RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Chapter 20 – Appendix 20.3 Flood Risk Assessment

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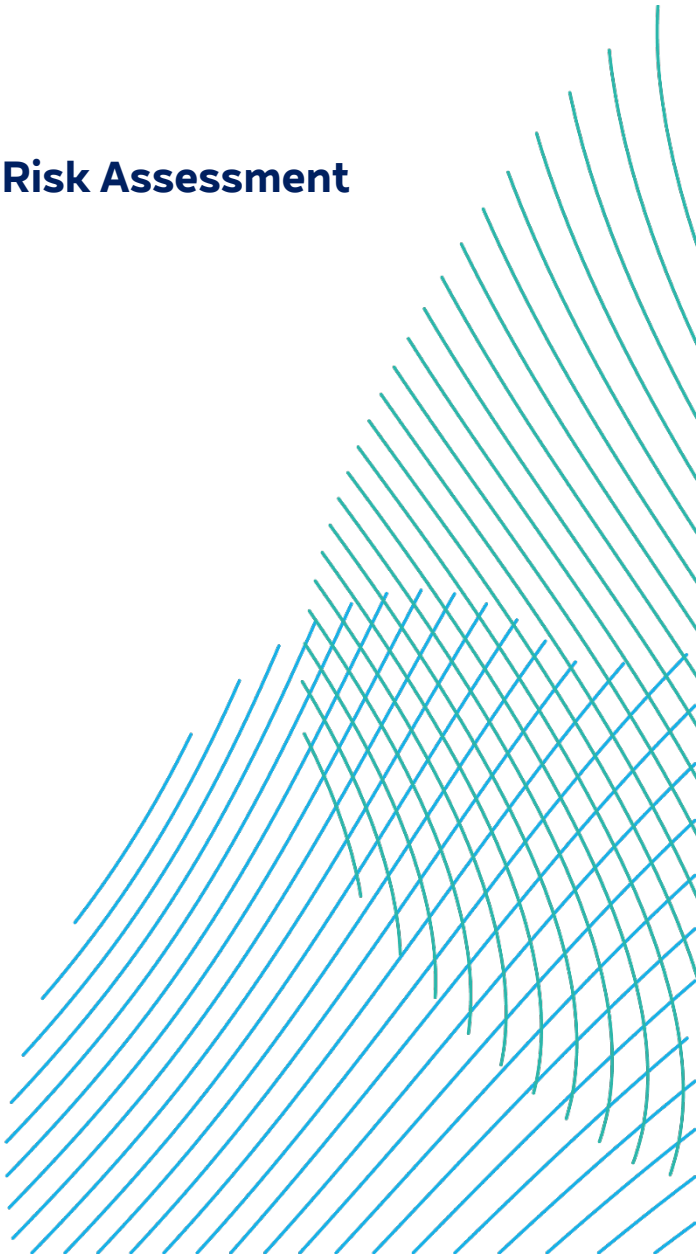

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Glossary

Term	Definition
Aquifer	Geological strata that hold water.
Cable Construction Compound	Area set aside to facilitate construction of the onshore export cables. These will be located adjacent to the onshore export cable corridor, with access to the highway.
Coastal Catchment	Land which drains directly to the coastal or estuarine waters, rather than through a river water body – not part of a river water body catchment.
Coastal / Tidal Flooding	When high tide events overtop the shoreline to cause flooding to land behind.
Fluvial Flooding	When flows within watercourses exceed the capacity of the watercourse causing out of bank flows.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Geomorphology	The study of landforms and the processes that shape them.
Groundwater	Water stored below the ground in rocks or other geological strata.
Horizontal Directional Drilling (HDD)	HDD is a trenchless technique to bring the offshore cables ashore at the landfall and can be used for crossing other obstacles such as roads, railways and watercourses onshore.
Jointing Bays	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The point on the coastline at which the offshore export cables are brought onshore, connecting to the onshore export cables at the Transition Joint Bay.
Link Boxes	Below ground structures housing cable equipment, located along the cable route alongside each jointing bay.

Term	Definition
Main Rivers	Usually larger rivers and streams. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk.
Mitigation Areas	Areas captured within the Development Area specifically for mitigating expected or anticipated impacts.
Offshore Development Area	The Offshore Development Area encompasses the wind farm site and the options for the offshore transmission works.
Onshore Development Area	The Onshore Development Area for PEIR is the boundary within which all onshore infrastructure required for the Projects will be located including landfall, onshore export cable route, accesses, construction compounds and onshore substations. The Onshore Development Area is to be refined through the consultation and engineering review process.
Onshore Export Cable Corridor	This is the area which includes cable trenches, haul roads, spoil storage areas, and limits of deviation for micro-siting. For assessment purposes, the cable corridor does not include the onshore substations, Transition Joint Bays or temporary access routes; but includes construction compounds (purely for the cable route).
Onshore Grid Connection Points	The electricity transmission network connection locations for the Projects..
Onshore Substations	A compound containing electrical equipment required to transform and stabilise electricity generated by the Projects so that it can be connected to the electricity transmission network. There will be one onshore substation for each Project.
Onshore Substation Zones	Parcels of land within the Onshore Development Area where the onshore substation infrastructure (including the haul roads, temporary construction compounds and associated cable routeing) may be located.
Ordinary Watercourse	Other rivers are called 'Ordinary Watercourses'. Lead local flood authorities, district councils and internal drainage boards carry out flood risk management work on Ordinary Watercourses.

Term	Definition
Other Trenchless Techniques	Other techniques (aside from HDD) for installation of ducts or cables where trenching may not be suitable such as micro tunnelling or auger boring.
Surface Water Flooding	Surface water flooding occurs when rainwater does not drain away through normal drainage systems or soak into the ground, but lies on or flows over the ground instead.
The Applicant	RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited as the owners of DBS West and DBS East respectively are the named undertakers that will have the benefit of the Development Consent Order. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited.
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).
Transition Joint Bay	The Transition Joint Bay (TJB) is an underground structure at the landfall that houses the joints between the offshore export cables and the onshore export cables.

Acronyms

Term	Definition
AOD	Above Ordnance Datum
AP	Annual Probability
AStGWF	Areas Susceptible to Groundwater Flooding
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
CoCP	Construction Code of Practice
DBS	Dogger Bank South
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act
HDD	Horizontal Directional Drilling
IDB	Internal Drainage Board
IDD	Internal Drainage District
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
NFM	Natural Flood Management
NPPF	National Planning Policy Framework

Term	Definition
NPS	National Policy Statement
PEIR	Preliminary Environmental Information Report
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RBD	River Basin District
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SPZ	Source Protection Zones
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
TJB	Transition Joint Bay
WFD	Water Framework Directive

20.3 Flood Risk Assessment

20.3.1 Introduction

1. RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited (hereafter 'the Applicant') is proposing to construct an offshore wind farm off the coast of East Riding of Yorkshire, named Dogger Bank South (DBS) East and DBS West offshore wind farms (herein 'the Projects'). DBS will include a number of offshore and onshore elements, including an offshore wind farm, offshore export cables to landfall, onshore export cables and two onshore substations for connection to the electricity transmission network.
2. It is noted that the Environmental Impact Assessment (EIA) presented in the Preliminary Environmental Information Report (PEIR), is based on a design envelope approach. For example, the siting of the project infrastructure is limited to the identification of a number of search areas and zones.
3. As such this is based on the current understanding of the Projects with the location of the landfall, onshore export cables and onshore substations to be confirmed. Refinements to the design of the Projects will be reported on and assessed in the Environmental Statement (ES) which will support the Development Consent Order (DCO) application, including an updated Flood Risk Assessment (FRA).
4. The final detailed design of the Projects infrastructure will be confirmed through detailed engineering design studies that will be undertaken post-consent. In order to provide a precautionary but robust assessment at this stage of the development process, a worst-case scenario has been considered in terms of the potential flood risk impact that may arise.
5. The following document comprises a FRA to support **Chapter 20 Flood Risk and Hydrology** of the PEIR.

20.3.1.1 Aims

6. The aim of this FRA is to provide sufficient justification to regulators and other stakeholders that the Projects are appropriate and in line with planning and national policy requirements regarding flood risk.

7. The aims of this FRA are:

- To establish whether the Projects are likely to be affected by current or future flooding from any source of flood risk;
- To assess and identify the potential for the Projects 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 PEIR with regards to flooding, supported by the application of the Sequential Test and, where necessary, the Exception Test.

20.3.1.2 Methodology

8. This FRA has been prepared in accordance with the methodology and guidance set out in:

- EN-1 Overarching National Policy Statement for Energy (Department of Energy & Climate Change, 2011);
- Revised Draft EN-1 Overarching National Policy Statement (NPS) for Energy (Department for Business, Energy & Industrial Strategy, 2022);
- 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, 2022); and
- Environment Agency's climate change allowance guidance (Environment Agency, 2022).

9. The Revised Draft EN-1 Overarching NPS for Energy (2022) comprises an update to the EN-1 Overarching National Policy Statement (NPS) for Energy (2011) and is aligned with the guidance set out in NPPF and the supporting PPG.

10. The NPPF sets out the UK Government planning policies for England and seeks to ensure that flood risk is considered at all stages of the planning and development process. Its policies aim to avoid inappropriate development in areas at highest risk of flooding, and to direct development away from these areas.

11. 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 (e.g. fluvial, coastal, surface water, groundwater, reservoir and sewer flooding). It also provides guidance on how this is to be considered in the context of the location of site-specific development.

12. Further guidance, on the application of the Sequential Test and Exception Test is provided in the supporting Planning Practice Guidance for Flood Risk and Coastal Change (Department for Levelling Up, Housing and Communities, 2022), which was updated on 25 August 2022.

13. In the recent update to the Planning Practice Guidance, it was extended to include clarification on the application of the Sequential Test for all sources of flood risk, not only fluvial and coastal / tidal flooding, as well as summarising an additional consideration with regard to the presence of flood risk management infrastructure.

14. 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.

15. 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).

16. The updated Environment Agency guidance 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 UKCP18 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.

17. The updated guidance on the values for peak rainfall allowance are now provided for 1% annual probability (AP) events and for 3.3% AP 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.

18. The relevance and the applicability of the above policy and guidance has been considered within this FRA. In addition, the appropriate climate change allowances have been reviewed and included within Section 6 of this FRA.

20.3.1.3 Study Area

19. Due to the scale of the Projects spanning an area from the coastline of the East Riding of Yorkshire to approximately 25km inland, the flood risk varies across the Onshore Development Area. Therefore, to aid in this assessment the Onshore Development Area has been sub-divided into key sections within this document.

20. The flood risk to the possible landfall location, onshore export cable corridor and onshore substation zones are identified separately within this FRA report as outlined below:

- Possible landfall location;
- Onshore export cable corridor;
- Substation zone 1; and
- Substation zone 4.

21. This FRA is structured to introduce all relevant polices and guidance related to flood risk, prior to identifying the existing flood risk within the study area for each element of the Projects.

22. Following the identification of the flood risk to each element of the Projects, 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, the Projects.

20.3.2 Policy, Guidance and Consultation

23. **Table 20-1** outlines all documents that are referenced in this FRA. In the following section, the documents and their constraints related to the Projects are discussed in greater detail.

Table 20-1 Summary of Policy and Guidance Documents

Policy or Guidance Document	Author / Produced on behalf of	Year Published / Updated
National Planning Policy Framework	Ministry of Housing, Communities and Local Government	2012, updated 2021
Planning Practice Guidance (PPG) for Flood Risk and Coastal Change	Ministry of Housing, Communities & Local Government	2014, updated 2022
Flood risk assessments: climate change allowances guidance	Environment Agency	2016, updated 2022
East Riding Local Plan Update 2020 – 2039 Draft Strategy Document Update	East Riding of Yorkshire Council	May 2021
East Riding Local Flood Risk Management Strategy (2015 -2027)	East Riding of Yorkshire Council	December 2015
Strategic Flood Risk Assessment: Level 1	Capita produced on behalf of East Riding of Yorkshire Council	November 2019
Flamborough Head to Gibraltar Point Shoreline Management Plan	Humber Estuary Coastal Authorities Group	December 2010
Hull and Coastal Streams Catchment Flood Management Plan	Environment Agency	December 2010

20.3.2.1 National Planning Policy Framework

24. NPPF (Ministry of Housing, Communities and Local Government, 2021), Planning Practice Guidance (PPG) for Flood Risk and Coastal Change (Ministry of Housing, Communities and Local Government, 2022) 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.

25. 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 Projects needs to be considered along with the flood risk to the Onshore Development Area.

26. 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.

27. Further guidance, on the application of the Sequential Test and Exception Test is provided in the supporting PPG (Ministry of Levelling Up, Communities and Local Government, 2022) in terms of all sources of flood risk, Flood Zones and the Vulnerability Classification relevant to the development.

28. Within the supporting PPG (Paragraph 027), it is noted that:

    "*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.*"

29. The 2022 update to the PPG (published on 25th August 2022) requires the Sequential Test to assess the flood risk from all sources, in terms of development vulnerability for reasonably alternative sites.

30. For the purposes of the FRA, based on the indicative flood risk issues in relation to the Projects, the application of a sequential approach has been considered, specifically with regard to the onshore substation zones.

31. This assessment has sought to consider the potential flood risk from all sources in greater detail with the aim of sequentially locating it, wherever possible, to avoid the risk.

20.3.2.2 East Riding Local Plan

32. The East Riding Local Plan was adopted in 2016 however; the council is required to review and update the Local Plan within 5 years of adoption. Therefore, a draft Local Plan Strategy Document Update was made in 2021 by East Riding of Yorkshire Council.

33. As the development proposals is for the construction of Offshore Wind Farms, the relevant policies in the Local Plan and subsequent draft Local Plan Strategy Document Update have been considered as follows:

- Policy SI: Sustainable development states:
  - "*When considering development proposals, the Council will take a positive approach that reflects the three overarching objectives of sustainable development as set out in paragraph 8 of the National Planning Policy Framework, economic, social and environmental, whilst taking into account local circumstances. It will work proactively with applicants to find solutions which mean that proposals can be approved wherever possible, and to secure development that supports the Council's Vision and Objectives for the Local Plan and the other documents which make up the development plan.*
  - *The Local Plan should be read as a whole and in conjunction with the other documents which make up the development plan. Planning applications that accord with the policies in the development plan will be approved without delay, unless Chapter 4 Spatial Strategy 4 East Riding Local Plan Strategy Documents Update – Draft May 2021 37 material considerations indicate otherwise.*
  - *Proposals should ensure that, where appropriate, development will support the future sustainable growth of settlements. Future access and connectivity to neighbouring land should be taken into consideration.*"

34. The draft Local Plan Strategy Document Update notes that the council will take a positive approach that reflects the economic, social and environmental aspects of sustainable development, as set out in the NPPF.

35. Chapter 4 Spatial Strategy of the draft Local Plan Strategy Document Update (2021) discusses the need to address climate change within East Riding. It highlights the need for the council to consider mitigating against climate change through the implementation of "*renewable and low carbon energy technologies*" and adapting to these measures by considering "*the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.*"

36. Furthermore, section 4.17 of the draft Local Plan Strategy Document Update states:

- "*The Council has recently declared a climate emergency and has recommended that a climate change strategy be prepared that identifies key opportunities for mitigation and adaptation for the East Riding. Prior to this, the Humber Industrial Strategy Prospectus (2019) had already set the ambition to develop the Humber into a net-zero carbon industrial economy by 2040. The prospectus recognises that the 'Energy Estuary' contributes to over a quarter of the UK's energy and is at the forefront of developing the UK's world-leading offshore wind sector.*
- *In terms of onshore wind, the East Riding alone has a grid connected operational capacity in the order of 330MW of electricity. This is likely to be one of the highest wind energy capabilities in the country. In addition to wind energy, a number of solar, bio-renewable and other renewable energy projects are operational or permitted. As such, the East Riding is in a good position to support the shift to a low carbon economy…*"

37. Policy S2: Addressing Climate Change of the draft Local Plan Strategy Document Update states:

- "*Development Proposals will be supported where they contribute to a reduction in greenhouse gas emissions and incorporate adaptation to the expected impacts of climate change.*
- *Directing most new development to areas where there are services, facilities, homes and jobs, which reduces the need to travel and where it can be served more easily by sustainable modes of transport.*
    - *Efficiently using land, mineral, energy and water resources.*
    - *The re-use of the area's building stock and previously developed land.*
    - *Building at higher densities where appropriate and supporting opportunities for mixed use development.*

- *Promoting sustainable modes of transport and well-connected places.*
- *Promoting the creation of economic clusters for the renewable and low carbon energy sector.*
- *Incorporating high standards of sustainable design and construction which involve the prudent and efficient use of natural resources and built-in resilience to the impacts of climate change (e.g. overheating, flood risk).*
- *Incorporating renewable, low carbon and decentralised energy generation in appropriate locations and schemes.*
- *Supporting proposals that protect, enhance and link habitat networks to allow biodiversity to adapt to climate change.*
- *Conserving, enhancing and linking green infrastructure networks to provide flood management, shading for urban areas and natural air conditioning.*
- *Steering development away from areas of high flood risk, as far as possible, and ensuring development is as resilient as possible to any residual risks.*
- *Supporting sustainable flood management proposals.*
- *Implementing the most recent Shoreline Management Plan.*
- *Managing development in coastal areas and facilitate the re-location/roll back of development from areas between Barmston and Spurn Point.*
- *Exploiting carbon capture approaches through the creation and expansion of woodland, restoration of peat bogs and coastal ecosystems, and the deployment of new technologies.*"

38. In addition, Policy ENV6: Managing Environmental Hazards of the draft Local Plan Strategy Document Update is relevant as it states:

- "*Environmental hazards, such as flood risk, coastal change, nutrient deposition, aerial pollution, groundwater pollution and other forms of pollution, will be managed to ensure that development does not result in unacceptable consequences to its users, the wider community, and the environment.*
- *Flood risk*
  - *The risk of flooding to development, from all sources both now and in the future, will be managed by applying a sequential test to ensure that development is steered towards areas of lowest risk, as far as*

possible. The sequential test will, in the first instance, be undertaken on the basis of the East Riding Strategic Flood Risk Assessments (SFRA) and the Environment Agency's Flood Map, within appropriate search areas. Where development cannot be steered away from Flood Zone 3, the sub-delineation of Zone 3, detailed within the relevant SFRA, will be used to apply the sequential test, with preference given to reasonably available sites that are in the lower risk/hazard zones. Where necessary, development must also satisfy the exception test.

- *If, following applications of the sequential test, it has not been possible to successfully steer development to a site at low risk of flooding from all sources now and in the future, a sequential approach will be taken to the site design and layout, aiming to steer the most vulnerable of uses towards the lowest risk parts of the site and upper floors.*

- *Flood risk will be proactively managed by ensuring that new developments:*
  - *limit surface water run-off to existing run-off rates on greenfield sites, and on previously developed land reduce existing run-off rates by a minimum of 30%, or to greenfield run-off rate;*
  - *do not increase flood risk within or beyond the site;*
  - *incorporate Sustainable Drainage Systems (SuDS) into major development proposals and proposals at risk of flooding, unless demonstrated to be inappropriate;*
  - *do not culvert or otherwise build over watercourses, unless supported by the Risk Management Authority;*
  - *have a safe access/egress route from/to Flood Zone 1 or establish that it will be safe to seek refuge at a place of safety within a development;*
  - *incorporate high levels of flood resistant and resilient design if located in a flood risk area;*
  - *are adequately set-back from all watercourses including culverted stretches; and*
  - *adhere to other relevant SFRA recommendations.*"

39. This FRA has considered flood risk to the Projects in the context of the above policies set out in the Local Plan and draft Local Plan Strategy Document Update.

20.3.2.3 Preliminary Flood Risk Assessment

40. The most recent Preliminary Flood Risk Assessment (PFRA) for the county was produced to outline and manage the risks of flooding in East Riding of Yorkshire up to 2027.

41. 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 and has been considered in the Strategic Flood Risk Assessment.

20.3.2.4 Local Flood Risk Management Strategy

42. The East Riding Local Flood Risk Management Strategy (LFRMS) (2015 - 2027) was produced by East Riding of Yorkshire Council in 2015. It outlines the aims and objectives of the Council in their role as the Lead Local Flood Authority (LLFA) and provides policies based on these aims.

43. There is a requirement to identify flood risk areas including those areas in Flood Zone 1 which have critical drainage problems, and which have been notified for to the local planning authority by the Environment Agency. These are identified by the Environment Agency as Critical Drainage Areas (CDAs).

44. Consideration of CDAs is necessary to inform key flood risk priorities; however, from a review of the East Riding LFRMS none of the locations within the Onshore Development Area appear to be within areas designated as CDAs.

45. However, it is noted that drainage catchments have been considered within the East Riding LFRMS and the mapping indicates that the possible landfall location and onshore export cable corridor fall within the Barmston Main Drain and the River Hull catchments.

46. Policy CI: Providing infrastructure and facilities within the East Riding Local Flood Risk Management Strategy states:

    - "*Proposals for new and/or improved infrastructure and facilities will be supported where they enhance the quality and range of services and facilities or facilitate delivery of new development needs.*"

47. As the Projects comprise the construction of offshore windfarms, it is concluded that that this infrastructure will enhance the use of renewable energy within the local area as well as at a national scale.

20.3.2.5 Strategic Flood Risk Assessment

48. A Strategic Flood Risk Assessment (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. The 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.

49. The East Riding of Yorkshire produced a Strategic Flood Risk Assessment Level 1 in November 2019; hereafter referred to as the SFRA.

50. The SFRA identified areas in Flood Zones 3b, 3a, 2 and 1 as well as risk from flooding from other sources. It also provides a comprehensive summary of historic flooding information.

51. The SFRA notes that the primary fluvial / tidal flood risk in the East Riding is associated with the Humber estuary, River Hull, River Aire, River Derwent, Market Weighton canal, River Ouse and Dutch River. However, it also notes much of the East Riding is defended against fluvial and coastal flooding. As such, much of the flood risk to the area is residual and likely to be as a result of flood events exceeding the standard of protection afforded by the defence, defence or pumping failure, or flooding behind the defences due to local runoff or groundwater.

52. It also notes that coastal flood risk will be influenced by coastal erosion and, therefore in the future, this may introduce areas to the risk of flooding where localised high ground or smaller sea cliffs are eroded away. This effect may be accelerated by climate change (e.g. sea level rise), or as a result of changing wave climate. As such, it indicates that Shoreline Management Plans should be referenced in areas where coastal erosion may increase the risk of coastal flooding now or in the future.

53. The SFRA also notes that as part of the development of the PFRA, the LLFA examined settlements to identify indicative Flood Risk Areas. It considered Goole, Beverley and Bridlington to be at substantial risk of surface water flooding as well as the Flood Risk Area which included the Haltemprice area of the East Riding. As such, integrated (combined fluvial and surface water) modelling was undertaken to provide a more detailed analysis of the risk of flooding from surface water.

54. The extensive information and mapping within the SFRA is considered in the production of this FRA.

20.3.2.6 Catchment Flood Management Plans

55. 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).

56. 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.

57. The Onshore Development Area is located in the Hull and Coastal Streams Catchment Flood Management Plan. As with other key documents the information provided in the CFMP is considered in the production of this FRA.

20.3.2.7 Shoreline Management Plans

58. Shoreline Management Plans (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.

59. The Onshore Development Area, specifically the possible landfall location, is within the study area of the Flamborough Head to Gibraltar Point Shoreline Management Plan.

60. The possible landfall location is within Policy Unit C Wilsthorpe to Atwick and the short, medium and long term policy for this unit is 'No Active Intervention'. Although the SMP notes for this policy unit that:

    "No Active Intervention will occur though all epochs. However, works may be necessary to maintain the functionality of the Barmston Drain. In keeping with existing permissions, the privately owned defences at Ulrome currently protecting caravan parks would not be maintained under this policy and erosion of the shoreline would occur."

61. The information set out within the SMP for this policy unit has been considered in the assessment of flood risk for the possible landfall location.

20.3.2.8 Flood Risk Stakeholders and Consultation

62. The Onshore Development Area is located within the unitary authority area of the East Riding of Yorkshire Council, in their role as the Lead Local Flood Authority (LLFA).

63. 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.

64. As the LLFA, East Riding of Yorkshire 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.

65. The Environment Agency is a key flood risk stakeholder to the Projects, this is due to their permissive powers related to the management of the Main Rivers that the onshore export cable corridor will be required to cross.

66. A review of the mapping provided by the Association of Drainage Authorities has confirmed that the Onshore Development Area is partially located within an Internal Drainage District (IDD) overseen by the Beverley and North Holderness Internal Drainage Board (IDB). They are the Land Drainage Authority for ordinary watercourses within their IDD and they have permissive powers to manage water levels and undertake flood alleviation works in their area.

67. The Applicant will engage in dialogue with all three of the above key stakeholders to ensure flood risk related to their specific watercourses are fully considered and that permitting requirements regarding the need to cross watercourses within their administrative control are addressed.

20.3.2.9 Potential Permitting / Consenting Requirements

68. 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.

69. 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.

70. All Main Rivers and Ordinary Watercourses identified to be crossed by the Projects will be identified as part of the Onshore Crossing Schedule in **Chapter 5 Project Description** (**Appendix 5-1)** and the appropriate permitting requirements identified.

20.3.3 Baseline Environment

20.3.3.1 Hydrology

71. The review of the hydrology for the Projects has been based on river water body catchments as defined by the Environment Agency. Receptors are those river water bodies that are crossed, or their catchments are crossed, by the Onshore Development Area, as well as those that are located downstream. Water body catchments are grouped within their respective operational catchments.

72. The majority of the Onshore Development Area falls within the catchment of the River Hull. This river system drains the eastern side of the Yorkshire Wolds and flows in a generally north-south direction to join the Humber Estuary at Hull. Within the possible landfall location there are several short watercourses that flow directly to the coast. In addition, several of the River Hull's tributaries rise very close to the coast and flow inland to join the main river.

73. The Onshore Development Area lies within three river catchments and crosses the following water bodies:

- Barmston Sea Drain operational catchment;
  - Barmston Sea Drain/Skipsea Drain to Confluence;
  - Coastal catchment;
- Upper Hull operational catchment;
  - Mickley Dike catchment;
  - Old How/Frodingham Beck to River Hull;
- Lower Hull operational catchment;
  - Catchwater Drain;
  - Foredyke Stream Upper;
  - Foredyke Stream Lower to Holderness Drain;
  - Holderness Drain Source to Foredyke Stream;
  - Beverley and Barmston Drain;
  - Hull from Arram Beck to Humber;
  - High Hunsley to Arram Area; and
  - High Hunsley to Woodmansey Are.

74. The Onshore Development Area crosses the following Main Rivers:

- Stream Dyke;
- Monk Dyke;
- Meaux and Routh East Drain;
- Holderness Drain;
- River Hull;
- Beverley and Barmston Drain; and
- Catchwater Drain.

75. The Onshore Development Area also crosses the following drains which are part of the Beverley and North Holderness IDB:

- Skipsea Drain;
- Dunnington Sewer;
- Arnold and Riston Drain;
- Turf Gutter;
- Turf Gutter and Eske River Side Drain;
- South Bullock Drain;
- Storkhill Drain;
- South Bullock (N. Branch - Diggins Arms); and
- South Bullock (S. Branch - Chalk Arm).

20.3.3.2 Existing Surface Water Drainage System

76. In addition to the above information, it is noted that the Projects will be located on predominantly rural, agricultural land, where there is likely to be limited existing formal surface water drainage systems.

77. However, as noted above there are a large number of agricultural land drains and Ordinary Watercourses that will need to be crossed along the onshore export cable corridor.

20.3.3.3 Geology and Hydrogeology

78. The British Geological Survey (BGS) 1:50,000 scale solid and superficial geology geological mapping has been reviewed for the Onshore Development Area.

79. As would be expected from a linear project of this nature, the geological conditions within the Onshore Development Area vary. However, these can be summarised as follows:

- Superficial Deposits:
  - Till, Devensian - Diamicton.
  - Superficial Deposits - Sand and gravel.
  - Alluvium - Clay, silt, sand and gravel.
  - Glaciofluvial Deposits, Devensian
  - Lacustrine Deposits - Sand, silt and clay
- Bedrock Geology:
  - Rowe Chalk Formation - Chalk.
  - Flamborough Chalk Formation - Chalk.

80. Superficial deposits are varied but are dominated by till (diamicton). A wide belt of alluvium (sand, silt and clay), interspersed with more restricted pockets of glaciofluvial sand and gravel, runs north-south through the Onshore Development Area. Around the periphery of Beverley there are also Quaternary river terrace sediments and areas of head (head is poorly sorted, poorly stratified angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope).

81. Superficial deposits support extensive Secondary (undifferentiated) aquifers. For these features it is not possible to apply either a Secondary A or B definitions, because of the variable characteristics of the rock type – they have only a minor value. The Onshore Development Areas also crosses several Secondary A aquifers in the River Hull valley and other alluvial settings. Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers. Small Secondary B aquifers are also present near the coast in the Skipsea area. Secondary B aquifers are lower permeability layers which may yield limited amounts of groundwater due to localised features such as fissures, permeable horizons and weathering.

82. The Bedrock geology of the Onshore Development Area is defined as being a Principal aquifer. Principal aquifers provide significant quantities of drinking water, and water for business needs. They may also support rivers, lakes and wetlands.

20.3.3.4 Ground Investigations

83. To aid the understanding of flood risk and to inform the identification of potential drainage solutions for the permanent above ground infrastructure, i.e. onshore substations, a series of ground investigations should be undertaken in these locations once further information is available.

84. The results of these investigations will be 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 substations and to aid in the development of the detailed design.

20.3.4 Definition of Flood Hazard

85. This section explores the risk of flooding to the key study area elements (possible landfall location, onshore export cable corridor and onshore substation zones), as well as the temporary elements of the Projects. Where flood risk is identified, appropriate mitigation methods are identified later in the FRA.

20.3.4.1 Risk of Flooding

86. The PPG, through the application of the Sequential Test, aims to steer development towards areas at lowest risk of flooding and away from medium and high flood risk areas.

87. Flood Zones are informed by the extent of modelling undertaken by the Environment Agency and are shown on the Environment Agency Flood Map for Planning.

88. All designated Main Rivers, as well as some of the larger Ordinary Watercourses included in the modelling, are considered within the Flood Zone dataset.

89. Flood Zones are defined in Table 1 of the PPG (2022) as follows:

- Flood Zone 1 – Low Probability:
  - Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
- Flood Zone 2 – Medium Probability:
  - Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
- Flood Zone 3a – High Probability:
  - Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
- Flood Zone 3b – Functional Floodplain:
  - This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:
    - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
    - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).
  - Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

90. The updated PPG (2022) provides guidance on how the Sequential Test should be applied to other sources of flooding, and specifically surface water flooding. When considering the risk of flooding from surface water, the online national mapping showing surface water flood extents has been considered alongside the above Flood Zone information.

91. It is acknowledged that there may be a flood risk associated with Ordinary Watercourses which are intercepted by the onshore export 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 element of the Projects.

20.3.4.2 Watercourse Crossings

92. Information provided within the Onshore Crossing Schedule in **Chapter 5 Project Description** (**Appendix 5-1**) and set out in **Table 20-13** of **Chapter 20 Flood Risk and Hydrology** indicates the onshore export cable corridor will cross 7 Environment Agency Main Rivers as well as a number of ordinary watercourses.

93. All Main Rivers will be crossed using trenchless techniques, to avoid direct interaction with these watercourses. With regard to the other Ordinary Watercourses, the crossing method will be considered on an individual basis, following discussion with the LLFA and IDB.

94. As previously noted, it is likely to be necessary to gain consent from the Environment Agency, LLFA and / or the IDB for the construction phase of the Projects, to ensure that the Main Rivers or Ordinary Watercourses are not impacted by the works.

95. It is likely that further route refinement will include amendments to the number of watercourse crossings. The identification of both trenched and trenchless watercourse crossings along the onshore export cable corridor will be updated in the Environmental Statement.

20.3.5 Possible landfall location

20.3.5.1 Overview of Proposed Activities

96. The offshore export cables make landfall near Skipsea, at an exact location that is to be confirmed. The offshore export cables will be connected to the onshore export cables in Transition Joint Bays (TJBs), having been pre-installed under the intertidal zone by HDD. There are two landfall locations identified for the PEIR.

97. The landfall area extends inland to allow the TJBs to be located beyond any areas at risk of natural coastal erosion, and to provide space for temporary construction logistics and access requirements.

98. A trenchless solution (likely to be a Horizonal Directional Drill) is to be used to install ducts that will house the cables under the beach. The ducts will run from the TJB, located landward of landfall, to an exit location which could either be located in the intertidal or below mean low water springs. TJBs are permanent infrastructure where the offshore and onshore export cables are joined. The offshore export cables will be pulled ashore through these pre-installed HDD ducts and will interface with the onshore cables at the TJB.

99. A temporary onshore construction compound will be required to accommodate the drilling rigs, ducting and welfare facilities. Further details related to the possible landfall location and works are provided in **Chapter 5 Project Description**.

20.3.5.2 Historical Flooding

100. To understand the likely risk of flooding to the Projects 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 Development 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.

101. The Environment Agency Historical Flood Extent map at the possible landfall location demonstrates that it is situated in a location along the coastline that has not been affected by a historic flood extent. However, the mapping indicates that historic flooding has occurred to the west of Skipsea, associated with the Skipsea Drain.

20.3.5.3 Flood Zones

102. The possible landfall locations are situated along the coastal frontage at Skipsea and are both shown to be partially situated within Flood Zone 3, which extends approximately 91m inland. The indicative locations of the temporary construction compound zones are all located within Flood Zone 1.

20.3.5.4 Flooding from Rivers

103. Given the location of the possible landfall locations and their close proximity to the North Sea, the dominant source of flooding is from tidal sources, as opposed to being at risk from fluvial sources.

104. Therefore, there would be no fluvial risk to the possible landfall locations based on the existing flood risk, the use of trenchless techniques for installation of the onshore export cables as they make landfall and their location below ground once operational.

20.3.5.5 Flooding from the Sea

105. Given that the possible landfall locations are situated along the coastal frontage to the east of Skipsea and the presence of Flood Zone 3 in this location it is concluded that there is a tidal flood risk to the possible landfall locations, during the construction phase.

106. However, based on the use of trenchless techniques for installation of the onshore export cables as they make landfall, the tidal flood risk once operational is considered to be low.

20.3.5.6 Flooding from Surface Water

107. At the possible landfall locations, the majority of the area is not considered to be at risk from surface water flooding during a 3.3% Annual Probability (AP) (High Risk), 1% AP (Medium Risk) or 0.1% AP (Low Risk) surface water flood event.

108. However, there are some areas at increased risk of surface water flooding to the north of Hornsea Road as well as areas within the southern possible landfall location.

109. Any surface water flood risk to the possible landfall locations and the onshore export cables in this location 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. Furthermore, the land will be reinstated and existing ground levels will be maintained.

110. On this basis, the risk of flooding from surface water is therefore considered to be low for the possible landfall locations and the temporary onshore construction compound.

20.3.5.7 Flooding from Groundwater

111. The Onshore Development Area is underlain by a single groundwater body comprising Hull and East Riding Chalk.

112. This area is located over superficial deposits of Till, Devensian – Diamicton, Glaciofluvial Deposits, Devensian – Sand and gravel and Lacustrine deposits.

113. The SFRA shows the Areas Susceptible to Groundwater Flooding (AStGWF), which is a strategic scale map showing groundwater flood areas based on a 1km square grid. The data shows the proportion of each 1km grid square where geological and hydrogeological conditions indicate groundwater might emerge.

114. The mapping demonstrates that the possible landfall locations are situated in an area where <25% of the area is classified as being at risk of groundwater emergence.

115. Once operational, the effect that the possible landfall locations and onshore export cables will have on groundwater flows is likely to be low, as the target depth for the onshore export cables will be between 1.6m and 2m below ground. Given the operational depth of the onshore export cables, they are likely to be constructed within the superficial deposits.

116. 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 and could be encountered during the below-ground engineering works.

117. However, the potential presence of groundwater will be identified as part of the ground investigations and appropriate mitigation measures incorporated into the Projects, as required.

118. If perched groundwater were to be encountered, it would need to be mitigated by appropriate construction techniques and in accordance with an appropriate method statement. This will be secured within the Outline Code of Construction Practice, which will be produced to accompany the Environmental Statement and submitted as part of the DCO application.

119. Based on the above information there is likely to be a low groundwater flood risk to the possible landfall locations during construction and any risk will be mitigated, as outlined above.

20.3.5.8 Flooding from Sewers

120. The SFRA has been reviewed to assess the risk of sewer flooding to the possible landfall locations. The SFRA has not provided any data to show that sewer flooding has occurred at the possible landfall locations.

121. Furthermore, the possible landfall locations are located within existing rural areas and, therefore, it is likely that there is a limited foul sewer network within proximity of the possible landfall locations. Therefore, the risk of flooding from sewers is considered to be low.

20.3.5.9 Flooding from Reservoirs

122. The Environment Agency Flood Risk from Reservoirs map shows that the possible landfall locations are not at risk from reservoir flooding under any situation. Therefore, there is no risk of flooding from this source.

20.3.5.10 Flooding from Canals and other Artificial Sources

123. The possible landfall locations are not located near to any canals or other artificial sources. As such there is no risk of flooding from canals or other artificial sources to the possible landfall locations.

20.3.5.11 Summary of Flooding

124. Overall, the possible landfall locations are not at risk of flooding from sewers, canals or other artificial sources or reservoirs. In addition, there is a low risk of flooding associated with groundwater sources.

125. The possible landfall locations are partially located within Flood Zone 3; however, the predominant risk of flooding at this location is tidal.

126. As such, there is no risk of fluvial flooding (from Main Rivers) as the dominant source of flooding to the areas of Flood Zone 3 are tidal in nature.

127. The possible landfall locations are also considered to be at low risk from surface water flooding as any areas identified as having a higher risk of surface water flooding appear to be associated with watercourses or localised areas of lower-lying land.

20.3.6 Onshore Export Cable Corridor

20.3.6.1 Overview of Proposed Activities

128. At this stage of the Projects design, broad onshore export cable corridors have been identified within which the onshore export cables will be located. The onshore export cable corridor route has been assessed from the possible landfall locations up to the two proposed substation zones.

129. The onshore export cable works include all the infrastructure necessary to connect the offshore export cables via TJBs, to the onshore substation locations and connection to the National Grid. The type and arrangement of cables is dependent upon the electrical transmission system adopted.

130. From the landfall at Skipsea, the onshore export cable corridor travels west, crossing Hornsea Road (B1242), and continuing to Dunnington Lane before turning and heading south past Dunnington, Nunkeeling, Catfoss, and across West Road (A1305) at Sigglesthorne.

131. The onshore export cable corridor then turns southwest and continues passing the village of Riston Grange, crossing Whitecross Road (A165) and again crossing Hornsea Road (A1305) as it heads west north of Tickton. The route then crosses Driffield Road (A164) to the north of Beverley before turning south crossing Constitution Hill (A1035) to the west of Beverley, down across York Road, Newbald Road, and Broadgate (B1230), before reaching the onshore substation zones located at Beverley Road along the A1709 and A164.

132. This section of the FRA covers the entirety of the onshore export cable corridor over its length of approximately 39km, which is wholly located within the East Riding of Yorkshire administrative area.

20.3.6.2 Historical Flooding

133. To understand the likely risk of flooding to the Projects 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 Development 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.

134. The Environment Agency Historical Flood Extent map indicates that parts of the onshore export cable corridor have been affected by historical flooding. These appear to be associated with a small area around the Skipsea Drain and also locations around the River Hull and Beverley and Barmston Drain. These appear to be related to locations that are shown to be within Flood Zones, as described below.

20.3.6.3 Flood Zones

135. The majority of the onshore export cable corridor is situated within Flood Zone 1, however there are some sections of the onshore export cable corridor which are located within Flood Zone 2 or Flood Zone 3.

136. The majority of the onshore export cable corridor from Skipsea to Long Riston is situated within Flood Zone 1. However, there are three relatively small, isolated areas along this section which are located in Flood Zone 2 or Flood Zone 3. At these specific locations the onshore export cable corridor is required to cross over a series of watercourses comprising the Skipsea Drain, Dunnington Sewer and Stream Dike.

137. From a location to the west of Whitecross Road (A165) to a location to the east of Driffield Road (A164), the majority of the onshore export cable corridor is located within Flood Zone 2 or Flood Zone 3, according to the Environment Agency Flood Map for Planning. This section of the onshore export cable corridor crosses 4 Main Rivers and several Ordinary Watercourses.

138. The onshore export cable corridor from Driffield Road (A164) to both of the proposed substation zones is located in Flood Zone 1.

20.3.6.4 Flooding from Rivers

139. As noted in section 20.3.6.1, the onshore export cable corridor is required to cross several Main Rivers and Ordinary Watercourses and therefore there is a risk of fluvial flooding.

140. Part of the onshore export cable corridor is located in close proximity to the coastline; however, the Environment Agency Flood Map for Planning demonstrates that the flood risk to the onshore export cable corridor in this location is based upon fluvial flooding from the Skipsea Drain.

141. Whilst there is a fluvial flood risk to the onshore export cable corridor, given the use of trenchless techniques for installation of the onshore export cables at key watercourses and its location below ground once operational, there will be limited fluvial flood risk to the onshore export cable corridor once constructed.

20.3.6.5 Flooding from the Sea

142. The onshore export cable corridor is considered to be at low risk from tidal flooding as the sections located within Flood Zone 2 or Flood Zone 3 are associated with fluvial flooding.

143. Therefore, there would be no tidal flood risk to the onshore export cable corridor based on the existing flood risk.

20.3.6.6 Flooding from Surface Water

144. The Environment Agency Surface Water Flood Map indicates there are a number of isolated areas of surface water flooding along the onshore export cable corridor. Some of these isolated areas appear to be areas of ponding, likely to be linked to areas of lower ground levels resulting in pockets of surface water.

145. The areas where the onshore cable corridor crosses over either Main Rivers or the Ordinary Watercourses are identified as being at increased 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.

146. There are some areas at greater surface water risk between Whitecross Road (A165) and Driffield Road (A164). It is noted that these are in similar locations to the areas at increased fluvial flood risk and, as such, it is likely that the flood risk in this location may be linked.

147. At this stage in the Project's design, the use of trenchless techniques cannot be committed to at all locations and the engineering feasibility of using such techniques needs further assessment before it can be confirmed.

148. However, any surface water flood risk to the onshore export 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 and the land will be reinstated with the existing ground levels maintained.

20.3.6.7 Flooding from Groundwater

149. The Onshore Development Area is underlain by a single groundwater body comprising Hull and East Riding Chalk.

150. The onshore export cable corridor is situated over superficial deposits of Till, Devensian formation which are classified as a Secondary (undifferentiated) superficial aquifer and Alluvium, Sand/Gravel and Glaciofluvial deposit formations which are classified as Secondary A superficial aquifer. Alluvium and Glaciofluvial deposit formations are classified as Secondary A superficial aquifer.

151. The SFRA shows the Areas Susceptible to Groundwater Flooding (AStGWF), which is a strategic scale map showing groundwater flood areas based on a 1km square grid. The data shows the proportion of each 1km grid square where geological and hydrogeological conditions indicate groundwater might emerge.

152. The mapping demonstrates that the onshore cable corridor passes through several areas susceptible to groundwater emergence.

153. The onshore export cable corridor passes through areas at relatively low risk of groundwater emergence (i.e. < 25% of the area within the 1km grid is at risk of groundwater emergence) through to areas at greater risk (i.e. >= 75% of the 1km grid is at risk of groundwater emergence).

154. Notwithstanding the above, once operational the effect that the onshore export cables will have on groundwater flows is likely to be low, as the target depth for the onshore export cables will be between 1.6m and 2m below ground. Given the operational depth of the onshore export cables, they are likely to be constructed within the superficial deposits.

155. 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.

156. However, the potential presence of groundwater will be identified as part of the ground investigations and appropriate mitigation measures incorporated into the Projects, as required.

157. If perched groundwater were to be encountered, it would need to be mitigated by appropriate construction techniques and in accordance with an appropriate method statement. This will be secured within the Outline Code of Construction Practice, which will be produced to accompany the Environmental Statement and submitted as part of the DCO application.

158. Based on the above information there is likely to be a low to moderate groundwater flood risk along the onshore export cable corridor during construction and any risk will be mitigated, as outlined above.

20.3.6.8 Flooding from Sewers

159. The SFRA has been assessed to review the potential sewer flood risk to the onshore export cable corridor. The SFRA states the following:

"*New Sewer systems are typically designed to accommodate the 3.3% AP storm without flooding at the ground surface in accordance with Sewers for Adoption. However, many of the existing sewers were not built to this specification. These sewers can become overloaded as new development adds to the loads on the network.*

Even where sewers are built to the current specification, they may become overwhelmed by events with a higher magnitude. Sewer flooding can also be caused due to blockages, collapses or equipment (e.g. pumping station) failure.

Many of the systems in East Riding were constructed prior to the introduction of the now required design standard 3.3% AP (1 in 30 years). The limitations of the sewer system in East Riding were highlighted in 2007, when the existing drainage structure and public sewers were overwhelmed by the prolonged and heavy rainfall. However, since then Yorkshire Water have undertaken work to update and improve the sewer system in East Riding."

160. Following review of the SFRA, it was concluded that there is no specific information to indicate sewer flooding is an issue along the route of the onshore export cable corridor.

161. In addition, the onshore export cable corridor is located within existing rural and agricultural land and, therefore, it is likely that there is a limited foul sewer network. Therefore, the risk of flooding from sewers is therefore considered to be low.

20.3.6.9 Flooding from Reservoirs

162. The Environment Agency Flood Risk from Reservoirs map shows that none of the onshore export cable corridor is at risk from reservoir flooding under any situation. Therefore, there is no risk of flooding from this source.

20.3.6.10 Flooding from Canals and other Artificial Sources

163. The SFRA flood risk mapping has been reviewed alongside other online mapping, and it appears that the onshore export cable corridor is not located near to any canals or artificial sources. As such, there is no risk of flooding from canals or other artificial sources to the onshore export cable corridor.

20.3.6.11 Summary of Flooding

164. Overall, the onshore export cable corridor is not at risk of flooding from tidal, sewers, canals or other artificial sources or reservoirs. There is a variable risk from low to moderate of groundwater flooding occurring along parts of the onshore export cable corridor.

165. The main risk of flooding to the onshore export cable corridor is likely to be fluvial flooding. The majority of the onshore export cable corridor is located in Flood Zone 1, however there are some sections of the onshore export cable corridor which are located within Flood Zone 2 and 3. These are associated with a number of Main Rivers as well as Ordinary Watercourses.

166. In addition, the locations where the onshore export cable corridor crosses the Ordinary Watercourses are at increased 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.

167. In addition, there are some isolated pockets of surface water flooding which are likely to be linked areas of lower ground levels. However, any surface water flood risk to the onshore export cable corridor will be temporary in nature and removed once construction is complete as all onshore infrastructure will be located below ground.

20.3.7 Onshore Substation Zone 1

168. The precise location of the onshore substations and grid connection is subject to ongoing consultation and refinement. At this stage in the Project's design, two onshore substation zones have been defined through the Project's site selection process, within which the onshore substations could be located.

20.3.7.1 Overview of Proposed Activities

169. Onshore substation zone 1 is located to the south of Beverley, to the north east of Poplar Farm and the A1079 and east of the Driffield Road (A164).

170. The actual substation location is dependent on the final electrical solution taken forward and whether the substations are to be co-located or not.

171. Therefore, the location, footprint and size is yet to be confirmed; however, the onshore substations will be constructed to accommodate the connection of both DBS East and DBS West to the transmission grid.

20.3.7.2 Historical Flooding

172. To understand the likely risk of flooding to the Projects 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 Development 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.

173. The Environment Agency Historical Flood Extent map demonstrates that onshore substation zone 1 is not located in an area that has been affected by historical flooding.

20.3.7.3 Flood Zones

174. Onshore substation zone 1 is wholly located within Flood Zone 1 according to the Environment Agency Flood Zone Map. There are areas of Flood Zone 2 and Flood Zone 3, located approximately 100m to the north and south of onshore substation zone 1, with the northern flood extent associated with the Autherd Drain.

20.3.7.4 Flooding from Rivers

175. A review of mapping indicates that there is an Ordinary Watercourse, comprising a small drain located along a field boundary, to the western side of the area of the onshore substation zone 1.

176. However, as the Environment Agency Flood Map for Planning indicates the onshore substation zone 1 is located within Flood Zone 1, it can be concluded that fluvial flood risk to the site is relatively low.

20.3.7.5 Flooding from the Sea

177. Onshore substation zone 1 is situated inland and approximately 23km away from the nearest coastline. Furthermore, it is defined as being in Flood Zone 1 and therefore it can be concluded that onshore substation zone 1 is at very low risk from tidal flooding.

20.3.7.6 Flooding from Surface Water

178. The Environment Agency Surface Water Flood Map indicates there is a small area located towards the north of substation zone 1 which could experience surface water flooding in a 3.3% AP, 1% AP and 0.1% AP surface water event.

179. The surface water flood mapping indicates there may be a surface water flow path running through substation zone 1 south to north and connecting into the Autherd Drain. The surface water flow path is indicated to flow through substation zone 1 during a 1% AP and 0.1% AP surface water event.

180. Whilst the area at increased risk is relatively isolated and small in nature, it should be considered in the placement / location of the onshore substation within the wider onshore substation zone.

181. On this basis, whilst overall the risk of flooding from surface water is considered to be low for substation zone 1, there is a need to consider this flood risk in greater detail as part of the final proposed location of the onshore substation.

20.3.7.7 Flooding from Groundwater

182. The Onshore Development Area is underlain by a single groundwater body comprising Hull and East Riding Chalk.

183. The onshore substation zone 1 is located over superficial deposits of Till, Devensian formation which is classified as a Secondary (undifferentiated) superficial aquifer. Secondary undifferentiated means rock deposits with variable permeability and storage properties that are neither consistently Secondary A nor Secondary B.

184. It is also located over Superficial deposits – sand and gravel which is classified as a Secondary A superficial aquifer. Secondary A Aquifer is 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, lakes or wetlands.

185. The SFRA shows the Areas Susceptible to Groundwater Flooding (AStGWF), which is a strategic scale map showing groundwater flood areas based on a 1km square grid. The data shows the proportion of each 1km grid square where geological and hydrogeological conditions indicate groundwater might emerge.

186. The mapping demonstrates that the onshore substation zone 1 is located in an area which is not susceptible to groundwater flooding.

187. The onshore substation could be located above a secondary A and Secondary (Undifferentiated) Aquifer. Therefore, it is important to note that perched groundwater may be present and could be encountered during the below-ground engineering works.

188. However, the potential presence of groundwater will be identified as part of the ground investigations and appropriate mitigation measures incorporated into the Projects, as required.

189. If perched groundwater were to be encountered, it would need to be mitigated by appropriate construction techniques and in accordance with an appropriate method statement. This will be secured within the Outline Code of Construction Practice, which will be produced to accompany the Environmental Statement and submitted as part of the DCO application.

190. Based on the above information there is likely to be a low groundwater flood risk to the onshore substation during construction and any risk will be mitigated, as outlined above.

20.3.7.8 Flooding from Sewers

191. The SFRA has been reviewed to assess the risk of sewer flooding to substation zone 1. The SFRA has not provided any specific data to show that sewer flooding has occurred within substation zone 1.

192. Furthermore, onshore substation zone 1 is located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of this location.

193. Therefore, the risk of flooding from sewers is considered to be low for this onshore substation zone.

20.3.7.9 Flooding from Reservoirs

194. The Environment Agency Flood Risk from Reservoirs map shows that onshore substation zone 1 is not at risk from reservoir flooding under any situation. Therefore, there is no risk of flooding from this source.

20.3.7.10 Flooding from Canals and other Artificial Sources

195. The onshore substation zone 1 is not located near to any canals or other artificial sources. As such there is no risk of flooding from canals or other artificial sources to this onshore substation zone.

20.3.7.11 Summary of Flooding

196. Overall, the onshore substation zone 1 is not considered to be at risk of flooding from tidal, sewers, reservoirs, canals or other artificial sources. There is also a low risk of flooding from groundwater sources.

197. The onshore substation zone 1 is located in Flood Zone 1 and is therefore considered to be at low risk from fluvial flooding.

198. A small, isolated area of the proposed location is at risk from surface water flooding with an indicative surface water flow path which runs northwards towards the Authered Drain. Whilst the area at increased risk is relatively isolated and small in nature, it should be considered in the placement / location of the onshore substation within the wider onshore substation zone.

199. On this basis, whilst overall the risk of flooding from surface water is considered to be low for the onshore substation zone, there is a need to consider this flood risk in greater detail as part of the final proposed location of the onshore substation.

20.3.8 Onshore Substation Zone 4

200. The precise location of the onshore substations and grid connection is subject to ongoing consultation and refinement. At this stage in the Project's design, two onshore substation zone have been defined through the Project's site selection process, within which the onshore substations could located.

20.3.8.1 Overview of Proposed Activities

201. The proposed location of onshore substation zone 4 is located to the south west of Beverley. It is situated to the south of the A1079 and to the west of Poplar Farm and the Driffield Road (A164).

202. The actual substations location are dependent on the final electrical solution taken forward and if the substations are to be co-located or not.

203. Therefore, the location, footprint and size is yet to be confirmed; however, the onshore substations will be constructed to accommodate the connection of both DBS East and DBS West to the transmission grid.

20.3.8.2 Historical Flooding

204. To understand the likely risk of flooding to the Projects 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 Development 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.

205. The Environment Agency Historical Flood Extent map demonstrates that onshore substation zone 4 is not located in an area that has been affected by historical flooding.

20.3.8.3 Flood Zones

206. According to the Environment Agency Flood Zone Map onshore substation zone 4 is wholly located within Flood Zone 1. It is also located over 500m from the nearest Flood Zone 2 extent, which is to the south of onshore substation zone 4.

20.3.8.4 Flooding from Rivers

207. A review of mapping indicates that there is an Ordinary Watercourse, comprising a small drain located along a field boundary, running through the centre of the area of the onshore substation zone 4.

208. However, as the Environment Agency Flood Map for Planning indicates the onshore substation zone 4 is located within Flood Zone 1, it can be concluded that fluvial flood risk to the site is relatively low.

20.3.8.5 Flooding from the Sea

209. Onshore substation zone 4 is situated inland and approximately 25km away from the nearest coastline. Furthermore, it is defined as being in Flood Zone 1 and therefore it can be concluded that onshore substation zone 4 is at very low risk from tidal flooding.

20.3.8.6 Flooding from Surface Water

210. The Environment Agency Surface Water Flood Map indicates there is an Ordinary Watercourse and overland flow path which runs through the onshore substation zone 4. It appears to originate from two points, to the north east and south west, which then join to become a single overland flow path through the centre of onshore substation zone 4.

211. The majority of onshore substation zone 4 is likely to remain unaffected by surface water flooding during the 3.3% AP and 1% AP event, with the risk limited to the area immediately adjacent to the Ordinary Watercourse. However, the mapping indicates an increased surface water flow path during the 0.1% AP surface water event.

212. Whilst the area at increased risk is relatively isolated and small in nature, it should be considered in the placement / location of the onshore substations within the wider onshore substation zone.

213. On this basis, whilst overall the risk of flooding from surface water is considered to be low for the onshore substation zone, there is a need to consider this flood risk in greater detail as part of the final proposed location of the onshore substations.

20.3.8.7 Flooding from Groundwater

214. The Onshore Development Area is underlain by a single groundwater body comprising Hull and East Riding Chalk.

215. The onshore substation zone 4 is located over superficial deposits which are Till, Devensian - Diamicton. Till, Devensian formation is classified as a Secondary (undifferentiated) superficial aquifer. Secondary undifferentiated means rock deposits with variable permeability and storage properties that are neither consistently Secondary A nor Secondary B.

216. The SFRA shows the Areas Susceptible to Groundwater Flooding (AStGWF), which is a strategic scale map showing groundwater flood areas based on a 1km square grid. The data shows the proportion of each 1km grid square where geological and hydrogeological conditions indicate groundwater might emerge.

217. The mapping demonstrates that the onshore substation zone 4 is located in an area which is not susceptible to groundwater flooding.

218. The onshore substations could be located above a secondary A and Secondary (Undifferentiated) Aquifer. Therefore, it is important to note that perched groundwater may be present and could be encountered during the below-ground engineering works.

219. However, the potential presence of groundwater will be identified as part of the ground investigations and appropriate mitigation measures incorporated into the Projects, as required.

220. If perched groundwater were to be encountered, it would need to be mitigated by appropriate construction techniques and in accordance with an appropriate method statement. This will be secured within the Outline Code of Construction Practice, which will be produced to accompany the Environmental Statement and submitted as part of the DCO application.

221. Based on the above information there is likely to be a low groundwater flood risk to the onshore substations during construction and any risk will be mitigated, as outlined above.

20.3.8.8 Flooding from Sewers

222. The SFRA has been reviewed to assess the risk of sewer flooding to the onshore substation zones. The SFRA has not provided any specific data to show that sewer flooding has occurred within the onshore substation zone 4.

223. Furthermore, onshore substation zone 4 is located within existing agricultural land and, therefore, it is likely that there is a limited foul sewer network within proximity of this location.

224. Therefore, the risk of flooding from sewers is considered to be low for onshore substation zone 4.

20.3.8.9 Flooding from Reservoirs

225. The Environment Agency Flood Risk from Reservoirs map shows that onshore substation zone 4 is not at risk from reservoir flooding under any situation. Therefore, there is no risk of flooding from this source.

20.3.8.10 Flooding from Canals and other Artificial Sources

226. The onshore substation zone 4 is not located near to any canals or other artificial sources. As such there is no risk of flooding from canals or other artificial sources to onshore substation zone 4.

20.3.8.11 Summary of Flooding

227. Overall, the onshore substation zone 4 is not considered to be at risk of flooding from tidal, sewers, reservoirs, canals or other artificial sources. There is also a low risk of flooding from groundwater sources.

228. The onshore substation zone 4 is located in Flood Zone 1 and is therefore considered to be at low risk from fluvial flooding.

229. The Environment Agency Surface Water Flood Map indicates there is an Ordinary Watercourse and overland flow path which runs through the centre of onshore substation zone 4.

230. The majority of onshore substation zone 4 is likely to remain unaffected by surface water flooding during the 3.3% AP and 1% AP event, with the risk limited to the area immediately adjacent to the Ordinary Watercourse. However, the mapping indicates an increased surface water flow path during the 0.1% AP surface water event. Whilst the area at increased risk is relatively isolated and small in nature, it should be considered in the placement / location of the onshore substations within the wider onshore substation zone.

231. On this basis, whilst overall the risk of flooding from surface water is considered to be low for onshore substation zone 4, there is a need to consider this flood risk in greater detail as part of the final proposed location of the onshore substations.

20.3.9 Temporary Works – Construction Compounds

20.3.9.1 Overview of Proposed Activities

232. Temporary construction compounds are required to support the onshore cable installation. This will include several secondary compounds and up to two main compounds. In addition, the landfall and substation works would have their own dedicated construction compounds.

233. Up to two main compounds will be required to support the cable duct installation and cable pulling works (one for each project). These would operate as hubs for the onshore construction works and would house the central offices, welfare facilities, and stores, as well as acting as staging posts and secure storage for equipment and component deliveries.

234. The construction works will also require a series of secondary construction compounds that will 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.

235. Each secondary compound (up to approximately eight in total) would be approximately 75m x 75m in size with either direct access to the construction easement or require construction haul road to reach construction easement.

236. At the current time the final locations of the main compounds and the secondary compounds have not been confirmed. On this basis, an overview of the indicative temporary construction compound zones has been undertaken as part of this FRA. As the locations of the construction compounds are confirmed, further details will be provided in the FRA to accompany the Environmental Statement, as part of the DCO application.

20.3.9.2 Review of Flood Risk from All Sources

237. The majority of the indicative temporary construction compound zones appear to be located in Flood Zone 1. However, there are a number of locations where the onshore export cable corridor passes through Flood Zone 2 and Flood Zone 3, where there may also be a need to locate temporary construction compounds in these flood zones.

238. In addition, whilst many of the indicative temporary construction compound zones appear to be located in areas at limited risk of surface water flooding, there are small areas of surface water flooding, including areas of ponding as well as overland flow paths, in a number of these locations.

239. The temporary construction compound zones are located within existing agricultural land and therefore, it is likely that there is a limited foul sewer network within the proximity of their locations. The risk of flooding from sewers is therefore considered to be low for the temporary construction compounds.

240. The indicative locations for the temporary construction compound zones are within areas that are not at risk of flooding from reservoir sources under any situation. Therefore, there is no risk of flooding from this source.

241. The temporary construction compound zones are not located near to any canals or other artificial sources. As such there is no risk of flooding from canals or other artificial sources to these elements of the Projects.

242. To address the flood risk from both fluvial flooding and surface water flooding there is a need to ensure the impact is mitigated by the use of appropriate construction techniques and in accordance with an appropriate method statement. This will be secured within the Outline Code of Construction Practice, which will be produced to accompany the Environmental Statement and submitted as part of the DCO application.

20.3.10 Consideration of the Sequential and Exception Test

20.3.10.1 Sequential and Exception Test Overview

243. The NPPF requires the application of the Sequential Test and, where necessary, the Exception Test. Guidance on the application of the Sequential Test is provided in the Planning Practice Guidance (PPG) for Flood Risk and Coastal Change (updated on 25th August 2022), which provides criteria in relation to the appropriate allocation of development types and flood risk. As stated in Paragraph 023 of the PPG:

"*The aim of the sequential approach is to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. This means avoiding, so far as possible, development in current and future medium and high flood risk areas considering all sources of flooding including areas at risk of surface water flooding. Avoiding flood risk through the sequential test is the most effective way of addressing flood risk because it places the least reliance on measures like flood defences, flood warnings and property level resilience features.*

The aim of the Sequential Test is to ensure that a sequential risk-based approach is followed to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account. Where it is not possible to locate development in low-risk areas, the Sequential Test should go on to compare reasonably available sites:

- *Within medium risk areas; and*
- *Then, only where there are no reasonably available sites in low and medium risk areas, within high-risk areas.*"

244. As noted in Paragraph 031 of the PPG:

"*The Exception Test is not a tool to justify development in flood risk areas when the Sequential Test has already shown that there are reasonably available, lower risk sites, appropriate for the proposed development. It would only be appropriate to move onto the Exception Test in these cases where, accounting for wider sustainable development objectives, application of relevant local and national policies would provide a clear reason for refusing development in any alternative locations identified.*

The Exception Test should only be applied if the Sequential Test has shown that there are no reasonably available, lower-risk sites, suitable for the proposed development, to which the development could be steered."

245. Following the consideration of the Sequential Test, the need for demonstration of the Exception Test depends on the potential vulnerability of the proposed development proposed, based on the Flood Risk Vulnerability Classification, and the Flood Zone within which it would be located, as summarised in Table 2 of the PPG which has been reproduced as **Table 20-2**.

246. Furthermore, in Paragraph 031 the PPG provides the following guidance on the criteria required to pass the Exception Test whereby it should be demonstrated that:

- development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh 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.

247. The NPPF clarifies that both elements of the Exception Test should be satisfied for development to be allocated or permitted in situations where suitable sites at lower risk of flooding are not available following application of the Sequential Test.

Table 20-2 Flood Risk Vulnerability and Flood Zone 'Incompatibility' Table 2 of the PPG

Flood Zones	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	Exception Test required	✓	✓	✓
Flood Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Flood Zone 3b *	Exception Test required *	X	X	X	✓ *

Key:
✓ Exception test is not required
X Development should not be permitted

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.
* In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

248. In terms of the Project, and based on the guidance in both NPPF and the supporting PPG, the Project is classed as '**Essential Infrastructure**' which is defined as:

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

249. Based on the guidance set out in the PPG, 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.

20.3.10.2 Application of the Sequential Test

250. With regards to the application of the Sequential Test for all sources of flood risk it is noted that principally the works for the Project are to be located in Flood Zone 1, including the majority of the onshore export cable corridor and the onshore substation zones.

251. Permanent above-ground structures, comprising the onshore substations, are to be located within Flood Zone 1 and are therefore in accordance with the Sequential Test guidance related to placing development in the lowest flood risk areas.

252. 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.

253. Due to the large-scale nature of the works, it is acknowledged that there are locations where infrastructure is required to pass through Flood Zone 3. This relates specifically to the onshore export cable corridor and areas adjacent to the possible landfall location. It is also noted that the principal interaction with Flood Zone 3 is at key locations along the onshore export cable corridor (associated with the need to cross existing watercourses).

254. Due to the linear nature of the Projects it is not possible to avoid these areas entirely, and whilst they have been avoided, where possible, this is not entirely possible. As such it is noted that elements of the Projects located within Flood Zone 3, comprising the onshore export cable corridor and possible landfall locations require consideration of the Exception Test, as set out in the following section.

255. With regards to surface water flood risk, it is noted that the possible landfall locations and onshore substation zones are principally at low risk of surface water flooding, although there are areas within these zones that are at increased risk.

256. Within the onshore substation zones, whilst there are areas at increased surface water risk, the location / layout of the onshore substations within the zones, has not yet been defined as part of the Project. Therefore, it is considered that flood risk concerns can be appropriately mitigated through further assessment. On this basis, the Projects are in accordance with the Sequential Text in that areas principally at low risk have been identified over those areas at increased risk.

257. Furthermore, with regards to other sources of flooding it is noted that the Projects have been located such that they are at low risk of flooding from reservoirs, sewers, groundwater, canals and other artificial sources. Therefore, these have been located in areas at low risk of flooding and are in accordance with the guidance set out in the PPG with regard to the consideration of the Sequential Test.

258. On this basis, it is concluded that the Project has been appropriately sequentially located in accordance with the guidance set out in the PPG with regard to the application of the Sequential Test and that the sequential approach has been adopted in the location of key elements of the infrastructure, wherever possible.

20.3.10.3 Application of the Exception Test

259. As noted in the previous section it is not possible for a Project of this scale to wholly avoid areas at increased risk of flooding from all sources. As such, following the guidance set out in the PPG, there is a need to consider the requirements of the Exception Test for those elements that are located in Flood Zone 3.

260. This is of specific relevance to the onshore export cable corridor and possible landfall locations.

261. 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 the Projects, as Nationally Significant Infrastructure Projects (NSIP) provide energy certainty utilising a sustainable / renewable source of energy at a national scale.

262. 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 the onshore export cable corridor as well as the onshore substation zones are not located within an area considered to be at risk of fluvial / tidal flooding.

263. Elements that are likely to pass through areas at increased risk of flooding, i.e. Flood Zone 3 or high surface water flood risk, 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.

264. For the subterranean development, it is only during the construction works that there is the potential for a temporary increase in flood risk and this will be mitigated through the use of appropriate management measures.

265. Once operational, the flood risk to the onshore export cable corridor will have been removed as the transition joint bays and cables will be wholly located underground, with the latter sealed through a watertight manhole cover with no interaction with the above ground Flood Zones. The only visible above ground structures will be the concrete link boxes.

266. In addition, it is proposed that at the landfalls the Projects will be constructed through the use of trenchless techniques. Therefore, during construction and once operational, there will be limited interaction with the above ground Flood Zones.

267. Furthermore, those elements that require the application of the Exception Test have demonstrated that the Project provides wider sustainability benefits to the community associated with the provision of renewable energy, and that it can be designed such that it would be safe for its lifetime without increasing flood risk elsewhere.

20.3.11 Climate Change

20.3.11.1 Climate Change Overview

268. 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.

269. Given the potential sources of flooding identified in this FRA and the nature of various elements of the Project, there are two main aspects of climate change which are likely to impact the Project, 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.

270. Whilst storm surges and waves are likely to be larger in the future and sea levels will be higher than in the present day, this is unlikely to affect the Project as the elements of the infrastructure likely to be affected by this source of flooding will be located below-ground once operational.

20.3.11.2 Peak River Flow Allowances

271. The climate change allowance related to peak river flow and fluvial flooding is only likely to be relevant to the onshore substations, once operational, as the onshore export cables will also be located below ground once constructed.

272. The Projects are wholly situated in the Hull and East Riding Management Catchment Allowance. The peak river flow allowances for this Management Catchment are summarised in **Table 20-3** below.

Table 20-3 Hull and East Riding Management Catchment Peak River Flow Allowances

Epoch	Central	Higher Central	Upper End
2020s	9%	15%	33%
2050s	9%	17%	37%
2080s	20%	33%	66%

273. Given both onshore substation zone 1 and onshore substation zone 4 are located within Flood Zone 1, the increase in fluvial flooding relating to climate change is unlikely to affect the onshore substation zones.

274. However, both onshore substation zones are located in proximity to Ordinary Watercourses and therefore the effects of climate change on fluvial flood risk from these sources may lead to an increased risk in fluvial flooding.

20.3.11.3 Peak Rainfall Allowances

275. The Environment Agency guidance setting out the appropriate climate change allowances to be adopted for different development lifetimes (Environment Agency, 2022) are summarised as follows:

Development with a lifetime beyond 2100:

- This includes development proposed in applications or local plan allocations.
- For FRAs and SFRAs 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 water flooding.

Development with a lifetime of 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).

Development with a lifetime up to 2060:

- For development with a lifetime up to 2060, take the same approach but use the central allowance for the 2050s epoch (2022 to 2060).

276. As noted above, the Projects are located in the Hull and East Riding Management Catchment. The peak rainfall allowances applicable to this Management Catchment are summarised in **Table 20-4** and **Table 20-5** below.

Table 20-4 3.3% Annual Exceedance Rainfall Event Allowances

Parameter	Central	Upper End
2050s	20%	35%
2070s	25%	35%

Table 20-5 1% Annual Exceedance Rainfall Event Allowances

Parameter	Central	Upper End
2050s	20%	40%
2070s	25%	40%

277. Depending on the design lifetime of the Projects, the above allowances will need to be considered in line with the commencement of operation and incorporated into the design of the surface water drainage, as appropriate.

20.3.12 Surface Water Drainage

20.3.12.1 Onshore Infrastructure Pre-Construction Work

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

279. 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.

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

20.3.12.2 Landfall and Onshore Export Cable Corridor Construction Drainage

281. The possible landfall locations and onshore export cable corridor will only be at risk of flooding during the construction phase. 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.

282. During construction, at the possible landfall locations and along the onshore export cable corridor the Project would use trenchless crossing techniques at key watercourse crossing locations, including all Main Rivers.

283. All Main Rivers 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, in some locations the depth may be up to 20m below the channel bed.

284. In these locations the use of trenchless techniques will be confirmed and agreed with the regulators to confirm there will be no impact on flood risk during the construction works.

285. It is, however, likely that trenched crossings will be carried out at Ordinary Watercourses crossed by the onshore export cables. This method has the potential to directly alter the hydrology of the watercourses. Trenched crossings involve installing temporary dams 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.

286. 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.

287. 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 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.

288. It will be necessary to install additional field drainage parallel to the cable trenches along the onshore export 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. The requirements for temporary drainage will be defined during the preparation of the Surface Water Management Plan (SWMP) during the detailed design stage of the Project'.

289. 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, LLFA and IDB, as appropriate. 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.

20.3.12.3 Temporary Construction Compounds Surface Water Drainage

290. The location of temporary construction compounds is yet to be confirmed; however, the implementation of temporary construction compounds could lead to an increase in surface water during the construction phase as the impermeable area is likely to temporarily increase.

291. However, this will be managed through the implementation temporary drainage which will be defined during the preparation of the Surface Water Management Plan (SWMP) during the detailed design stage of the Projects.

292. The temporary construction compounds will only be at risk of surface water flooding during construction as, following completion, the compounds and any associated temporary access tracks will be fully reinstated and would have no operational use.

293. The detailed methodology to be used for any temporary construction compounds drainage shall be agreed with the LLFA and IDB, as appropriate. 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.

20.3.12.4 Onshore Export Cable Corridor Post-Construction

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

295. Existing land drains along the onshore export 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.

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

20.3.12.5 Onshore Substation Operational Surface Water Drainage

297. During the development of this FRA the discharge of surface water from the onshore substations has been considered within the context of the surface water flood risk and the need to ensure that any drainage solutions do not result in an increase in flood risk either to or from the onshore substations.

298. Surface water drainage requirements will be designed to meet the requirements of the NPPF, NPS EN-1 and the CIRIA SuDS Manual C753 (CIRIA, 2015), with runoff limited where feasible and in accordance with best practice.

299. A summary of the SuDS hierarchy is provided as follows:

- Rainwater re-use (rainwater harvesting/greywater recycling);
- An adequate soakaway or other infiltration system;
- Hybrid solution of infiltration and discharging to a surface water body;
- To a surface water body (e.g. an ordinary watercourse);
- To a surface water sewer, highway drain, or other drainage system; and
- To a combined sewer.

300. An Outline Operational Drainage Plan will provide details of the proposed surface water drainage design confirming 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 any attenuation features will be confirmed, in accordance with the above guidance, during the development of the detailed design.

301. As further information becomes available, the operational drainage at the onshore substations will be developed in consultation with the East Riding of Yorkshire Council (as the LLFA) and Beverley and North Holderness IDB, as appropriate, 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 onshore substation.

302. The surface water drainage design at the onshore substations 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 to account for the requirements of undertaking maintenance work such as ease of access for personnel, vehicles or machinery.

303. A management and maintenance plan of any proposed surface water drainage infrastructure will also be agreed with relevant stakeholders then adopted for the lifetime of the development.

20.3.13 Flood Risk Mitigation Measures

20.3.13.1 Mitigation Measures Overview

304. Residual risk is the risk that remains after flood management or mitigation measures have been installed or included within the design. This FRA has considered the residual flood risk to and from the Projects and whether there is a need for any further mitigation measures to manage the residual flood risk.

20.3.13.2 Onshore Design Mitigation

305. As previously noted, the Onshore Development 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. In addition, the Onshore Development Area is principally located in areas at low risk of surface water flooding.

306. As such, the sequential approach has been adopted in regard to the location of above-ground structures with infrastructure being located in Flood Zone 1 and at low risk of surface water flooding, where possible.

307. At the possible landfall locations, where the works have the potential to affect the tidal / coastal flood risk, it is proposed to carry out the construction of the landfall using trenchless techniques.

308. In addition, all Main Rivers 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, in some locations the depth may be up to 20m below the channel bed. Although ground disturbance will occur at entry and exit points, there will be no direct impact on the watercourses themselves.

309. However, it is noted that trenched crossings will be carried out on other smaller Ordinary Watercourses to be crossed by the onshore export cable corridor.

310. At all watercourse crossing locations, a site-specific investigation will be carried out at detailed design stage, to identify the local ground and groundwater conditions.

311. For the proposed trenched crossings this will enable a site-specific risk assessment to be undertaken and to understand the potential impact of any works on flows along the watercourse and also the flood risk in the local area.

312. During construction, the onshore export 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.

313. Following construction of the landfall and onshore export cables there will be no permanent above ground elements, except for the proposed link boxes which will, where possible, be located adjacent to field boundaries and in accessible locations. 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.

314. Furthermore, all temporary construction compounds and temporary access tracks will be fully reinstated and would have no operational use.

20.3.13.3 Flood Warning and Evacuation

315. 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 either fluvial or surface water flooding takes place during the construction stages of the development.

316. 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.

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

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

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

320. It is anticipated that the Projects 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 / machinery / materials, including moving assets to safety where possible, turning off / isolating services and moving to safety; and
- Safe access and egress routes.

321. 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 the Projects.

322. It should be noted that large parts of the onshore export 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.

323. As such the Flood Warning and Evacuation Plan will need to include independent checks of potential adverse weather conditions (i.e Met office weather warnings) alongside any alerts or warnings issued by the Environment Agency.

324. These checks will also account for risks outside flood alerts / flood warnings and will enable contractors and site managers to consider how this information will affect planned works, especially areas in close proximity to key watercourses.

325. During construction, contractors and management should liaise with the relevant risk management authorities and emergency planning officers 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, as required.

20.3.13.4 Access and Egress

326. Both onshore substation zones 1 and 4 are located within Flood Zone 1, and as such any personnel within these areas would be at low risk of flooding from fluvial sources.

327. However, there is a potential risk of surface water flooding to both onshore substation zones 1 and 4. These should be taken into account when considering the design, location and layout of the substations to ensure they are suitably located, wherever possible, and to appropriately mitigate against any potential flood risk.

328. Once operational, requirements for personnel to access the onshore substations will be limited and transient in nature, i.e. there will be no requirements to remain on site overnight.

329. As such, the onshore substations could be evacuated, upon receipt of a heavy rainfall warning, prior to flooding occurring. This ensures operators of the onshore substations would not be placed at risk during such an event.

330. In addition, the risk of surface water flooding is relatively localised in nature and egress routes from the onshore substations would be readily available to areas not identified as being at risk.

20.3.14 Conclusions

331. The Projects have been considered within the context of the guidance set out in the NPPF and the supporting PPG. On this basis, all potential sources of flood risk to the onshore infrastructure within the Onshore Development Area have been considered.

20.3.14.1 Possible landfall locations

332. The possible landfall locations are not at risk of flooding from sewers, canals or other artificial sources or reservoirs. In addition, there is a low risk of flooding associated with groundwater sources.

333. In terms of tidal flood risk to the possible landfall locations, the onshore export cables as they make landfall are likely to be required to pass under areas shown as being in Flood Zone 2 and Flood Zone 3, predominantly between Hornsea Sands and Ulrome Sands.

334. However, as the onshore export cables at landfall comprise below ground infrastructure they will not be at risk from flooding as they will be installed using trenchless techniques.

20.3.14.2 Onshore Export Cable Corridor

335. A review of the flood risk along the onshore export cable corridor has been undertaken and it has been noted that it will primarily be located in Flood Zone 1. However, there are some sections of the onshore export cable corridor which are located within Flood Zone 2 and 3 associated with a number of Main Rivers as well as Ordinary Watercourses.

336. In addition, the locations where the onshore export cable corridor crosses the Ordinary Watercourses are at increased 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.

337. The use of trenchless techniques has been embedded in the scheme design for the crossing of Main Rivers and as such the impact of flood risk in these locations would be low.

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

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

340. Once operational there will be no flood risk to or from the onshore export cables linked to fluvial, tidal, surface or sewer flooding as they will be located wholly below ground.

341. In addition, any residual risk of flooding from groundwater shall be mitigated using suitable waterproofing of the cables, links and boxes and joint bays.

20.3.14.3 Onshore Substation Zones

342. There are currently two onshore substation zones being considered for the location of the proposed onshore substations, these are known as onshore substation zone 1 and onshore substation zone 4.

343. Overall, neither onshore substation zone 1 or onshore substation zone 4 are considered to be at risk of flooding from tidal, sewers, reservoirs, canals or other artificial sources. There is also a low risk of flooding from groundwater sources.

344. In addition, onshore substation zone 1 and onshore substation zone 4 are both located in Flood Zone 1, which represents a low risk of flooding from fluvial sources.

345. With regards to the surface water flood risk, the Environment Agency Surface Water Flood Map indicates that both onshore substation zone 1 and onshore substation zone 4 have areas of surface water flood risk located within their extent.

346. The Environment Agency Surface Water Flood Map shows a surface water flow path running through onshore substation zone 1 from south to north and connecting into the Autherd Drain.

347. The Environment Agency Surface Water Flood Map indicates the presence of an Ordinary Watercourse and overland flow path which runs through the centre of onshore substation zone 4.

348. Whilst the area at increased risk is relatively small in comparison with the wider onshore substation zones, during the detailed design it should be considered with regards to the placement / location of the onshore substations within the wider onshore substation zones.

349. On this basis, whilst overall the risk of flooding from surface water is considered to be low for the onshore substation zones, there is a need to consider this flood risk in greater detail as part of the final design of the onshore substations.

350. Once operational, access to the onshore substations 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.

351. Furthermore, surface water drainage requirements for the onshore substations will be subject to considerations alongside the SuDS Hierarchy to meet the requirements of the relevant policy and guidance.

352. The operational drainage at the onshore substations will be designed taking into account of the greenfield runoff rate, proposed runoff rates, volume of storage required and the proposed approach for discharge of water from the onshore substations.

20.3.14.4 Summary of Flood Risk

353. In summary, this FRA has been undertaken in accordance with NPPF and the methodology and criteria provided for the application of the Sequential Test and Exception Test within the PPG.

354. As noted previously, principally the Projects are to be located in Flood Zone 1 and at low risk from surface water flooding, including the majority of the onshore export cable corridor and the onshore substation zones. Furthermore, there is a low risk of flooding from all other sources of flood risk.

355. Permanent above-ground structures, comprising the onshore substations, are to be located within Flood Zone 1 and are therefore in accordance with the Sequential Test guidance related to placing development in the lowest flood risk areas.

356. 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.

357. With regards to surface water flood risk, it is noted that the possible landfall locations and onshore substation zones are principally at low risk of surface water flooding, although there are areas within these zones that are at increased risk.

358. Within the onshore substation zones, whilst there are areas at increased surface water risk, the location / layout of the onshore substations within the zone, has not yet been defined as part of the Project. Therefore, it is considered that flood risk concerns can be appropriately mitigated through further assessment. On this basis, the Projects are in accordance with the Sequential Test in that areas principally at low risk have been identified over those areas at increased risk.

359. Due to the large-scale nature of the works, it is acknowledged that there are locations where infrastructure is required to pass through or to be located in Flood Zone 3 or at increased risk of surface water flooding. This relates to the onshore export cable corridor and areas adjacent to the possible landfall location. It is also noted that the principal interaction with Flood Zone 3 is at key locations along the onshore export cable corridor (associated with the need to cross existing watercourses).

360. Due to the linear nature of the Projects it is not possible to avoid these areas entirely, and whilst they have been avoided, where possible, this is not entirely possible. As such it is noted that elements of the Projects located within Flood Zone 3, comprising the onshore export cable corridor and possible landfall locations require consideration of the Exception Test.

361. 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 the Projects, as Nationally Significant Infrastructure Projects (NSIP) provide energy certainty utilising a sustainable / renewable source of energy at a national scale.

362. 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 the onshore export cable corridor as well as the onshore substation zones are not located within an area considered to be at risk of fluvial / tidal flooding.

363. Elements that are likely to pass through areas at increased risk of flooding, i.e. Flood Zone 3 or high surface water flood risk, 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.

364. For the subterranean development, it is only during the construction works that there is the potential for a temporary increase in flood risk and this will be mitigated through the use of appropriate management measures.

365. Therefore, it is considered that the second part of the Exception Test is compiled with, as it has been demonstrated that the infrastructure can de designed such that it would be safe for its lifetime, without increasing flood risk elsewhere.

366. On the basis of the flood risk identified both to and from the Project, and consideration of both the Sequential Test and Exception Test, it is therefore concluded that the Projects are appropriate in terms of flood risk and is in accordance with the NPPF.

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