Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 3

Appendix 18.2 - Flood Risk Assessment

August 2022
Document Reference: 6.3.18.2
APFP Regulation: 5(2)(a)

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Title:		
Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects **Environmental Statement** **Appendix 18.2 Flood Risk Assessment**		
Pins Document no.: 6.3.18.2		
Document no.: C282-RH-Z-GA-00078		
Date:	Classification	
August 2022	Final	
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Approved by:	Date:	
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Glossary of Acronyms

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
AStGWf	Areas Susceptible to Groundwater Flooding
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
DCO	Development Consent Order
DEFRA	Department for the Environment and Rural Affairs
DEP	Dudgeon Offshore Wind Farm Extension Project
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
ERT	Electrical Resistivity Tomography
FRA	Flood Risk Assessment
HDD	Horizontal Directional Drilling
HRA	Habitat Regulations Assessment
IDB	Internal Drainage Board
km	Kilometre
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
NFM	Natural Flood Management
NGET	National Grid Electricity Transmission
NPPF	National Planning Policy Framework
NPS	National Policy Statement
PEIR	Preliminary Environmental Information Report
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
SAC	Special Area of Conservation
SEP	Sheringham Offshore Wind Farm Extension Project
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SPZ	Source Protection Zone

SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
UK	United Kingdom
WFD	Water Framework Directive
WMA	Water Management Alliance

Glossary of Terms

Dudgeon Offshore Wind Farm Extension site	The Dudgeon Offshore Wind Farm Extension offshore lease area.
Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
DCO order limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and Habitat Regulations Assessment (HRA) for certain topics.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable corridor which would house HDD entry or exit points.
Infield cables	Cables which link the wind turbine to the offshore substation platform(s).
Interlink cables	Cables linking two separate project areas. This can be cables linking: 1) DEP South and DEP North 2) DEP South and SEP 3) DEP North and SEP 1 is relevant if DEP is constructed in isolation or first in a phased development.
Integrated Grid Option	Transmission infrastructure which serves both extension projects.
Jointing bays	Underground structures constructed at regular intervals along the onshore cable corridor to join sections of cable and facilitate installation of the cables into the buried ducts.

Landfall	The point at the coastline at which the offshore export cables are brought onshore and connected to the onshore export cables.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.
Offshore scoping area	An area that encompasses all planned offshore infrastructure, including landfall options at both Weybourne and Bacton, and allows sufficient room for receptor identification and environmental surveys. This has been refined following further site selection and consultation.
Offshore substation platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Onshore cable corridor	The area between the landfall and the onshore substation site, within which the onshore cable circuits will be installed along with other temporary works for construction.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV.
Onshore substation	Compound containing electrical equipment to enable connection to the National Grid.
Separated Grid Option	Transmission infrastructure which allows each project to transmit electricity entirely separately.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension lease area.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
The Applicant	Equinor New Energy Limited.
Transition joint bay	Connects offshore and onshore export cables at the landfall. The transition joint bay will be located above mean high water.

18.2 FLOOD RISK ASSESSMENT

18.2.1 Introduction

18.2.1.1 Project Background

1. Equinor New Energy Limited (hereafter ‘the Applicant’) is proposing to extend the existing operational Dudgeon and Sheringham Shoal Offshore Wind Farms, named the Dudgeon Offshore Wind Farm Extension Project (DEP) and the Sheringham Shoal Offshore Wind Farm Extension Project (SEP). SEP and DEP will include a number of offshore and onshore elements including an offshore wind farm, export cables to landfall, onshore buried cables and an onshore substation for connection to the electricity transmission network.
2. The final design of SEP and DEP will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust assessment at this stage of the development process, the worst-case scenario comprising both SEP and DEP have been considered in terms of the potential flood risk impact that may arise.
3. This accounts for the fact that whilst SEP and DEP are the subject of one Development Consent Order (DCO) application, it is possible that either one or both SEP and DEP will be developed, and if both are developed, that construction may be undertaken either concurrently or sequentially.
4. Royal HaskoningDHV was commissioned to undertake a Flood Risk Assessment (FRA) to support the DCO application for the SEP and DEP proposals.

18.2.1.2 Aims

5. The aim of this FRA is to provide sufficient justification to regulators and other stakeholders that SEP and DEP are appropriate and in line with planning and national policy requirements regarding flood risk.
6. The aims of this FRA are:
    - To establish whether SEP and DEP are likely to be affected by current or future flooding from any source of flood risk;
    - To assess and identify the potential for SEP and DEP to increase flood risk elsewhere to off site receptors;
    - To provide recommendations on potential measures required to reduce flood risk, if applicable; and
    - To provide information required to support the Environmental Statement (ES) with regards to flooding, supported by the application of the Sequential Test and, where necessary, the Exception Test.

18.2.1.3 Methodology

7. This FRA has been prepared in accordance with the methodology and guidance set out in EN-1 Overarching National Policy Statement (NPS) for Energy (Department of Energy & Climate Change, 2011), National Planning Policy Framework (NPPF) (Ministry of Housing, Communities & Local Government, 2021), Planning Practice Guidance (PPG) for Flood Risk and Coastal Change (Ministry of Housing, Communities & Local Government, 2021), and the Environment Agency's climate change allowance guidance (Environment Agency, 2022).

8. The Environment Agency originally published its guidance on climate change allowances for Flood Risk Assessments in February 2016, which was subsequently updated in July 2021 and May 2022.

9. This comprised a number of amendments including updates on the values to be used and how to apply the peak river allowances as well as updates to the approach with regard to peak rainfall allowances. The updated guidance on peak river flow allowances included amendments to utilise the UKCP19 projections and provided a change of approach from the use of river basin districts to the use of management catchments. Additionally, there was a change in guidance on how to apply peak river flow allowances such that the central allowance is to be adopted for all assessments except for essential infrastructure, where the higher central allowance is to be applied.

10. The updated guidance on the values for peak rainfall allowance are now provided for 1% annual exceedance probability (AEP) events and for 3.3% AEP events, as well as 2 future epochs rather than 3 epochs. Furthermore, the guidance on the approach to adopt for the application of peak rainfall allowances has changed, using the central allowance for development with a lifetime up to 2100 and the upper end allowance for development with a lifetime from 2100 to 2125.

11. The relevance and the applicability of the updated climate change guidance has been considered within this FRA.

12. The latest climate change guidance sets out the Environment Agency's recommended climate change allowances for development when considering flood risk and coastal change for planning purposes (Environment Agency, 2022). The principal aim of these policies and guidance documents is to avoid inappropriate development in areas at risk of flooding and, wherever possible, to direct development away from the areas at highest flood risk. The appropriate climate change allowances have been reviewed and included within **Section 18.2.6** of this FRA.

18.2.1.3.1 Study Area

13. Due to the scale of SEP and DEP the flood risk varies across the study area. Therefore, to aid this assessment the DCO order limits has been divided into four key sections within this document:

- **Landfall area** – where the offshore export cables will connect to the onshore export cables close to Weybourne. The landfall location extends inland to facilitate the provision of a temporary construction compound and access tracks.
- **Onshore cable corridor** – the proposed route the onshore export cables will take between the landfall location and the onshore substation. This includes associated access tracks, link boxes, joint bays and reference to the temporary construction compounds (however the temporary construction compounds are the subject of a separate section).
- **Onshore substation** – including the onshore substation operational area, permanent access, 400kV National Grid Electricity Transmission (NGET) connection to the existing National Grid substation at Norwich Main and temporary works relating to the onshore substation, access and construction compounds.
- **Temporary works** – relating to the construction compounds to be located along the onshore cable corridor.

14. The flood risk to the landfall location, onshore cable corridor and onshore substation area are each identified separately within this FRA report.

15. Furthermore, the assessment relating to flood risk connected to the onshore cable corridor are further sub-divided into categories based on Water Framework Directive (WFD) Surface Water Operational Catchments (**Figure 18.2.1**) as outlined below:

- Landfall area:
  - **Section 108**: Landfall (within the North Norfolk WFD Surface Water Operational Catchment).
- Onshore cable corridor:
  - **Section 18.2.4.4**: North Norfolk WFD Surface Water Operational Catchment;
  - **Section 18.2.4.5**: Bure WFD Surface Water Operational Catchment;
  - **Section 18.2.4.6**: Wensum WFD Surface Water Operational Catchment; and
  - **Section 18.2.4.7**: Yare WFD Surface Water Operational Catchment.
- Onshore substation site:
  - **Section 18.2.4.8**: Onshore Substation Site (within the Yare WFD Surface Water Operational Catchment).
- Temporary Works – Construction Compounds:
  - **Section 18.2.4.9**: Construction Compounds (within multiple catchments).

16. This FRA is structured to introduce all relevant polices and guidance for FRAs and identify the existing flood risk within the study area of SEP and DEP.

17. Following the identification of the flood risk to each element of SEP and DEP, mitigation measures related to the construction and operation of these is then discussed to ensure that there is no increase in flood risk either to, or as a result of, SEP and DEP.

18.2.2 Policy, Guidance and Consultation

18.2.2.1 Policy Guidance and Introduction

18. **Table 18.2.1** outlines all documents that are referenced in this FRA. Beneath the table, the documents and their constraints to SEP and DEP are discussed in greater detail.

Table 18.2.1: Policy or Guidance Documents Referenced in this FRA

Policy or Guidance Document	Author / Produced on behalf of	Year Published
National Planning Policy Framework	Ministry of Housing, Communities and Local Government	2012, updated 2021
Planning Practice Guidance (NPPF PPG) for Flood Risk and Coastal Change	Ministry of Housing, Communities & Local Government	2014, updated 2021
Flood risk assessments: climate change allowances guidance	Environment Agency	2016, latest update in May 2022
Norfolk Lead Local Flood Authority (LLFA) Statutory Consultee for Planning Guidance Document	Norfolk County Council	Version 4, March 2019, updated 2021
Preliminary Flood Risk Assessment (PFRA)	Norfolk County Council	2011
Strategic Flood Risk Assessment (SFRA) Level 1 including of relevance the North Norfolk SFRA and Greater Norwich Area SFRA	Broadland District Council, Great Yarmouth Borough Council, the Borough Council of King's Lynn & West Norfolk, North Norfolk District Council, Norwich City Council, South Norfolk Council and the Broads Authority	2017
Greater Norwich Level 2 SFRA	Norfolk County Council	Draft Report published 2021
North Norfolk Local Plan 2016-2036	North Norfolk District Council	Proposed Submission Version issued for consultation January 2022
Joint Core Strategy for Broadland, Norwich and South Norfolk	Broadland, Norwich and South Norfolk Council	Adopted March 2011, amendments adopted January 2014
Norfolk Local Flood Risk Management Strategy (LFRMS)	Norfolk County Council	2015
Broadland Rivers Catchment Flood Management Plan (CFMP)	Environment Agency	2009
North Norfolk Catchment Flood Management Plan	Environment Agency	2009

Policy or Guidance Document	Author / Produced on behalf of	Year Published
SMP6: Kelling Hard to Lowestoft Ness Shoreline Management Plan (SMP)	East Anglia Coastal Group	2012

18.2.2.2 National Planning Policy Framework

19. NPPF (Ministry of Housing, Communities and Local Government, 2021), NPPF PPG for Flood Risk and Coastal Change (Ministry of Housing, Communities and Local Government, 2021) and 'Flood risk assessments: climate change allowances guidance' (Environment Agency, 2022) provide direction on how flood risk should be considered at all stages of the planning and development process.

20. The planning system should ensure that new development is safe and not exposed unnecessarily to the risks associated with flooding. This FRA sets out the planning and wider context within which the project needs to be considered along with the flood risk to the onshore study area.

21. The revised NPPF (2021) provides clarification that all strategic policies / plans should apply a sequential, risk-based approach to the location of development taking into account all sources of flood risk. It also provides guidance on how this is to be considered in the context of the location of site-specific development. Further guidance, on the application of the Sequential Test and Exception Test is provided in the supporting NPPF PPG (Ministry of Housing, Communities and Local Government, 2021) in terms of fluvial and tidal flood risk, Flood Zones and the Vulnerability Classification relevant to the development.

22. Within the supporting NPPF PPG it is noted that:

- *"The Sequential Test does not need to be applied for individual developments on sites which have been allocated in development plans through the Sequential Test… Nor should it normally be necessary to apply the Sequential Test to development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea), unless the Strategic Flood Risk Assessment for the area, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change)."*
- *"When applying the Sequential Test, a pragmatic approach on the availability of alternatives should be taken… For nationally or regionally important infrastructure the area of search to which the Sequential Test could be applied will be wider than the local planning authority boundary."*
- *"Any development proposal should take into account the likelihood of flooding from other sources, as well as from rivers and the sea. The sequential approach to locating development in areas at lower flood risk should be applied to all sources of flooding, including development in an area which has critical drainage problems, as notified to the local planning authority by the Environment Agency, and where the proposed location of the development would increase flood risk elsewhere."*

23. However, neither the NPPF nor the supporting NPPF PPG provides a set of criteria as to how the Sequential Test should be applied for other sources of flooding, for example surface water flooding, in terms of development vulnerability and the varying level of flood risk. It is understood that there are likely to be future updates to the NPPF PPG to provide greater clarification but at the time of writing this FRA it has not been published.

24. For the purposes of the FRA, based on the indicative flood risk issues in relation to SEP and DEP, the application of a sequential approach has been considered, specifically with regard to the onshore substation site. This assessment has sought to consider the potential surface water flood risk in greater detail with the aim of sequentially locating it, wherever possible, to avoid this risk. Further details on this approach are provided in **Section 18.2.4.8.7**.

18.2.2.2.1 Probability of Flooding – Flood Zones

25. **Table 18.2.2** defines each flood zone and associated probability, taken from **Table 1** of the NPPF PPG . Through the application of the Sequential Test, the NPPF PPG aims to steer development towards areas at lowest risk of flooding (Flood Zone 1).

26. Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zones 2 and 3, applying the Exception Test if required.

Table 18.2.2: Summary of Flood Zone Definitions

Flood Zone	Probability of Flooding	Return Periods
1	Low	Land having a less than 1 in 1,000 annual probability of river or sea flooding.
2	Medium	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
3a	High	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
3b	High – Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

27. The Exception Test is a method to demonstrate that flood risk to people and property will be managed satisfactorily, while not being prohibitive to development where suitable sites at lower risk of flooding are not available.

28. The Exception Test requires developments to demonstrate that:

- The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- The development would be safe for its lifetime without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

29. Flood Zones are informed by modelling undertaken by the Environment Agency and refer to the probability of fluvial or tidal / coastal flooding, ignoring the presence of defences.

30. The extent of the modelling includes all designated Main Rivers. Any watercourse that is not classified as a Main River is referred to as an Ordinary Watercourse. This covers streams, drains, ditches and passages through which water flows that do not form the network of Main Rivers. Some larger Ordinary Watercourses (including Internal Drainage Board (IDB) maintained watercourses) are also included in the Environment Agency's modelling and may therefore be included within the extent of the Flood Zone datasets.

18.2.2.2.2 Probability of Flooding – Surface Water Flooding

31. It is important that FRAs also identify and mitigate against risks from all identified sources of flooding. The Environment Agency provides national datasets on surface water flood risk, classified into four categories: Very Low, Low, Medium and High (**Table 18.2.3**).

Table 18.2.3: Summary of Surface Water Flood Risk Definitions

Probability of Flooding	Description
Very Low	Each year the area has a chance of flooding of less than 1 in 1,000 (0.1%)
Low	Each year the area has a chance of flooding of between 1 in 1,000 (0.1%) and 1 in 100 (1%)
Medium	Each year the area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)
High	Each year the area has a chance of flooding of greater than 1 in 30 (3.3%)

18.2.2.3 Local Plan

32. The Order limits encompasses the following Local Plans:

- The North Norfolk Local Plan 2016 - 2036 was published as a Proposed Submission Version in January 2022 and therefore has not yet been adopted. In the meantime, the current Local Plan comprises the Core Strategy (2008, updated 2012) and supporting documents.
- Joint Core Strategy for Broadland, Norwich and South Norfolk - Adopted March 2011, amendments adopted January 2014.

33. The Joint Core Strategy for Broadland, Norwich and South Norfolk was prepared to provide assistance to local developers, applicants, and Local Planning Authority officers on how to apply local and national planning policy using, amongst other evidence, the Council's Strategic Flood Risk Assessment (SFRA). It identifies spatial planning objectives and sets out, where new development in such areas is desirable for reasons of sustainability, ways to minimise the contributors to climate change and address its impact.

34. A review of the Proposed Submission Version of the North Norfolk Local Plan 2016 – 2036 has identified that the guidance in relation to flood risk is aligned with the guidance in NPPF. Section 3.7 of the North Norfolk Local Plan 2016 – 2036, and specifically Policy CC7, is relevant to this FRA as it discusses, amongst other elements, the use of the Sustainable Drainage Systems (SuDS) hierarchy and the adoption of appropriate drainage measures. This topic has been subject to consultation with Norfolk County Council, in their role as the LLFA during the development of this FRA.

35. The North Norfolk Development Control Guidance Note: Development and Coastal Erosion was published in April 2009. It aims to aid decision-makers in balancing the need to preserve the sustainability of the coastal environment – and, all the while, fulfilling North Norfolk District Council's duties as a planning and coastal management authority.

36. The guidance shows how the predictions for coastal erosion, contained within the Kelling Hard to Lowestoft Ness Shoreline Management Plan (see **Section 18.2.2.8**), can be applied in decisions about new development, and it explains the different approach needed for different types of development and land use.

18.2.2.4 Preliminary Flood Risk Assessment

37. The most recent Preliminary Flood Risk Assessment (PFRA) for the county was produced by Norfolk County Council in July 2011 (Norfolk County Council, 2011) to assist in its duties to manage local flood risk and deliver its requirements under the Flood Risk Regulations 2009.

38. The PFRA provides a high-level overview of the potential risk of flooding from local sources and identifies areas at flood risk which may require more detailed studies. The PFRA is used to inform the development of the Local Flood Risk Management Strategy (see **Section 18.2.2.6**).

18.2.2.5 Strategic Flood Risk Assessment

39. An SFRA is a high-level strategic document carried out by local planning authorities to provide a comprehensive and robust appraisal of the extent and nature of flood risk from all sources of flooding, at present and in the future. An SFRA takes into consideration the impacts of climate change and assesses the impact that land use changes and development are likely to have on flood risk.

40. A consortium of local planning authorities comprising Broadland District Council, Great Yarmouth Borough Council, the Borough Council of King's Lynn & West Norfolk, North Norfolk District Council, Norwich City Council, South Norfolk Council and the Broads Authority produced Level 1 SFRAs in 2017.

41. An addendum to the Level 1 North Norfolk Strategic Flood Risk Assessment was subsequently published in 2018 as a result of the new Wells-next-the-Sea coastal modelling outputs.

42. The SEP and DEP study area falls within the North Norfolk SFRA study area and the Greater Norwich Area SFRA study area. The Level 1 SFRA informs the Local Plan for Development by delineating areas that are at High risk of flooding from tidal, fluvial and surface water sources. Therefore, development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the NPPF.

43. Furthermore, Norfolk County Council published the Greater Norwich Level 2 SFRA in 2021; however, a review of the sites assessed within this document indicate these are not of relevance to the SEP and DEP study area.

44. The information contained within the North Norfolk Level 1 SFRA and Greater Norwich Area Level 1 SFRA has been considered in the development of this FRA.

18.2.2.6 Local Flood Risk Management Strategy

45. Norfolk County Council produced the Norfolk Local Flood Risk Management Strategy (LFRMS) in 2015 (Norfolk County Council, 2015), which outlines the aims and objectives of the Council as the LLFA and provides policies based on these aims.

46. The Town and Country Planning (Consultation) (England) Direction 2021 notes that flood risk areas include “Flood Zone 1 which has critical drainage problems and which has been notified for the purposes of article 10 of the Order to the local planning authority by the Environment Agency”. These are identified by the Environment Agency as Critical Drainage Areas (CDAs) and separately by the LLFA within the LFRMS as Critical Drainage Catchments (CDCs).

47. Consideration of CDAs and CDCs is necessary to inform key flood risk priorities. The LFRMS did not identify any locations within the onshore study area that are designated as either CDAs or being within CDCs.

18.2.2.7 Catchment Flood Management Plan

48. Catchment Flood Management Plans (CFMPs) consider all types of inland flooding including from rivers, groundwater, surface water and tidal flooding. Flooding directly from the sea (coastal flooding) is covered in Shoreline Management Plans (SMPs) (see **Section 18.2.2.8**). CFMPs consider the likely impacts of climate change, the effects of how we manage the land and how areas can be developed sustainably to establish flood risk management policies which will deliver sustainable flood risk management for the long term.

49. The onshore study area is covered by two CFMPs:

- Broadland Rivers CFMP (Environment Agency, 2009a); and
- North Norfolk CFMP (Environment Agency, 2009b).

50. The Broadland Rivers CFMP covers the majority of the onshore study area. The CFMP includes the catchment of five major rivers: the Rivers Ant, Bure, Wensum, Yare and Waveney. These catchments drain into a tidally dominated area of inland waterways known as the Broads and finally out to sea through the mouth of the River Yare at Great Yarmouth. The CFMP indicates that the main sources of flood risk within the onshore study area are river flooding from the River Wensum, River Yare and River Bure, tide locking, failure of pumping stations and breaching/failure of embankments.

51. The area covered by the North Norfolk CFMP includes the landfall location. It identifies that the main sources of flood risk in the area are fluvial and tidal flooding from the Spring Beck as well as sudden summer storms that can result in flash flooding. The Spring Beck outfalls through coastal defences so is prone to tide locking, which could be exacerbated by future sea level rise.

18.2.2.8 Shoreline Management Plan

52. SMPs are non-statutory plans for coastal defence management planning. They aim to identify the best ways to manage flood and erosion risk and develop an 'intent of management' for the shoreline.

53. The onshore study area is covered within SMP6: Kelling Hard to Lowestoft Ness (Aecom, 2012). Specifically, the landfall is located within Policy Unit 6.01: Kelling Hard to Sheringham.

54. The preferred policy option for this policy unit over the next three epochs is to allow natural processes to take place i.e. allow coastal retreat through a policy of no active intervention on the open coast.

55. There is a short length of palisade at Weybourne to prevent breach of the shingle ridge. As the shingle ridge rolls back this will become exposed and local flood defence works could be implemented in a setback position to maintain facilities and reduce flood risk at this location.

18.2.2.9 Flood Risk Stakeholders and Consultation

18.2.2.9.1 Key flood risk stakeholders

56. The onshore study area is located within the authority area of Norfolk County Council.

57. Additionally, three District Councils cover the onshore study area:

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

58. Norfolk County Council is the LLFA covering the onshore study area. Under the Flood and Water Management Act 2010 LLFAs are responsible for managing flooding from surface water, groundwater and Ordinary Watercourses. Among other responsibilities they are required to deliver a strategy for local flood risk management in their areas, to investigate flooding and to maintain a register of flood risk assets.

59. As the LLFA, Norfolk County Council is also responsible for consenting works that affect the flow of an Ordinary Watercourse under the terms of the Flood and Water Management Act 2010, Land Drainage Act 1991 and Water Resources Act 1991.

60. The Norfolk Rivers IDB is responsible for maintaining watercourses within a 14,985ha area, which includes parts of the onshore study area.

61. All of the watercourses that the Norfolk Rivers IDB maintains, discharge by gravity into Environment Agency Main Rivers.

62. The Norfolk Rivers IDB is part of the larger Water Management Alliance (WMA), which consists of six IDBs (Broads IDB, East Suffolk IDB, King's Lynn IDB, Norfolk Rivers IDB, South Holland IDB and Waveney, Lower Yare and Lothingland IDB) that are responsible for maintaining key watercourses and granting Ordinary Watercourse consent within the region.

63. The onshore study area crosses multiple channels that are either within the Internal Drainage District or maintained by the Norfolk Rivers IDB.

64. The Environment Agency is also a key flood risk stakeholder in this project, due to their management of the Main Rivers that the onshore cable corridor will cross.

18.2.2.9.2 Potential Permitting / Consenting Requirements

65. Any works, either temporary or permanent, which will alter the flow of water along a watercourse or require the erection of a culvert, bridge or modification to the channel will require consent from the corresponding relevant authorities such as the Environment Agency, LLFA or IDB.

66. As set out in the Environmental Permitting (England and Wales) Regulations 2016, a permit or exemption is required for any activities which will take place:

- On or within 8 metres (m) of a Main River (16m, if the Main River is tidal);
- On or within 8m of a flood defence structure or culverted Main River (16m, if Main River is tidal);
- Any activity within 16m of a sea defence structure;
- Quarrying or excavation within 16m of any Main River, flood defence (including a remote defence) or culvert; and/or
- Activities carried out on the floodplain of a Main River, more than 8m from the riverbank, culvert or flood defence structure (or 16m, if the Main River is tidal) and planning permission has not already been obtained.

67. The key types of watercourse consent required for SEP and DEP can be split by consenting authority as follows:

- Environment Agency:
  - **Exclusions:** Permission is not required for defined excluded activities with operations taking place within the description and conditions of the exclusion. Exclusions include, but are not limited to, when working in an emergency, if a Marine Management Organisation licence has been applied for, using ladders and scaffold towers, and services crossing a river within an existing structure. The Environment Agency provides a full list of exclusions online which should be checked prior to undertaking any works.
  - **Exemptions**: Application for a permit is not required if an activity meets the description and conditions of one of the exempt flood risk activities. Exemptions must be registered with the Environment Agency before any work can be carried out. Exemptions include, but are not limited to, electrical cable service crossing over a Main River, service crossing below the bed of a Main River not involving an open cut technique, temporary dewatering of a work area for no more than 4 weeks, and maintaining a raised river defence or sea defence. The Environment Agency provides a full list of exemptions online which should be checked prior to undertaking any works.
  - **Standard Rules**: Application for an environmental permit Part B11 – Flood Risk Activity Standard rules application; and
  - **Bespoke**: Application for an environmental permit Part B10 – Flood Risk Activities.
- Water Management Alliance (Norfolk Rivers IDB): Application for Land Drainage Consent; and
- Norfolk County Council: Application for Consent for Works Affecting Ordinary Watercourses.

68. All Main Rivers and Ordinary Watercourses identified to be crossed by SEP and DEP to date have been identified as part of the Crossing Schedule (**Appendix 4.1 Crossing Schedule** (Document reference 6.3.4.1)).

69. All necessary applications for watercourse consents will be made to and agreed with the appropriate authority post-DCO consent.

18.2.2.9.3 Data collection and consultation

70. To accurately ascertain potential flood risk to the site, data from the Environment Agency, Norfolk County Council (in their role as the Lead Local Flood Authority) and North Norfolk Rivers IDB was requested to support the FRA for SEP and DEP.

71. Information on flooding incidents, investigations and assets of relevance to the FRA was received from Norfolk County Council on 9th July 2020. During an Expert Topic Group (ETG) meeting with Norfolk County Council on 11 November 2021 it was also confirmed that there were unlikely to be any additional surface water flooding records, especially around the onshore substation, due to the rural nature of its location.

72. Data related to IDB-maintained watercourses and information relevant to flood risk was provided by Norfolk Rivers IDB on 28th September 2020.

73. The Environment Agency Product 4, 5 and 8 data packages were requested, and information provided on 29th July 2020 for key locations related to strategic watercourse crossings along the onshore cable corridor, landfall location and the onshore substation search area.

74. The Environment Agency data includes:

- Product 4 data package consisting of flood zones, defences and storage areas, areas benefiting from defences, statutory Main River designations, historical flood event outlines and more detailed information from computer river models (including model extent, information on one or more specific points, flood levels and flood flows);
- Product 5 data package comprising reports, including flood modelling and hydrology reports and modelling guidelines for the River Yare (2014) and Mulbarton (2014), River Wensum (2017), River Tud (2017) and River Bure (2018) - consisting of fluvial modelling reports, guidelines and technical notes; and
- Product 8 data package comprising Flood Defence Breach Hazard Map including maximum flood depth, maximum flood velocity, and maximum flood hazard from the Wells-next-the-Sea model, which was completed in 2018.

75. The information provided by the Environment Agency, Norfolk County Council and Norfolk Rivers IDB has subsequently been used to inform this FRA.

76. In addition, ongoing consultation has been undertaken with the Environment Agency, Norfolk County Council and Norfolk Rivers IDB at a series of ETG meetings during the production of this FRA which have sought to further investigate and understand the flood risk in relation to the SEP and DEP.

18.2.3 Baseline Environment

18.2.3.1 Existing Surface Water Drainage System

77. SEP and DEP will primarily be located on rural, agricultural land where there are limited existing formal surface water drainage systems. However, there are a large number of agricultural land drains, Ordinary Watercourses and IDB-maintained watercourses, especially along the onshore cable corridor.

18.2.3.2 Geology and Hydrogeology

78. The British Geological Survey (BGS) 1:50,000 scale solid and superficial geology geological mapping has been reviewed. The geological conditions within the study area, as shown on the BGS online viewer and on **Figure 17.1.3** of **Appendix 17.1 Land Quality Desk Study and Preliminary Risk Assessment Report**, is as follows:

- **Superficial Deposits**
  - Marine Beach Deposits - Shingle, sand, silt and clay; beach deposits may be in the form of dunes, sheets or banks; in association with the marine environment.

  - River Terrace Deposits - Sand and gravel, locally with lenses of silt, clay or peat.
  - Head Deposits - Gravel, sand and clay depending on upslope source and distance from source. Locally with lenses of silt, clay or peat and organic material.
  - Alluvium - Clay, silt, sand and gravel. Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.
  - Sheringham Cliffs Formation - Consists of a thick glacial sequence that contains several distinctive subdivisions varying from stratified fine-grained sands, matrix-supported diamictons, clay and sand.
  - Briton's Lane Sand and Gravel Member - Horizontal, massive and low angle planar cross-bedded gravels and cobble gravels with thin seams of horizontal and rippled sand.
  - Weybourne Town Till Member – A highly calcareous silt and chalk-rich matrix supported diamicton.
  - Lowestoft Formation - Chalky till, together with outwash sands and gravels, silts and clays.
  - Happisburgh Glacial Formation - A range of diamictons, sands and gravels, sands and laminated silts and clays.
  - Bacton Green Till Member - Extensive diamicton with beds/laminae of sorted material including sand, silt and clay.
- **Bedrock Geology**
  - Wroxham Crag Formation - Interbedded gravels, sands, silts and clays.
  - Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations - Chalk with flints.

79. The superficial Marine Beach Deposits, River Terrace Deposits, Alluvium and Briton's Lane Sand and Gravel Member are classified as Secondary A Aquifers.

80. Secondary A Aquifers are composed of permeable strata capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of baseflow to rivers.

81. The Happisburgh Glacial Formation and Bacton Green Till are classified as Secondary B Aquifers / Unproductive Strata. A Secondary B Aquifer comprises predominantly lower permeability strata which may in part have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.

82. The Head Deposits, Sheringham Cliffs Formation, Weybourne Town Till Member and Lowestoft Formation are classified as Secondary Undifferentiated Aquifers. Secondary Undifferentiated Aquifers are defined by the Environment Agency as being assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

83. The Wroxham Crag Formation and White Chalk Supergroup are classified as Principal Aquifers. Aquifers with this classification are composed of geology that exhibits high permeability and / or provide a high level of water storage. They may support water supply and / or river baseflow on a strategic scale.

84. The Department for Environment, Food & Rural Affairs' (DEFRA) MAGIC Map indicates that the study area has been classified as having a Medium to High groundwater vulnerability risk. A High groundwater vulnerability designation indicates that the soil is easily able to transmit pollution to groundwater, which is characterised by high leaching potential in soils and the absence of low permeability superficial deposits.

85. The majority of the landfall location, onshore cable corridor and onshore substation study area is located within Source Protection Zone (SPZ) 3, as shown on **Figure 17.1.3** of **Appendix 17.1 Land Quality Desk Study and Preliminary Risk Assessment Report**. The western half of the landfall location between the village of Weybourne and the A148 (Cromer Road) and a section of the onshore cable corridor between the villages of Little Barningham and Oulton are not located in an SPZ.

86. The study area is underlain by two WFD groundwater bodies, as shown on **Figure 18.2** of **Chapter 18 Water Resources and Flood Risk**:

- North Norfolk Chalk; and
- Broadland Rivers Chalk & Crag.

87. Both aquifers are designated as Principal Aquifers by the Environment Agency meaning they usually provide a high level of water storage.

18.2.3.2.1 Summary of Initial Ground Investigations

88. To aid in the understanding of flood risk and to inform the identification of potential drainage solutions for the permanent above ground infrastructure, i.e. onshore substation, a series of investigations have been undertaken. The results of these were utilised to understand the potential for infiltration to be adopted, in line with the SuDS Hierarchy, for the operational drainage of surface water from the onshore substation site.

89. As such, infiltration tests were carried out at the onshore substation site in September 2021, as part of a suite of initial ground investigation surveys. Despite the bedrock geology of chalk, the soakaway tests were abandoned due to a lack of infiltration into the ground over the time period that was monitored (180 – 300 minutes) indicating that the superficial deposits in these locations may be hindering drainage.

90. A geophysical survey was conducted at the onshore substation site in April 2022 with the aim of mapping the shallow subsurface and identifying areas with potentially higher infiltration rates. The survey comprised electromagnetic ground conductivity mapping and Electrical Resistivity Tomography (ERT).

91. The geophysical survey has mapped compositional variations in the superficial deposits across the onshore substation site. Areas of decreased clay / moisture are likely to represent well-drained ground and have therefore been highlighted as features for further ground investigations.

92. The results found:

- A broad linear feature crosses the southern part of the onshore substation site and consists of granular material with less clay / moisture content. The borehole records suggest this is gravel and sand overlaying the chalk bedrock.
- A broad area with low conductivity is located at the base of a low shallow valley, which represents relatively less clay / moisture in the near surface and could be indicative of thin superficial deposits overlaying shallow chalk.

93. In summary, the geophysical survey identified a channel-like feature across the onshore substation site. This feature correlates with records of gravel / sand deposits above chalk observed in the borehole data from the initial ground investigation. The location of the buried channel indicates an area which is likely to be more permeable in nature. The remaining soils across the onshore substation site are likely to be more cohesive in nature i.e. comprising clays and silts and therefore they are likely to be less permeable in nature.

94. Further consideration of these geophysical survey results was used to aid in the development of a further phase of supplementary ground investigations, undertaken in June 2022.

95. In the supplementary ground investigations three cable percussive boreholes, were located within the potential granular channel and a further cable percussive borehole was located within the other potential granular area.

96. These boreholes are subject to ongoing monitoring to understand the potential for infiltration as a method to drain the surface water from the onshore substation.

18.2.3.3 Hydrology

97. The Environment Agency's WFD surface water operational catchments are based on surface hydrological catchments and have therefore been used to delineate the boundaries of each surface water drainage catchment within the FRA. The WFD catchment areas are shown in **Figure 18.2.1**.

98. The onshore study area is located within four surface water hydrological catchments:

- North Norfolk WFD Surface Water Operational Catchment, which covers approximately 11.7 kilometres (km)^2 of the study area, encompasses the entire landfall location and a small portion at the northern extent of the onshore cable corridor. The larger rivers rise in the south of the area and are generally small and steep in their upper reaches. In their lower reaches the geography is flatter and the rivers become wider. There are no formal flood defences in this area; however, there are informal flood banks along some river reaches and many of the rivers have been modified and straightened in the past. Spring Beck, classified as a Main River through Weybourne and as an Ordinary Watercourse to the south of Weybourne, is located to the east of the landfall location and flows north into the North Sea **(Figure 18.2.2)**.
- Bure WFD Surface Water Operational Catchment, within which the River Bure and the catchments of two of its tributaries within its upper reaches, Scarrow Beck and Mermaid Stream, are intersected by the onshore cable corridor. The River Bure rises at Melton Constable and flows southwest through the Broads to meet the sea at Great Yarmouth. Its upper reaches are steeper and suffer from sediment runoff due to historical management. The lower reaches include a range of wetland features including Hoveten Great Broad and Marshes, Woodbastwick Fens and Marshes, Bure Marshes and Norfolk Broads.
- Wensum WFD Surface Water Operational Catchment, which covers a length of approximately 20km of the onshore cable corridor. The River Wensum and two of its tributaries, the River Tud and Swannington Beck, are crossed by the onshore cable corridor, along with a portion of the catchment of Blackwater Drain. The Wensum is designated along much of its length as a Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) due to its internationally rare status as a chalk river system, including the location of the proposed crossing. It passes through Fakenham and the Pensthorpe Nature Reserve and continues in a broadly south-easterly direction through Norwich to join the River Yare at Whitlingham.
- Yare WFD Surface Water Operational Catchment, which covers approximately 14.5km of the length of the onshore cable corridor as well as the onshore substation study area. The River Yare and two of its tributaries, the River Tiffey and the Intwood Stream, are crossed by the onshore cable corridor close to the onshore substation study area. The River Yare rises south of Dereham and flows east towards Norwich, with the River Tiffey being a major tributary. It is joined by the Wensum at Whitlingham and flows into Breydon Water following which it enters the sea at Great Yarmouth.

99. There are a number of Ordinary Watercourses within the sub-catchments which are crossed by the DCO order limits. Ordinary Watercourses are all rivers, streams, ditches and drains that are not designated Main Rivers and therefore managed by the Environment Agency, instead they are the responsibility of IDBs and LLFAs.

100. There are three locations where the onshore cable corridor crosses watercourses maintained by the Norfolk Rivers IDB, as shown in **Figure 18.2.2.**

18.2.4 Definition of Flood Hazard

101. This section explores the risk of flooding to the key study area elements (landfall location, onshore cable corridor and onshore substation), as well as the temporary elements, as outlined in **Section 18.2.1.3.1**. Where flood risk is identified, appropriate mitigation methods are discussed within **Section 18.2.8**.

18.2.4.1.1 Flood Zones

102. The NPPF PPG, through the application of the Sequential Test, aims to steer development towards areas at lowest risk of flooding (Flood Zone 1) and away from Medium and High flood risk areas (Flood Zones 2 and 3) (**Table 18.2.2**).

103. Flood Zones are informed by the extent of modelling undertaken by the Environment Agency. All designated Main Rivers, as well as some of the larger Ordinary Watercourses (including IDB-maintained watercourses) included in the modelling, are considered within the Flood Zone datasets.

104. It is acknowledged that there may be a flood risk associated with Ordinary Watercourses which are intercepted by the onshore cable corridor. However, due to the relative size and frequency of these watercourses and the associated information related to flood risk they are considered independently from Main Rivers, as well as within the surface water flood risk section for each of the study area elements.

105. Neither the NPPF or the supporting NPPF PPG provide a set of criteria as to how the Sequential Test should be applied for other sources of flooding, for example surface water flooding, as the focus is on Flood Zones and appropriate vulnerability classifications. However, on the basis that NPPF notes all sources of flooding should be considered, this assessment has also sought to consider the potential surface water flood risk in greater detail with the aim of sequentially locating it, wherever possible, to avoid this risk. It is important to note this has been considered alongside the assessment of Flood Zones for all elements of SEP and DEP.

18.2.4.1.2 Watercourse Crossings

106. Information provided within the Crossing Schedule (**Figure 18.2.2**) indicates that there are six Environment Agency Main Rivers that are crossed by the DCO order limits. These include the River Bure, River Wensum, River Yare, Intwood Stream, River Tiffey and the River Tud.

107. There are 43 watercourse crossings identified within the study area, including Main Rivers, smaller streams and tributaries. Furthermore, there are numerous ponds of varying size located either wholly or partially within the study area.

108. SEP and DEP have committed to the use of trenchless techniques for the crossing of Main Rivers and IDB-maintained Ordinary Watercourses.

109. The proposed crossing method for all onshore crossings identified to date is provided in **Appendix 4.1 Crossing Schedule** (Document reference 6.3.4.1) i.e. open cut trench or trenchless crossing methods. A description of these crossing types is also provided in **Chapter 4 Project Description**.

110. Site specific crossing methodologies will be subject to agreement post-consent with the Environment Agency, Norfolk Rivers IDB and Norfolk County Council (as the LLFA), as appropriate. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

18.2.4.2 Landfall Location

18.2.4.2.1 Overview of Proposed Activities

111. The approach to the cable installation at the landfall location will be to use trenchless techniques.

112. The offshore and onshore cables will be jointed in one or two transition joint bays onshore and each export cable will require one trenchless installation (i.e. two in total).

113. The onshore transition joint bay(s) will be located underground. A pit will be dug out and will remain open until the cables are pulled through and jointed. The pit will be refilled once the transition joint bay(s) have been installed.

114. In addition, there will be a construction compound to support the trenchless activities which will be temporary in nature. The land will be reinstated after completion of SEP and DEP.

18.2.4.2.2 Historical Flooding

115. To understand the likely risk of flooding to SEP and DEP a review of historical flood events and its frequency has been undertaken. This review aims to provide an understanding of the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues. However, it should be noted that the absence of historical flood records does not necessarily confirm that flooding has not occurred.

116. In the review of the data provided by the Environment Agency it shows one historical flood extent outline that affected much of the North Norfolk Coastline, occurring in 1953.

117. The east coast of the United Kingdom (UK) was hit by a storm surge on the 31st January / 1st February 1953. As a result, areas of the North Norfolk district experienced major flooding. The Environment Agency recorded flooding at Horsey and along the coast from Decoy Wood to Weybourne due to overtopping of defences (North Norfolk SFRA, 2017).

118. In addition, the Environment Agency provided a historic flood extent map, identifying the areas affected by the 1953 flood event. This map shows that the landfall site is located within the 1953 flood extent, as shown on **Figure 18.2.3**.

119. The North Norfolk SFRA also identifies Weybourne as having been affected by flooding as a result of a combination of a high spring tide and low atmospheric pressure. The North Norfolk coastline suffered a tidal surge on the 5th / 6th December 2013. Water levels in some areas were higher than those experienced in the 'Great Flood of 1953' and whilst, owing to pre-planning and forewarnings, there was no loss of life or injury, significant damage was caused to both sea defences and property in towns and villages along North Norfolk's coastline. 152 houses and businesses were flooded and / or damaged as a direct result of the tidal surge, with over 200 households evacuated in Norfolk. The Environment Agency recorded flooding at Walcott, Cley-next-the-Sea, Weybourne and Wells-next-the-Sea due to overtopping of defences.

18.2.4.2.3 Flood Zones

120. The landfall location is largely within Flood Zone 1, as defined by the Environment Agency. Part of the landfall location falls within Flood Zone 2 and 3 associated with the areas closest to the beach / coastal areas to the north west of Weybourne. This flood risk is associated with tidal / coastal flood risk as well as the Spring Beck, which is classified as an Environment Agency Main River through Weybourne (**Figure 18.2.3**).

18.2.4.2.4 Flooding from Rivers

121. The flood zones in the landfall location are largely dominated by tidal processes and therefore the risk of flooding from fluvial sources is considered to be Low.

122. The only identified fluvial flood zone within the landfall location is associated with the urban area (Weybourne) of the Spring Beck.

123. Modelling carried out for the Weybourne Stream (Spring Beck) to support the North Norfolk SFRA (North Norfolk District Council, 2017) provides the 1 in 25 year return period extent which has been utilised to define areas of Flood Zone 3b. The North Norfolk SFRA has provided flood risk mapping that indicates Holt Road, Church Street and Beach Road are located within the flood extents of Flood Zone 3b. This flood risk is relatively localised within Weybourne itself and does not extend to the wider area.

18.2.4.2.5 Flooding from the Sea

124. Part of the coastal / beach area to the northwest of Weybourne has been identified as being located within Flood Zone 3 (**Figure 18.2.3**). The remaining coastal frontage to the east of Weybourne has been identified as Flood Zone 1, due to the presence of cliffs which act as a natural flood barrier.

125. The proposed location of the landfall is situated to the northwest of Weybourne, west of Beach Lane. Data provided by the Environment Agency shows that the landfall location is identified as being in Flood Zone 3 (**Figure 18.2.3**).

126. The Environment Agency provided modelled Product 8 (breach) data for the Wells-next-the-Sea model, which was completed in 2018. There are 4 breach scenarios along the North Norfolk coastline which simulate a failure of the open coast dune (breach 001 and breach 003) and embankment (breach 002 and breach 004) defences.

127. The flood level associated with the 1 in 200 year breach scenario is 4.88m Above Ordnance Datum (AOD) and 5.60m AOD for the 1 in 200 year plus an allowance for climate change breach scenario. The main risk of flooding from tidal sources is primarily along Beach Lane within Weybourne.

128. A small section of the beach along the frontage for the landfall location, in the vicinity of Weybourne, is identified as being in Flood Zone 3 i.e. below the cliff line (**Figure 18.2.3**).

129. As the offshore export cables are to be brought onshore using trenchless techniques (e.g. Horizontal Directional Drilling (HDD)) there would be no flood risk to these cables as they make landfall. Therefore, the landfall location is at Low risk of flooding from the sea based on the existing flood risk and use of trenchless techniques for installation.

18.2.4.2.6 Flooding from Groundwater

130. The North Norfolk SFRA (North Norfolk District Council, 2017) contains limited information on the risk of flooding from groundwater sources. Isolated low-lying valley areas may be subject to local groundwater flooding; however, the details of such areas are unknown.

131. The superficial Marine Beach Deposits and Briton's Lane Sand and Gravel Member, which cover much of the landfall location, are classified as Secondary A Aquifers.

132. As part of the North Norfolk SFRA deliverables, mapping showing the Areas Susceptible to Groundwater flooding (AStGWf) is available. The AStGWf is a strategic-scale map showing groundwater flood areas on a 1km square grid. The data were produced to provide indicative flood risk areas for PFRA studies and to allow the authorities to determine the risk of flooding from groundwater. The data show the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge.

133. The AStGWf dataset shows that areas more susceptible to groundwater flooding are generally associated with the valleys of watercourses and along coastline areas.

134. The landfall location is generally within an area not identified to be at risk on the AStGWf mapping; however, areas along the coastline are within the <25% category.

135. The LFRMS notes that groundwater can play a role in coastal erosion, as water within the rock strata can create instabilities within coastal cliffs (Norfolk County Council, 2015).

136. The landfall construction will involve below-ground works including excavation for the transition joint bays and a trenchless method of installation for the offshore export cables (such as HDD). As there are works below ground, there is the potential for groundwater flooding to occur, primarily during construction. However, given the landfall is located in an area not at risk on the AStGWF mapping and the relatively shallow depth of the construction, between 1.2m and 3m below ground, the landfall is unlikely to be affected by groundwater flooding. As such, the landfall location is at Low risk of flooding from groundwater.

18.2.4.2.7 Flooding from Surface Water

137. The Environment Agency's Long-Term Flood Risk Information map (**Figure 18.2.4**) shows the landfall location to be almost entirely within an area at Very Low risk of surface water flooding i.e. primarily outside the extent of the 1 in 1,000 year surface water flooding event. Whilst the landfall location is principally at Very Low risk, there are small localised areas in proximity to the Ordinary Watercourses which are at increased surface water risk.

138. There are four identified Ordinary Watercourses located within the landfall location: three tributaries of the Spring Beck located south of Weybourne, and the Osier Carr located on the eastern side of the landfall location.

139. For each of these Ordinary Watercourses, there are isolated areas within the landfall location which are shown to be at varying risk of surface water flooding, from Low risk (i.e. land which has a chance of flooding of between 0.1% and 1%) through to High risk (i.e. land which has a chance of flooding of greater than 3.3%).

140. The risk of surface water flooding within the landfall location is therefore considered generally to be Very Low with specific areas at a higher risk of flooding associated with the land in proximity to Ordinary Watercourses.

18.2.4.2.8 Flooding from Sewers

141. Within the North Norfolk SFRA historical incidents of flooding are detailed by Anglian Water through their DG5 register. The North Norfolk SFRA (North Norfolk District Council, 2017) did not report any flooding from sewers within the landfall location based on the DG5 register for the North Norfolk district. The landfall is primarily located within existing agricultural land and it is likely that there is no foul sewer network within proximity of this location. As such, there is a Low risk of flooding from sewer sources.

18.2.4.2.9 Flooding from Reservoirs

142. Reservoirs with an impounded volume greater than 25,000 cubic metres (m^3) are governed by the Reservoirs Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively Low. Recent changes to legislation under the Flood and Water Management Act2010 require the Environment Agency to designate the risk of flooding from these reservoirs.

143. Flooding from reservoirs is defined based on the implications of a large uncontrolled release of water from registered reservoirs i.e. greater than $25,000m^3$. The Environment Agency Flood Risk from Reservoirs map shows the landfall location is not at risk of reservoir flooding.

18.2.4.2.10 Flooding from Canals and other Artificial Sources

144. There are no canals or other artificial sources within the landfall location. Therefore, there is no risk of flooding to the landfall location from canals or other artificial sources.

18.2.4.2.11 Summary of Flooding Sources

145. Overall, the landfall location is not at risk from sewers, reservoirs, canals or other artificial sources. There is a Low level of flood risk associated with groundwater.

146. The risk of surface water flooding is generally Very Low with areas at High risk generally associated with land which is immediately adjacent to Ordinary Watercourses.

147. The risk of flooding from Main Rivers is generally Low (Flood Zone 1) with some higher risk areas within the urban area of Weybourne (Flood Zones 2 and 3). The landfall location is largely within Flood Zone 1, as defined by the Environment Agency. However, a small part of the landfall location falls within Flood Zone 2 and 3 associated with beach / coastal areas to the north west of Weybourne.

148. Despite the presence of Flood Zone 2 and 3, there is a Low risk of flooding associated with tidal / coastal flood risk on the basis that trenchless techniques are to be utilised.

18.2.4.3 Onshore Cable Corridor

18.2.4.3.1 Overview of Proposed Activities

149. The width of the onshore cable corridor will be 60m, increasing to 100m at trenchless crossing zones. This width accounts for the required construction footprint, including trenches, haul road, spoil storage, drainage etc.

150. The onshore export cables will be installed in trenches, comprising one trench per project.

151. Jointing bays will be used to pull the cables into the ducts and / or to join the cable lengths to each other. Link boxes are used for earthing cables and will be installed inside a protective concrete chamber.

152. The jointing bays are subsurface structures, while the link boxes will require access (for inspections) from the surface during operations and will therefore be located at ground level. The frequency of jointing bays and link boxes will be no greater than one every 500m along the onshore cable corridor.

153. A main construction compound will be required to support the construction of the onshore export cables. This will operate as a central base for the onshore construction works and could house offices, welfare facilities, and stores, as well as acting as a staging post and secure storage for equipment and component deliveries.

154. In addition, eight secondary construction compounds will be located along the onshore cable corridor. These would operate as support bases for the onshore construction works as the cable work fronts pass through an area. They may house portable offices, welfare facilities, localised stores, as well as acting as staging posts for localised secure storage for equipment and component deliveries.

155. Due to their temporary nature, the temporary construction compounds have been considered separately in **Section 18.2.4.9**.

156. For the purpose of identifying flood risk in this FRA, the onshore cable corridor is divided into four sub sections based upon the boundaries of the WFD Surface Water operational catchments (hereafter referred to as the WFD catchment) (**Figure 18.2.1**).

18.2.4.3.2 Watercourse Crossings

157. In addition to the above elements there will be a number of locations where the onshore cable corridor crosses Main Rivers and Ordinary Watercourses.

158. All Main Rivers and IDB-maintained watercourses will be crossed using trenchless techniques, to avoid direct interaction with these watercourses. The cable entry and exit pits will be at least 9m from the banks of the watercourse, and the cable will be at least 2m below the channel bed.

159. As noted previously in **Section 18.2.2.9.2**, it may be necessary to gain consent from the Environment Agency, IDB or Local Authority for the construction phase of the project, to ensure that the Main Rivers or Ordinary Watercourses are not impacted by the works.

18.2.4.4 Onshore Cable Corridor Section 1 – North Norfolk WFD Surface Water Operational Catchment

18.2.4.4.1 Overview

160. This first section of the onshore cable corridor runs from the landfall location, south towards Bodham, before crossing into the adjacent Bure WFD catchment to the east of Baconsthorpe.

18.2.4.4.2 Historical Flooding

161. To understand the likely risk of flooding to SEP and DEP a review of historical flood events and its frequency has been undertaken. This review aims to provide an understanding as to the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues. However, it should be noted that the absence of historical flood records does not necessarily confirm that flooding has not occurred.

162. Neither the Environment Agency nor the North Norfolk SFRA has any records to indicate that the onshore cable corridor within the North Norfolk WFD catchment has been previously affected by flooding from any source. However, although the LLFA has indicated that flooding has not occurred along this section of the cable corridor, there is one recorded LLFA flooding incident (undated) at Meadow Lane, Kelling which is located approximately 900m away from the cable corridor at Weybourne.

18.2.4.4.3 Flood Zones

163. The onshore cable corridor within the North Norfolk WFD catchment is located within Flood Zone 1, as defined by the Environment Agency Flood Map for Planning (**Figure 18.2.5**).

18.2.4.4.4 Flooding from Rivers

164. As the onshore cable corridor is located in Flood Zone 1 there is no risk of fluvial flooding associated with Main Rivers in this section of the onshore cable corridor (**Figure 18.2.5**).

165. The Environment Agency Main River (Spring Beck) runs through the DCO order limits for a short section at the landfall location where it flows into the sea adjacent to Beach Lane. Furthermore, the onshore cable corridor will pass under Spring Beck to the south of Weybourne, where it is no longer a Main River and is classed as an Ordinary Watercourse.

166. To the west of Station Road, along the eastern bank of Spring Beck, a series of Natural Flood Management (NFM) measures have been implemented including scrapes, leaky dams and tree planning adjacent to the watercourse, to reduce flood risk downstream in Weybourne.

167. In this location, crossing of the watercourse would be undertaken using trenchless techniques (e.g. HDD). The trenchless crossing will be designed to avoid disturbing both Spring Beck and the natural flood management features on its floodplain.

168. Therefore, there would be no fluvial flood risk to the onshore cable corridor based on the existing flood risk and use of trenchless techniques for installation.

18.2.4.4.5 Flooding from the Sea

169. The majority of the onshore cable corridor is located away from the coast and as such the risk associated with tidal flooding is limited to the landfall location and the extent of the onshore cable corridor that connects with it. Therefore, there is no risk of flooding from the sea in this location and the primary flood mechanisms are likely to be as a result of fluvial or surface water sources.

18.2.4.4.6 Flooding from Groundwater

170. The DCO order limits associated within the North Norfolk WFD catchment is located over superficial deposits of Weybourne Town Till Member, which are classified as Secondary Undifferentiated Aquifers (see **Section 18.2.3.2**).

171. The North Norfolk SFRA AStGWf map shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. The route of the onshore cable corridor, south of Bodham and East of Baconsthorpe is not within an area identified to be at risk of groundwater flooding.

172. Furthermore, once operational, the effect that the onshore export cables will have on groundwater flows is likely to be low as the buried cable will be located at a target depth of 1.2m below ground (subject to localised variations such as limiting interaction to shallow or near surface groundwater). Given the depth of the onshore export cables, it is likely to be constructed within the superficial deposits, and therefore will not interact with the bedrock below.

173. As the construction works require earthworks in order to place the onshore export cables, it is important to note that perched groundwater may be present below areas of the onshore cable corridor and could be encountered during the below-ground engineering works. The risk to the onshore export cables from the perched groundwater, if encountered, would need to be mitigated by appropriate construction techniques and in accordance with an appropriate method statement to ensure Health and Safety and Environmental Permitting requirements are satisfied. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

174. Furthermore, any water flowing into the trenches during the construction period will be discharged into local ditches or drains via temporary interceptor drains. This will also be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

175. Based on the above information there is likely to be a Very Low groundwater flood risk along the onshore cable corridor and any risk will be mitigated, as outlined above.

18.2.4.4.7 Flooding from Surface Water

176. The areas where the onshore cable corridor crosses the Ordinary Watercourses (to be crossed using trenched techniques) are identified as having a higher risk of surface water flooding. However, this is primarily limited to the width of the watercourse channel and relates to the lower lying area comprising the channel itself and the land draining into it.

177. Within the North Norfolk WFD catchment, the onshore cable corridor crosses an Ordinary Watercourse, to be crossed using trenched techniques), labelled as crossing RDX006 on **Figure 18.2.2**. The area around this watercourse is shown on the Environment Agency's Long-Term Flood Risk Information map as being primarily at Low risk of surface water flooding with isolated areas of Medium and High risk. Further downstream outside the DCO order limits the risk of flooding is classified as High, although this is primarily confined within the banks of the watercourse (**Figure 18.2.6**).

178. Any surface water flood risk to the onshore cable corridor will be temporary in nature and removed once construction is complete as all onshore infrastructure associated with the onshore export cables will be located below ground.

179. The land will be reinstated and existing ground levels will be maintained. Mitigation during construction is discussed in **Section 18.2.8** in relation to both surface water and Ordinary Watercourses. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

180. The risk of flooding from surface water is therefore considered to be Low for this section of the onshore cable corridor.

18.2.4.4.8 Flooding from Sewers

181. Within the North Norfolk SFRA historical incidents of flooding are detailed by Anglian Water through their DG5 register. The DG5 database records incidents of flooding relating to public foul-, combined- or surface water sewers and displays which properties suffered flooding (on a 4-5 postcode digit basis).

182. The North Norfolk SFRA did not report any flooding from sewers within this section of the onshore cable corridor based on the DG5 register for North Norfolk district.

183. The onshore cable corridor is located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of this location. The risk of flooding from sewers is therefore considered to be Low for this section of the onshore cable corridor.

18.2.4.4.9 Flooding from Reservoirs

184. Legislation and definitions relating to flood risk from reservoirs is set out in **Section 18.2.4.2.9**. The Environment Agency Flood Risk from Reservoirs map shows this section of the onshore cable corridor is not at risk of reservoir flooding.

18.2.4.4.10 Flooding from Canals and other Artificial Sources

185. The onshore cable corridor is not located near to any canals or other artificial sources within the North Norfolk WFD catchment. As such there is no risk of flooding from these sources.

18.2.4.4.11 Summary of Flooding Sources

186. Overall, this section of the onshore cable corridor is not at risk from sewers, reservoirs, canals or other artificial sources. There is a Low level of flood risk associated with groundwater. The risk of flooding from tidal / coastal flooding or fluvial flooding (from Main Rivers) is Low as the onshore cable corridor is located in Flood Zone 1,

187. This section of the onshore cable corridor crosses one Ordinary Watercourse (River Glaven) within the North Norfolk WFD Catchment and the risk of surface water flooding is generally Low with isolated areas at higher risk associated with land immediately adjacent to the Ordinary Watercourse.

18.2.4.5 Onshore Cable Corridor Section 2 – Bure WFD Surface Water Operational Catchment

18.2.4.5.1 Overview

188. This second section of the onshore cable corridor runs from the boundary of the North Norfolk WFD catchment (east of Baconsthorpe) for approximately 12km in a southerly direction before crossing into the adjacent Wensum WFD catchment, approximately 1km to the south west of Oulton.

18.2.4.5.2 Historical Flooding

189. To understand the likely risk of flooding to SEP and DEP, a review of historical flood events and their frequency has been undertaken. This review aims to provide an understanding as to the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues, However, it should be noted that the absence of historical flood records does not necessarily confirm that flooding has not occurred.

190. Neither the Environment Agency nor the North Norfolk SFRA has any records to indicate that the onshore cable corridor within the Bure WFD catchment has been previously affected by flooding from any source. The LLFA has not indicated that there have been any recorded flood incidents in close proximity to the onshore cable corridor within this area.

18.2.4.5.3 Flood Zones

191. Whilst the onshore cable corridor is primarily in Flood Zone 1, it intersects two Flood Zone 3 extents within this section (**Figure 18.2.7**):

- Approximately 400m of the onshore cable corridor to the south of Little Barningham, adjacent to Matlaske Road falls within Flood Zone 2 or Flood Zone 3. This flood extent is associated with the watercourse crossing labelled as PRoW003in **Appendix 4.1 Crossing Schedule** (Document reference 6.3.4.1) and shown on **Figure 18.2.2**.
- Approximately 700m of the onshore cable corridor to the east of Saxthorpe falls within Flood Zone 2 or Flood Zone 3, associated with the River Bure, and labelled as RVX001 on **Figure 18.2.2**.

18.2.4.5.4 Flooding from Rivers

192. The onshore cable corridor crosses one Main River and seven Ordinary Watercourses in this section (**Figure 18.2.1** & **Figure 18.2.7**):

- Main River
  - Bure (u/s confluence with Scarrow Beck) (RVX001)
- Ordinary Watercourse
  - PRoW003 (Tributary of the Upper River Bure)

- RDX0018 / RDX019 / UTX019 / WDX001 (x3) (ditches draining towards the River Bure)

193. There is the potential for a fluvial flood risk to the onshore cable corridor during construction associated with these watercourses. The crossing of the River Bure watercourse would be undertaken using trenchless techniques (e.g. HDD). The trenchless crossing will be designed to avoid disturbing the River Bure.

194. Where the onshore cable corridor crosses the Ordinary Watercourses, these will be crossed using trenched techniques in some instances. The risk to the onshore export cables will be mitigated by appropriate construction techniques and in accordance with an appropriate method statement to ensure Health and Safety and Environmental Permitting requirements are satisfied. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

195. The risk of flooding to the onshore cable corridor will be removed upon completion of the cable laying phase, as all infrastructure will be located underground, with the cable, joint bays and link boxes sealed from water ingress.

18.2.4.5.5 Flooding from the Sea

196. The majority of the onshore cable corridor is located away from the coast and as such the risk associated with tidal flooding is limited to the landfall location and the extent of the onshore cable corridor that connects with it. Therefore, there is no risk of flooding from the sea in this location.

18.2.4.5.6 Flooding from Groundwater

197. The onshore cable corridor within the Bure WFD catchment is located over bedrock (Wroxham Crag Formation - Sand and gravel) designated as a Principal Aquifer. Principal Aquifers are considered to provide a high level of water storage (**see Section 18.2.3.2**).

198. The North Norfolk SFRA AStGWf map shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge.

199. The onshore cable corridor is located at variable risk along its route and some parts, generally associated with the valleys of watercourses, are shown to have an increased susceptibility to groundwater flooding, with a number of small $1km^2$ areas showing a >=75% susceptibility to groundwater flooding.

200. The effect the onshore cable corridor shall have on groundwater flows once operational is likely to be Low as the buried cable will be located at a target depth of 1.2m below ground, although this will be subject to localised variations (i.e. limiting interaction to shallow or near surface groundwater).

201. Given the depth of the onshore export cables, it is likely to be constructed within the superficial deposits, and therefore will not be within the principal chalk aquifer. No dewatering of, or discharges into, the Principal Aquifer are anticipated.

202. As the construction works require earthworks in order to place the onshore export cables, it is important to note that perched groundwater may be present below areas of the onshore cable corridor and could be encountered during the below-ground engineering works, including trenchless crossings that may be constructed deeper than 2m to allow for the crossing of infrastructure and watercourses. The risk to the onshore export cables from the perched groundwater, if encountered, would need to be mitigated by appropriate construction techniques. It would also be necessary to ensure there is no creation of a groundwater conveyance route. This mitigation would be in accordance with an appropriate method statement to ensure Health and Safety and Environmental Permitting requirements are satisfied. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

203. Furthermore, any water flowing into the trenches during the construction period will be discharged into local ditches or drains via temporary interceptor drains. This will also be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

204. Based on the above information there is likely to be a Low groundwater flood risk along the onshore cable corridor. However, this risk will be mitigated as outlined above.

18.2.4.5.7 Flooding from Surface Water

205. The Environment Agency's Long-Term Flood Risk Information map (**Figure 18.2.8**) shows this section to be located almost entirely in an area at Very Low risk of surface water flooding i.e. primarily outside the extent of the 1 in 1,000 year surface water flooding event.

206. The areas where the onshore cable corridor crosses the Ordinary Watercourses are identified as having a higher risk of surface water flooding. However, this is primarily limited to the width of the watercourse channel and relates to the lower lying area comprising the channel itself and the land draining into it.

207. Within the Bure WFD catchment, the onshore cable corridor crosses seven Ordinary Watercourses. PRoW003 (**Figure 18.2.2**) is primarily associated with a Low risk of surface water flooding with smaller isolated areas of Medium and High risk. The areas at Medium and High risk are primarily confined to the channel. The Low risk scenario (i.e. 1 in 1,000 year event) could affect land immediately adjacent to the watercourses.

208. The River Bure and associated ditches draining into it (RDX0018 / RDX019 / UTX019 / WDX001 (x3)) generally have a Low risk of flooding which is primarily confined within the banks of the watercourses.

209. Any surface water flood risk to the onshore cable corridor will be temporary in nature and removed once construction is complete as all onshore infrastructure associated with the onshore export cables will be located below ground.

210. The land will be reinstated, and existing ground levels will be maintained. Mitigation during construction is discussed in **Section 18.2.8** in relation to both surface water and Ordinary Watercourses. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

211. The risk of flooding from surface water is therefore considered overall to be Low for this section of the onshore cable corridor.

18.2.4.5.8 Flooding from Sewers

212. Within the North Norfolk SFRA historical incidents of flooding are detailed by Anglian Water through their DG5 register. The DG5 database records incidents of flooding relating to public foul-, combined- or surface water sewers and displays which properties suffered flooding (on a 4-5 postcode digit basis).

213. The North Norfolk SFRA did not report any flooding from sewers within this section of the onshore cable corridor based on the DG5 register for North Norfolk district.

214. The onshore cable corridor is located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of this location. The risk of flooding from sewers is therefore considered to be Low for this section of the onshore cable corridor.

18.2.4.5.9 Flooding from Reservoirs

215. Legislation and definitions relating to flood risk from reservoirs are in **Section 18.2.4.2.9**. The Environment Agency Flood Risk from Reservoirs map shows this section of the onshore cable corridor intersects the reservoir flooding extent.

216. This flood extent is in the vicinity of the Bure and adjacent ditches. However, based on the regulatory requirements associated with reservoirs, the risk of reservoir failure remains Very Low.

18.2.4.5.10 Flooding from Canals and other Artificial Sources

217. The onshore cable corridor is not located near to any canals or other artificial sources within the Bure WFD catchment. As such there is no risk of flooding from these sources.

18.2.4.5.11 Summary of Flooding Sources

218. Overall, this section of the onshore cable corridor is not at risk from tidal / coastal flooding, sewers, canals or other artificial sources.

219. There is a Very Low level of flood risk associated with reservoirs and a Low risk of groundwater flooding.

220. Where this section of the onshore cable corridor crosses the River Bure (Main River) it crosses land that is classed as Flood Zone 2 and Flood Zone 3.

221. The onshore cable corridor also crosses a number of Ordinary Watercourses within the Bure WFD Catchment; however, the risk of surface water flooding is generally Low with areas at higher risk associated with land immediately adjacent to the Ordinary Watercourses.

18.2.4.6 Onshore Cable Corridor Section 3 – Wensum WFD Surface Water Operational Catchment

18.2.4.6.1 Overview

222. This third section runs from the Bure WFD catchment (to the south west of Oulton) to an area east of Colton, where it crosses into the adjacent Yare WFD catchment.

18.2.4.6.2 Historical Flooding

223. To understand the likely risk of flooding to SEP and DEP a review of historical flood events and their frequency has been undertaken. This review aims to provide an understanding as to the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues. However, it should be noted that the absence of historical flood records does not necessarily confirm that flooding has not occurred.

224. Neither the Environment Agency nor the North Norfolk SFRA or Greater Norwich Area SFRA appear to have any records to indicate that the onshore cable corridor within the Wensum WFD catchment has been previously affected by flooding from any source.

225. The LLFA provided historical flood incident records, which included a record of flooding associated with a Norfolk-wide heavy rainfall and flooding event which occurred on 6th October 2019 along the A47 between Easton and Honningham. There is also another recorded flood event (undated) provided by the LLFA, which took place along Marlingford Road, Easton, approximately 742m west from the onshore cable corridor.

18.2.4.6.3 Flood Zones

226. Whilst the onshore cable corridor is primarily in Flood Zone 1, it intersects three Flood Zone 3 extents within this section (**Figure 18.2.9**):

- Approximately 220m of the onshore cable corridor to the east of Swannington falls within Flood Zone 2 or Flood Zone 3. This flood extent is associated with the Trout Stream, which is classified as an IDB-maintained watercourse.
- Approximately 1.1km of the onshore cable corridor, between Morton on the Hill and Attlebridge, which is associated with the River Wensum, two sections of the IDB-maintained watercourse and multiple Ordinary Watercourses, fall within Flood Zone 2 or Flood Zone 3.
- Approximately 200m of the onshore cable corridor, east of Honningham, associated with the River Tud and its tributaries, falls within Flood Zone 2 or Flood Zone 3.

18.2.4.6.4 Flooding from Rivers

227. The onshore cable corridor crosses two Main Rivers, three sections of IDB-maintained watercourses and four Ordinary Watercourses in this section (**Figure 18.2.2**):

- Main River
  - River Wensum (RVX002)
  - River Tud (RVX003)

228. The Ordinary Watercourses within this catchment are small ditches / drains associated with the larger adjacent Main Rivers.

229. There is the potential for a fluvial flood risk to the onshore cable corridor during construction associated with these watercourses. The crossing of the River Wensum and River Tud watercourses would be undertaken using trenchless techniques (e.g. HDD). The trenchless crossing will be designed to avoid disturbing either the River Wensum or the River Tud. In addition, crossing of any of the IDB-maintained watercourses and ordinary watercourses will also be undertaken using trenchless techniques.

230. The risk of flooding to the onshore cable corridor will be removed upon completion of the cable laying phase, as all infrastructure will be located underground, with the cable, joint bays and link boxes sealed from water ingress.

18.2.4.6.5 Flooding from the Sea

231. The majority of the onshore cable corridor is located away from the coast and as such the risk associated with tidal flooding is limited to the landfall location and the extent of the onshore cable corridor that connects with it. Therefore, there is no risk of flooding from the sea in this location.

18.2.4.6.6 Flooding from Groundwater

232. The onshore cable corridor within the Wensum WFD catchment is located over bedrock (Wroxham Crag Formation and Chalk Super Group in the south of the catchment) designated as a Principal Aquifer. Principal Aquifers are considered to provide a high level of water storage (**see Section 18.2.3.2**).

233. The North Norfolk SFRA AStGWf map shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge.

234. The onshore cable corridor is located within variable risk areas along its route and some parts, generally associated with the Main Rivers and adjacent Ordinary Watercourses, are shown to have an increased susceptibility to groundwater flooding, with a number of $1km^2$ areas showing a >=75% susceptibility to groundwater flooding.

235. The effect the onshore cable corridor shall have on groundwater flows once operational is likely to be Low as the buried cable will be located at a target depth of 1.2m below ground, although this will be subject to localised variations (i.e. limiting interaction to shallow or near surface groundwater).

236. Given the depth of the onshore export cables, it is likely to be constructed within the superficial deposits, and therefore will not be within the Principal Aquifer. No dewatering of, or discharges into, the Principal Aquifer are anticipated.

237. As the construction works require earthworks in order to place the onshore export cables, it is important to note that perched groundwater may be present below areas of the onshore cable corridor and could be encountered during the below-ground engineering works, including trenchless crossings that may be constructed deeper than 2m to allow for the crossing of infrastructure and watercourses. The risk to the onshore export cables from the perched groundwater, if encountered, would need to be mitigated by appropriate construction techniques. It would also be necessary to ensure there is no creation of a groundwater conveyance route. This mitigation would be in accordance with an appropriate method statement to ensure Health and Safety and Environmental Permitting requirements are satisfied. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

238. Furthermore, any water flowing into the trenches during the construction period will be discharged into local ditches or drains via temporary interceptor drains. This will also be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

239. Based on the above information there is likely to be a Low groundwater flood risk along the onshore cable corridor. However, this risk will be mitigated as outlined above.

18.2.4.6.7 Flooding from Surface Water

240. The Environment Agency's Long-Term Flood Risk Information map (**Figure 18.2.10**) shows this section of the onshore cable corridor to be located mostly in an area at Very Low risk of surface water flooding i.e. primarily outside the extent of the 1 in 1,000 year surface water flooding event.

241. The areas where the onshore cable corridor crosses the Ordinary Watercourses are identified as having a higher risk of surface water flooding. However, this is primarily limited to the width of the watercourse channel and relates to the lower lying area comprising the channel itself and the land draining into it.

242. Within the Wensum WFD catchment, the onshore cable corridor crosses Main Rivers, IDB-maintained watercourses and a number of Ordinary Watercourses (**Figure 18.2.2**).

243. The Trout Stream, an IDB-maintained watercourse (IDB001), is shown to have a Medium and High risk of flooding. The Medium and High risk scenarios (1 in 100 year and 1 in 30 year, respectively) extend beyond the channel and are shown to primarily impact agricultural land immediately adjacent to the watercourse.

244. The River Wensum (RVX002) generally has a Low risk of flooding and this is primarily confined within the banks of the watercourse.

245. IDB002 (an IDB-maintained watercourse), WDX003 and RDX032 have primarily a Low risk of surface water flooding with smaller isolated areas of Medium and High risk. The Medium and High (1 in 100 year and 1 in 30 year, respectively) scenarios are primarily confined to the channel. The flood extent for the lower occurrence scenarios (1 in 1,000 year event) could affect land immediately adjacent to the watercourse.

246. The River Tud (RVX003) is shown to have a Medium and High risk of flooding. The area shown to be at High risk of flooding extends approximately 100m either side of the River Tud.

247. Any surface water flood risk to the onshore cable corridor will be temporary in nature and removed once construction is complete as all onshore infrastructure associated with the onshore export cables will be located below ground.

248. The land will be reinstated and existing ground levels will be maintained. Mitigation during construction is discussed in **Section 18.2.8** in relation to both surface water and Ordinary Watercourses. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

249. The risk of flooding from surface water is therefore considered to be higher within this catchment compared with sections 1 and 2 of the onshore cable corridor. Whilst the flood risk is generally Low, there are areas at Medium and High risk. This is due to the relatively high number of watercourse crossings that are required in this section of the onshore cable corridor.

18.2.4.6.8 Flooding from IDB-Maintained Watercourses

250. The onshore cable corridor crosses three IDB-maintained watercourses in this catchment (**Figure 18.2.2**):

251. There is a High risk of flooding where the cable corridor intersects the IDB-maintained watercourses; however, this is relatively localised and limited to the location of the crossing. Consultation with the North Norfolk IDB indicates that adopted IDB-maintained watercourses are subject to stricter oversight (including Byelaw 10, no works within 9m) and obstructions within any Ordinary Watercourse within the District (that does not include Main Rivers) are consented by the IDB.

18.2.4.6.9 Flooding from Sewers

252. Within the North Norfolk SFRA and Greater Norwich Area SFRA historical incidents of flooding are detailed by Anglian Water through their DG5 register. The DG5 database records incidents of flooding relating to public foul-, combined- or surface water sewers and displays which properties suffered flooding (on a 4-5 postcode digit basis).

253. Neither SFRA reports any flooding from sewers within this section of the onshore cable corridor based on the DG5 register.

254. The onshore cable corridor is located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of this location. The risk of flooding from sewers is therefore considered to be Low for this section of the onshore cable corridor.

18.2.4.6.10 Flooding from Reservoirs

255. Legislation and definitions relating to flood risk from reservoirs are in **Section 18.2.4.2.9**. The Environment Agency Flood Risk from Reservoirs map shows this section of the onshore cable corridor intersects the reservoir flooding extent.

256. This reservoir flood extent is associated with the Main Rivers of the River Wensum and River Tud (and adjacent ditches / drains), as well as the Trout Stream. However, based on the regulatory requirements associated with reservoirs, the risk of reservoir failure remains Very Low.

18.2.4.6.11 Flooding from Canals and other Artificial Sources

257. The onshore cable corridor is not located near to any canals or other artificial sources within the Wensum WFD catchment. As such there is no risk of flooding from these sources.

18.2.4.6.12 Summary of Flooding Sources

258. Overall, this section of the onshore cable corridor is not at risk from tidal / coastal flooding, sewers, canals or other artificial sources.

259. There is a Low level of flood risk associated with groundwater flooding and a Very Low risk associated with reservoir flooding.

260. Parts of this section of the onshore cable corridor cross two Main Rivers (the River Wensum & the River Tud) and therefore these locations are in either Flood Zone 2 or Flood Zone 3.

261. The onshore cable corridor also crosses multiple Ordinary Watercourses within the Wensum WFD catchment. Whilst the flood risk is generally Low, there are areas at Medium and High risk. This is due to the relatively high number of watercourse crossings that are required in this section of the onshore cable corridor. and therefore, the risk of surface water flooding is generally higher when compared with sections 1 and 2 of the onshore cable corridor.

18.2.4.7 Onshore Cable Corridor Section 4 – Yare WFD Surface Water Operational Catchment

18.2.4.7.1 Overview

262. This fourth section of the onshore cable corridor runs from the Wensum WFD catchment (east of Colton) for approximately 14.5km in a south then easterly direction before reaching the onshore substation study area close to Norwich Main Substation.

18.2.4.7.2 Historical Flooding

263. To understand the likely risk of flooding to SEP and DEP a review of historical flood events and their frequency has been undertaken. This review aims to provide an understanding as to the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues, However, it should be noted that the absence of historical flood records does not necessarily confirm that flooding has not occurred.

264. Neither the Environment Agency nor the North Norfolk SFRA or Greater Norwich Area SFRA appear to have any records to indicate that the onshore cable corridor within the Yare WFD catchment has been previously affected by flooding from any source.

265. The LLFA has provided historical flood incident records which included one record of flooding, identified as part of the South Norfolk Flood Investigation 2013 - 2016, along Marlingford Road, Easton.

18.2.4.7.3 Flood Zones

266. Whilst the onshore cable corridor is primarily in Flood Zone 1 it intersects four Flood Zone 3 extents within this section (**Figure 18.2.11**):

- Approximately 120m of the onshore cable corridor to the west of Marlingford falls within Flood Zone 2 or Flood Zone 3. This flood extent is associated with the River Yare which is classified as a Main River.
- Approximately 370m of the onshore cable corridor, east of Barford, associated with the River Tiffey, is classified as Flood Zone 2 or Flood Zone 3. The River Tiffey has been classified as a Main River.
- Approximately 80m of the onshore cable corridor, east of Ketteringham, associated with an Ordinary Watercourse (WDX016) has been classified as Flood Zone 2 or Flood Zone 3.
- Approximately 200m of the onshore cable corridor, east of Swardeston, associated with the Intwood Stream, falls within Flood Zone 2 or Flood Zone 3.

18.2.4.7.4 Flooding from Rivers

267. The onshore cable corridor crosses three Main Rivers and a number of Ordinary Watercourses in this section (**Figure 18.2.2**):

- Main River
  - River Yare (RVX004)
  - River Tiffey (RVX005)
  - Intwood Stream (RVX006)

268. The Ordinary Watercourses within this catchment comprise a number of ditches / drains. Many of these are located along field boundaries, relate to localised overland flow paths or comprise smaller Ordinary Watercourses (DKX004, DKX005, DKX006, DKX007, DKX008, DKX009, RDX047, RDX049, WDX014, WDX015 and WDX016). However, two of these are associated with the larger adjacent Main Rivers (WDX009 and DKX002).

269. There is the potential for a fluvial flood risk to the onshore cable corridor during construction associated with these watercourses. The crossing of the River Yare, River Tiffey and Intwood Stream watercourses would be undertaken using trenchless techniques (e.g. HDD). The trenchless crossing will be designed to avoid disturbing any of the watercourses.

270. Where the onshore cable corridor crosses the Ordinary Watercourses, these will be crossed using trenched techniques in some instances. The risk to the onshore export cables will be mitigated by appropriate construction techniques and in accordance with an appropriate method statement to ensure Health and Safety and Environmental Permitting requirements are satisfied. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

271. The risk of flooding to the onshore cable corridor will be removed upon completion of the cable laying phase, as all infrastructure will be located underground, with the cable, joint bays and link boxes sealed from water ingress.

18.2.4.7.5 Flooding from the Sea

272. The majority of the onshore cable corridor is located away from the coast and as such the risk associated with tidal flooding is limited to the landfall location and the extent of the onshore cable corridor that connects with it. Therefore, there is no risk of flooding from the sea in this location.

18.2.4.7.6 Flooding from Groundwater

273. The onshore cable corridor within the Yare WFD catchment is located over bedrock (Chalk Super Group) designated as a Principal Aquifer. Principal Aquifers are considered to provide a high level of water storage (**See Section 18.2.3.2**).

274. The North Norfolk SFRA AStGWf map shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge.

275. The onshore cable corridor is located within variable risk areas along its route and some parts, generally associated with the Main Rivers and adjacent Ordinary Watercourses, are shown to have an increased susceptibility to groundwater flooding, with a number of 1km^2 areas showing a >=75% susceptibility to groundwater flooding.

276. The effect the onshore cable corridor shall have on groundwater flows once operational is likely to be Low as the buried cable will be located at a target depth of 1.2m below ground, although this will be subject to localised variations (i.e. limiting interaction to shallow or near surface groundwater).

277. Given the depth of the onshore export cables, it is likely to be constructed within the superficial deposits, and therefore will not be within the principal chalk aquifer at depth. No dewatering of, or discharges into, the Principal Aquifer are anticipated.

278. As the construction works require earthworks in order to place the onshore export cables, it is important to note that perched groundwater may be present below areas of the onshore cable corridor and could be encountered during the below-ground engineering works, including trenchless crossings that may be constructed deeper than 2m to allow for the crossing of infrastructure and watercourses. The risk to the onshore export cables from the perched groundwater, if encountered, would need to be mitigated by appropriate construction techniques. It would also be necessary to ensure there is no creation of a groundwater conveyance route. This mitigation would be in accordance with an appropriate method statement to ensure Health and Safety and Environmental Permitting requirements are satisfied. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

279. Furthermore, any water flowing into the trenches during the construction period will be discharged into local ditches or drains via temporary interceptor drains. This will also be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

280. Based on the above information there is likely to be a Low groundwater flood risk along the onshore cable corridor. However, this risk will be mitigated as outlined above.

18.2.4.7.7 Flooding from Surface Water

281. The Environment Agency's Long-Term Flood Risk Information map (**Figure 18.2.12**) shows this section of the onshore cable corridor to be located primarily in an area at Very Low risk of surface water flooding i.e. primarily outside the extent of the 1 in 1,000 year surface water flooding event.

282. The highest risk of surface water flooding is generally associated with land either side of the Main Rivers at the onshore cable corridor crossing points and relates to the channel itself as well as the adjacent lower lying land which is draining into it.

283. The smaller ditches / drains, identified in **Section 18.2.4.7.4**, generally have a lower risk of flooding, with the Low risk being confined to the channel.

284. The Yare, Tiffey and adjacent Ordinary Watercourses have primarily a Low risk of surface water flooding with some areas of Medium and High risk. The Medium and High (1in 100 year and 1 in 30 year, respectively) scenarios are shown to potentially affect adjacent lower land, although these areas are mainly associated with the floodplain of the watercourses. The flood extent for the lower occurrence scenarios (i.e. 1 in 1,000 year event) could affect land up to 100m either side of the watercourse.

285. The Intwood Stream and associated ditches that intersect the onshore cable corridor primarily have a High risk of flooding associated with them.

286. The smaller ditches / drains, identified in **Section 18.2.4.7.4**, generally have a lower risk of flooding, with the Low risk being confined to the channel.

287. Any surface water flood risk to the onshore cable corridor will be temporary in nature and removed once construction is complete as all onshore infrastructure associated with the onshore cable corridor will be located below ground.

288. The land will be reinstated, and existing ground levels will be maintained. Mitigation during construction in discussed in **Section 18.2.8** in relation to both surface water and Ordinary Watercourses. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

289. The risk of flooding from surface water is therefore considered to be higher within this catchment compared with other sections of the onshore cable corridor. Whilst the flood risk is generally ‘Low, there are areas at Medium and High risk. This is due to the relatively high number of watercourse crossings that are required in this section of the onshore cable corridor and therefore, the risk of surface water flooding is generally higher when compared with sections 1 and 2 of the onshore cable corridor.

18.2.4.7.8 Flooding from Sewers

290. Within the North Norfolk SFRA and Greater Norwich Area SFRA, historical incidents of flooding are detailed by Anglian Water through their DG5 register. The DG5 database records incidents of flooding relating to public foul-, combined- or surface water sewers and displays which properties suffered flooding (on a 4-5 postcode digit basis).

291. Neither SFRA reports any flooding from sewers within this section of the onshore cable corridor based on the DG5 register.

292. The onshore cable corridor is located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of this location. The risk of flooding from sewers is therefore considered to be Low for this section of the onshore cable corridor.

18.2.4.7.9 Flooding from Reservoirs

293. Legislation and definitions relating to flood risk from reservoirs are in **Section 18.2.4.2.9**.

294. The Environment Agency Flood Risk from Reservoirs map shows this section of the onshore cable corridor is not at risk of reservoir flooding.

18.2.4.7.10 Flooding from Canals and other Artificial Sources

295. The onshore cable corridor is not located near to any canals or other artificial sources within the Yare WFD catchment. As such there is no risk of flooding from these sources.

18.2.4.7.11 Summary of Flooding Sources

296. Overall, this section of the onshore cable corridor is not at risk from tidal / coastal flooding, sewers, reservoirs, canals or other artificial sources.

297. There is a Low level of flood risk associated with groundwater flooding.

298. The onshore cable corridor also crosses multiple Ordinary Watercourses within the Yare WFD Catchment. Whilst the flood risk is generally Low, there are areas at Medium and High risk. This is due to the relatively high number of watercourse crossings that are required in this section of the onshore cable corridor and the risk of surface water flooding is therefore generally higher when compared with sections 1 and 2 of the onshore cable corridor.

299. Parts of this section of the onshore cable corridor cross three Main Rivers (River Yare, River Tiffey and Intwood Stream) and therefore these locations are in either Flood Zone 2 or Flood Zone 3.

300. Additionally, for the Main Rivers, the land immediately adjacent is also shown as being at increased risk from surface water flooding.

18.2.4.8 Onshore Substation

18.2.4.8.1 Overview of Proposed Activities

301. The onshore substation site is located in arable land south of the existing Norwich Main substation. The site is located approximately 250m south of Norwich Main, immediately west of the Norwich to Ipswich rail line, and approximately 600m north of the nearest village (Swainsthorpe). It will be of a sufficient size to accommodate the maximum footprint required for both SEP and DEP. **Figure 18.2.13** illustrates the topography of the site.

302. A new permanent operational access will be required to access the onshore substation. This access will share part of the existing access to National Grid's Norwich Main substation. A new section of this existing access will continue south between the Norwich Main site (to the west) and the rail line (to the east). The permanent access road will be 6m wide and designed to provide operation and maintenance access throughout the operational life of the substation.

303. The substation will include:

- Control building(s);
- Transformers;
- Switchgear;
- Shunt reactors;
- Access road – for operation and maintenance access to equipment;
- Adjacent areas for identified landscape screening;
- Drainage and any required flood risk management measures; and
- 400kV buried cable connection to the existing Norwich Main substation.

18.2.4.8.2 Historical Flooding

304. To understand the likely risk of flooding to SEP and DEP, a review of historical flood events and their frequency has been undertaken. This review aims to provide an understanding as to the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues. However, it should be noted that the absence of historical flood records does not necessarily confirm that flooding has not occurred.

305. Neither the Environment Agency nor the Greater Norwich Area SFRA indicate the onshore substation site has been previously affected by flooding from any source.

306. The data provided by the LLFA indicated that there have been two recorded flood events which have taken place in the surrounding area of the proposed onshore substation. The records show that flooding has taken place between 2014 – 2018 at Five Acres, Stoke Holy Cross and at Rectory Lane, Mulbarton in June 2018; however, these are some distance from the DCO order limits and therefore unlikely to be associated with any flooding at the onshore substation site.

18.2.4.8.3 Flood Zones

307. Based on the Flood Map for Planning and information provided by the Environment Agency, the onshore substation site is located in Flood Zone 1 (**Figure 18.2.14**). Therefore, the overall fluvial and tidal flood risk to the onshore substation is considered to be Low.

18.2.4.8.4 Flooding from Rivers

308. The River Tas is located approximately 969m away from the onshore substation site and the Intwood Stream passes approximately 1.9km away from the onshore substation site.

309. However, given that the onshore substation site is located entirely within Flood Zone 1, the risk of flooding from this source is deemed to be Low.

18.2.4.8.5 Flooding from the Sea

310. The onshore substation site is located away from the coast and as such the risk associated with tidal flooding is limited to the landfall location and the extent of the onshore cable corridor that connects with it.

311. Therefore, there is no risk of flooding from the sea in this location and the primary flood mechanisms are likely to be as a result of other flooding sources.

18.2.4.8.6 Flooding from Groundwater

312. The onshore substation site lies within the Broadland Rivers Chalk and Crag WFD Groundwater Body. The Greater Norwich Area SFRA covers the onshore substation site. The data provided within the Greater Norwich Area SFRA demonstrates that the onshore substation site is located in an area with 25% to 50% susceptibility to groundwater flooding.

313. Ground investigations carried out for the onshore substation site, in September 2021, indicated that the groundwater level was relatively deep at the time of the surveys.

314. As part of the ground investigations, groundwater strikes were encountered during the preliminary investigation whilst drilling at a depth of 17.00 –18.00m bgl (9.86 – 9.96m AOD).

315. All exploratory boreholes were installed with groundwater monitoring wells and subsequent groundwater monitoring indicates the monitored levels to be at 16.27 – 17.70m bgl (10.16 –10.69m AOD) in two of the boreholes. Groundwater was not encountered within the remaining exploratory boreholes.

316. Based on the above information there is likely to be a Low groundwater flood risk to the onshore substation site. Furthermore, any minimal risk can be mitigated within the design through landscaping and raising the platform above ground level.

18.2.4.8.7 Flooding from Surface Water

317. The Environment Agency’s Long-Term Flood Risk Information map identified that the original onshore substation site footprint presented within the Preliminary Environmental Information Report (PEIR) would be located within an area showing an overland flow path (**Figure 18.2.15**). In this location there is shown to be a Low to High risk of surface water flooding.

318. The land in this area falls from west to east towards the railway line, which subsequently appears to form a barrier to the overland flow path crossing the fields. This results in the mapping showing a potential area of ponding adjacent to the railway line.

319. No Ordinary Watercourses have been identified as a potential cause of the overland flow pathway and it is most likely that this is the result of topography and surface water runoff from the agricultural areas to the north and west.

320. During consultation with Norfolk County Council, it was noted that flooding in this location had not been previously reported. Furthermore, based on anecdotal historical information from the resident farmer, it was noted that this location had not been subject to flooding or any ponding of water.

321. On this basis, and taking into account the potential risk associated with surface water flooding to the onshore substation site, further investigation and assessment was undertaken to inform this FRA.

322. A hydraulic modelling study was undertaken to determine the potential impact of surface water flooding on the onshore substation site. Further details related to the surface water modelling undertaken to inform the site refinement process are provided in **Annex 18.2.2 Onshore Substation Hydraulic Modelling Technical Note**.

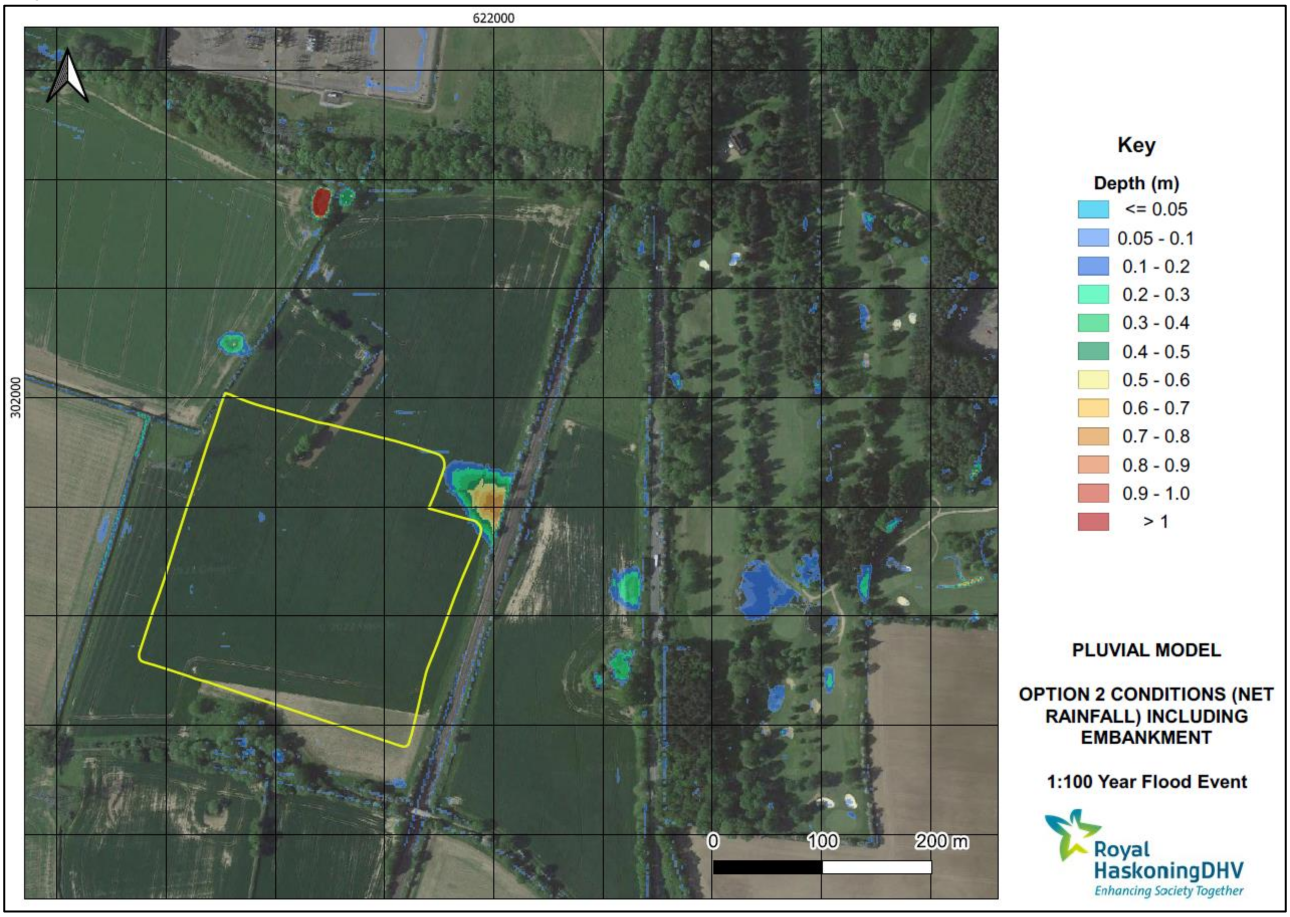
323. A direct rainfall model was built in TUFLOW 2D modelling software and rainfall from a series of return period events was applied to the catchment. The latest rainfall data and LiDAR data were incorporated to ensure the resulting surface water extents were as accurate as possible.

324. The results of this modelling exercise were similar to the Environment Agency's Long-Term Flood Risk surface water mapping; however, the extent was slightly smaller which is considered to be a result of the refinement of the site-specific parameters that were incorporated within the model. Additionally, the modelling exercise provided greater clarity on the likely flood depths in this location as well as the extents for a number of flood risk scenarios.

325. Once the flood extents and depth results had been generated, a number of design iterations relating to the orientation and shape of the onshore substation platform were assessed to determine their potential interaction with the surface water flood risk.

326. Following a number of initial design iterations the results demonstrated that a N-S orientation and W-E orientation for the onshore substation platform could be accommodated within a substation footprint modified from the original PEIR layout with minimal interaction with the potential surface water flood risk (i.e. embedded mitigation), as demonstrated in **Plate 1**, for the 1 in 100 year surface water event.

Plate 1: 1 in 100 Year Extent From the Surface Water Modelling with Onshore Substation Layout



327. By adopting this layout for the onshore substation platform, it was identified this would not only have a minimal impact on the overland flow paths but also aids in protecting the onshore substation platform itself from surface water flooding. As noted above, further details related to the surface water modelling undertaken to inform the site refinement process are provided in **Annex 18.2.2 Onshore Substation Hydraulic Modelling Technical Note**.

328. In addition, it is recommended that any permanent or temporary access routes, welfare and ancillary infrastructure should be located away from the area of increased surface water flood risk near the northern boundary of the site, where reasonably practical, or designed in such a way so as not to interfere with the area at increased flood risk, to ensure the risk of flooding is minimised and flow conveyance is not inhibited.

329. Alteration of ground levels within the overland flow pathway should be avoided, where possible. However, further information relating to ground levels will be obtained as part of more detailed site investigations, which will inform the development of appropriate mitigation measures. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

330. To understand the impact the onshore substation and access road may have on surface water flood risk, and to consider the potential for an increase in off-site flood risk, the onshore substation platform was modelled with the north west access road included.

331. The results of this modelling exercise found that both the surface water flood extent and maximum flood depths are slightly reduced compared with the results from the baseline modelling. This reduction can be attributed to the incorporation of the onshore substation platform in the model. By including the onshore substation platform within the model, rainfall falling on the platform during an event does not contribute to the flooding as it is assumed this will be collected by the surface water drainage system to be implemented as part of SEP and DEP.

332. As such there is a small reduction in surface water flood depth and extent in the area of potential flooding close to the onshore substation platform (see **Section 18.2.8.1.2** for further illustrations). In addition, there is no change in the wider off-site flood risk as the surface water flooding is contained in an area within the onshore substation site.

333. Further mitigation measures related to the access road will be required to ensure the development does not increase surface water runoff or exacerbate the flood risk associated with the overland flow pathway. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17) and **Outline Operational Drainage Plan** (Document reference 9.20).

18.2.4.8.8 Flooding from Sewers

334. The Greater Norwich Area SFRA covers the onshore substation site. It states that historical incidents of flooding have been detailed by Anglian Water in their DG5 register. This database records incidents of flooding relating to public foul-, combined- or surface water sewers and identifies which properties suffered flooding. A total of 264 recorded flood incidents have been identified in the Greater Norwich Area. The postcode or location of these sewer flood incidents is not stated in the SFRA and therefore it is not possible to ascertain if these would have affected the onshore substation site.

335. However, given that the onshore substation site is located within existing agricultural land with a limited foul sewer network within proximity, the risk of flooding from sewers is considered to be Low.

18.2.4.8.9 Flooding from Reservoirs

336. Legislation and definitions relating to flood risk from reservoirs are in **Section 18.2.4.2.9**.

337. The Environment Agency Flood Risk from Reservoirs map shows that the onshore substation site is not at risk of reservoir flooding.

18.2.4.8.10 Flooding from Canals and other Artificial Sources

338. The onshore substation site is not located near to any canals or other artificial sources. As such there is no risk of flooding from these sources.

18.2.4.8.11 Summary of Flooding Sources

339. Overall, the onshore substation site is not at risk from tidal / coastal flooding, river flooding, groundwater, sewers, reservoirs, canals or other artificial sources.

340. The onshore substation site is considered to be at varying risk from surface water. Whilst the wider onshore substation site is primarily at Low risk of surface water flooding there is a key area at Medium to High risk of surface water flooding as a result of an overland flow path crossing the site and ponding close to the railway embankment. Mitigation measures will be required to ensure this will not pose a risk to the onshore substation either during construction or post-development. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17) and **Outline Operational Drainage Plan** (Document reference 9.20).

18.2.4.9 Temporary Works – Construction Compounds

18.2.4.9.1 Overview of Proposed Activities

341. There are a series of temporary construction compounds which will be located at key locations along the onshore cable corridor (illustrated in Chapter 4 on **Figure 4.10**). These are required to support the proposed works which will take place on land. They will house portable offices and welfare facilities, as well as acting as staging posts for localised secure storage for equipment and component deliveries. There will be 9 compounds located along the cable corridor (from the landfall site to the onshore substation site). In addition, there will be two further construction compounds, with one located at the landfall and one at the onshore substation site. All 11 construction compounds have been considered in the following section.

18.2.4.9.2 Flood Zones and Surface Water Flood Risk

342. The first compound will be located at the landfall site and will be situated in proximity to Weybourne coastline. This compound is shown as being partially located in Flood Zone 2 and 3. In the event of a tidal flood being forecast, mitigation measures will need to be put in place to ensure that materials remain confined to the compound and portable offices, welfare facilities and storage are secured, to prevent and minimise damages from flood waters. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

343. This compound is primarily at Very Low risk from surface water flooding with a very small area to the eastern edge of the compound potentially at risk during the 1 in 1,000 year (0.1%) event.

344. The 2nd compound will be located to the south side of the A148, to the north of Bodham. This compound is located in Flood Zone 1 i.e. Low risk of fluvial flooding. This location is also at Very Low risk from surface water flooding.

345. The 3rd compound is located between Plumstead and Matlaske. This compound will be located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk from surface water flooding.

346. The 4th compound is located next to Blickling Road, approximately 1.8km to the east of Saxthorpe. This compound will be located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk from surface water flooding.

347. The 5th compound is located adjacent to the B1149, approximately 1.6km southeast from Oulton. This compound is located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk from surface water flooding.

348. The 6th compound will be located approximately 1.5km to the south of Cawston, to the north of Reepham Road. It is located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk from surface water flooding.

349. The 7th compound is located next to Old Fakenham Road and the A1067, to the south east of Attlebridge. This compound is located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk from surface water flooding.

350. The 8th compound is located adjacent to Church Lane, approximately 1km southwest of Easton. It is located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk from surface water flooding.

351. The 9th compound is located approximately 0.8km north of the A11 and is situated to the south side of Ketts Oak (B1172). It is located in Flood Zone 1 i.e. Low risk of fluvial flooding and is primarily at Very Low risk from surface water flooding. There is a small area in the centre of the area proposed for the compound which could be at risk from surface water flooding during the 1 in 1,000 (0.1%) year event (i.e. likely to be at Low risk of flooding); however, this appears to comprise an area of ponding likely to be linked to a topographically low point and therefore does not represent an inherent source of flood risk either to the compound or the wider area.

352. The 10th compound is located next to Hethersett Road approximately 1.2 km north of East Carleton. This compound will be located in Flood Zone 1 i.e. Low risk of fluvial flooding and is also at Very Low risk of surface water flooding.

353. The 11th compound is situated within the onshore substation area and will be located in Flood Zone 1. However, it is shown to be at risk from surface water flooding based on the Environment Agency Long Term Flood Risk mapping for surface water flooding. A comparison of the proposed location of this compound has been carried out with the results of the surface water modelling undertaken for this FRA, as set out in **Section 18.2.4.8.7**. The compound appears to be located outside the 1 in 100 (1%) year surface water flood extent and therefore is considered to be at Low risk from surface water flooding. However, any requirements for extra mitigation measures will be reviewed during the design of the compound to ensure the safety of users and to minimise any damage during construction. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

354. Overall, 10 of the 11 compounds are located in Flood Zone 1 and are therefore at Very Low risk from flooding. The compound situated at the landfall site is located partly in Flood Zone 2 and 3. This compound is likely to require extra mitigation measures to ensure safety and minimise damage should there be a tidal flood event forecast.

355. All of the compounds are considered to be at either Low risk or Very Low risk from surface water flooding.

18.2.4.9.3 Historical Flooding

356. To understand the likely risk of flooding to SEP and DEP a review of historical flood events and their frequency has been undertaken. This review aims to provide an understanding as to the context of flooding in the onshore study area, identifying areas of focus where there are likely to be flooding issues.

357. Data provided by the LLFA indicates that none of the proposed locations for the compounds has been affected by flooding in the past. Absence of historical flood records does not necessarily confirm that flooding has not occurred; however, the relatively rural location of each of the compounds is such that flooding is unlikely to have affected the proposed locations.

18.2.4.9.4 Flooding from Groundwater

358. The North Norfolk SFRA AStGWf map shows the proportion of each 1km grid square where geological and hydrogeological conditions indicate that groundwater might emerge. Compounds situated north of Bodham and east of Plumstead, , are generally not within an area identified to be at risk.

359. The compounds situated in the Bure WFD Surface Water Operational Catchment, Wensum WFD Surface Water Operational Catchment and the Yare WFD Surface Water Operational Catchment, are located in areas at variable risk along the cable corridor and some parts, generally associated with the valleys of watercourses, are shown to have an increased susceptibility to groundwater flooding, with a number of small $1km^2$ areas showing a >=75% susceptibility to groundwater flooding.

360. The compounds are temporary structures that will only remain whilst construction is taking place. As such it is considered that the risk of groundwater flooding is Low.

18.2.4.9.5 Flooding from Sewers

361. Within the North Norfolk SFRA and Greater Norwich Area SFRA historical incidents of flooding are detailed by Anglian Water through their DG5 register. The DG5 database records incidents of flooding relating to public foul-, combined- or surface water sewers and displays which properties suffered flooding (on a 4-5 postcode digit basis).

362. Neither SFRA indicates there are any reports of flooding from sewers within the locations of the compounds based on the DG5 register.

363. The compounds will be located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of their locations. The risk of flooding from sewers is therefore considered to be Low for the compounds.

18.2.4.9.6 Flooding From Reservoirs

364. Legislation and definitions relating to flood risk from reservoirs are in **Section 18.2.4.2.9**. The Environment Agency Flood Risk from Reservoirs map indicates the compounds are not at risk of reservoir flooding.

18.2.4.9.7 Flooding from Canals and other Artificial Sources

365. The compounds are not near to any canals or other artificial sources and as such there is no risk of flooding from these sources.

18.2.4.9.8 Summary of Flooding Sources

366. Overall, the construction compounds located along the onshore cable corridor are not considered to be at risk from tidal / coastal flooding, fluvial flooding (from Main Rivers), sewers, reservoirs, canals or other artificial sources.

367. The compound located at the landfall is primarily in Flood Zone 1 (i.e. Low risk of flooding); however there is a risk of coastal / tidal flooding to a small area to the eastern edge of the compound, which is located in either Flood Zone 2 (Medium risk) or Flood Zone 3 (High risk).

368. Additionally, a number of the compounds are identified as being at Low risk from groundwater flooding. However, as the compounds are temporary in nature, will only be required during the construction phase of the project and will not require below-ground construction works, the risk is not considered to be significant.

18.2.5 Consideration of the Sequential Test and Exception Test

369. As noted in **Section 18.2.2.2**, NPPF requires the application of the Sequential Test and, where necessary, the Exception Test. Guidance on the application of the Sequential Test is currently provided in the supporting NPPF PPG, which provides criteria in relation to fluvial and tidal flood risk and their relevant flood zones.

370. The aim of the Sequential Test is to ensure that a sequential approach is adopted to steer new development to areas with the lowest probability of flooding, i.e. Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the local authority can consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites for development in Flood Zone 1 or 2, should the suitability of sites in Flood Zone 3 be considered.

371. It also noted that if it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the Exception Test may have to be applied. The need for the Exception Test depends on the potential vulnerability of the site and the development proposed, based on the Flood Risk Vulnerability Classification, as summarised in **Table 18.2.4**.

372. The NPPF notes that the application of the Exception Test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage.

373. It also provides guidance on the criteria required to pass the Exception Test, where it is necessary to demonstrate that:

- the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

- the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

374. The NPPF clarifies that both elements of the Exception Test should be satisfied for development to be allocated or permitted.

375. Furthermore, the NPPF provides clarification that all strategic policies / plans should apply a sequential, risk-based approach to the location of development taking into account all sources of flood risk. It also provides guidance on how this is to be considered in the context of the location of site-specific development.

376. As noted above, the NPPF and the supporting NPPF PPG provides guidance on suitable development types within each Flood Zone, as identified in **Table 18.2.4**, which has been considered for SEP and DEP.

Table 18.2.4: Flood Zone and Vulnerability Classification Compatibility

Flood Zone	Flood Risk Vulnerability Classification				
1	✓	✓	✓	✓	✓
2	✓	Exception Test required	✓	✓	✓
3a	Exception Test required	×	Exception Test required	✓	✓
3b	Exception Test required	×	×	×	✓

377. In terms of SEP and DEP, and based on the guidance in the NPPF PPG, the works are classed as ‘Essential Infrastructure’ which is defined as:

- Essential transport infrastructure (including mass evacuation routes), which must cross the area at risk;
- Essential utility infrastructure which must be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood; and
- Wind turbines.

378. SEP and DEP is partially located within Flood Zones 1, 2 and 3, as defined by the Environment Agency’s online Flood Map for Planning (Environment Agency, undated) and therefore, the Sequential Test has been considered in accordance with the NPPF PPG.

379. Development classed as 'Essential Infrastructure' is considered acceptable in Flood Zones 1 and 2, whilst development located within Flood Zone 3 is required to pass the Exception Test, as shown in **Table 18.2.4**.

380. Principally the works for SEP and DEP are to be located in Flood Zone 1, including the majority of the onshore cable corridor and the onshore substation. Permanent above-ground structures are to be located within Flood Zone 1. Subterranean development is also located primarily in Flood Zone 1, with some locations in Flood Zone 2 and 3 where it is required to pass under, or in proximity to, existing watercourses.

381. Due to the large-scale nature of the works, it is acknowledged that there are locations where infrastructure is required to pass through or be located in Flood Zone 3. This relates to the area of the onshore cable corridor adjacent to the landfall location and key locations along the onshore cable corridor (associated with the need to cross existing watercourses). These are the elements of SEP and DEP which need to be subject to the consideration of the Exception Test.

382. Subterranean development will only be at potential risk of flooding during the construction phase. Once operational, the flood risk to the onshore cable corridor will have been removed as the transition joint bays, cables and link boxes will be wholly located underground, with the latter sealed through a watertight manhole cover with no interaction with the above-ground Flood Zones.

383. Taking into account the two parts of the Exception Test, it is concluded that the first part comprising the provision of wider sustainability benefits to the community has been passed on the basis that SEP and DEP, as a nationally significant infrastructure project, is providing energy certainty utilising a sustainable source of energy at a national scale.

384. With regard to the second part of the Exception Test, it is necessary to consider the project in the context of its scale and that the majority of SEP and DEP is not located at flood risk. Those elements that are likely to pass through areas at increased risk of flooding, i.e. Flood Zone 3, comprise the subterranean development which, following construction, will not be vulnerable to flood risk during its operational lifetime and will not increase flood risk elsewhere. Only during construction is there the potential for a temporary increase in flood risk and this will be mitigated through the use of appropriate management measures which will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

385. On this basis, it is concluded that SEP and DEP has been appropriately sequentially located in accordance with the guidance set out in the NPPF PPG with regard to the application of the Sequential Test.

386. With regard to the guidance in NPPF that all sources of flooding should be considered alongside the requirement to apply a sequential approach, it is noted that the current NPPF PPG does not provide guidance in relation to the criteria for the application of the Sequential Test for these sources. However, on the basis of the potential surface water flood risk at the onshore substation site and to ensure a robust assessment of flood risk, an iterative approach has been adopted to the design of the onshore substation, as set out in **Annex 18.2.2 Onshore Substation Hydraulic Modelling Technical Note**. This is to minimise its interaction with the potential surface water flood risk in this location, as set out in **Section 18.2.4.8**. Given that flood risk from all other sources of flooding is Low no further assessment of other potential flood risk sources is required.

387. However, this assessment concludes that the sequential approach has been adopted in the location of key elements of the infrastructure, wherever possible. Furthermore, those elements that require the application of the Exception Test have demonstrated that SEP and DEP provide wider sustainability benefits to the community associated with the provision of renewable energy, and that it would be safe for its lifetime without increasing flood risk elsewhere.

18.2.6 Climate Change

388. In the future, the risk of flooding from all potential sources of flood risk are likely to be amplified as a result of the predicted changes associated with climate change. Given the potential sources of flooding identified in this FRA, there are two main aspects of climate change which are likely to impact SEP and DEP, both in terms of flood risk to infrastructure as well as increasing the potential for there to be an off-site impact on other receptors. These factors comprise an increase in peak river flows and an increase in the duration and intensity of rainfall events, which is likely to increase the magnitude of surface water flooding. For other sources of flood risk there is unlikely to be an impact due to future climate change either to the SEP and DEP infrastructure or as a result of it.

389. The climate change allowance related to peak river flow and fluvial flooding is only likely to be relevant to the onshore substation site, as all other elements of SEP and DEP will be below ground once constructed.

390. Given the onshore substation site is currently located within Flood Zone 1 and at least 1.2km from the nearest Main River, the increased fluvial flooding relating to climate change is unlikely to affect the onshore substation site, especially given the elevated nature of the intervening ground. This is the only onshore infrastructure that will not be located below ground following construction. Therefore, the effects of climate change on fluvial sources will not impact SEP and DEP onshore infrastructure.

391. When considering surface water flood risk, the Norfolk LLFA Statutory Consultee Guidance Document (Version 4, updated 2021) requires an assessment of the lifetime of the development, the vulnerability of the proposed land use and a justification related to the choice of allowance.

392. Further to the above guidance the Environment Agency has issued updated climate change allowance guidance, specifically with regard to the application of peak rainfall allowances (Environment Agency, 2022).

393. The surface water climate change allowances are determined by the predicted increase in peak rainfall intensity. These are determined by regional variations, based on management catchments, which are sub-catchments of river basin districts. The SEP and DEP onshore study area is primarily located in the Broadland Rivers Management Catchment, with the landfall and northern part of the onshore cable corridor located in the North Norfolk Rivers Management Catchment.

394. As the only permanent above-ground onshore infrastructure is to be located at the onshore substation site, this is within the Broadland Rivers Management Catchment and therefore the allowances for this Management Catchment have been considered further within this FRA.

395. The Environment Agency guidance setting out the appropriate climate change allowances to be adopted for different development lifetimes (Environment Agency, 2022) is summarised below:

- Development with a lifetime beyond 2100:
  - This includes development proposed in applications or local plan allocations.
  - For flood risk assessments and strategic flood risk assessments assess the upper end allowances. You must do this for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125).
  - Design your development so that for the upper end allowance in the 1% annual exceedance probability event.
  - There is no increase in flood risk elsewhere your development will be safe from surface water flooding.
- Development with a lifetime of between 2061 and 2100:
  - For development with a lifetime between 2061 and 2100 take the same approach (as for a development with a lifetime beyond 2100) but use the central allowance for the 2070s epoch (2061 to 2125).

396. As noted above, the onshore substation site is situated in the Broadland Rivers Management Catchment.

Table 18.2.5: Peak Rainfall Intensity Allowance for the Broadland Rivers Management Catchment

Broadland Rivers Management Catchment	Central 1 in 30 year (3.3%)	Upper end 1 in 30 year (3.3%)	Central 1 in 100 year (1%)	Upper end 1 in 100 year (1%)
2050s	20%	40%	20%	45%
2070s	20%	40%	20%	40%

397. On the basis of the above guidance, assuming 40 years of operation, with commencement of operation in 2028 the required allowance is an increase of 20% for the 1 in 100 (1%) year event applying the central allowance (**Table 18.2.5**). In addition, sensitivity testing has been undertaken for the 1 in 100 year plus 40% allowance for climate change.

398. The 1 in 100 year plus 20% for climate change allowance will be accommodated, as a minimum, within the drainage design by increasing peak rainfall in hydraulic calculations and providing appropriate on-site attenuation and storage, in accordance with the Norfolk LLFA Statutory Consultee Guidance Document (Version 4, March 2019). This will be secured within the **Outline Operational Drainage Plan** (Document reference 9.20).

399. The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is more uncertain. Milder, wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months. Ongoing groundwater monitoring is being undertaken to understand seasonal variation; however, given the information obtained to date on the existing groundwater levels i.e. Low risk, it is considered that the onshore substation site is unlikely to be affected by future changes in groundwater flooding.

18.2.7 Surface Water Drainage

18.2.7.1.1 Onshore Infrastructure Pre-Construction Work

400. Prior to commencement of the construction works, detailed drainage surveys will be undertaken to support the development of the detailed drainage design for all elements of the onshore infrastructure.

401. The drainage infrastructure will be developed and agreed with the appropriate regulators, where relevant, and implemented to minimise water within the working areas, ensure ongoing drainage of surrounding land and that there is no increase in surface water flood risk.

402. This will assess the current and proposed runoff rates, volume of storage required and the proposed approach for discharge of water from the site.

403. Norfolk LLFA Statutory Consultee Guidance Document (Version 4, updated 2021) notes that the Environment Agency has classified the majority of Norfolk's Main River channels and surface waterbodies as having a high sensitivity rating, e.g. SSSI or salmonid fish stretches. This assessment is based on the species and habitats found in these systems with the rating given as an indication of the surface water bodies susceptibility to change. The sensitivity of these watercourses is likely to extend to all of the connecting tributaries and Ordinary Watercourses which flow into these river channels and surface waterbodies.

404. Additionally, Norfolk has many Principal Aquifers and groundwater drinking water source protection zones which would also be classed as a 'sensitive' protective resource. SEP and DEP will need to confirm if there is a significant amount of secondary superficial aquifer above the Principal Aquifer to provide protection and not be classed as 'sensitive'. Any mitigation measures that are required during the construction of SEP and DEP will need to take into account the above factors when designing the construction drainage. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

405. A specialised drainage contractor will undertake surveys, locate drains, and create drawings pre- and post-construction, to ensure appropriate reinstatement. Construction drainage will include provisions to minimise flood risk within the working area and ensure ongoing drainage of surrounding land.

18.2.7.1.2 Landfall Location and Onshore Cable Corridor Surface Water Drainage

406. The landfall location and onshore cable corridor will only be at risk of surface water flooding during construction. However, during the construction phase and once operational, there is a risk that drainage ditches and surface water flow routes could be adversely affected should the works not be appropriately managed and the ground reinstatement not carefully managed.

407. SEP and DEP would use trenchless crossing techniques at key watercourse crossing locations, including all Main Rivers and IDB-maintained watercourses. In these locations the use of trenchless techniques will be confirmed and agreed with the regulators to ensure they are located a sufficient distance below the bed of the channel and therefore there will be no impact on flood risk as all proposed elements will be located below ground.

408. It is, however, likely that trenched crossings will be carried out on Ordinary Watercourses crossed by the onshore cable corridor. This method has the potential to directly alter the geomorphology, hydrology and physical habitat value of the watercourses. Trenched crossings involve installing temporary dams (composed of sand bags, straw bales and ditching clay, or another suitable technique) upstream and downstream of the crossing point. The cable trench is then excavated in the dry area of river bed between the two dams with the river flow maintained using a temporary pump or flume.

409. There is the potential for the installation techniques to affect the bed and banks of the watercourse, which could result in an impact on flows along the watercourse and indirectly a change in flood risk, which will need to be managed during construction.

410. At these locations, a site-specific investigation will be carried out at detailed design stage to identify the local ground and groundwater conditions, enable a site-specific hydrogeological risk assessment to be undertaken and to understand the potential impact of any works on flows along the watercourse and flood risk in the local area.

411. It will be necessary to install additional field drainage parallel to the cable trenches along the onshore cable corridor to ensure the existing drainage characteristics of the land are maintained and there is no increase in flood risk to on- and off-site receptors during and after construction. All temporary drainage would pass through a silt interceptor before being discharged.

412. The detailed methodology to be used for any temporary construction at crossing points over existing ditches and watercourses shall be agreed with the Environment Agency, Local Authority and / or IDB. To manage this ahead of the main works, the Principal Contractor will develop the construction drainage in consultation with the landowner and other statutory stakeholders.

18.2.7.1.3 Onshore Cable Corridor Post-Construction

413. Following construction of the landfall and onshore export cables there will be no permanent above ground elements.. Furthermore, all temporary logistics compounds and temporary access tracks will be fully reinstated and would have no operational use.

414. Existing land drains along the onshore cable corridor will be reinstated with at least the same capacity as the pre-construction channel to prevent any potential impacts on flood risk, this will be based on the information obtained during the pre-construction survey.

415. The backfilling of material, within both construction drainage channels and along the onshore cable corridor itself, will prevent a conduit from forming and ensure there are no changes to the local flow rates due to permeability changes.

18.2.7.1.4 Onshore Substation Surface Water Drainage

416. During the development of this FRA there has been consultation with both the Environment Agency and Norfolk County Council with regard to the proposed methods that are available and suitable for the discharge of surface water from the onshore substation site. This was also considered within the context of the surface water flood risk at the onshore substation site and the need to ensure that the drainage solutions did not result in an increase in flood risk either to the SEP and DEP infrastructure or as a result of SEP and DEP.

417. Surface water drainage requirements will be designed to meet the requirements of the NPPF, NPS EN-1and the Construction Industry Research and Information Association (CIRIA) SuDS Manual C753 (CIRIA, 2015), with runoff limited where feasible through the use of infiltration techniques within the DCO order limits.

418. Drainage options have been considered within the context of the principles of the SuDS hierarchy and the aim has been to discharge surface water runoff as high up the hierarchy of drainage options as reasonably practicable. A summary of the SuDS hierarchy is provided as follows:

   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.

419. During evaluation of the SuDS hierarchy and potential surface water drainage options for the onshore substation site, it was identified that there are significant constraints related to their applicability. These constraints and the associated justification for moving down the SuDS hierarchy are documented within **Annex 18.2.1 Onshore Substation Drainage Study** (Document reference 6.3.18.2.1).

420. In addition, the initial details of the drainage design for the options identified in the **Annex 18.2.1 Onshore Substation Drainage Study** (Document reference 6.3.18.2.1) are set out within the **Outline Operational Drainage Plan** (Document reference 9.20).

421. The **Outline Operational Drainage Plan** (Document reference 9.20) confirms that sufficient storage will be provided to attenuate surface water and discharge at a controlled rate during surface water events. The volume and final location of the attenuation features will be confirmed, in accordance with the above guidance, during the development of the detailed design.

422. The onshore substation will include an operational access route connecting the existing access road at Norwich Main to the northern side of the SEP and DEP onshore substation platform. The access route will be designed such that surface water drainage from the access road is incorporated into the wider drainage design. Furthermore, it will be designed to ensure that any surface water / overland flow path that it needs to cross will continue to pass below the access road to limit the displacement of surface water flooding in the area.

423. As part of the assessment undertaken to date, the scope for using infiltration as the primary option for the surface water drainage continues to be investigated. Initial results from the soakaway testing indicated relatively poor infiltration capacity. However, the geophysical surveys and supplementary ground investigation has found there may be areas of the onshore substation site with relatively good infiltration capacity and these locations are subject to further ongoing investigation.

424. There are no surface water bodies in proximity to the onshore substation site or other surface water drainage systems that are suitable locations for the discharge of surface water drainage from the onshore substation.

425. As such, two options for surface water drainage from the onshore substation have been progressed. These two options comprise either the use of appropriate infiltration measures (subject to ongoing investigation with regards to the potential for infiltration to be adopted) or the connection of the surface water drainage into the Anglian Water foul sewer to the south of the onshore substation site. It is acknowledged that these are not preferred options in the context of the SuDS hierarchy; however, following discussions with the Environment Agency, Norfolk County Council and Anglian Water it has been acknowledged by all parties that surface water drainage from the site is constrained.

426. As further information becomes available, the operational drainage at the onshore substation will continue to be developed in consultation with Norfolk County Council (as the LLFA), the Environment Agency and other stakeholders and implemented to ensure the existing runoff rates to the surrounding water environment are maintained at pre-development rates. This process will also confirm the greenfield runoff rate, proposed runoff rates, volume of storage required and the final proposed approach for discharge of water from the site.

427. The Norfolk LLFA Statutory Consultee Guidance Document (Version 4, March 2019) requires the management and maintenance of SuDS to appropriately account for the construction, operation, and maintenance requirements of all components of the drainage system (surface and sub-surface).

428. The operational drainage at the substation will consider the likely maintenance requirements of new and existing infrastructure. It is important that maintenance is also considered in the design of the drainage system and the development site to account for the requirements of undertaking maintenance work such as ease of access for personnel, vehicles or machinery. A management and maintenance plan of any proposed surface water drainage infrastructure will be agreed with relevant stakeholders then adopted for the lifetime of the development.

18.2.7.1.5 Temporary Compounds Surface Water Drainage

429. The implementation of construction compounds may increase surface water run off temporarily due to an increase in impermeable area during the construction phase. However, this can be managed through the implementation of trenches to collect rainfall and enable either infiltration to occur or discharge to a nearby ditch or watercourse. The collection and discharge of the water can be dictated by the topography of the land to allow for the surface runoff to flow into trenches to be implemented during the construction of the onshore cable corridor.

430. The compounds will only be at risk of surface water flooding during construction as reinstatement will be carefully managed'. Furthermore, the drainage systems serving the compounds will require management and maintenance whilst in use.

431. A total of 9 compounds will be situated at various locations along the onshore cable corridor during the construction works, plus two further compounds, one at the landfall and one at the onshore substation site. All of these will be removed once the work is completed. Upon completion, the compounds and any associated temporary access tracks will be fully reinstated and would have no operational use.

18.2.8 Flood Risk Mitigation Measures

432. Residual risk is the risk that remains after flood management or mitigation measures have been installed. This FRA has considered the residual flood risk and whether there is a need for any measures to manage the residual flood risk.

18.2.8.1.1 Onshore Cable Corridor Design Mitigation

433. As previously noted, the onshore study area is primarily located within Flood Zone 1, i.e. outside of Flood Zones 2 and 3, in areas at Low risk of flooding from fluvial or tidal sources. The sequential approach has been adopted in regard to the location of above-ground structures with infrastructure being located in Flood Zone 1, where possible.

434. At the landfall location, where the works have the potential to affect the tidal / coastal flood risk, SEP and DEP propose carrying out the landfall works using trenchless techniques.

435. It is, however, likely that trenched crossings will be carried out on Ordinary Watercourses crossed by the onshore cable corridor.

436. At these locations, a site-specific investigation will be carried out at detailed design stage, to identify the local ground and groundwater conditions, enable a site-specific hydrogeological risk assessment to be undertaken and to understand the potential impact of any works on flows along the watercourse and flood risk in the local area.

437. During construction, the onshore cable corridor will be designed such that it will be bounded by parallel drainage channels (one on each side) to intercept drainage within the working width. Additional drainage channels will be installed to intercept water from the cable trench. This will be discharged at a controlled rate into local ditches or drains via temporary interceptor drains. Depending upon the precise location, water from the channels will be infiltrated or discharged into the drainage network.

438. Trenchless crossings have been embedded in the scheme design for crossing Main Rivers and IDB-maintained watercourses. The cable will be installed at least 2m below the water body and, although ground disturbance will occur at entry and exit points, there will be no direct impact on the watercourses themselves.

439. Where temporary or permanent access tracks are required to cross an existing watercourse there is an increased risk of flooding (i.e. partially crossing the Flood Zone 3 extent). In this location the design will include appropriately sized crossings over the watercourse and retain existing ground elevations, wherever possible, to ensure continued floodplain capacity and / or flow conveyance.

440. Following construction of the landfall and onshore export cables there will be no permanent above ground elements. Additionally, it is proposed that drainage will be reinstated to match the existing baseline condition. As such there would be no impact on surface water drainage. Furthermore, all temporary logistics compounds and temporary access tracks will be fully reinstated and would have no operational use.

18.2.8.1.2 Onshore Substation Design Mitigation

441. As noted above, a number of design iterations have been undertaken, following consultation with Norfolk County Council, as the LLFA, to minimise the interaction between the onshore substation and the potential surface water flood risk.

442. As part of the design iteration, the current onshore substation layout allows for the provision of either a W-E orientation or N-S orientation within the current footprint. This has been amended and designed such that it is located away from the surface water overland flow routes, where possible. The onshore substation platform includes sloped sides / embankments which have also been considered within the context of the results of the surface water modelling.

443. The flood extents for the 1 in 100 year plus 20% for climate change and 1 in 100 year plus 40% for climate change events have been overlaid with the layout of the onshore substation platform, as shown in

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447. Plate 2 and **Plate 3,** respectively. This has confirmed that there is minimal interaction with the surface water flood extent up to and including the 1 in 100 year plus 40% for climate change event.

Plate 2: 1 in 100 Year Plus 20% for Climate Change Extent in Comparison with the Onshore Substation Layout

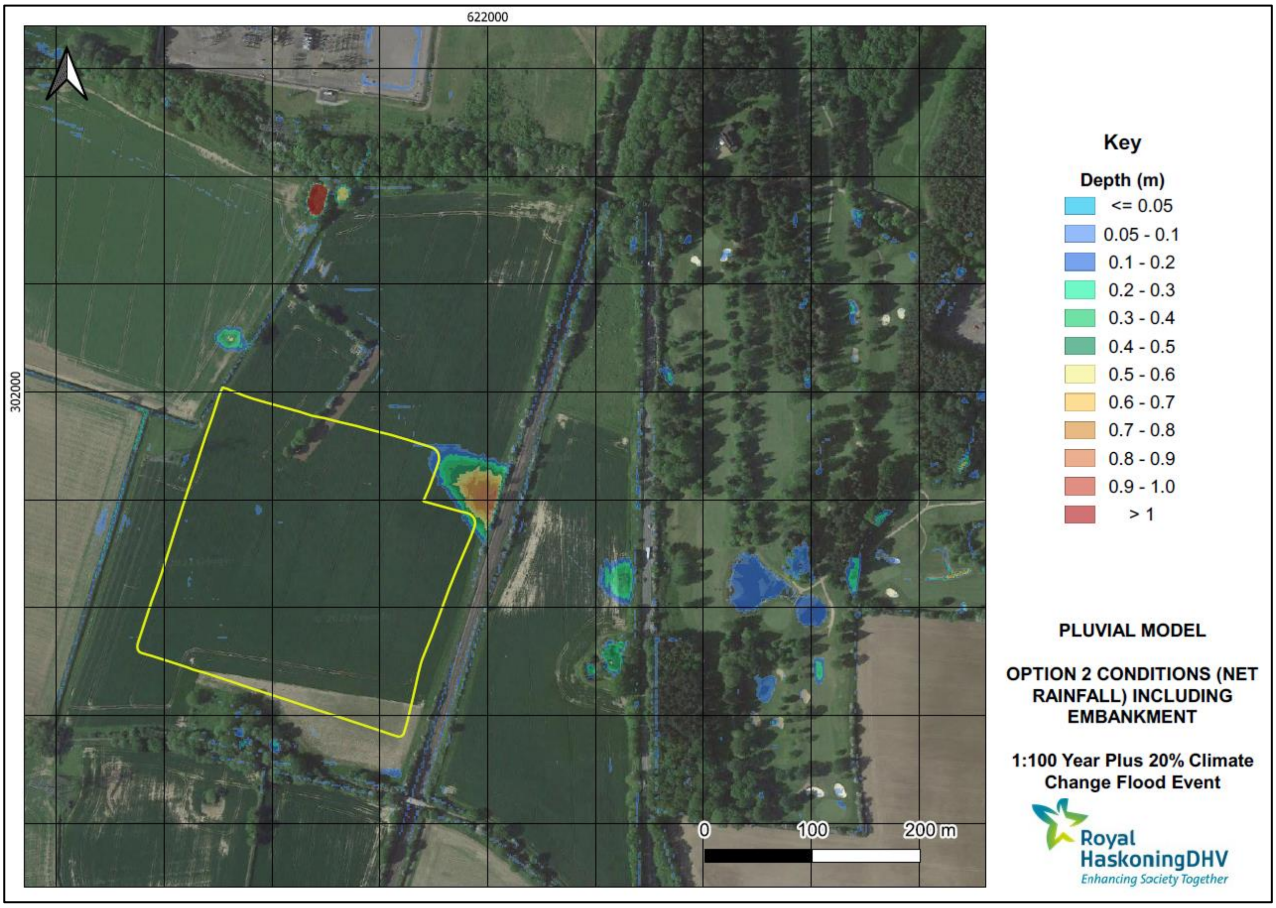
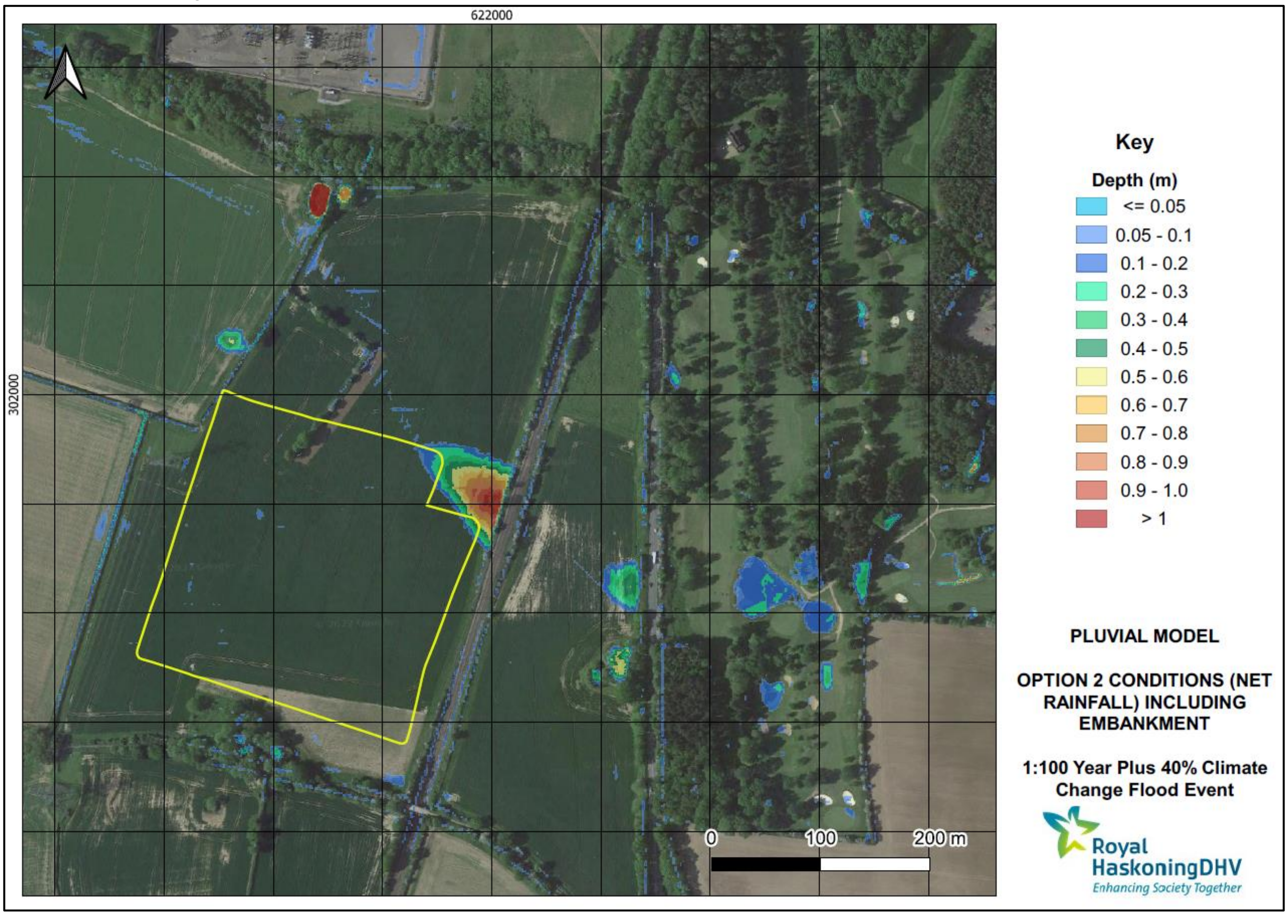


Plate 3: 1 in 100 Year Plus 40% for Climate Change Extent in Comparison with the Onshore Substation Layout



448. The alteration of ground levels within the overland flow pathway will be avoided, where possible, and the platform design has been developed to avoid the low-lying area where surface water may pond.

449. There is the potential for the construction of the onshore substation and associated infrastructure to result in the addition of low permeability surfacing, increasing the rate of surface water runoff from the site without appropriate mitigation.

450. As previously noted, the operational drainage will be developed and agreed in consultation with Norfolk County Council, as the LLFA, the Environment Agency and other stakeholders and implemented to ensure the existing runoff rates to the surrounding water environment are maintained at pre-development rates. This will assess the greenfield runoff rate, proposed runoff rates, volume of storage required and the proposed approach for discharge of water from the site. The outline operational drainage has been set out in **Outline Operational Drainage Plan** (Document reference 9.20).

18.2.8.1.3 Displacement of Flood Water

451. In addition to the above assessment of flood risk to the onshore substation site, it is also necessary to consider the potential for SEP and DEP to have an impact on off-site flood risk. As part of the modelling exercise set out in **Annex 18.2.2 Onshore Substation Hydraulic Modelling Technical Note**, an assessment of the potential displacement of flood water has been undertaken.

452. **Plate 4** and **Plate 5** show the results of the 1 in 100 year (plus 20% for climate change) and 1 in 100 year (plus 40% for climate change) events, respectively, with the onshore substation platform and access road included within the model.

Plate 4: 1 in 100 Year Plus 20% for Climate Change Extent with Onshore Substation Layout and Access Road

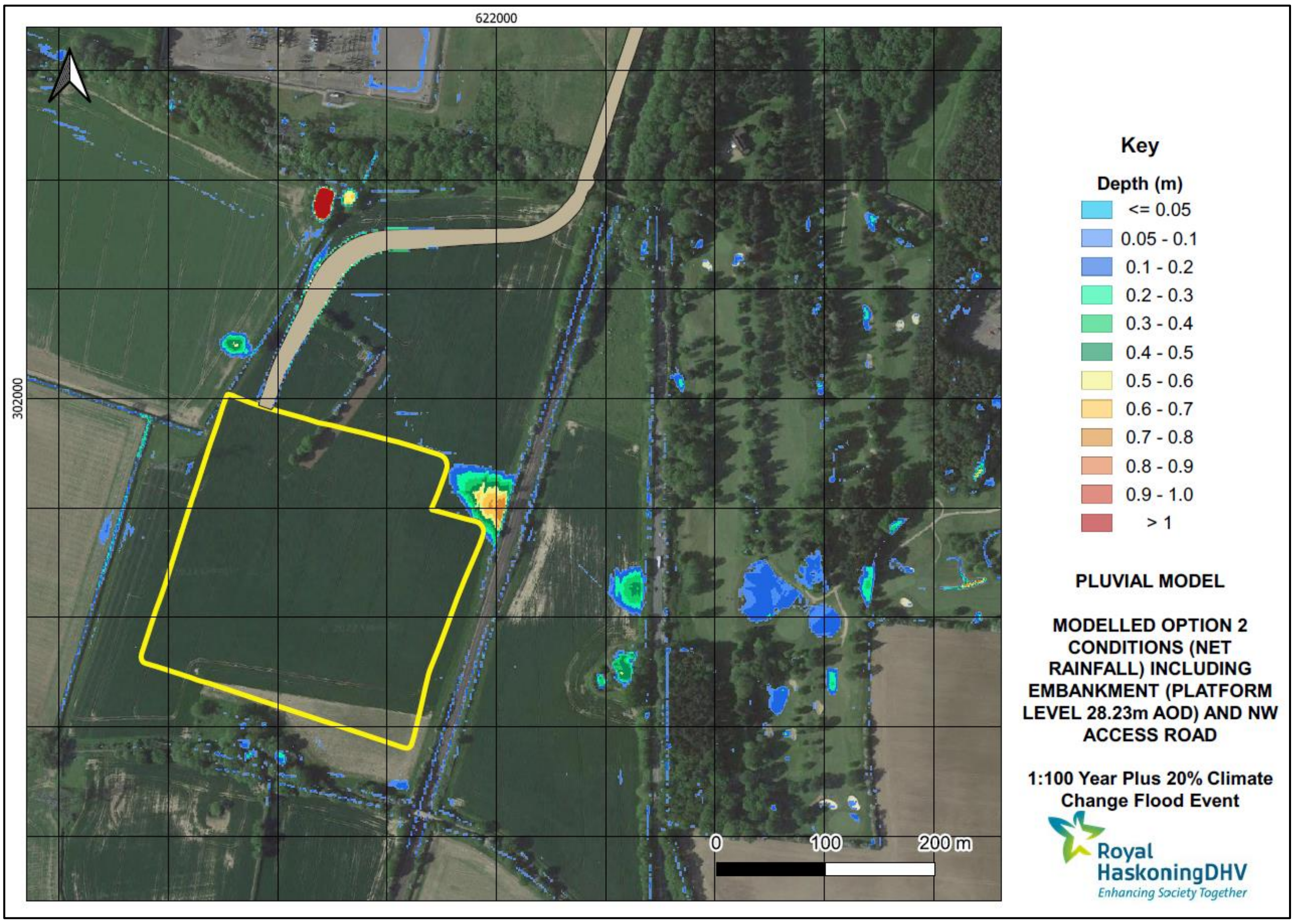
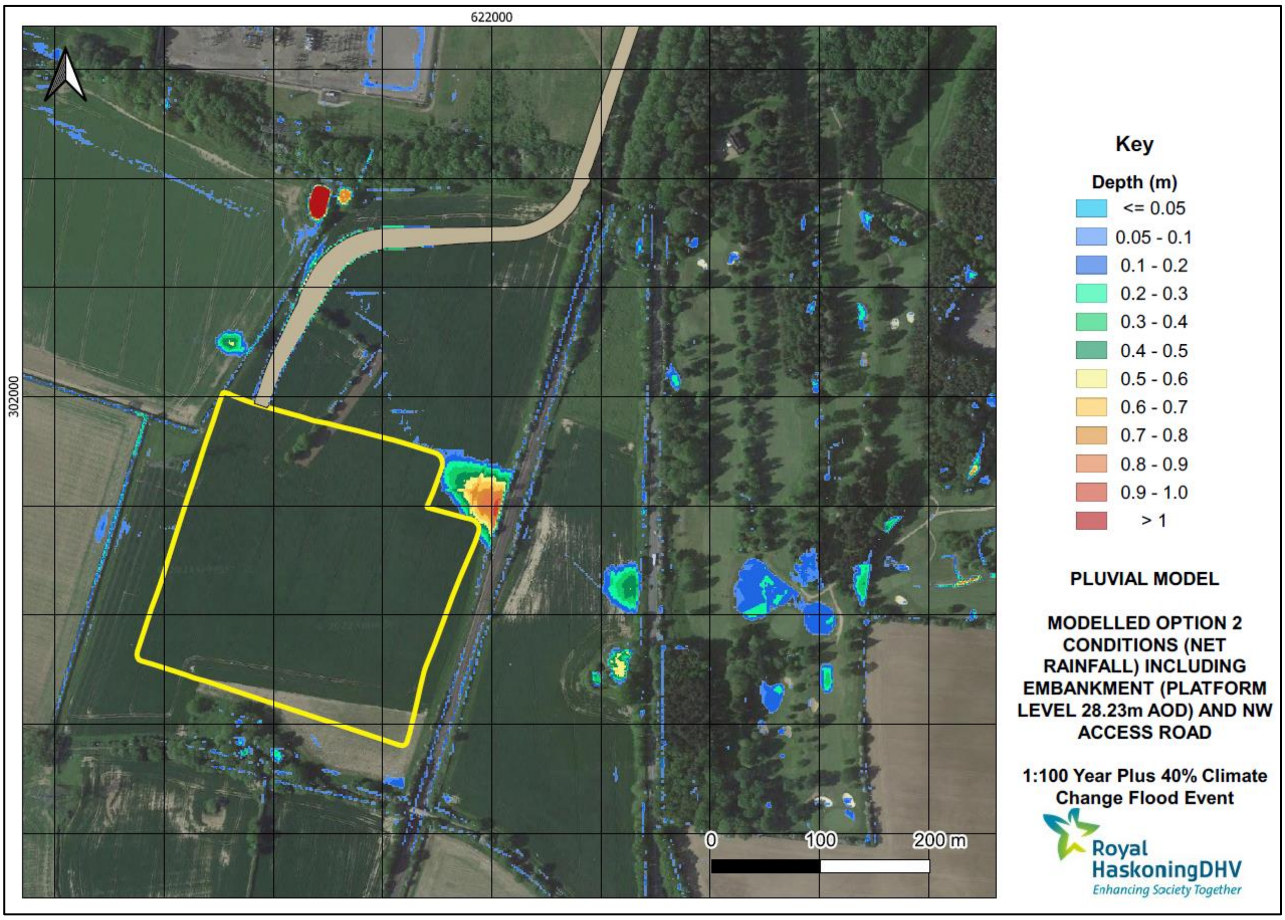


Plate 5: 1 in 100 Year Plus 40% for Climate Change Extent with Onshore Substation Layout and Access Road



453. The results of this modelling exercise show that both the surface water flood extent and maximum flood depths are slightly reduced compared with the results from the baseline modelling. This reduction can be attributed to the incorporation of the onshore substation platform in the model. By including the onshore substation platform within the model, the rainfall falling on the platform during an event does not contribute to the flooding as it is assumed this will be collected by the surface water drainage system to be implemented as part of the project.

454. As such there is a small reduction in surface water flood depth and extent in the area of potential flooding close to the onshore substation platform. Furthermore, it confirms that there is no change in the wider off-site flood risk as the surface water flooding continues to be contained within the onshore substation site.

18.2.8.1.4 Flood Warning and Evacuation

455. While construction work is taking place on site, site workers and users will be required to monitor local weather forecasts and ensure there is an evacuation route in place in the event that fluvial flooding takes place during the construction stages of the development. This will be secured within the **Outline Code of Construction Practice** (Document reference 9.17).

456. Where there are Environment Agency Flood Alerts and Flood Warnings, it is recommended that site users sign up to receive the relevant flood warnings and alerts.

457. A flood warning and evacuation plan is a list of steps to be taken in case of a flood, although it can also include steps such as taking out the relevant insurance or using recommended flood mitigation products.

458. Specific flood warning and evacuation plans should be produced for the construction phase of the onshore cable corridor, specifically related to construction works at watercourse crossing locations where personnel or materials may be located, albeit temporarily, within Flood Zones 2 and 3.

459. All personnel should be made aware of any access routes which are located within Flood Zones 2 and 3 and any flood warnings issued for those areas should result in the relevant access routes being cleared of all project personnel and, where possible, all project plant / materials.

460. A site-specific flood warning and evacuation plan should include practical steps for protecting SEP and DEP, be easy to communicate and consider delegated responsibility, or whether personnel are likely to require additional support during a flood event.

461. It is anticipated that SEP and DEP will require a comprehensive flood warning and evacuation plan including the following aspects:

- A list of important contacts, including Floodline, utilities companies and insurance providers;
- A description or map showing locations of service shut-off points;
- Basic strategies for protecting property, including moving assets to safety where possible, turning off / isolating services and moving to safety; and
- Safe access and egress routes.

462. As noted above, the Environment Agency provide a free Flood Alert ("flooding is possible") and Flood Warning ("flooding is expected") service for fluvial flooding (rising river levels). It is recommended that the flood warning and evacuation plan considers how receipt of these flood alerts or warnings may affect their operations.

463. It should be noted that large parts of the onshore cable corridor are in rural undeveloped areas that are not covered by flood warnings. Furthermore, it is important to note that Environment Agency flood alerts and warnings are not issued in response to surface water flooding.

464. As such the flood warning and evacuation plan will include independent checks (i.e. Met Office Weather Warnings) alongside any alerts or warnings issued by the Environment Agency. These checks will also account for risks outside of the alerts / warnings in areas that may be at risk from failure of defences (such as a breach). This will enable contractors and site managers to consider how this information will affect planned works, especially areas in close proximity to key watercourses.

465. During construction, contractors and management should liaise with Norfolk County Council, as the LLFA, and the Environment Agency so they are aware of any forecast related to heavy rainfall events. The potential for flooding can then be assessed to enable work to stop, especially in areas in close proximity to key watercourses, and the site cleared of all personnel in this instance.

18.2.8.1.5 Access and Egress

466. The onshore substation will be located within Flood Zone 1, and as such any personnel within these areas would be at Low risk of flooding from rivers or the sea.

467. There is however a potential risk of surface water flooding to the area associated with an overland flow path which crosses the site. The access road to the platform will be raised above the ground such that it would not flood in a surface water event. Furthermore, this ensures that safe access and egress to the onshore substation platform would remain available during a surface water flood event.

468. Once operational, access to the onshore substation will be limited and transient in nature, i.e. there will be no requirement to remain on site overnight and the site can be evacuated, upon receipt of a warning of heavy rainfall, prior to flooding occurring. This ensures operators of the site would not be placed at risk during such an event.

18.2.9 Conclusions

469. SEP and DEP has been considered within the context of the guidance set out in the NPPF and the supporting NPPF PPG. All sources of flood risk, both to the SEP and DEP infrastructure, and arising as result of its construction, have been considered.

470. In terms of the existing flood risk, the landfall location is primarily located within Flood Zone 1, at Low risk of flooding from fluvial or tidal sources.

471. Furthermore, at the landfall location, the cables are likely to be required to cross Flood Zones 2 and 3 around the urban area of Weybourne and coastal frontage, as they come onshore. However, as the cables comprise below-ground infrastructure they will not be at risk from flooding as they will be installed using trenchless techniques.

472. A review of the flood risk along the onshore cable corridor has been undertaken and it has been noted that the onshore cable corridor will primarily cross through Flood Zone 1, with some locations in Flood Zone 2 and 3, primarily associated with watercourse crossings.

473. The use of trenchless techniques has been embedded in the scheme design for Main Rivers and IDB-maintained watercourses and as such the impact on flood risk in these locations would remain Low.

474. Trenched crossings will be carried out on Ordinary Watercourses crossed by the onshore cable corridor. Any temporary damming and re-routeing of watercourses along the onshore cable corridor will be designed such that the original flow volumes and rates are maintained to ensure flood risk is not increased.

475. These are temporary impacts provided the bed and banks are reinstated to their original level, position, planform and profile. At these locations, a site-specific investigation will be carried out at detailed design stage, to identify the local ground and groundwater conditions, enable a site-specific hydrogeological risk assessment to be undertaken and to understand the potential impact of any works on flows along the watercourse and flood risk in the local area.

476. Once operational, there will be no flood risk posed to the onshore export cables from fluvial, tidal, surface or sewer flooding. A residual risk of flooding from groundwater shall be mitigated using suitable waterproofing of the cables, link boxes and joint bays.

477. The onshore substation site is located within Flood Zone 1, which represents a Low risk of flooding from fluvial sources.

478. Whilst there is a risk of surface water flooding to the onshore substation site, following the completion of surface water modelling the flood risk has been clarified in relation to the onshore substation location. Further to a number of design iterations, the onshore substation platform has been designed such that it is located away from the surface water overland flow routes, where possible.

479. It is proposed that the access road to the platform will be designed to avoid interaction with the flood risk areas by being sufficiently elevated so as not to flood in a surface water event. This ensures that safe access and egress to the onshore substation platform would remain available during a surface water flood event.

480. Furthermore, it will be designed to ensure that any surface water / overland flow path that it needs to cross will continue to pass below the access road to limit the displacement of surface water flooding in the area.

481. Once operational, access to the onshore substation will be limited and transient in nature, i.e. there will be no requirement to remain on site overnight and the site can be evacuated, upon receipt of a warning of heavy rainfall, prior to flooding occurring. This ensures operators of the site would not be placed at risk during such an event.

482. Surface water drainage requirements for the onshore substation have been subject to consideration alongside the SuDS hierarchy and it has been designed to meet the requirements of the relevant policy and guidance to ensure the existing runoff rates to the surrounding water environment are maintained at pre-development rates.

483. The operational drainage at the substation has been designed taking into account the greenfield runoff rate, proposed runoff rates, volume of storage required and the proposed approach for discharge of water from the site.

484. An assessment has been undertaken in accordance with the methodology and criteria provided on the application of the Sequential Test and Exception Test contained within the NPPF PPG. Principally SEP and DEP is located in Flood Zone 1, including the majority of the onshore cable corridor and the onshore substation. Subterranean development is also located primarily in Flood Zone 1, with some locations in Flood Zone 2 and 3 where it is required to pass under, or in proximity to, existing watercourses. Given the flood risk vulnerability classification of SEP and DEP, it is necessary to consider the application of the Exception Test.

485. It is concluded that SEP and DEP accords with the first part of the Exception Test in that it provides wider sustainability benefits to the community.

486. It is also considered that the second part of the Exception Test is complied with, as it has been demonstrated that the infrastructure will be safe for the duration of their lifetime, without increasing flood risk elsewhere.

487. On the basis of the flood risk identified both to and from SEP and DEP, and consideration of both the Sequential Test and Exception Test, it is therefore concluded that the proposed development is appropriate in terms of flood risk and is in accordance with the National Planning Policy Framework.

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