater Drain	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
	Wendling Beck	High	High		Negligible	**Minor Adverse**	Negligible	**Minor Adverse**
River Wissey	Upper River Wissey	Medium	Medium	The spatial extent of permanent development will be limited, and the embedded mitigation measures described in Table 20.13 will control the accidental release of foul drainage from the permanent onshore development and surface water drainage from the operational onshore project substation and National Grid substation extension.	Low	**Minor Adverse**	Negligible	**Minor Adverse**
Groundwater Bodies	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and	High	High	The potential for this impact will be significantly reduced by using inert solid plastic insulation within the cables, rather than historic oil insulated cables, therefore	Negligible	**Minor Adverse**	Negligible	**Minor Adverse**

Catchment	Sub-catchment	Sensitivity	Value	Assessment	Magnitude	Impact significance prior to mitigation	Magnitude following investigation	Residual impact
	North Norfolk Chalk			removing the potential for fluid leakage from the cables during operation.				

Additional measures

202. Given the negligible magnitude of effect, no further mitigation is proposed for the Bure and Wensum catchments.

203. In addition to the embedded mitigation measures to prevent the release of foul drainage that are described in section 20.7.1, the potential for impacts associated with the supply of fine sediment and other contaminants from the onshore project substation and National Grid substation extension in the River Wissey catchment will be reduced by the measures described in Table 20.41.

Table 20.41 Additional measures for impacts associated with the supply of fine sediment and other contaminants during operation

Measure
All fuels, oils, lubricants and other chemicals will be stored in an impermeable bund with at least 110% of the stored capacity. Damaged containers will be removed from site. All refuelling will take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils will be used where possible.
Spill kits will be available on site at all times. Sand bags or stop logs will also be available for deployment on the outlets from the site drainage system in case of emergency.

Impacts following additional measures

204. The additional measures described above will reduce the potential for impacts resulting from the accidental release of sediment and other contaminants into the surface drainage network and connected groundwaters (noting that underground cables will be composed of inert plastic). The reduced magnitude of effect following mitigation and the resulting residual impacts due to this reduction are summarised for each receptor in Table 20.40 and range from **negligible** to **minor adverse**.

20.7.6 Potential Impacts during Decommissioning

205. This section describes the potential impacts of the decommissioning of the onshore infrastructure with regards to water resources and flood risk receptors. Further details are provided in Chapter 5 Project Description.

206. No decision has been made regarding the final decommissioning policy for the onshore cables, as it is recognised that industry best practice, rules and legislation change over time. It is likely the cables would be pulled through the ducts and removed, with the ducts themselves left in-situ.

207. In relation to the onshore project substation the programme for decommissioning is expected to be similar in duration to the construction phase. The detailed activities and methodology would be determined later within the project lifetime, but are expected to include:

- Dismantling and removal of outside electrical equipment from the onshore project substation;

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

208. Whilst details regarding the decommissioning of the onshore project substation are currently unknown, considering the worst case assumption which would be the removal and reinstatement of the current land use at the site, it is anticipated that the impacts would be no worse than those assessed during construction.

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

20.7.7 Water Framework Directive Compliance

210. The assessment outlined in sections 20.7.4, 20.7.5 and 20.7.6 demonstrates that the project has the potential to result in a range of effects on water receptors, including the hydrology, geomorphology and water quality of surface waters and the quality and quantity of groundwater. Although this assessment has demonstrated that these effects are largely not significant in EIA terms (see further explanation in the previous sections), a separate detailed WFD Compliance Assessment has been undertaken to determine whether the proposed development is compliant with the requirements of the WFD (see section 20.2 for further details). The WFD Compliance Assessment has considered whether the impacts described above have the potential to cause deterioration in the status of surface and groundwater bodies, or prevent status objectives being achieved in the future.

211. The full compliance assessment methodology and the findings of the assessment are described in full in Appendix 20.2, and summarised for both scenarios in Table 20.42. Note that a brief summary of the relationship between the WFD water bodies listed below and the water receptors used in this assessment is provided in section 20.6.

Table 20.42 Summary of WFD Compliance Assessment (Scenario 1 and Scenario 2)

Water body	Deterioration in status?	Prevent objectives being achieved?	Compliant with WFD?
Rivers			
East Ruston Stream (GB105034055670)	No	No	Yes
New Cut (GB105034050940)	No	No	Yes
North Walsham and Dilham Canal (disused) (GB105034055710)	No	No	Yes
King's Beck (GB105034055730)	No	No	Yes
Bure (Scarrow Beck to Horstead Mill) (GB105034050932)	No	No	Yes
Mermaid Stream (GB105034050900)	No	No	Yes
Wensum US Norwich (GB105034055881)	No	No	Yes
Blackwater Drain (Wensum) (GB105034051120)	No	No	Yes
Wendling Beck (GB105034051020)	No	No	Yes
Wissey - Upper (GB105033047890)	No	No	Yes
Groundwater			
Broadland Rivers Chalk & Crag (GB40501G400300)	No	No	Yes
Cam and Ely Ouse Chalk (GB40501G400500)	No	No	Yes
North Norfolk Chalk (GB40501G400100)	No	No	Yes

212. The WFD Compliance Assessment demonstrates that, following the mitigation measures outlined for each impact in sections 20.7.1 and 20.7.4, there will be no non-temporary impacts on the status of any river or groundwater bodies that are sufficient to result in deterioration in the status of these water bodies. Furthermore, the project will not prevent water body status objectives being achieved in the future. The project is therefore considered to be compliant with the requirements of the WFD.

20.8 Cumulative Impacts

213. This section describes the CIA for water resources and flood risk, taking into consideration other plans, projects and activities.

214. The assessment of cumulative impact has been undertaken here as a two-stage process. Firstly, all the impacts from the previous sections have been assessed for potential to act cumulatively with other projects. This summary assessment is set out in Table 20.43. The impacts would occur at the same locations on the same receptors under each scenario, albeit at different magnitudes. Therefore, it is considered that there is potential for cumulative impacts to occur under both scenarios.

Table 20.43 Potential Cumulative Impacts

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction 1: Direct disturbance of surface water bodies	Yes	High	Impacts to surface water receptors may be exacerbated by other projects
Construction 2: Increased sediment supply	Yes	High	Impacts to surface water and groundwater receptors may be exacerbated by other projects
Construction 3: Accidental release of fuels, oils, lubricants, foul waters and construction materials	Yes	High	Impacts to surface water receptors may be exacerbated by other projects
Construction 4: Changes to surface water runoff and flood risk	Yes	High	Impacts to surface water and groundwater receptors may be exacerbated by other projects
Operation 1: Increased surface water runoff, altered groundwater flows and changes to flood risk	Yes	High	Impacts to surface water and groundwater receptors may be exacerbated by other projects
Operation 2: Supply of fine sediment of and other contaminants	Yes	High	Impacts to surface water and groundwater receptors may be exacerbated by other projects
Decommissioning	The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be no worse than those identified during the construction stage.		

215. The second stage of the CIA is an assessment of whether there is spatial or temporal overlap between the extent of potential effects of the onshore project area and the potential effects of other projects scoped into the CIA upon the same receptors. To identify whether this may occur, the potential nature and extent of effects arising from all projects scoped into the CIA have been identified together with any overlaps between these and the effects identified above. Where there is an overlap, an assessment of the cumulative magnitude of effect is provided.

216. Projects identified for potential cumulative impacts that were agreed as part of the Norfolk Boreas PEIR consultation. These projects, as well as any relevant

development applications submitted since this consultation have been considered and their anticipated potential for cumulative impact are detailed in Table 20.44.

217. The remainder of the section details the nature of the cumulative impacts against all those receptors scoped in for cumulative assessment.

Table 20.44 Summary of Projects considered for the CIA in Relation to Water Resources and Flood Risk

Project	Status	Development period	[1]Distance from Norfolk Boreas (km)	Project definition	Project data status	Included in CIA	Rationale
National Infrastructure Planning							
Norfolk Vanguard Offshore Wind Farm	Application submitted	Expected construction 2020 to 2025	0 – projects are co-located	Full ES available: https://infrastructure.planninginspectorate.gov.uk/projects/eastern/norfolk-vanguard/?ipcsection=docs	High	Yes (Scenario 1) No (Scenario 2)	Under Scenario 1, the overlap between the proposed project boundaries for Norfolk Boreas and Norfolk Vanguard may result in direct and / or indirect impacts during construction and operation. Construction activities for Norfolk Vanguard along the cable route will be complete prior to commencement of cable-pulling activities for Norfolk Boreas. However, construction of the onshore project substation and Necton National Grid extension sites will overlap. Scenario 2 assumes that Norfolk Vanguard would not be constructed. There is therefore no potential for cumulative impacts to occur under this scenario.
Hornsea Project Three Offshore Wind Farm	Application submitted	Expected construction start date 2021. Duration 6 to 10 years dependent on phasing.	0 – cable intersects project 32 between substation locations	Full ES available: https://infrastructure.planninginspectorate.gov.uk/projects/eastern/hornsea-project-three-offshore-wind-	High	Yes	The cable corridor for the Hornsea Project 3 Offshore Wind Farm makes landfall at Weybourne with grid connection at Norwich Main. The Hornsea Project 3 cable corridor crosses the Norfolk Boreas onshore cable route within the Blackwater Drain water body catchment. The Hornsea Project 3 Offshore Wind Farm would also cross watercourses in the River Wensum and the River Bure

[1] Shortest distance between the considered project and Norfolk Boreas – unless specified otherwise.

Project	Status	Development period	[1]Distance from Norfolk Boreas (km)	Project definition	Project data status	Included in CIA	Rationale
				farm/?ipcsection =docs			catchments, both of which will also be crossed by Norfolk Boreas. Overlapping proposed project boundaries may result in impacts of a direct and / or indirect nature during construction and operation.
Dudgeon Offshore Wind Farm	Commissioned	Constructed	0	http://dudgeonoffshorewind.co.uk/	High	No	Construction and commissioning of the onshore project substation for the Dudgeon Offshore Wind Farm is complete and operation commenced in 2017. The project has therefore been considered as part of the existing baseline.
A47 corridor improvement programme – North Tuddenham to Easton	Pre-application (application due 2020)	Start works April 2021 Open May 2023	26.7	https://highwaysengland.co.uk/projects/a47-north-tuddenham-to-easton-improvement-scheme/	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
A47 corridor improvement programme – A47 Blofield to North Burlingham	Pre-application (application due 2019)	Start works 2021 Open 2022	23	https://highwaysengland.co.uk/projects/a47-blofield-to-north-burlingham/	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
A47 corridor improvement programme – A47 / A11 Thickthorn	Pre-application (application due 2019)	Start works 2021 Open 2023	18	https://highwaysengland.co.uk/projects/a47-thickthorn-junction/	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
Norwich Western Link	Pre-application	Expected construction	2.8	https://www.norfolk.gov.uk/roads-and-	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as

Project	Status	Development period	[1]Distance from Norfolk Boreas (km)	Project definition	Project data status	Included in CIA	Rationale
		start late 2022		transport/major-projects-and-improvement-plans/norwich/norwich-western-link			a result of a lack of hydrological connectivity between the projects.
Third River Crossing (Great Yarmouth)	Pre-application (application due 2019)	Expected construction start in late 2020 Open early 2023	28	https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/great-yarmouth/third-river-crossing	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
King's Lynn B Power Station amendments	Approved	Expected construction start 2019 to 2022	28	https://www.kingslynnbccgt.co.uk/	High	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
North Norfolk District Council							
PF/17/1951 Erection of 43 dwellings and new access with associated landscaping, highways and external works	Approved	Anticipated Q2 2018	0.7	Application available: https://idoxpa.north-norfolk.gov.uk/online-applications/applicationDetails.do?activeTab=summary&keyVal=_NN	High	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.

Project	Status	Development period	[1]Distance from Norfolk Boreas (km)	Project definition	Project data status	Included in CIA	Rationale
				ORF_DCAPR_92323			
Bacton and Walcott Coastal Management Scheme	Submitted	Construction start date Spring 2019	1.0	Public information leaflets available: https://www.north-norfolk.gov.uk/media/3371/bacton-to-walcott-public-information-booklet-july-2017.pdf	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
Coastal defence/protection works, Happisburgh PF/18/0751	Approved	Coastal protection over 10 year duration from August 2018	TBC	https://idoxpa.north-norfolk.gov.uk/online-applications/applicationDetails.do?activeTab=summary&keyVal=_NNORF_DCAPR_93543	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.
Breckland Council							
Erection of 85 Dwellings with Associated Open Space 3PL/2018/1246/F	Awaiting Decision	Application received 04/10/18.	1.26	http://planning.breckland.gov.uk/OcellaWeb/planningDetails?reference=3PL/2018/12	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.

Project	Status	Development period	[1]Distance from Norfolk Boreas (km)	Project definition	Project data status	Included in CIA	Rationale
				46/F&from=planningSearch			
Residential development of 40 No. units comprising a mix of housing types, accommodating open space and appropriate associated infrastructure with vehicle access via Hall Road 3PL/2018/0993/F	Approved	Application approved 11/02/19. Construction must begin within 2 years.	1.42	http://planning.breckland.gov.uk/OcellaWeb/planningDetails?reference=3PL/2018/0993/F&from=planningSearch	Medium	No	No cumulative effects on onshore water resources and flood risk are anticipated as a result of a lack of hydrological connectivity between the projects.

218. Impacts that could potentially occur cumulatively are considered to be similar to those impacts considered during construction and operation and outlined in sections 20.7.4 and 20.7.5, although the magnitude could potentially be increased if activities affect the same surface water catchment or groundwater body at the same time.

219. In summary, the following projects will be assessed for potential direct cumulative impacts:

- Norfolk Vanguard Offshore Wind Farm (Scenario 1 only); and
- Hornsea Project Three (Scenarios 1 and 2).

20.8.1 Cumulative Impacts during Construction

20.8.1.1 Impact 1: Direct disturbance of surface water bodies

20.8.1.1.1 Scenario 1

220. Hornsea Project Three will result in the direct disturbance of surface watercourses in the Blackwater Drain, River Wensum and River Bure sub-catchments. Under Scenario 1, the Norfolk Boreas will install temporary crossings in the Blackwater Drain (one crossing) and River Bure (five crossings) sub-catchments, but will not install any temporary crossings in the River Wensum sub-catchment. Norfolk Vanguard will install both permanent and temporary crossings in the same sub-catchments as Norfolk Boreas. However, the temporary crossings associated with Norfolk Vanguard will be removed prior to commencement of Norfolk Boreas, and activities associated with Norfolk Boreas will be limited to the reinstallation of temporary crossings.

221. The mitigation measures outlined in sections 20.7.1 and 20.7.4.1 will prevent any significant adverse impacts on surface water catchments resulting from Norfolk Boreas.

222. Hornsea Project Three and Norfolk Vanguard have stated that they would adopt a similar suite of best practice mitigation measures to minimise disturbance of the river channel, and maintain river flows and sediment transport during construction, including the use of trenchless techniques to cross the major watercourses, ensuring that any culverts (e.g. for access tracks and haul roads) are suitably sized to accommodate flow volumes, and ensuring that the bed and banks of the watercourse are reinstated to their previous condition (Ørsted, 2018; Norfolk Vanguard Limited, 2018). The application of these measures across both projects would limit further impacts on surface waters to a negligible magnitude.

223. The residual impacts on surface waters resulting from direct disturbance during construction of Norfolk Boreas are **negligible** to **minor adverse**. When the potential

for additional watercourse crossings in each of these catchments is taken into account, a **minor adverse** cumulative impact on each catchment is predicted.

20.8.1.1.2 Scenario 2

224. As stated above, Hornsea Project Three will result in the direct disturbance of surface watercourses in the Blackwater Drain, River Wensum and River Bure sub-catchments, all of which will also be affected by Norfolk Boreas under Scenario 2. However, the mitigation measures outlined for each project (as described in section 20.7.4.1) would limit further impacts on surface waters to a negligible magnitude.

225. The residual impacts on surface waters resulting from direct disturbance during construction of Norfolk Boreas are **moderate adverse** for the River Bure and Blackwater Drain sub-catchments and **minor adverse** for the River Wensum sub-catchment.

226. When the potential for additional watercourse crossings in each of these catchments is taken into account, a **minor** to **moderate adverse** cumulative impact on each catchment is predicted. Note that the moderate adverse impact is based on a worst case assumption of multiple culvert crossings, and that the impacts of individual crossings are not considered to result in significant effects. Further information is provided in section 20.7.4.1.3.

20.8.1.2 Impact 2: Increased sediment supply

20.8.1.2.1 Scenario 1

227. Under Scenario 1, there is the potential for direct cumulative impacts upon sediment supply in surface water catchments where activities from Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three take place. Construction activities for the Norfolk Boreas and Norfolk Vanguard substations will occur within the upper Wissey catchment, while construction activities for the Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three cable routes will occur within the River Bure, Blackwater Drain and River Wensum catchments (although activities associated with Norfolk Boreas will be limited to jointing pit excavation, reinstallation of limited areas of running track, and cable pulling under this scenario).

228. Construction activities such as earthworks, the creation of areas of bare ground by removing surface vegetation cover and soil storage could all increase sediment supply to surface watercourses. In the absence of mitigation, direct cumulative impact on sediment would be considered to be high, resulting in a significance of effect ranging between **moderate** to **major** adverse (depending upon the sensitivity of the receptors).

229. However, Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three would adopt similar best practice mitigation measures which would avoid, reduce or offset the effects of direct impacts upon sediment supply. These include the design of drainage requirements to retain sediment and meet the requirements of the NPPF and NPS EN-5, the retention of buffer strips adjacent to watercourses, avoiding storage of materials close to watercourses, and a suite of best practice pollution control measures including wheel washing, dust suppression and road cleaning (Ørsted, 2018; Norfolk Vanguard Limited, 2018). These measures are considered highly likely to reduce the significance of effect to an acceptable level. As a result of this mitigation, the cumulative effect is likely to be of negligible magnitude. The cumulative impact is therefore considered to be **minor adverse**.

20.8.1.2.2 Scenario 2

230. Under Scenario 2, there is the potential for direct cumulative impacts upon sediment supply in surface water catchments where activities from Norfolk Boreas and Hornsea Project Three take place (Blackwater Drain, River Wensum and River Bure). Construction activities such as earthworks, the creation of areas of bare ground by removing surface vegetation cover and soil storage could all increase sediment supply to surface watercourses. In the absence of mitigation, direct cumulative impacts on sediment would be considered to be high, resulting in a significance of effect ranging between **moderate** to **major** adverse (depending upon the sensitivity of the receptors).

231. However, the mitigation measures described for each project in section 20.8.1.2.1 would limit further impacts on surface waters to a negligible magnitude.

232. The cumulative impact is therefore considered to be **minor** to **moderate adverse**.

20.8.1.3 Impact 3: Accidental release of fuels, oils, lubricants, foul waters and construction materials

20.8.1.3.1 Scenario 1

233. Under Scenario 1, there is potential for the accidental release of fuels, oils, lubricants, foul waters and construction materials in catchments where project activities overlap (the upper Wissey sub-catchment for Norfolk Boreas and Norfolk Vanguard, and the River Bure, Blackwater Drain and River Wensum sub-catchments for Norfolk Boreas and Hornsea Project Three). However, Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three would adopt similar best practice mitigation measures which would avoid accidental releases of fuels, oils, lubricants, foul waters and construction materials through measures such as the implementation of appropriate SuDS techniques, drainage strategies and construction working methodologies to industry recognised best practice standards (Ørsted, 2018; Norfolk

Vanguard Limited, 2018). As a result of this mitigation, the cumulative effect is considered to be of negligible magnitude. The cumulative impact is therefore considered to be **minor adverse**.

20.8.1.3.2 Scenario 2

234. As stated above, construction activities which could potentially release contaminants for Norfolk Boreas and Hornsea Project Three will overlap in the Blackwater Drain, River Wensum and River Bure sub-catchments. However, the mitigation measures outlined for each project in section 20.8.1.3.1 would limit cumulative effects on surface waters to a negligible magnitude. The cumulative impact is therefore considered to be **minor adverse**.

20.8.1.4 Impact 4: Changes to surface water runoff and altered subsurface flows

20.8.1.4.1 Scenario 1

235. Due to the geographical overlap between Norfolk Boreas, Norfolk Vanguard onshore project substation (because of the Norfolk Boreas cable pulling, Norfolk Boreas can only occur after the installation of the ducting by Norfolk Vanguard) and Hornsea Project Three, there is the potential for direct cumulative impacts upon surface water runoff and subsurface flow characteristics during construction. Construction activities for the Norfolk Boreas and Norfolk Vanguard substations will occur within the upper Wissey catchment, while construction activities for Norfolk Boreas and Hornsea Project Three will occur within the River Bure, Blackwater Drain and River Wensum catchments.

236. There is potential for the unmitigated effects of the proposed construction activities to have significant cumulative impacts on surface water runoff and subsurface flows. These would result in an impact significance ranging between moderate to major adverse (depending upon the sensitivity of the receptors; the statutory designations associated with the River Wensum results in a greater impact than for less sensitive watercourses).

237. However, Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three would adopt similar best practice mitigation measures which would seek to avoid, reduce or offset the effects of direct impacts upon drainage. These would include the design of a surface water drainage strategy, the implementation of SuDS techniques and a construction-stage drainage system, limiting runoff to the 1 in 1 year runoff rate and the minimisation of new impermeable surfaces (Ørsted, 2018; Norfolk Vanguard Limited, 2018). These measures are considered highly likely to reduce the significance of effect to an acceptable level. As a result of these mitigation measures, the cumulative magnitude of effect is considered to be negligible, and the cumulative impact is therefore considered to be **minor adverse**.

20.8.1.4.2 Scenario 2

238. Due to the geographical overlap between Norfolk Boreas and Hornsea Project Three, there is the potential for direct cumulative impacts upon surface water runoff and subsurface flow characteristics during construction in the River Bure, Blackwater Drain and River Wensum catchments. However, the mitigation measures outlined for each project in section 20.8.1.4.1 would limit cumulative effects on surface waters to a negligible magnitude. The cumulative impact is therefore considered to be **minor adverse**.

20.8.2 Cumulative Impacts during Operation

20.8.2.1 Impact 1: Changes to surface water runoff and groundwater flows

20.8.2.1.1 Scenario 1

239. Under Scenario 1, the operational phases of Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three could potentially alter surface runoff and groundwater flows where permanent infrastructure overlaps. The Blackwater Drain, River Wensum and River Bure catchments will contain the cable route for the project, Norfolk Vanguard and Hornsea Project Three, while the River Wissey catchment will contain the onshore project substations for the project and Norfolk Vanguard.

240. However, each project would adopt best practice mitigation measures which would avoid, reduce or offset the effects of increased surface runoff and altered groundwater flows. These include the reinstatement of land drains along the cable route (Norfolk Vanguard), the incorporation of drains either side of the cable corridor (Hornsea Project Three), and restricting runoff at the onshore project substations to the greenfield rate (Ørsted, 2018; Norfolk Vanguard Limited 2018). These measures are considered highly likely to reduce the cumulative magnitude of effect to negligible. The cumulative impact is therefore considered to be **negligible** to **minor adverse**.

20.8.2.1.2 Scenario 2

241. Under Scenario 2, the operational phases of Norfolk Boreas and Hornsea Project Three could potentially alter surface runoff and groundwater flows in the Blackwater Drain, River Wensum and River Bure sub-catchments. However, the mitigation measures that are described for each project in section 20.8.2.1.1 are expected to limit cumulative effects on surface waters to a negligible magnitude. The cumulative impact is therefore considered to be **negligible** to **minor adverse**.

20.8.2.2 Impact 2: Supply of fine sediment and other contaminants

20.8.2.2.1 Scenario 1

242. Under Scenario 1, the operational phases of the Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three could potentially supply fine sediment and other contaminants where permanent infrastructure overlaps. The Blackwater Drain, River Wensum and River Bure catchments will contain the cable route for the project and Hornsea Project Three, while the River Wissey catchment will contain the onshore project substations for the project and Norfolk Vanguard.

243. Each project would adopt similar best practice mitigation measures which would avoid, reduce or offset the effects of increased supply of fine sediment and other contaminants. These include the appropriate storage and capping of topsoil to minimise wind and water erosion, implementation of appropriate SuDS techniques, drainage strategies, and construction working methodologies to industry recognised best practice standards. Such strategies are considered highly likely to reduce the significance of effect to an acceptable level. Although unmitigated impacts have the potential to be significant, the adoption of these measures would mean that any cumulative effects would be of negligible magnitude. The cumulative impact is therefore considered to be **minor adverse**.

20.8.2.2.2 Scenario 2

244. Under Scenario 2, the operational phases of Norfolk Boreas and Hornsea Project Three could potentially supply fine sediment and other contaminants to the Blackwater Drain, River Wensum and River Bure sub-catchments.

245. However, both projects would adopt similar best practice mitigation measures which would avoid, reduce or offset the effects of increased supply of fine sediment and other contaminants (section 20.8.2.2.1). Although unmitigated impacts have the potential to be significant, the adoption of these measures would mean that any cumulative effects would be of negligible magnitude. The cumulative impact is therefore considered to be **minor adverse**.

20.8.3 Cumulative Impacts during Decommissioning

246. Decommissioning of the Norfolk Boreas, Norfolk Vanguard and Hornsea Project Three may potentially take place at the same time. The detail and scope of the decommissioning works for the project will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are considered to be no worse than those identified during the construction stage.

20.9 Transboundary Impacts

247. There are no transboundary impacts with regards to water resources and flood risk as the onshore project area is not sited in close proximity to any international boundaries.

20.10 Inter-relationships

248. Table 20.45 provides a description of the likely inter-related effects arising from the proposed project on water resources and flood risk receptors.

Table 20.45 Water resources and flood risk inter-relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Impacts upon groundwater bodies	Chapter 19 Ground Conditions and Contamination	Sections 20.7.4.4.1, 20.7.5.1, 20.7.5.2, 20.8.2.1 and 20.8.2.2	Potential impacts on ground conditions could affect the quality and quantity of groundwater and hydrologically-connected surface waters.
Surface water related impacts upon designated sites	Chapter 22 Onshore Ecology	Sections 20.7.4.1, 20.7.4.2, 20.7.4.3, 20.7.5.1 and 20.7.5.2	Potential impacts on the condition of designated surface waters could impact upon the ecological receptors supported by these features.

20.11 Interactions

249. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts are presented in Table 20.46, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 20.46 Interaction between impacts

Potential interaction between impacts				
Construction				
	Direct disturbance of surface water bodies	Increased sediment supply	Accidental release of fuels, oils, lubricants, foul waters and construction materials	Changes to surface water runoff and flood risk
Direct disturbance of surface water bodies	-	Yes	Yes	Yes
Increased sediment supply	Yes	-	Yes	Yes
Accidental release of fuels, oils, lubricants, foul waters and construction materials	Yes	Yes	-	No
Changes to surface water runoff and flood risk	Yes	Yes	No	-
Operation				
	Increased surface water runoff, altered groundwater flows and changes to flood risk		Supply of fine sediment and other contaminants	
Increased surface water runoff, altered groundwater flows and changes to flood risk	-		Yes	
Supply of fine sediment and other contaminants	Yes		-	
Decommissioning				
It is anticipated that interactions between decommissioning impacts will be similar in nature to those between construction stage impacts.				

20.12 Summary

250. A summary of the findings of this EIA for water resources and flood risk is presented in Table 20.47 for Scenario 1 and Table 20.48 for Scenario 2. In accordance with the assessment methodology presented in section 20.4, this table should only be used in conjunction with the additional narrative explanations provided in section 20.7.

251. Under Scenario 1, with the application of mitigation measures the project is predicted to have no greater than **minor adverse** impacts in relation to water resources and flood risk.

252. Under Scenario 2, **moderate adverse** residual impacts are predicted on the River Bure catchment and River Wensum catchment as a worst case where permanent culverts are used, and due to increased sediment supply when assessed on a worse case sub-catchment basis. It is important to note that this assessment is based on the cumulative effect of multiple crossings within each sub-catchment, rather than the impacts associated with any single crossing. Whilst the worst case of permanent culverts are considered to result in some significant impacts, where permanent culverts can be avoided any changes occur as a result of temporary crossings will be temporary and reversible and, with mitigation would not result in significant residual impacts.

253. With the application of mitigation measures all other assessed impacts for water resources and flood risk are **negligible** to **minor adverse**.

Table 20.47 Potential Impacts Identified for Water Resources and Flood Risk under Scenario 1

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
Construction							
Impact 1: Direct disturbance of surface water bodies	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Minor adverse**	Measures to minimise the impact of temporary culverts.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		River Bure	Medium / High	Medium	**Major adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wensum catchment	Penny Spot Beck	High / High	Low	**Moderate adverse**		**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Wendling Beck	High / High	Low	**Moderate adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Negligible	**Minor adverse**		**Minor adverse**
Impact 2: Increased sediment supply	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Embedded measures plus additional construction best practice measures to manage sediment and	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		New Cut	Low / High	Negligible	**Negligible**		**Negligible**
		River Bure	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**

[2] Please note this is the highest sensitivity/value of receptor assessed per impact.

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Negligible	**Minor adverse**	surface drainage.	**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Wendling Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Negligible	**Minor adverse**	Embedded measures plus additional construction best practice measures to manage sediment and surface drainage.	**Minor adverse**
Impact 3: Accidental release of fuels, oils, lubricants, foul waters and construction materials	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		New Cut	Low / High	Negligible	**Negligible**		**Negligible**
		River Bure	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Wendling Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wissey catchment	Upper River Wissey	Medium / Medium	Low	**Minor adverse**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Minor adverse**
	Groundwater	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk	High / High	Low	**Moderate adverse**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Minor adverse**
Impact 4: Changes to surface water runoff and flood risk	River Burecatchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Measures to minimise the impact of temporary culverts.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		New Cut	High / High	Negligible	**Minor adverse**		**Minor adverse**
		River Bure	Medium / High	Low	**Minor adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Low	**Moderate adverse**		**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
		Wendling Beck	High / High	Low	**Moderate adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Medium	**Moderate adverse**	Embedded measures plus development of a surface water drainage plan.	**Minor adverse**
Operation							
Impact 1: Increased surface water runoff, altered groundwater flows, and changes to flood risk	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Embedded measures plus development of a surface water drainage plan.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		New Cut	Low / High	Negligible	**Negligible adverse**		**Minor adverse**
		River Bure	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Wendling Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Low	**Minor Adverse**	Embedded measures plus development	**Negligible**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
						of a surface water drainage plan.	
	Groundwater bodies	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk	High / High	Negligible	**Minor adverse**	Embedded measures plus development of a surface water drainage plan.	**Minor adverse**
Impact 2: Supply of fine sediment and other contaminants	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Embedded measures only.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		New Cut	Low / High	Negligible	**Negligible**		**Minor adverse**
		River Bure	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wensum catchment	River Wensum	High / High	Negligible	**Minor adverse**	Embedded measures only.	**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Wendling Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Low	**Minor adverse**	Embedded measures plus best practice pollution control measures.	**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
	Groundwater bodies	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk	High / High	Negligible	**Minor adverse**	Embedded measures plus best practice pollution control measures.	**Minor adverse**
Decommissioning							
Impacts similar to those during construction							
Cumulative – Construction							
Impact 1: Direct disturbance of surface water bodies	As per construction						**Minor adverse**
Impact 2: Increased sediment supply	As per construction						**Minor adverse**
Impact 3: Accidental release of fuels, oils, lubricants, foul waters and construction materials	As per construction						**Minor adverse**
Impact 4: Increased surface runoff and flood risk	As per construction						**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[2]	Magnitude	Significance	Additional Mitigation	Residual Impact
Cumulative – Operation							
Impact 1: Increased surface water runoff, altered groundwater flows, and changes to flood risk	As per operation						**Negligible to Minor adverse**
Impact 2: Supply of fine sediment and other contaminants	As per operation						**Minor adverse**
Cumulative – Decommissioning							
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts at decommissioning are considered to be no worse than cumulative impacts for the construction phase.							

Table 20.48 Potential Impacts Identified for Water Resources and Flood Risk under Scenario 2

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
Construction							
Impact 1: Direct disturbance of surface water bodies	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible to low	**Negligible to Minor adverse**	Embedded mitigation plus additional measures to manage direct disturbance from culverting and dam and divert methods.	**Negligible**
		East Ruston Stream	High / High	Low	**Moderate adverse**		**Minor adverse**
		River Bure	Medium / High	Negligible to Medium	**Minor to Major adverse**		**Moderate adverse**
		King's Beck	Medium / High	Negligible to Low	**Minor to Moderate adverse**		**Minor adverse**
	River Wensum	River Wensum	High / High	Negligible	**Minor adverse**	Embedded mitigation plus additional measures to manage direct disturbance from culverting and dam and divert methods.	**Minor adverse**
		Blackwater Drain	High / High	Negligible to High	**Minor to Major adverse**		**Moderate adverse**
		Wendling Beck	High / High	Negligible to Medium	**Minor to Major adverse**		**Moderate adverse**
		Penny Spot Beck	High / High	Negligible to Medium	**Minor Major adverse**		**Moderate adverse**
	River Wissey	Upper River Wissey	Medium / Medium	Low to Medium	**Minor adverse**	Embedded mitigation plus additional	**Minor adverse**

[3] Please note this is the highest sensitivity/value of receptor assessed per impact.

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
						measures to manage direct disturbance from culverting and dam and divert methods.	
Impact 2: Increased sediment supply	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Embedded measures plus additional construction best practice measures to manage sediment and surface drainage.	**Negligible**
		East Ruston Stream	High / High	Low	**Moderate adverse**		**Moderate adverse**
		New Cut	Low / High	Negligible	**Minor adverse**		**Minor adverse**
		River Bure	Medium / High	Low	**Moderate adverse**		**Moderate adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Negligible	**Minor adverse**	Embedded measures plus additional construction best practice measures to manage sediment and surface drainage.	**Minor adverse**
		Blackwater Drain	High / High	Low	**Moderate adverse**		**Moderate adverse**
		Wendling Beck	High / High	Low	**Moderate adverse**		**Moderate adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wissey catchment	Upper River Wissey	Medium / Medium	Medium	**Moderate adverse**	Embedded measures plus additional construction best practice measures to manage sediment and surface drainage.	**Minor adverse**
Impact 3: Accidental release of fuels, oils, lubricants, foul waters and construction materials	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Low	**Minor adverse**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Negligible**
		East Ruston Stream	High / High	Medium	**Major adverse**		**Minor adverse**
		New Cut	Low / High	Medium	**Major adverse**		**Minor adverse**
		River Bure	Medium / High	Low	**Moderate adverse**		**Minor adverse**
		King's Beck	Medium / High	Low	**Moderate adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Low	**Moderate adverse**		**Minor adverse**
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Low	**Moderate adverse**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Minor adverse**
		Blackwater Drain	High / High	Medium	**Major adverse**		**Minor adverse**
		Wendling Beck	High / High	Medium	**Major adverse**		**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wissey catchment	Upper River Wissey	Medium / Medium	Low	**Minor adverse**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Minor adverse**
	Groundwater	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk	High / High	Medium	**Major adverse**	Embedded measures plus development of a CMS with best practice pollution control measures.	**Minor adverse**
Impact 4: Increased surface water runoff and flood risk	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Low	**Minor adverse**	Embedded measures plus development of a surface water drainage plan.	**Negligible**
		East Ruston Stream	High / High	Low	**Moderate adverse**		**Minor adverse**
		New Cut	Low / High	Low	**Moderate adverse**		**Minor adverse**
		River Bure	Medium / High	Low	**Moderate adverse**		**Minor adverse**
		King's Beck	Medium / High	Low	**Moderate adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Low	**Moderate adverse**		**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Low	**Moderate adverse**	Embedded measures plus development of a surface water drainage plan.	**Minor adverse**
		Blackwater Drain	High / High	Low	**Moderate adverse**		**Minor adverse**
		Wendling Beck	High / High	Low	**Moderate adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Medium	**Moderate adverse**	Embedded measures plus development of a surface water drainage plan.	**Minor adverse**
Operation							
Impact 1: Increased surface water runoff, altered groundwater flows, and changes to flood risk	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Minor adverse**	Embedded measures plus development of a surface water drainage plan.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Moderate adverse**		**Minor adverse**
		New Cut	Low / High	Negligible	**Moderate adverse**		**Minor adverse**
		River Bure	Medium / High	Negligible	**Moderate adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Moderate adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Moderate adverse**		**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wensum catchment	River Wensum & Penny Spot Beck	High / High	Negligible	**Moderate adverse**		**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Moderate adverse**		**Minor adverse**
		Wendling Beck	High / High	Negligible	**Moderate adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Low	**Minor adverse**	Embedded measures plus development of a surface water drainage plan.	**Negligible**
	Groundwater bodies	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk	High / High	Low	**Moderate adverse**	Embedded measures plus development of a surface water drainage plan.	**Minor adverse**
Impact 2: Supply of fine sediment and other contaminants	River Bure catchment	North Walsham and Dilham Canal	Low / Low	Negligible	**Negligible**	Embedded measures only.	**Negligible**
		East Ruston Stream	High / High	Negligible	**Minor adverse**		**Minor adverse**
		New Cut	Low / High	Negligible	**Minor adverse**		**Minor adverse**
		River Bure	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		King's Beck	Medium / High	Negligible	**Minor adverse**		**Minor adverse**
		Mermaid Stream	Medium / High	Negligible	**Minor adverse**		**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
	River Wensum catchment	River Wensum	High / High	Negligible	**Minor adverse**	Embedded measures only.	**Minor adverse**
		Blackwater Drain	High / High	Negligible	**Minor adverse**		**Minor adverse**
		Wendling Beck	High / High	Negligible	**Minor adverse**		**Minor adverse**
	River Wissey catchment	Upper River Wissey	Medium / Medium	Low	**Minor adverse**	Embedded measures plus best practice pollution control measures.	**Minor adverse**
	Groundwater bodies	The Broadland Rivers Chalk & Crag, Cam and Ely Ouse Chalk, and North Norfolk Chalk	High / High	Negligible	**Minor adverse**	Embedded measures plus best practice pollution control measures.	**Minor adverse**
Decommissioning							
Impacts no worse than those during construction							
Cumulative - Construction							
Impact 1: Direct disturbance of surface water bodies	As per construction						**Minor to Moderate adverse**
Impact 2: Increased sediment supply	As per construction						**Minor to Moderate adverse**
Impact 3: Accidental release of fuels, oils,	As per construction						**Minor adverse**

Potential Impact	Receptor	Sub-catchment	Sensitivity/ Value[3]	Magnitude	Significance	Additional Mitigation	Residual Impact
lubricants, foul waters and construction materials							
Impact 4: Increased surface runoff and flood risk	As per construction						**Minor adverse**
Cumulative - Operation							
Impact 1: Increased surface water runoff, altered groundwater flows, and changes to flood risk	As per operation						**Negligible to Minor adverse**
Impact 2: Supply of fine sediment and other contaminants	As per operation						**Minor adverse**
Cumulative - Decommissioning							
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts at decommissioning are considered to be no worse than cumulative impacts for the construction phase.							

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