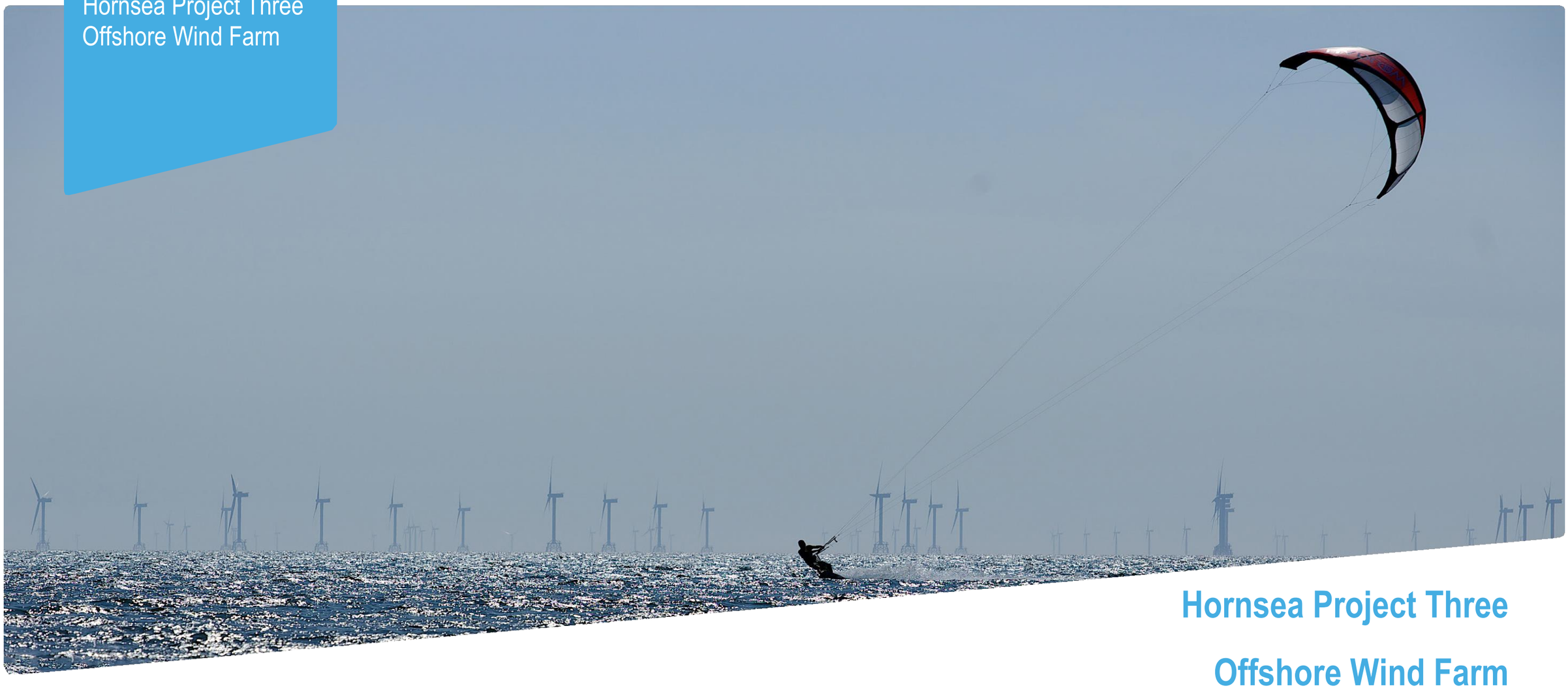
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Preliminary Environmental Information Report:
Chapter 2: Hydrology and Flood Risk

Date: July 2017

Hornsea 3
Offshore Wind Farm

DONG energy

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 3

Chapter 2: Hydrology and Flood Risk

Liability

This report has been prepared by RPS, with all reasonable skill, care and diligence within the terms of their contracts with DONG Energy Power (UK) Ltd.

Report Number: P6.3.2

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This report is also downloadable from the Hornsea Project Three offshore wind farm website at:
www.dongenergy.co.uk/hornseaproject3

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Front cover picture: Kite surfer near one of DONG Energy's UK offshore wind farms © DONG Energy Hornsea Project Three (UK) Ltd., 2016.

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Glossary

Term	Definition
Anglian Water	Anglian Water is a water company which supplies drinking water, drainage and sewerage services for the East of England via a network of pipe and pump infrastructure.
Aquifer	A body of permeable rock which can contain or transmit groundwater.
Catchment Flood Management Plan	Catchment Flood Management Plans (CFMPs) are documents produced by the Environment Agency with the aim to establish flood risk management policies which will deliver sustainable flood risk management for the long term across a catchment. They consider all types of inland flooding, from rivers, groundwater, surface water and tidal flooding within specific river basin district.
Catchments	An area that serves a watercourse with rainwater. Every part of land where the rainfall drains to a single watercourse is in the same catchment.
Climate change	A long term change in weather patterns, in the context of flood risk, climate change will produce more frequent severe rainfall.
Discharge consents	Consent granted by the Environment Agency to discharge into watercourses, subject to conditions.
Drainage Board (DB)	Drainage Boards are an integral part of water level management in the UK. Each DB is a local public authority established in areas of special drainage need in England and Wales. They have permissive powers to manage water levels within their respective drainage districts. They undertake works to reduce flood risk to people and property and manage water levels to meet local needs.
Exceptions Test	The Exceptions Test ensures that development is permitted in flood risk areas only in exceptional circumstances and when strict qualifying conditions have been met. It is carried out if the Sequential Test demonstrates that a development cannot be located in areas of low flood risk.
Field drainage	Limiting the effect of flooding by maintaining surface water and land drainage systems.
Flood Defences	A structure that is used to reduce the probability of floodwater affecting a particular area.
Flood risk assessment	A flood risk assessment is an assessment of the risk of flooding from all flood mechanisms, including the identification of flood mitigation measures, in order to satisfy the requirements of the NPPF and Planning Practice Guidance.
Flood Zone 1	Low Probability Land having a less than 1 in 1,000 annual probability of river or sea flooding.
Flood Zone 2	Medium Probability Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Flood Zone 3a	High Probability Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
Flood Zone 3b	The Functional Floodplain. This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.
Fluvial Flooding	Fluvial flooding occurs when rivers burst their banks as a result of sustained or intense rainfall.
Geology	The scientific study of the origin, history and structure of the earth.
Greenfield Runoff Rate	Rates of surface water run-off from a site that is undeveloped (greenfield).
Ground Conditions	An assessment of the history and chemical and physical characteristics of the soil conditions at a site.
Groundwater	All water which is below the surface of the ground in the saturated zone and in direct contact with the ground or subsoil.
Horizontal Directional Drilling (HDD)	Method for the installation of pipes, conduits and cables using a surface-launched drilling rig, this is used as a proxy for trenchless technology.
Hydrology	The study of the movement, distribution, and quality of water.
Lead Local Flood Authority (LLFA)	Lead Local Flood Authorities have responsibility for developing a Local Flood Risk Management Strategy for their area covering local sources of flooding. The local strategy produced must be consistent with the national strategy. It will set out the local organisations with responsibility for flood risk in the area, partnership arrangements to ensure co-ordination between these organisations, an assessment of the flood risk, and plans and actions for managing the risk.
Local authority (LA)	An administrative body in local government.
Main rivers	The term used to describe a water course in respect of which the Environment Agency has permissive powers in relation to its management.
Minor watercourses	The term used to describe a water course owned and operated by a local Drainage Board, a Lead Local Flood Authority or a private land owner.
National Planning Policy Framework (NPPF)	The National Planning Policy Framework sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. .
Ordinary watercourses	A river, stream, ditch, cut, sluice, dyke or non-public sewer that is not a designated Main river, and for which the local authority has flood risk management responsibilities and powers.
River Basin Management Plan (RBMPs)	River Basin Management Plans describe the river basin district, and the pressures that the water environment faces. It shows what this means for the current state of the water environment in the river basin district, and what actions will be taken to address the pressures. It sets out what improvements are possible by 2015 and how the actions will make a difference to the local environment - the catchments, estuaries, the coast and groundwater.
Sequential Test	A Sequential Test aims to steer new development to areas with the lowest probability of flooding by recommending that development is not allocated if there are reasonably available sites appropriate to the proposed development in areas with a lower probability of flooding.
Shoreline Management Plan	A Shoreline Management Plan is a large-scale assessment of the risks associated with coastal processes and sets out a policy framework to address these risks to people and the developed, historic and natural environments. Coastal processes include tidal patterns, wave height, wave direction and the movement of beach and seabed materials.
Strategic Flood Risk Assessment	A Strategic Flood Risk Assessment provides information on areas at risk from all sources of flooding.
Surface Water Management Plan	A tool to understand, manage and coordinate surface water flood risk between relevant stakeholders.
Surface water resources	Water on the surface of the land such as in a river, lake, wetland, or ocean.
Surface water run-off	Surface water run-off is flow of water that occurs when excess stormwater, meltwater, or other sources of water flows over a surface.

Term	Definition
Sustainable urban drainage systems (SuDs)	A sequence of management practices and control measures designed to mimic natural drainage processes by allowing rainfall to infiltrate, and by attenuating and conveying surface water runoff slowly at peak times.
Tidal (Coastal) flooding	Tidal flooding is caused by extreme tidal conditions including high tides and storm surges, overtopping local flood defences or coastal features.
Treated Effluent	Water that has received primary, secondary or advanced treatment to reduce its pollution or health hazards and is subsequently released from a wastewater facility after treatment.
UK Climate Projections 2009 (UKCP09)	Climate projections expressed in terms of absolute values. A projection of the response of the climate system to emission scenarios of greenhouse gases and aerosols, or radiative forcing scenarios based upon climate model simulations and past observations.
Undefended Flood Zone	Environment Agency mapped river and sea flood water extents which do not take into account the presence of flood defences.
Water Framework Directive (WFD)	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.
Water Quality	The physical, chemical and biological characteristics of water.

Acronym	Description
LLFA	Lead Local Flood Authority
MHWS	Mean High Water Springs
NPPF	National Planning Policy Framework
NPS	National Policy Statement
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
SPZ	Source Protection Zones
SSSI	Sites of Special Scientific Interest
SuDS	Sustainable Urban Drainage Systems
UKCP09	UK Climate Projections 2009
WFD	Water Framework Directive
WRA 1991	Water Resources Act 1991

Acronyms

Acronyms used within the PEIR are presented in the table below.

Acronym	Description
AONB	Area of Outstanding Natural Beauty
CoCP	Code of Construction Practices
CFMP	Catchment Flood Management Plan
DB	Drainage Board
DCLG	Department for Communities and Local Government
DECC	Department of Energy and Climate Change
Defra	Department of Food and Rural Affairs
EIA	Environmental Impact Assessment
FRA	Flood Risk Assessment
HDD	Horizontal Directional Drilling
LA	Local Authority
LDA 1991	Land Drainage Act 1991

Unit

Unit	Description
km	Kilometre
m	Metre
ha	Hectare
mm	Millimetre
m^2	Meter Squared

2. Hydrology and Flood Risk

2.1 Introduction

2.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the findings to date of the Environmental Impact Assessment (EIA) of the onshore elements of the Hornsea Project Three offshore wind farm (hereafter referred to as Hornsea Three) relevant to hydrology and flood risk (namely the Hornsea Three landfall area, the onshore cable corridor search area, the onshore HVAC booster station, the onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main National Grid substation), during its construction, operation and maintenance, and decommissioning. The onshore cable corridor search area comprises a 200 m wide corridor within which the refined onshore cable corridor (80 m wide) will be located. The refined onshore cable corridor will be included in the application for Development Consent. The onshore HVAC booster station is an option which would only be considered for the HVAC transmission option (see volume 1, chapter 3: Project Description).

2.1.1.2 This chapter summarises information from technical reports which are included at volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.

2.2 Purpose of this chapter

2.2.1.1 The primary purpose of the Environmental Statement is to support the Development Consent Order (DCO) application for Hornsea Three under the Planning Act 2008 (the 2008 Act). This PEIR constitutes the Preliminary Environmental Information for Hornsea Three and sets out the findings of the EIA to date to support pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of Statefor Development Consent.

2.2.1.2 The PEIR will form the basis for Phase 2 Consultation which will commence on 27 July and conclude on 20 September 2017. At this point, comments received on the PEIR will be reviewed and incorporated (where appropriate) into the Environmental Statement, which will be submitted in support of the application for development Consent scheduled for the second quarter of 2018.

2.2.1.3 This hydrology and flood risk chapter will:

- Present the existing environmental baseline established from desk studies, dedicated surveys and consultation;
- Present the potential environmental effects on hydrology and flood risk arising from Hornsea Three, based on the information gathered and the analysis and assessments undertaken to date;
- Identify any assumptions and limitations encountered in compiling the environmental information; and
- Highlight any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified at the relevant stage in the PEIR process.

2.2.1.4 The effects considered in this chapter include those on hydrology and surface water resources that form part of the onshore physical environment. Effects on hydrogeology and groundwater (including groundwater abstractions) are considered in volume 3, chapter 1: Geology and Ground Conditions.

2.3 Study area

2.3.1.1 The hydrology and flood risk study area is shown on Figure 2.1 and comprises the onshore elements of Hornsea Three (as described in paragraph 2.1.1.1) and the potential locations for the main compound, plus a 1 km buffer around the proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation, and a 250 m buffer around the Hornsea Three landfall and the onshore cable corridor search area. The potential locations of the main compounds are identified in volume 1, chapter 3: Project Description. Additional compounds will be required to facilitate the construction process and will be identified in the Environmental Statement.

2.3.1.2 The buffer size used for the study area was primarily to allow for refinement in final location and alignments of onshore infrastructure. A 250 m radius is considered appropriate for data collection taking into account the nature of the development and likely zone of influence on hydrological receptors. Given the landscape surrounding the development and ongoing anthropogenic activities it will be difficult to ascertain the exact source of any impacts on water quality beyond 250 m. The 1 km buffer was selected for the onshore HVAC booster station and onshore HVDC converter/HVAC substation to identify any potential receptors that might be affected by the proposed development.

2.3.1.3 The scope of the PEIR assessment for hydrology and flood risk has been discussed with the local planning authorities leading up to the PEIR submission and further feedback is welcomed at this stage.

2.4 Planning policy context

2.4.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to hydrology and flood risk, is contained in the Overarching National Policy Statement (NPS) for Energy EN-1 (Department of Energy and Climate Change (DECC), 2011a), the NPS for Renewable Energy Infrastructure EN-3 (DECC, 2011b) and the NPS for Electricity Networks Infrastructure EN-5 (DECC, 2011c).

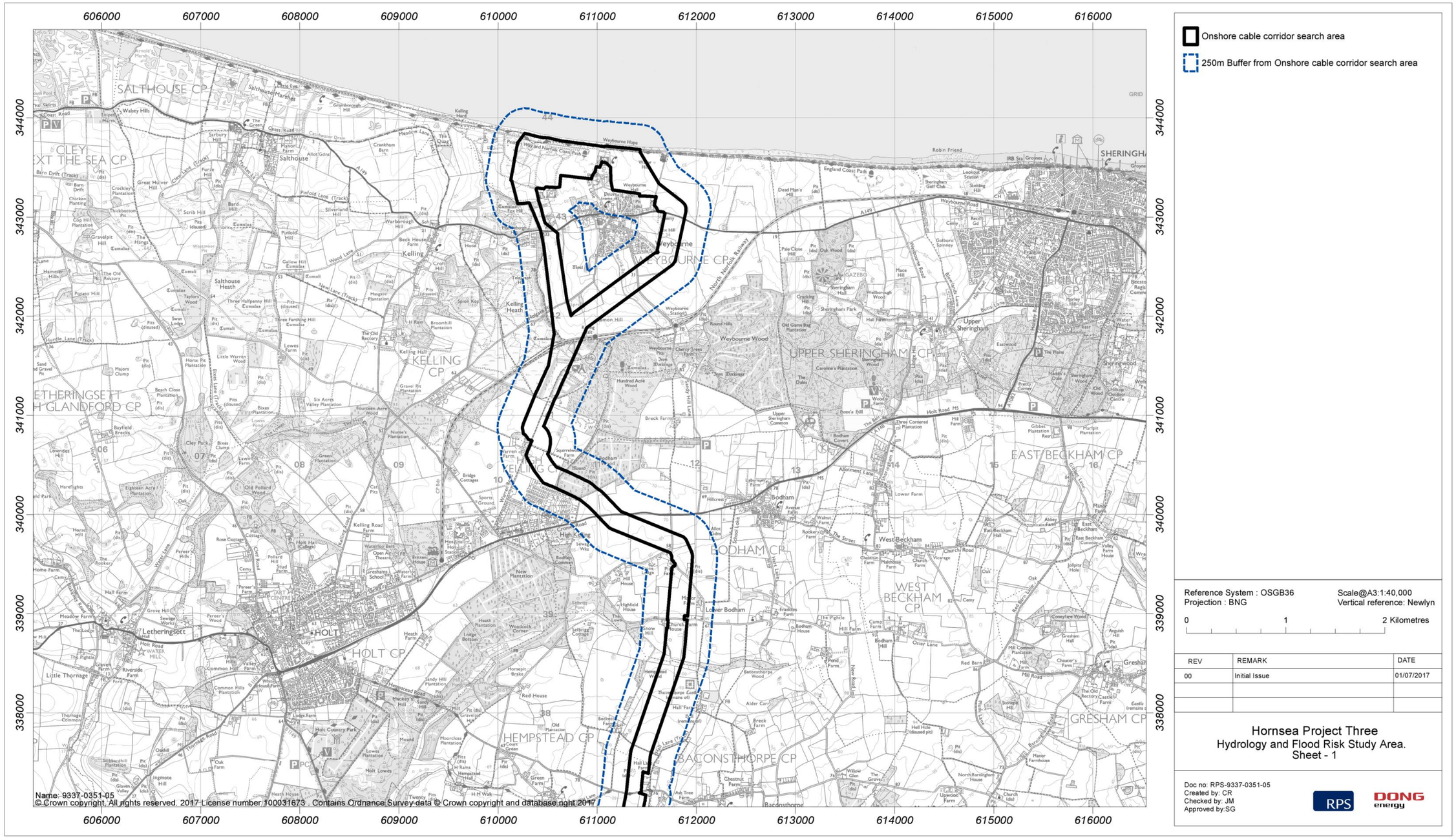
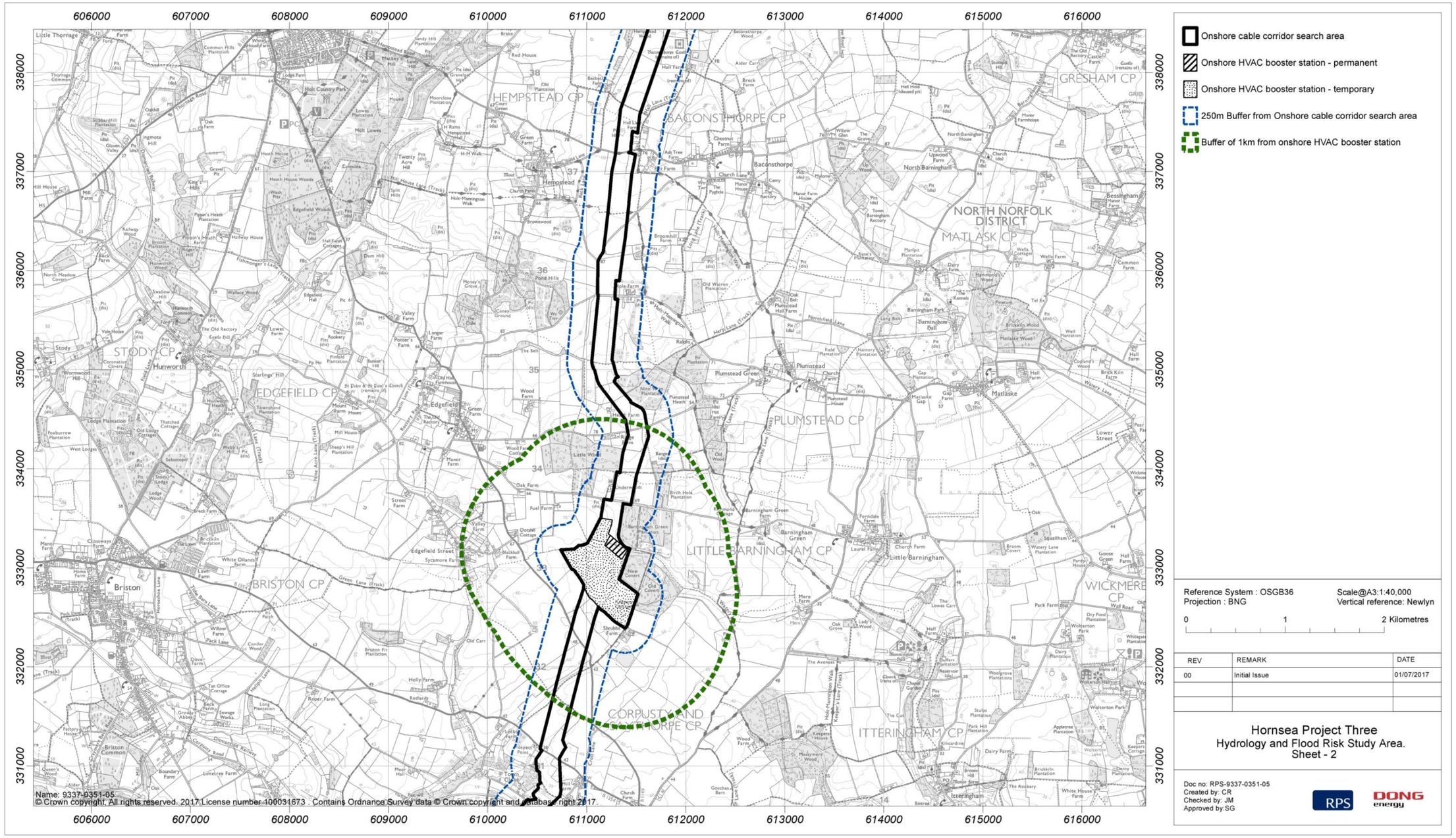


Figure 2.1: Hornsea Three hydrology and flood risk study area.



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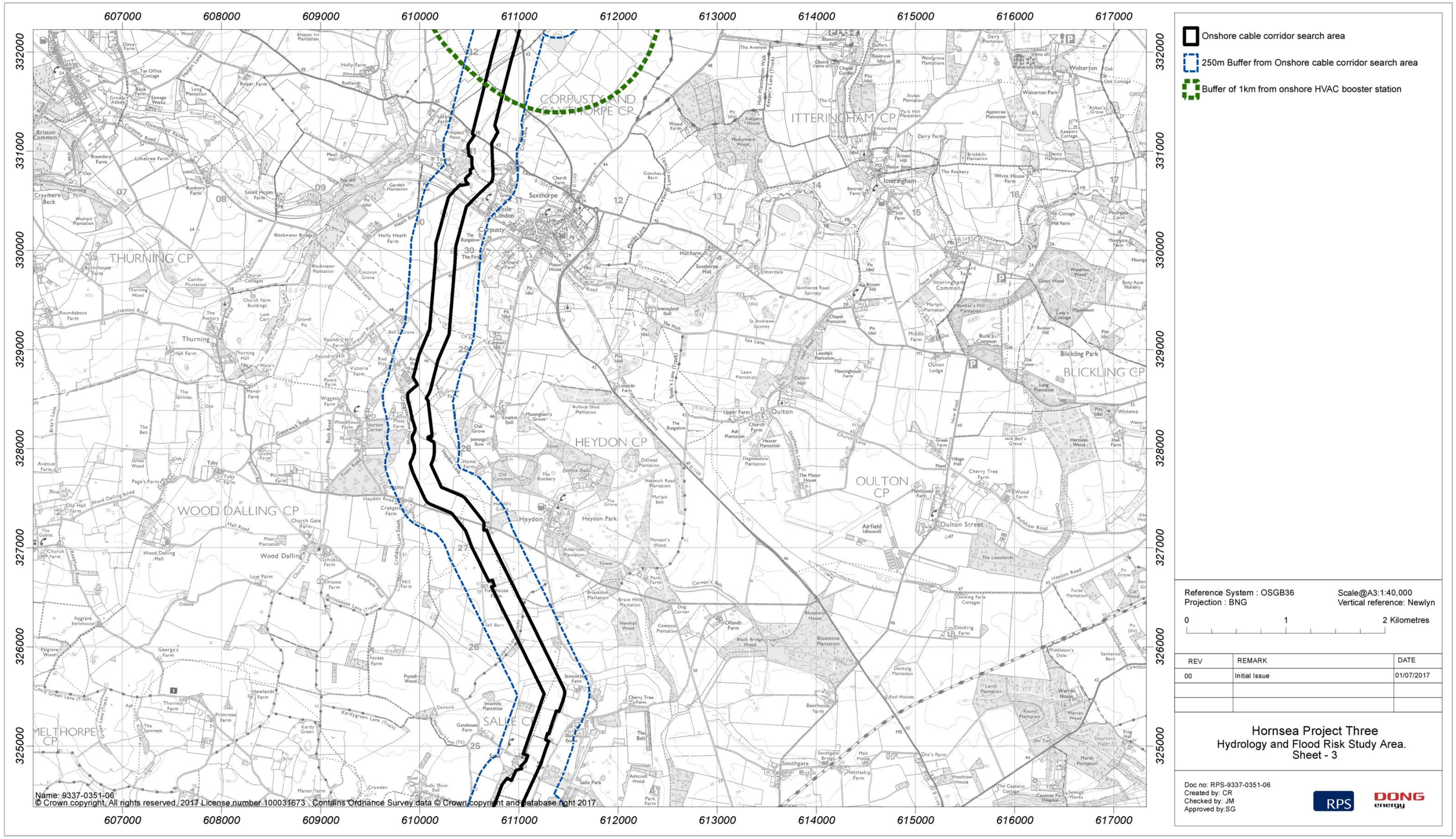

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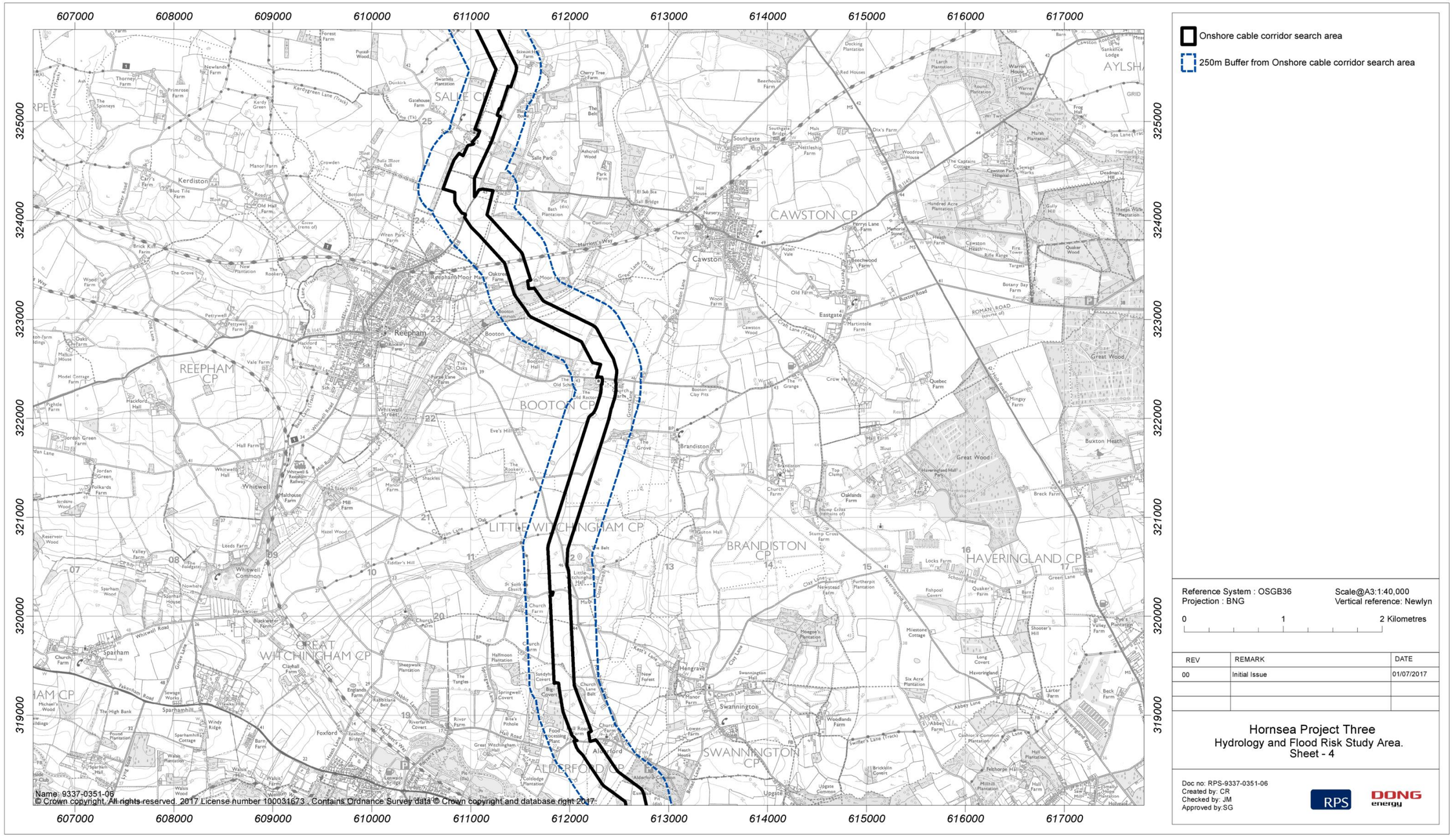

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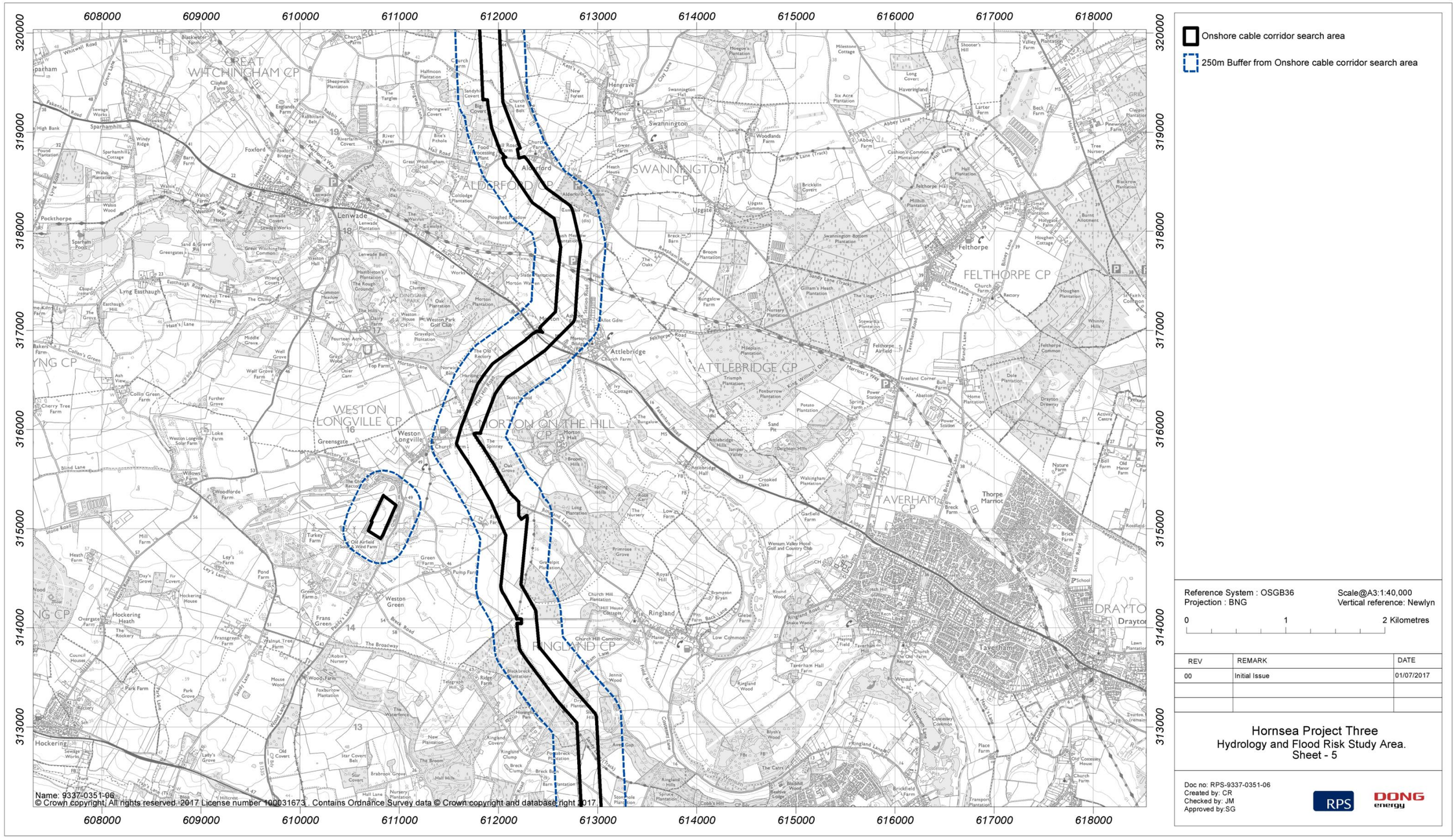

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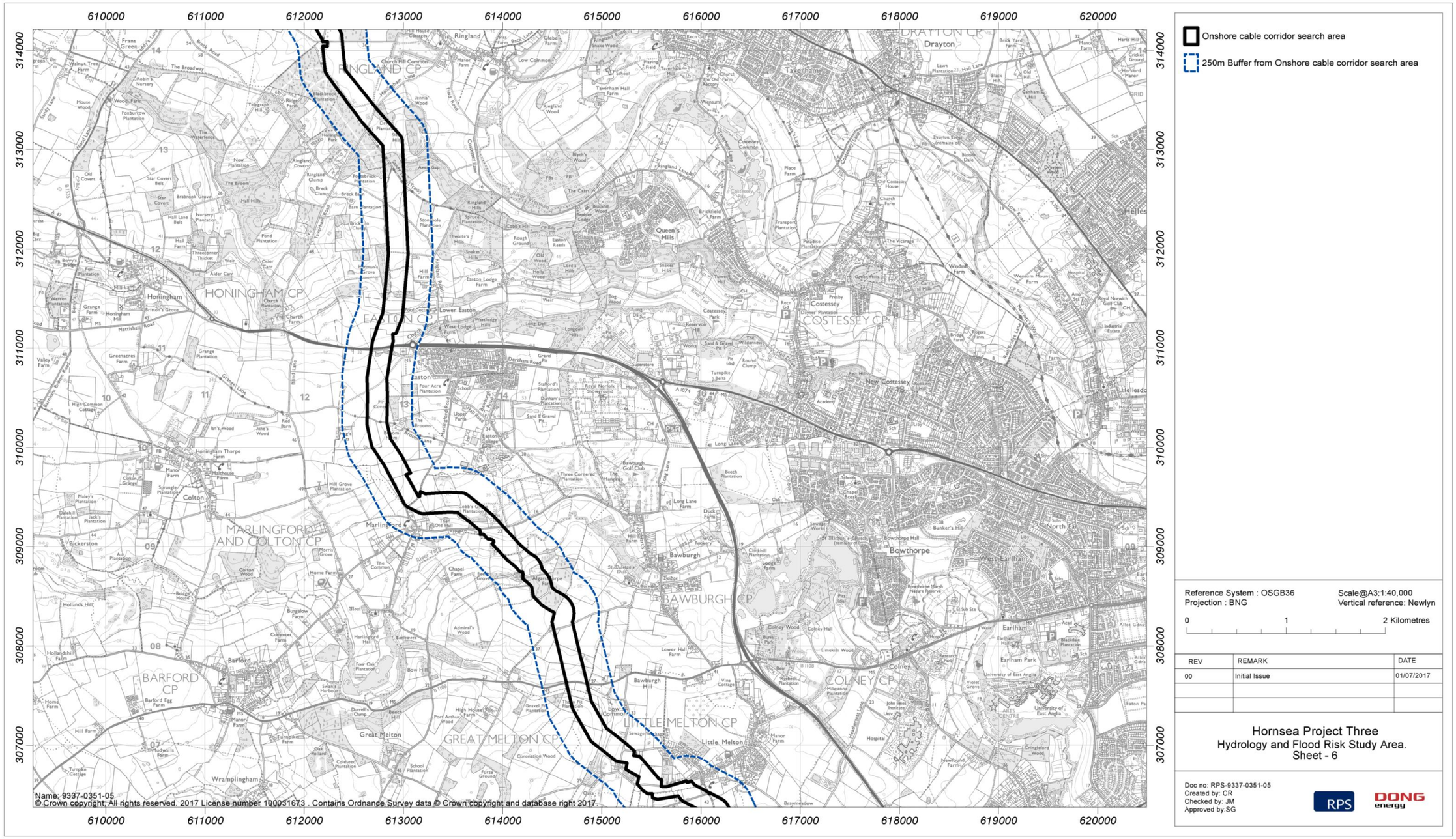

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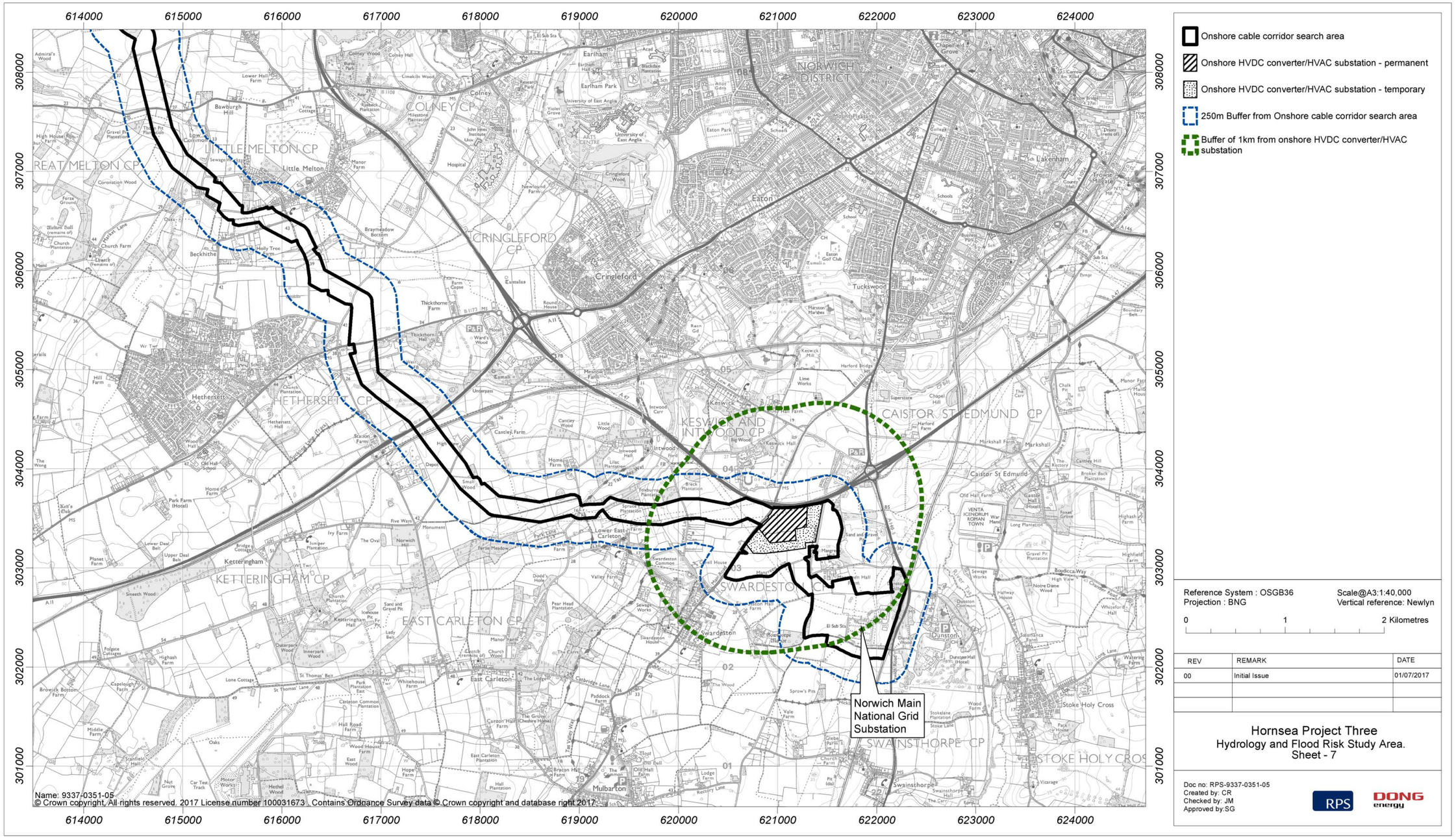

Figure 2.1: Hornsea Three hydrology and flood risk study area.

Specifically, the guidance provided within NPS EN-1, NPS EN-3 and NPS EN-5 was considered. Paragraph 4.8.6 (NPS EN-1) specifically identifies that applicants should have regard to climate change and should assess the resilience of their project to climate change. Paragraph 2.4.1 of NPS EN-5 specifically identifies the potential issues applicants should consider in terms of resilience to climate change. These are summarised in

2.4.1.2 Table 2.1 below. Other legislation, planning policy and guidance relevant to this chapter includes:

- National Planning Policy Framework (NPPF) (2012);
- North Norfolk District Council Core Strategy (2008);
- Joint Core Strategy (covering Broadland District, Norwich City and South Norfolk District (2011);
- Flood and Water Management Act 2010;
- Land Drainage Act 1991; and
- Water Resources Act 1991.

Table 2.1: Summary of NPS EN-1, EN-3 and EN-5 provisions relevant to hydrology and flood risk.

Summary of NPS EN-1, NPS EN-3 and NPS EN-5 policy relevant to the assessment of hydrology and flood risk	How and where considered in the PEIR
Climate change adaption	
Applicants for new energy infrastructure must take into account the potential impacts of climate change using the latest UK Climate Projections available at the time the ES was prepared to ensure they have identified appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. Should a new set of UK Climate Projections become available after the preparation of the ES, the decision maker should consider whether they need to request further information from the applicant (paragraph 4.8.6 NPS EN-1).	The characterisation of the flood risk baseline and future baseline has been established using the Environment Agency Flood Map for Planners and Strategic Flood Risk Assessments, which take into account climate change (see section 2.7.10). A site specific flood risk assessment (FRA) has been undertaken for the onshore HVAC booster station and HVDC converter/HVAC substation sites in line with the National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG) ID7 – Flood Risk and Coastal Change and includes a climate change allowance based on findings of the UK Climate Projections report (UKCP09) (2010).
Offshore and onshore wind farms are less likely to be affected by flooding but applicants should particularly set out how the proposal would be resilient to storms (paragraph 2.3.4 of NPS EN-3).	Resilience to storms is discussed in volume 2, chapter 1: Marine Processes in relation to the Hornsea Three landfall site. The resilience to flood risk along the onshore export cable route and at the onshore HVAC booster station and onshore HVDC converter/HVAC substation are set out within this chapter (chapter 2: hydrology and flood risk, Table 2.15) and volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.
As climate change is likely to increase risks to the resilience of some electricity infrastructure from flooding, for example, or in situations where it is located near the coast or is underground, applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and as appropriate, how it would be resilient to flooding, particularly for substations that are vital for the electricity transmission and distribution network (paragraph 4.4.1 NPS EN-5).	FRAs have been prepared for the proposed onshore HVAC booster station and HVDC converter/HVAC substation. The FRA forms volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.
Flood risk	
Applications for energy projects of 1 ha or greater in Flood Zone 1 in England and all proposals for energy projects located on Flood Zone 2 and 3 in England should be accompanied by an FRA. An FRA will also be required where an energy project less than 1 ha may be subject to sources of flooding other than rivers and the sea (for example surface water), or where the Environment Agency, Drainage Board or other body have indicated that there may be drainage problems. The FRA should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account (paragraph 5.7.4 of NPS EN-1).	FRAs have been prepared for the proposed onshore HVAC booster station and HVDC converter/HVAC substation as each site exceeds 1 ha. The FRAs are contained in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.

Summary of NPS EN-1, NPS EN-3 and NPS EN-5 policy relevant to the assessment of hydrology and flood risk	How and where considered in the PEIR
The minimum requirements for FRAs provided by applicants are that they should: • Be proportionate to the risk and appropriate to the scale, nature and location of the project; • Consider the risk of flooding arising from the project in addition to the risk of flooding to the project; • Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made; • Be undertaken by competent people, as early as possible in the process of preparing the proposal; • Consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure; • Consider the vulnerability of those using the site, including arrangements for safe access; • Consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made; • Consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes; • Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project; • Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems; • Consider if there is a need to be safe and remain operational during a worst case flood event over the development's lifetime; and • Be supported by appropriate data and information, including historical information on previous events (paragraph 5.7.5 NPS EN-1).	FRAs fulfilling the requirements stipulated within NPS EN-1 have been prepared. The FRAs are contained in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.
Further guidance can be found in Practice Guide which accompanies Planning Policy Statement 25 (PPS25) or successor documents (paragraph 5.7.6 NPS EN-1).	FRAs have been prepared taking into account the requirements of NPPF and PPG ID7 on flood risk. The FRAs are contained in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.
Applicants for the projects which may be affected by, or may add to, flood risk should arrange pre-application discussions with the Environment Agency and, where relevant other bodies such as Drainage Boards, sewerage undertakers, highways authority and reservoir owners and operators (paragraph 5.7.7 of NPS EN-1).	The Environment Agency, Norfolk County Council (Lead Local Flood Authority (LLFA)) and Norfolk Rivers Internal Drainage Board (IDB) have been consulted during the project to date as detailed in Table 2.3.
Consultation on the assessment methodologies should be undertaken at early stages with the Environment Agency (paragraph 5.7.8 of NPS EN-1).	The Environment Agency, LLFA and IDB have been consulted during the project to date as detailed in Table 2.3.
Water quality and resources	
The applicant should undertake an assessment of the existing status of, and impacts of the proposed project on water quality, water resources and physical modifications to the water environment (paragraph 5.15.2 of NPS EN-1).	The baseline environment (Section 2.7) is described for the hydrology and flood risk study area. An assessment of the impacts on water quality, resources and physical characteristics is provided in paragraphs 2.10.2.15 to 2.10.2.27.
The ES should in particular describe: • The existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges; • Existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies); • Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and • Any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions (paragraph 5.15.3 NPS EN-1).	Baseline water quality and resources for the hydrology and flood risk study area are described in Section 2.7. Watercourses in the hydrology and flood risk study area have been identified and information on abstractions, discharges, pollution incidents and water quality has been provided (see volume 6, annex 2.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents. The impacts on surface water courses are described in section 2.7. The impacts on SPZs are covered in chapter 1: Geology and Ground Conditions. A review of the Water Framework Directive (WFD) classifications for watercourses within the hydrology and flood risk study area has been undertaken (see Table 2.6).

2.4.1.3 NPS EN-1 and NPS EN-3 also highlight a number of points relating to the determination of an application and in relation to mitigation. These are summarised in Table 2.2 below.

Table 2.2: Summary of NPS EN-1 and NPS EN-3 policy on decision making relevant to this chapter.

Summary of NPS EN-1 policy on decision making (and mitigation) in relation to hydrology and flood risk	How and where considered in the PEIR
Climate change adaption	
The decision maker should be satisfied that there are no features of the design of new energy infrastructure critical to its operation which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections, taking account of the latest credible scientific evidence on, for example, sea level rise (for example by referring to additional maximum credible scenarios – i.e. from the Intergovernmental Panel on Climate Change or Environment Agency) and that necessary action can be taken to ensure the operation of the infrastructure over its estimated lifetime (paragraph 4.8.8 NPS EN-1).	Climate change has been taken into account in the characterisation of the baseline and future baseline environment (see paragraphs 2.7.10.1 to 2.7.10.5). Climate change is also considered in the FRA (see volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment).
Flood risk	
The decision maker should be satisfied that where relevant: the application is supported by an appropriate FRA; the Sequential Test has been applied as part of site selection; a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk; the proposal is in line with any relevant national and local flood risk management strategy; priority has been given to the use of sustainable urban drainage systems (SuDs) (as required in the next paragraph on National Standards); and in flood risk areas the project is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development (paragraph 5.7.9 NPS EN-1).	FRAs have been prepared, (see volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment) which consider the flood risks from the proposed development. The FRAs note that the development is sequentially acceptable. The FRAs have been undertaken in line with NPS EN-1, NPPF and PPG ID7 - Flood Risk and Coastal Change. Drainage strategies have also been prepared in line with SuDS, the key points of which are summarised in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.
The decision maker will need to be satisfied that the proposed drainage system complies with any National Standards published by Ministers under Paragraph 5(1) of Schedule 3 to the Flood and Water Management Act 2010. In addition, the DCO, or any associated planning obligations, will need to make provision for the adoption and maintenance of any SuDS, including any necessary access rights to property. The decision maker should be satisfied that the most appropriate body is being given the responsibility for maintaining any SuDS, taking into account the nature and security of the infrastructure on the proposed site. The responsible body could include, for example, the applicant, the landowner, the relevant local authority (LA), or another body, such as a Drainage Board (paragraph 5.7.10 NPS EN-1).	Drainage strategies have been prepared and are provided in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment. Drainage provisions will be set out in an agreement with the relevant LLFA.
The decision maker should not consent development in Flood Zone 2 in England unless it is satisfied that the Sequential Test requirements have been met. It should not consent development in Flood Zone 3 or Zone C unless it is satisfied that the Sequential and Exception Test requirements have been met. The technology-specific NPSs set out some exceptions to the application of the Sequential Test. However, when seeking development consent on a site allocated in a development plan through the application of the Sequential Test, informed by a strategic flood risk assessment, applicants need not apply the Sequential Test, but should apply the sequential approach to locating development within the site. (Paragraph 5.7.12 NPS EN-1).	The proposed onshore HVDC converter/HVAC substation and HVAC booster station are shown to be located entirely within Flood Zone 1 (volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment). Therefore, the Sequential Test for development has been met. The approach to flood risk and the assessment are described in the FRA (see annex 2.1) and has been summarised in this chapter (see paragraph 2.6.4.2 and 2.6.4.3). A small section of the onshore HVDC converter/HVAC substation is shown to be at risk from surface water flooding. Appropriate mitigation measures are outlined within the FRA (volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment).
Preference should be given to locating projects in Flood Zone 1 in England. If there is no reasonably available site in Flood Zone 1, then projects can be located in Flood Zone 2. If there is no reasonably available site in Flood Zones 1 or 2, then nationally significant energy infrastructure projects can be located in Flood Zone 3 subject to the Exception Test. Consideration of alternative sites should take account of the policy on alternatives (paragraph 5.7.13 NPS EN-1).	The entirety of the onshore HVAC booster station and the majority of the HVDC converter/HVAC substation and are located in Flood Zone 1 (as described in paragraphs 2.7.9.2 to 2.7.9.7). The approach to flood risk and the assessment are described in the FRA (see volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment) and has been summarised in this chapter (see paragraphs 2.6.4.2 and 2.6.4.3). Alternative sites are discussed in volume 1, chapter 4: Site Selection and Consideration of Alternative Sites.
The decision maker will find an Exception Test to be only appropriate for use where the Sequential Test alone cannot deliver an acceptable site, taking into account the need for energy infrastructure to remain operational during floods. It may also be appropriate to use it where as a result of the alternative site(s) at lower risk of flooding being subject to national designations such as landscape, heritage and nature conservation designations, for example Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS) it would not be appropriate to require the development to be located on the alternative site(s) (paragraph 5.7.15 NPS EN-1).	The approach to flood risk and the assessment are described in the FRA (see volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment) and has been summarised in this chapter (see paragraph 2.6.4.2 and 2.6.4.3). The Sequential Test has been applied by the LA and the site was found to be acceptable and therefore an Exception Test is not required.

Summary of NPS EN-1 policy on decision making (and mitigation) in relation to hydrology and flood risk	How and where considered in the PEIR
If an Exception Test is required the decision maker will have to be satisfied that all three elements of the test will have to be passed for development to be consented. For the Exception Test to be passed: • *"It must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk;* • *The project should be on developable, previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable, previously developed land subject to any exceptions set out in the technology-specific NPSs; and* • *An FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere subject to the exception below and, where possible, will reduce flood risk overall"* (paragraph 5.7.16 NP EN-1).	An Exception Test is not required as the Sequential Test demonstrated that the site is acceptable as described in the FRA (see volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment).

To satisfactorily manage flood risk, arrangements are required to manage surface water and the impact of the natural water cycle on people and property. The term SuDS refers to the whole range of sustainable approaches to surface water drainage management including, where appropriate:
• Source control measures including rainwater recycling and drainage; infiltration devices to allow water to soak into the ground, that can include:
  • Individual soakaways and communal facilities;
  • Filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns;
  • Filter drains and porous pavements to allow rainwater and run-off to infiltrate into permeable material below ground and provide storage if needed;
  • Basins ponds and tanks to hold excess water after rain and allow controlled discharge that avoids flooding; and
  • Flood routes to carry and direct excess water through developments to minimise the impact of severe rainfall flooding.
Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts. The surface water drainage arrangements for any project should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, unless specific off-site arrangements are made and result in the same net effect. It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site. There may be circumstances where it is appropriate for infiltration facilities or attenuation storage to be provided outside the project site, if necessary through the use of a planning obligation (paragraph 5.7.18 to 5.7.22 NPS EN-1).
	The entirety of the onshore HVAC booster station and the majority of the HVDC converter/HVAC substation and are located in Flood Zone 1 (as described in paragraphs 2.7.9.2 to 2.7.9.7). The Sequential Test has been applied and has been passed.
	Drainage designs will incorporate drainage measures in line with the requirements of NPS EN-1 and the NPPF.
	The approach to flood risk is presented in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment and has been summarised in this chapter (see paragraph 2.6.4.2 and 2.6.4.3).

The sequential approach should be applied to the layout and design of the project. More vulnerable uses should be located on parts of the site at lower probability and residual risk of flooding. Applicants should seek opportunities to use open space for multiple purposes such as amenity, wildlife habitat and flood storage uses. Opportunities should be taken to lower flood risk by reducing the built footprint of previously developed sites and using SuDS. Essential energy infrastructure which has to be located in flood risk areas should be designed to remain operational when floods occur. In addition, any energy projects proposed in Flood Zone 3b the Functional Floodplain (where water has to flow or be stored in times of flood), or Zone C2 in Wales, should only be permitted if the development will not result in a net loss of floodplain storage, and will not impede water flows. The receipt of and response to warnings of floods is an essential element in the management of the residual risk of flooding. Flood Warning and evacuation plans should be in place for those areas at an identified risk of flooding. The applicant should take advice from the emergency services when producing an evacuation plan for a manned energy project as part of the FRA. Any emergency planning documents, flood warning and evacuation procedures that are required should be identified in the FRA (paragraph 5.7.23 to 5.7.25 NPS EN-1).	The entirety of the onshore HVAC booster station and the majority of the HVDC converter/HVAC substation and are located in Flood Zone 1 (as described in paragraphs 2.7.9.2 to 2.7.9.7). The Sequential Test has been passed. The drainage design will incorporate drainage measures in line with the requirements of NPS EN-1 and the NPPF. The approach to flood risk and the proposed drainage strategy is presented in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment and has been summarised in this chapter (see paragraph 2.6.4.2 and 2.6.4.3).
Water quality and resources	
The decision maker should satisfy itself that a proposal has regard to the River Basin Management Plans and meets the requirements of the Water Framework Directive and its daughter directives, including those on priority substances and groundwater. The specific objectives for particular river basins are set out in River Basin Management Plans. The decision maker should also consider the interactions of the proposed project with other plans such as Water Resources Management Plans and Shoreline/Estuary Management Plans (paragraph 5.15.6 NPS EN-1).	The assessment and the proposed mitigation measures have taken into account the requirements of the River Basin Management Plan and Water Framework Directive (WFD) to ensure all potential impacts on the water environment are mitigated to within acceptable levels (see Table 2.15).
The decision maker should consider whether appropriate requirements should be attached to any development consent and/or planning obligations entered into to mitigate adverse effects on the water environment (paragraph 5.15.7 NPS EN-1).	This has been described and considered in relation to the site flood risk and hydrology within the assessment of Hornsea Three.
The decision maker considers whether mitigation measures are needed over and above any which may form part of the project application. A construction management plan may help codify mitigation at that stage. The risk of impacts on the water environment can be reduced through careful design to facilitate adherence to good pollution control practice. For example, designated areas for storage and unloading, with appropriate drainage facilities, should be clearly marked. The impact on local water resources can be minimised through planning and design for the efficient use of water, including water recycling (paragraphs 5.15.8 to 5.15.10 of NPS EN-1).	The approach to flood risk is presented in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment and has been summarised in this chapter (see paragraph 2.6.4.2and 2.6.4.3).

2.4.2 National Planning Policy Framework (2012)

2.4.2.1 The National Planning Policy Framework (NPPF) is a material consideration in determining planning applications. Paragraphs 99 to 108 of the NPPF outline the development requirements in terms of flood risk, water quality and resources and the impact of climate change. The NPPF stipulates that a site specific Flood Risk Assessment (FRA) is required for all proposals for new development in Flood Zones 2 and 3, and for any proposed development covering an area of 1 ha or greater in Flood Zone 1.

2.4.2.2 On 6 March 2014 the Department for Communities and Local Government (DCLG) launched the PPG as a web-based resource. PPG provides planning guidance on a range of topics including flood risk. PPG ID7 (March 2014) for Flood Risk and Coastal Change provides additional guidance in the implementation of the NPPF in relation to development and flood risk.

2.4.2.3 Further details on the NPPF and PPG ID7 Flood Risk and Coastal Change are provided in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.

2.4.3 Local Planning Policy

2.4.3.1 The onshore elements of Hornsea Three (as defined in paragraph 2.1.1.1) site falls within the administrative area of Norfolk County Council, North Norfolk District Council, Broadland District Council, South Norfolk District Council and Norfolk Rivers IDB. A summary of the relevant planning policy, legislation and Local Development Plans specific to Hornsea Three is provided below.

North Norfolk District Council Core Strategy

2.4.3.2 The Hornsea Three landfall, onshore HVAC booster station and the northern section of the onshore cable corridor search area are located within the district of North Norfolk. The Council is currently reviewing its Local Plan. The new Local Plan will provide the planning policy context for development across the whole of North Norfolk for the period 2016 – 2036 and the first draft will be presented to Secretary of State for independent examination by spring 2018. Until the revised Plan has been adopted, the main document for determining planning application and development matters is the existing Local Development Framework, of which the Core Strategy is the primary document of note.

2.4.3.3 Policy EN 10 covers Hydrology and Flood Risk. It states that "*The sequential test will be applied rigorously across North Norfolk and most new development should be located in Flood Risk Zone 1. New development in Flood Risk Zones 2 and 3a will be restricted to the following categories*:

- *water compatible uses;*
- *minor development;*
- *changes of use (to an equal or lower risk category in the flood risk vulnerability classification);*
- *where there is no operational development; and*
- *'Less vulnerable' uses where the sequential test has been passed.*

New development in Flood Zone 3b will be restricted to water compatible uses only.

The Strategic Flood Risk Assessment defines zones 2, 3a and 3b in parts of North Norfolk and this will be used to inform the application of the sequential test. Where this information is not available, the Environment Agency Flood Risk Zones and a site specific FRA will be used to apply the sequential test.

A site-specific FRA which takes account of future climate change must be submitted with appropriate planning applications in Flood Zones 2, 3a and 3b and for development proposals of 1 hectare or greater in Flood Zone 1.

Land in Flood Zone 1 that is surrounded by areas of Flood Zones 2 or 3 will be treated as if it is in the higher risk zone and a FRA will be required to prove that safe access / egress exists for the development or that the land will be sustainable for the duration of the flood period.

Appropriate surface water drainage arrangements for dealing with surface water run off from new development will be required. The use of SuDS will be the preference unless, following an adequate assessment, soil conditions and / or engineering feasibility dictate otherwise."

Joint Core Strategy Development Plan Document (Broadland, Norwich and South Norfolk)

2.4.3.4 The central and southern sections of the Hornsea Three onshore cable corridor search area and the onshore HVDC converter/HVAC substation are located within the Broadland district and South Norfolk district. The local plan for these districts comprises the Joint Core Strategy Development Plan Document (adopted in 2011) and amendments (adopted in 2014). There are no policies in the these document which specifically relate to hydrology or flood risk.

2.4.4 Flood and Water Management Act 2010

2.4.4.1 The Flood and Water Management Act 2010 implements the recommendations from Sir Michel Pitt's Review of the floods in 2007 and places a series of responsibilities on councils. The main aim of the Act is to improve flood risk management.

2.4.4.2 The Act designates councils as the Lead Local Flood Authority (LLFA) with a 'lead' role in managing flood risk from surface water, groundwater and ordinary watercourses across their jurisdictional area. This involves closely working with partners involved in flood and water management, namely the Environment Agency and Drainage Boards. Under the Act, Norfolk County Council was designated the LLFA for the hydrology and flood risk study area, becoming a statutory consultee on all planning applications for major developments. The LLFA is required to comment on planning applications in respect of surface water drainage.

2.4.5 Land Drainage Act 1991

2.4.5.1 Under Section 23 of the Land Drainage Act 1991 (LDA 1991) consent is required from the relevant Drainage Board (DB) for any works likely to obstruct, or affect the flow of, a watercourse. The relevant drainage authorities in respect of Hornsea Three are the Environment Agency, Norfolk County Council, North Norfolk District Council, Broadland District Council, South Norfolk District Council and Norfolk Rivers IDB. Section 66 of the LDA 1991 makes provisions for the creation of byelaws considered necessary for securing the efficient working of the drainage system. Under the byelaws, consent is required from the relevant drainage authority for any development within a particular distance of a drainage work. This distance varies between drainage authorities but in the case of Norfolk Rivers IDB, consent is required for works within 9 m of the edge of drainage/flood risk management features.

2.4.6 Water Resources Act 1991

2.4.6.1 The Water Resources Act 1991 (WRA 1991) makes provision for the creation of byelaws by the Environment Agency. Paragraph 5 of Schedule 25 allows for the Environment Agency to create byelaws for flood defence and drainage purposes. Paragraph 6 allows for byelaws for purposes of fisheries functions to be made. Paragraph 6A makes provision for the creation of fisheries byelaws for marine or aquatic environmental purposes.

2.4.7 The Environmental Permitting (England and Wales) Regulations 2016

2.4.7.1 Schedule 25 of the Environmental Permitting (England and Wales) Regulation 2016 applies in relation to flood risk activity in, over or under a watercourse. Under the regulations, consent is required from the Environment Agency to undertake works or to erect structures within 8 m of a non-tidal water body (and 16 m of a tidal body). An environmental permit is also required for any discharges to surface watercourses.

2.5 Consultation

2.5.1.1 A Consultation Report will accompany the Environmental Statement outlining all consultation activities undertaken in respect to Hornsea Three. Table 2.3 below summarises the issues raised relevant to hydrology and flood risk which have been identified during consultation activities to date. Table 2.3 also indicates either how these issues have been addressed within this PEIR or how the Applicant has had regard to them.

Table 2.3: Summary of key consultation issues raised during consultation activities undertaken for Hornsea Three relevant to hydrology and flood risk.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
November 2016	Anglian Water – Scoping response.	Paragraph 3.8.3 states that site investigations are due to be undertaken quarter 4 of 2016 and quarter 1 of 2017. Anglian Water would like to be consulted with regarding site surveys and ground investigations so we can mitigate any risks to our assets. Table 10.4 of the scoping report states that water supply pipelines could be damaged and there could be impacts on water quality during construction, operational and decommissioning phases. It is recognised that a desk based study will be carried out. Anglian Water recommends early engagement so that we can input into this study. Table 13.1 of the scoping report does not identify utilities, specifically water infrastructure. It is crucial that impacts on the network and on our assets are considered and any issues highlighted early on in the project. It is suggested that the Environmental Statement should include reference to the foul sewerage network, sewage treatment and water services. It is unclear what the requirement for potable water and wastewater services will be during the construction phases. Discussions with Anglian Water should take place to ensure this issue is considered at an early stage. In addition we would wish to review any impact on any schemes for water or wastewater, which are currently in design, which may be affected by the development. Reference is not made to Anglian Water's Resource Management Plan (WRMP) and it is suggested that this is taken into account. The WRMP is available to view at the following address: http://www.anglianwater.co.uk/environment/our-commitment/our-plans/water-resource-management.aspx	Site investigations within the onshore cable corridor search area are not due to take place until post consent. The design of any investigation would take into account the location of nearby utility services. Anglian Water will be consulted regarding any works that may be carried out in close proximity (within 10 m) of their assets. Specific Anglian Water drainage infrastructure is considered within the baseline conditions section of this chapter. The construction of Hornsea Three is unlikely to generate a requirement for potable water or wastewater services. Discharges to ground or surface water may be necessary at specific locations however, these discharges would be regulated by environmental permits where required. Anglian Water's WRMP was one of the information sources which informed the baseline section (see paragraph 2.6.1.2) and its principles have been used in the design of mitigation measures (Table 2.15).
November 2016	Barford and Wramplinham Parish Council – Scoping Response.	Any works in the Tiffey valley should be avoided as there are already many local flooding issues in this area. A large flood amelioration scheme was undertaken in the last few years however there are still ongoing flooding issues in the area.	The onshore cable corridor search area does not interact with the Tiffey valley.
November 2016	Natural England – Scoping Response.	The River Wensum SAC: The cable route has potential to directly affect both the hydrological processes and habitats present within the River Wensum SAC. There are many springs and seepages along the length of the river which would not be detectable during a desk study, and if missed has the potential to damage the river system, resulting in changes to the direction and speed of flow of the river water supply. Furthermore, there are floodplain meadows that form an integral part of the SAC that may be directly damaged by setting up the start of the underground cable within the wrong location. We therefore recommend that prior to any decisions on location a hydro-ecologist is employed to survey the area, to check for seepages/springs and to review where to place the cable to avoid damaging the habitats associated with the SAC. We would welcome placement of the cable as far away from the river as feasible, to protect the habitats and wildlife present in close proximity to the river. Norfolk Valley Fens SAC and component SSSIs: The area along the cable route includes several sites that form part of the Norfolk Valley Fens SAC. These sites, along with many of the locally designated sites in the area, form a complex network of hydrologically linked sites which are very sensitive to changes in water levels, quality or flow. Some of the sites that form part of this network and may be affected by the cable route are Alderford Common, Swanningate Upgate Common, Booton Common SSSIs (though this list is not exhaustive). We recommend that a desk study is carried out to ensure that all SSSIs associated with this SAC that may be affected by the cable route are scoped into the assessment. We advise that the Environmental Statement considers in detail how the placement of the route will affect surface and ground water flow across any of the sites that are components of the Norfolk Valley Fens SAC, along with any County Wildlife sites with a hydrological focus.	Hydrological characterisation of the proposed crossing locations of the Environment Agency designated main rivers is currently underway. The work comprises a desk study and site walkover to identify the hydrological and ecological features in these locations and how they interact. Potential constraints will be mapped and used to inform the design of the crossing methodologies in these areas. The hydrological characterisation work will be reported in the Environmental Statement.
November 2016	Norfolk County Council – Scoping Response.	The LLFA strongly recommend that any EIA or planning application for development is accompanied by a FRA/surface water drainage strategy to address: • Local sources of flood risk, including those from ordinary watercourses, surface run-off and groundwater. • How surface water drainage will be managed on the substation sites and show compliance with the written Ministerial Statement HCWS 161 by ensuring that SuDS for the management of run-off are put in place. • Post construction ground levels not disrupting current overland flow routes along and across the alignment of the proposed underground cables for land at risk of flooding. • Temporary arrangements to maintain overland flow paths that cross the alignment of the proposed underground cables for land at risk of flooding. • The requirement to seek consent from Norfolk County Council for works that affect the flow in ordinary watercourses outside of the control of an IDB.	The scope of the Hornsea Three FRA is outlined in paragraph 2.6.4.3. The full FRAs are provided in volume 6, annex 2.1: Onshore HVAC Booster Station and HVDC Convertor/HVAC Substation Flood Risk Assessment. The FRAs have been produced in line with the requirements of NPS EN-1 and the NPPF. Proposed drainage strategies have also been produced in line with relevant SuDS guidance and are appended to the FRAs.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		This supporting information would need to show how the development does not increase flood risk on the site or elsewhere, in line with NPPF (paragraph 103). In this particular case this would include appropriate information on SuDS proposals in accordance with appropriate guidance including "Non-statutory technical standards for sustainable drainage systems" March 2015 by Department for Environment, Food and Rural Affairs (Defra, 2015). The LLFA welcome that the applicant indicates that a FRA will be completed and it is recommend that this is undertaken in line with the requirements of the NPPF. The LLFA also welcome that the applicant indicates that an FRA will include a drainage strategy for the preparation of the onshore HVAC booster station and HVAC/HVDC substation site. It is recommended that appropriate SUDS features are incorporated into the development in accordance with policy guidelines. Where any SuDS are proposed it is important to demonstrate that the "SuDS hierarchy" has been followed both in terms of: • surface water disposal location, prioritised in the following order: disposal of water to shallow infiltration, to a watercourse, to a surface water sewer, combined sewer/deep infiltration (generally considered to be greater than 2 m below ground level); and • the SuDS components used within the management train (source, site and regional control). The LLFA would advise the applicant that the CIRA SuDS Manual C697 (2007) has recently been updated. Report C753 (2015) is now available free on the CIRIA website. On the 19 February 2016, the Environment Agency updated the guidance on climate change allowances for peak river flow and rainfall intensity. The information for the Anglian Region and transitional arrangements for use within the planning process can be found at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. The LLFA highlight that peak river flow climate change allowances should be considered for ordinary watercourses as well as main rivers. The LLFA note that an initial review of OS maps and Environment Agency data will be undertaken and include a review of the main rivers (as per section 10.2.6 of the Environmental Impact Assessment: Scoping Report published in October 2016). There are lengths of potentially affected watercourses in the search area that are controlled by the Norfolk Rivers IDB for which they will need to be consulted on separately. Please note, if there are any works proposed as part of this application that are likely to affect flows in an ordinary watercourse outside of the IDB areas, then the applicant is likely to need the approval of the County Council. The Council seeks to avoid culverting, and its consent for such works will not normally be granted except as a means of access. It should be noted that this approval is separate from planning. A link to the application forms can be found here https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-homeowners/consent-for-work-on-ordinary-watercourses. The LLFA would appreciate the applicant advising the Council's Flood and Water Management team, as soon as practicable, the approximate number of crossings of ordinary watercourses and the required timeframes for approval. This will enable the team to have adequate staffing resources in place to ensure approvals are not unduly delayed. A previous approval process for a similar project resulted in 90 separate consents which represents a significant draw on the teams' resources to process. The Flood and Water Management team are happy to engage in this process prior to application. The LLFA would expect a drainage strategy for the substation and preferred route for the cables to assess and justify compliance with the SuDS hierarchy for surface water disposal location. This would include: (1) Demonstration of infiltration testing completed to BRE365 requirements or equivalent (including 3 infiltration tests in quick succession at each location tested. Each location would be representative across the site and be at depths anticipated to be used on site). A description of where any infiltration is anticipated to be used in full or partially drained SuDS components within a strategy. (2) If site wide infiltration is not appropriate due to unfavourable rates, demonstration with evidence as to why there cannot be a connection made to the nearest watercourse. (3) As a final option, demonstration with evidence that Anglian Water would accept a connection to a surface water sewer. The drainage strategy should also contain a maintenance and management plan detailing the activities required and details of who will adopt and maintain the all the surface water drainage features for the lifetime of the development. Further guidance for developers can be found on our website at https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers.	

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
November 2016	Public Health England – Scoping Response.	Additional points specific to emissions to water - When considering a baseline (of existing water) and in the assessment and future monitoring of impacts these: • should include assessment of potential impacts on human health and not focus solely on ecological impacts; • should identify and consider all routes by which emissions may lead to population exposure (e.g. surface watercourses; recreational waters; sewers; geological routes etc.); • should assess the potential off-site effects of emissions to groundwater (e.g. on aquifers used for drinking water) and surface water (used for drinking water abstraction) in terms of the potential for population exposure; and • should include consideration of potential impacts on recreational users (e.g. from fishing, canoeing etc.) alongside assessment of potential exposure via drinking water.	Baseline surface water quality is highlighted in Table 2.6 and the abstraction licences, discharge consents and pollution incidents are shown in volume 6, annex 2.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents. The potential for pollution linkages from contaminated land affecting surface waters is considered in chapter 1: Geology and Ground Condition. No uncontrolled discharges (emissions) to surface water or groundwater from Hornsea Three during the construction or operation would be permitted. Where discharges are required, they would be regulated by an environmental permit which would identify potential impacts to human health and (if relevant) potential impacts on recreational users. Where environmental permits are required, they would be obtained post consent.
December 2016	PINS – Scoping Opinion.	The Scoping Report states that upon finalisation of the onshore Expected Cable Route corridor, the study area will be refined to include the temporary and permanent land take for the onshore elements of Hornsea Three. The applicant should take care to ensure that the study area is sufficient to consider potential impacts outside of the application site, noting the potential for flood risk elsewhere, and for impacts to occur downstream of the site. The study area should be agreed with relevant consultees and justified within the ES. The ES should include figures depicting the hydrological features described within the text in relation to the application site, including the network of ordinary watercourses, streams, drains and waterbodies referred to in paragraph 10.2.7 of the Scoping Report. The Secretary of State welcomes the proposal for a FRA and the assessment of impacts on WFD watercourses; these assessments should form an appendix to the ES. The scope of these assessments should be discussed and agreed with relevant consultees including the Environment Agency, the relevant internal drainage boards and the lead local flood authority. Section 4 of this Scoping Opinion provides further comments as to the need for WFD assessment. The FRA should take into account the most up to date climate change allowances and should cover tidal flood risk as well as fluvial impacts under present and projected sea level scenarios. Attention is drawn to the comments of Norfolk County Council (see Appendix 3 of this Opinion) regarding the climate change allowances for peak river flow and rainfall intensity, and more generally the contents of the FRA. Table 10.4 of the Scoping Report states that no site specific modelling is proposed to be undertaken to inform the assessment of potential impacts; however it does not explain how the assessment will be undertaken. The assessment methodology, and details of any guidance used, should be set out within the ES. The Secretary of State notes the measures to be adopted as part of the project, as detailed in paragraph of the Scoping Report and advises that draft versions of the identified plans (i.e. the Surface Water Management Plan and the CoCP) are provided with the application. The ES should also provide details of the mitigation to minimise impacts to existing flood defences and field drainage and infrastructure. Any necessary reinstatement measures should also be set out. The Secretary of State welcomes the preparation of a drainage strategy for the onshore HVAC booster station and HVAC/HVDC substation site. Attention is drawn to the comments of Norfolk County Council (see Appendix 3 of this Opinion) regarding the contents of a surface water drainage strategy. In relation to HDD activities, the ES should address potential risks to both groundwater resources and surface water bodies from leakage of drilling fluid and provide details of measures that will be implemented to address such risks.	The study area has not been specifically agreed with relevant consultees, however a standard approach has been adopted and is justified within the PEIR. The hydrology and study area is considered sufficient to address the potential impacts from Hornsea Three in relation to hydrology and flood risk. The hydrological features are outlined within volume 6, annex 2.2 Environment Agency and IDB Watercourses and Flood Zones. WFD objectives for the watercourses in the hydrology and flood risk study area are provided in Table 2.6 and the effects on these watercourses are assessed in section 2.10. The scope of the Hornsea Three FRA is outlined in paragraph 2.6.4.3. The full FRAs are provided in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation FRA. The FRAs have been produced in line with the requirements of NPS EN-1 and the NPPF taking into account the effects of climate change and potential for changes in flood risk. A proposed drainage strategy has also been produced in line with relevant SuDS guidance and is appended to the FRA. Assessment methodologies to inform the hydrology and flood risk chapter of the PEIR have been set out in section 2.6 and 2.9. A Code of Construction Practice and Surface Water Management Plan will accompany the Environmental Statement. Potential risks to groundwater resources and hydraulically connected surface waters are assessed in chapter 1: Geology and Ground Conditions.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
February 2017	Norfolk Rivers Internal Drainage Board – Meeting.	Approximately 800 assets maintained by Norfolk Rivers Internal Drainage Board (NRIDB) are coincident with the Hornsea Three onshore cable corridor search area. This number would decrease as the onshore export cable corridor is refined. Consent would be required where the onshore export cable crosses a maintained IDB drain/watercourse with the NRIDB's District. An IDB licence would be usually required to discharge surface water into a watercourse within the NRIDB's District, whether or not the receiving drain was maintained. NRIDB is compiling details of standardised approaches to cable installation beneath IDB assets, drawing on past experiences, and noting that some drains are more suitable to trenchless techniques and other are more suitable to open cut. NRIDB noted the need for managing channel flow during open cut installation. On site arrangements would be required for over pumping and that seasonal restrictions on installation may be required in areas prone to flash flood/flow.	IDB watercourses are identified in volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones.

2.6 Methodology to inform the baseline

2.6.1.1 Baseline data on the hydrological resources and flood risk within the hydrology and flood risk study area has primarily been collected using a desktop study of publicly available information. This information has been supplemented by information requested from the Environment Agency, Norfolk Rivers IDB, Norfolk County Council, North Norfolk District Council, Broadland District Council and South Norfolk District Council.

2.6.1.2 General information regarding the site setting of the hydrology and flood risk study area has been obtained from the following:

- BGS 1:50,000 geological mapping 131 Cromer, 132/148 Mundesley and North Walsham, and 147 Aylsham;
- BGS Aquifer Designation Maps;
- Kelling to Lowestoft Ness Shoreline Management Plan (AECOM, 2012);
- Environment Agency website (2016);
- The Centre for Ecology and Hydrology website (2016);
- Environment Agency Flood Hazard Mapping;
- Climate data (Met Office, 2016); and
- Anglian Water Water Resources Management Plan (2015).

2.6.2 Desktop study

2.6.2.1 Information on hydrology and flood risk within the hydrology and flood risk study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 2.4. below.

Table 2.4: Summary of key desktop reports.

Title	Source	Year	Author
Groundsure Environmental Search (Ref: RPS_3656707).	Groundsure.	February 2017	Groundsure Limited.
Draft Norfolk Local Flood Risk Management Strategy.	Norfolk County Council.	2015	Norfolk County Council.
North Norfolk Shoreline Management Plan.	Defra.	2010	Defra.
North Norfolk Catchment Flood Management Plan.	Environment Agency.	2009a	Environment Agency.
Broadland Rivers Catchment Flood Management Plan.	Environment Agency.	2009b	Environment Agency.
Anglian River Basin District River Basin Management Plan.	Defra and Environment Agency.	2009 (updated in 2016)	Defra and Environment Agency.
Strategic Flood Risk Assessment (North Norfolk, Broadland District Council, The Broads Authority, Norwich City Council and South Norfolk District Council).	North Norfolk, Broadland District Council, The Broads Authority, Norwich City Council and South Norfolk District Council.	2008	Millard Consulting Engineers.

2.6.3 Designated sites

2.6.3.1 There are no hydrologically designated sites within the hydrology and flood risk study area. Watercourses designated for their ecological interest are identified in chapter 3: Ecology and Nature Conservation.

2.6.4 Site specific surveys

2.6.4.1 In order to inform the EIA, a site-specific survey of key hydrological resources in the hydrology and flood risk study area was undertaken in March 2017. A summary of this survey is outlined in Table 2.5.

2.6.4.2 The onshore HVAC booster station and HVDC converter/HVAC substation will each cover an area of more than 1 hectare. In accordance with the guidance in the NPPF (and PPG ID7 – Flood Risk and Coastal Change) and NPS EN-1 a Flood Risk Assessment (FRA) has been undertaken. This is included in volume 6, annex 2.1: Onshore Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.

2.6.4.3 The key components of the FRA are as follows:

- Review of publicly available Environment Agency documentation, local flood management plans and future flood management schemes;
- Review of Strategic Flood Risk Assessments;
- Assessment of the flood risk to the existing and proposed development;
- A site specific assessment of flood risk at the proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation sites; and
- A hydrological assessment of the surface water flows for the proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation sites.

Table 2.5: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Year	Reference to further information
Hydrological characterisation surveys.	Proposed locations where the onshore cable corridor search area crosses main rivers.	The survey comprised a walkover of the proposed main river crossing locations to gather information on the local hydrological environment. Observations were made on the width of the main channel, flow and depth of the water, presence and location of tributaries and drainage ditches, and ecological habitats. The walkover survey was supplemented by a desk study to identify any abstraction licences, discharge consents/permits, flood risk information and landowner questionnaires.	RPS	March 2017	See section 2.7: Baseline environment.

2.7 Baseline environment

2.7.1.1 This section describes the hydrological resources and flood risk within the hydrology and flood risk study area. Observations from the hydrology characterisation survey and desk study have been included where relevant.

2.7.1.2 Land use within the hydrology and flood risk study area is predominantly agriculture together with areas of heathland, valley mires and woodland. The landscape is relatively flat lying with elevations reaching 100 m AOD near Sheringham.

2.7.2 Surface watercourses

2.7.2.1 The hydrology and flood risk study area includes a number of catchments associated with Environment Agency designated main rivers and ordinary watercourses. Definitions of these hydrological features are provided below and their locations are identified in volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones:

- main rivers – watercourses where the Environment Agency has permissive powers over their management; and
- ordinary watercourses – includes rivers, streams, ditches, drains which do not form part of a main river and area managed by either Norfolk County Council, as LLFA, or Norfolk Rivers IDB.

River Yare

2.7.2.2 The river rises south of Dereham to the west of the village of Shipdham. It flows in a generally eastward direction passing Barnham Broom and is joined by the River Tiffey before reaching Bawburgh. At Whitlingham, the Yare converges with the River Wensum. Within the hydrology and flood risk study area, the River Yare flows in an open channel and at the time of the site visit, the river was reasonably fast flowing. A number of field drains were noted within the hydrology and flood risk study area which fed into the river and were observed to be slow flowing/stagnant and heavily vegetated. Land close to the river is wet for the majority of the year and is susceptible to flooding. Anglian Water services were identified within the hydrology and flood risk study area.

River Tud

2.7.2.3 The River Tud is a tributary of the River Wensum. The Tud's source is just south of East Dereham and flows in an easterly direction for 27 km to its confluence with the Wensum below Hellesdon Mill. Within the hydrology and flood risk study area, the river flows in an open channel. A number of field drains were identified during the site visit which contained water but were slow flowing/still. Landowners in the hydrology and flood risk study area noted that the ditches hold water for the majority of the year, whilst the marshy area to the south of river is wet for the majority of the year.

River Wensum

2.7.2.4 This is a chalk fed river and is designated as a Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC). The source of the Wensum lies between the villages of Colkirk and Whissonsett in northwest Norfolk. The river flows westward initially, close to the villages of South Raynham, West Raynham and East Raynham. At New Mills Yard in the centre of Norwich, the river becomes tidal and navigable by boat. Within the hydrology and flood risk study area, the river flows in a wide open channel and is relatively fast flowing. A number of field drains were identified during the site visit which were slow flowing or stagnant and heavily vegetated. The topography surrounding the river is generally flat and the ground was soft with localised wet areas. Landowners in the hydrology and flood risk study area confirmed that the surrounding streams and ditches hold water all year round and the land near the river is susceptible to flooding.

River Bure

2.7.2.5 The river rises near Melton Constable, 18 km upstream of Aylsham. After Aylsham Lock and Burgh Bridge, the Bure passes through Buxton Lammas, Coltishall and along the northern border of the Halvergate Marshes and through Great Yarmouth where it meets Breydon Water and flows into the sea at Gorleston. Within the hydrology and flood risk study area, the river flows west to east in an open channel. At the time of the site visit, the river had a clear flow over a mixed gravel and sandy bed. A number of field drains lead up to or run parallel with the river. At the time of the site visit, the drains contained water but had a slow flow or were stagnant with algae on the surface in places.

River Glaven (Gunthorpe Stream)

2.7.2.6 The River Glaven flows for a 16 km (approximately) reach through Norfolk flowing in a general northerly direction through North Norfolk before discharging into the North Sea. The river has a catchment area of approximately 115 km^2 and from its source, it falls 50 m to the tidal limit at Cley sluice. The sub surface geology is predominantly chalk and in the parts of the lower valley, the river runs over chalk beds.

Spring Beck

2.7.2.7 Spring Beck flows near and through the village of Weybourne. The beck originates from a spring located on the edge of Hundred Acre Wood in an area called Weybourne Pits. From its source, it flows in a general northerly direction towards the village of Weybourne approximately 1.6 km to the north, discharging into the sea.

2.7.2.8 The hydrology and flood risk study area also passes through an Internal Drainage Board (IDB) area managed by Norfolk Rivers IDB. The Board's drainage and water level management infrastructure consists of a number of watercourses, of varying sizes, which all discharge by gravity into Environment Agency designated main rivers. The IDB maintains only the most critical ordinary watercourses (i.e.that are not main rivers), which equates to around 25% of the total length of ordinary watercourses in the IDB district. Key IDB drains which fall within the hydrology and flood risk study area are described below and are shown in volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones.

Intwood Stream

2.7.2.9 Intwood Stream originates as two streams: one branch outfall from Ketteringham Hall Lake flowing in a general north-easterly direction; the second branch issues close to Mulbarton and heads in a northerly direction converging at Intwood. The combined stream flows northerly and is joined by a number of smaller un-named tributaries and drainage channels before discharging into the River Yare, near Keswick. Within the hydrology and flood risk study area, Intwood Stream is a small channel watercourse narrowed by aquatic vegetation and is relatively fast flowing. A series of field drains discharge into Intwood Stream which are heavily vegetated and relatively shallow.

Swannington Beck

2.7.2.10 The beck is formed via inflows from the two sub-catchments, the largest of which originates from agricultural land to the northeast including Haveringland Lake and Upgate. The second reach originates at Brandiston and flows in a southerly direction fed by a number of un-named drainage and irrigation channels. The two reaches converge at Alderford to form Swannington Beck and discharging into the River Wensum. The beck is relatively shaded and flows in an open channel within the hydrology and flood risk study area. The channel is approximately 1 m wide and was slow flowing at the time of the site walkover. A number of field drains run parallel with Swannington Beck.

Blackwater Drain

2.7.2.11 The drain is formed via the convergence of a number of un-named streams which issue from numerous locations to the north of Reepham. The drain flows in a general southerly direction around the outskirts of Reepham discharging into the River Wensum. Blackwater Drain is tree-lined in places and flows in a westerly direction within the hydrology and flood risk study area along the boundary with Booton Common. There are a number of field drains leading to Blackwater Drain including a feeder ditch that runs south of Blackwater Drain, none of which drain into Booton Common.

2.7.3 Existing drainage

2.7.3.1 The hydrology and flood risk study area crosses a number of existing field drains, ditches and irrigation channels. The majority of the surface water channels crossed are privately owned and maintained. Several channels fall under the jurisdiction of the IDB, LLFA or Environment Agency and therefore, fall under the requirements of the Environmental Permitting Regulations 2016.

2.7.3.2 Furthermore, asset management plans indicate that the cable route corridor would cross Anglian Water-owned and maintained infrastructure at a number of locations.

2.7.4 Surface water abstractions

2.7.4.1 A number of surface water abstractions are located within the hydrology and flood risk study area. Some of the abstraction licences cross the onshore cable corridor search area, indicating that the farmer(s) have a licence to abstract water from any of the drainage channels within the surrounding area for use as irrigation water on fields. Abstraction licences are a good indication of how the surface watercourses in the hydrology and flood risk study area are utilised.

2.7.4.2 The abstraction licences taken from Groundsure data records identified seven surface water abstractions within the hydrology and flood risk study area. These are summarised below and identified in volume 6, annex 2.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.

- C J C Lee Ltd for the abstraction of water from the River Bure for use in spray irrigation;
- Honingham Aktieselskab two licences for the abstraction of water from the River Tud for use in spray irrigation.
- Great Melton Farms Ltd for the abstraction of water from the River Yare for use in spray irrigation.
- H W & H G Back two licences fo the abstraction of water from the River Yare for use in spray irrigation.

2.7.5 Private water supply

2.7.5.1 Norfolk County Council and North Norfolk District Council have confirmed that there are no private water supplies within 250 m of the hydrology and flood risk study area.

2.7.5.2 Broadlands District Council indicate that they hold no data regarding private water supply.

2.7.6 Discharge consents

2.7.6.1 Discharges of liquid effluent or waste water into surface waters are regulated by the Environment Agency using discharge consents and environmental permits. A review of Groundsure data identified approximately 30 consented discharges to surface waters within the hydrology and flood risk study area. The majority of the discharges related to final/treated effluent from domestic properties. Although the volume and parameters of the discharges are regulated (via the discharge consents and permits), the quality of the receiving surface water may potentially be affected.

2.7.6.2 The details and locations of the discharge consents and permits are provided within volume 6, annex 2.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.

2.7.7 Pollution incidents

2.7.7.1 Pollution incident mapping has been used to identify if the quality of watercourses within the hydrology and flood risk study area may have been affected by pollution. A review of Groundsure data identified approximately 10 pollution incidents in the hydrology and flood risk study area, however all of the incidents were reported as category 4 (no impact) which is defined by the Environment Agency under the common incident classification scheme as a substantiated incident with no impact to water quality (Further details regarding the common incident classification scheme can be found at www.gov.uk/government/organisations/environment-agency). Pollution incidents within the hydrology and flood risk study area are shown in 2.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.

2.7.8 Surface water quality

2.7.8.1 The Environment Agency has provided the most current (2012) Water Framework (WFD) Current Overall Status classifications for a number of watercourses within the the hydrology and flood risk study area. The WFD classification are not site specific but take the classification for the whole catchment of the waterbodies. Table 2.6 below lists the watercourses and associated WFD classification grade within the hydrology and flood risk study area and outlines the waterbodies which Hornses Three crosses.

2.7.8.2 Table 2.6 below lists the watercourses and associated WFD classification grade within the hydrology and flood risk study area and outlines the waterbodies which Hornsea Three crosses.

Table 2.6: WFD water quality data.

Catchment Waterbody Name	Hornsea Three specific Waterbodies	Current Overall Status (2015)	Objective Status
Gunthorpe Stream	River Glaven (Gunthorpe Stream)	Moderate	Good (2027)
Glaven	Spring Beck	Moderate	Good (2027)
River Bure (Scarrow Beck to Horstead Mill)	River Bure	Poor	Good (2027)
Blackwater Drain (Wensum)	Blackwater Drain	Moderate	Good (2021)
River Wensum (US Norwich)	River Wensum	Moderate	Good (2015)
River Tud	River Tud	Moderate	Good (2015)
River Yare (Tiffey to Wensum)	River Yare	Moderate	Good (2027)
Intwood Stream	Intwood Beck	Moderate	Good (2015)
Swannington Beck	Swannington Beck	Good	Good (2015)
Tas (Tasburgh to R. Yare)	River Yare	Moderate	Good (2015)

2.7.8.3 In summary, the WFD records show that the watercourses within the hydrology and flood risk study area have a varying WFD status of Poor to Moderate. However, all lower status waterbodies have objectives to improve with most aiming to achieve good status by 2027. For this chapter of the PEIR, all assessment of main and ordinary waterbodies will be based on a precautionary 'Good' status, in line with the Environment Agency objectives to improve the water quality of waterbodies.

2.7.8.4 A full description of the WFD classification process and associated definitions are available at: https://www.gov.uk/government/consultations/river-basin-management-planning-ministerial-guidance-and-standards.

2.7.9 Flood zones and flood defences

2.7.9.1 The Hornsea Three landfall is defined by exposed sands and gravels forming a coastline cliff face acting as a natural tidal defence. Publicly available online Environment Agency flood mapping indicates that there are no formal flood defences.

2.7.9.2 Volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones shows the Environment Agency flood zone risk map for the hydrology and flood risk study area. The maps are the first stage in identifying the flood risk for a particular location. However, the maps do not take into account the impact of local flood defences and climate change on flooding, and do not provide information on flood depth, speed or volume of flow. The maps do not show flooding from other sources such as groundwater, direct runoff from fields or overflowing sewers. A description of these flood sources is presented in volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.

2.7.9.3 The Environment Agency flood zone risk maps use four categories to describe the risk of flooding. These categories are set out in Table 2.7 below.

Table 2.7: Environment Agency Flood zone definitions.

Flood zone	Flood zone definition
Flood Zone 1	This land comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
Flood Zone 2	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5 – 0.1%) in any year.
Flood Zone 3(a)	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Flood Zone 3(b)	This zone comprises land where water has to flow or be stored in times of flood.

2.7.9.4 Environment Agency flood maps (see volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones) indicate that over 90% of the hydrology and flood risk study area (approximately 49 km) is located within NPPF Undefended Flood Zone 1 'low probability'. The Flood Zone maps depict the 'no defence' scenario.

2.7.9.5 A small area (approximately 3 ha) of the hydrology and flood risk study area close to the Hornsea Three landfall is shown as Flood Zone 3. The flood zone extents are associated with the flood envelope of Spring Beck, which flows in a south to north direction through Weybourne Village centre.

2.7.9.6 Other localised areas within the hydrology and flood risk study area are shown as Flood Zone 3. The flood zone extents are associated with the unnamed stream near Salle, Blackwater Drain, Swannington Beck, River Wensum, River Tud, River Yare, unnamed tributary of the River Yare at Lille Melton and Intwood Stream.

2.7.9.7 The Environment Agency's surface water flood mapping indicates that small localised areas of the onshore HVAC booster station and the HVDC converter/HVAC substation are being at 'low' risk of surface water flooding. The remainder of the onshore HVAC booster station and HVDC converter/HVAC substation and the sites are at 'very low' risk of surface water flooding. Further information is provided within volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment.

2.7.10 Future baseline scenario

2.7.10.1 The main impact on the hydrology and flood risk future baseline is associated with the potential effects of climate change, which may impact on future peak river flow rates, rainfall intensity and sea levels. A summary of potential climate change allowances as outlined by the Environment Agency (February 2016, updated February 2017) is presented below.

2.7.10.2 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. The NPPF and supporting PPG on Flood Risk and Coastal Change explain when and how FRAs should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.

2.7.10.3 In February 2016, the Environment Agency updated advice on climate change allowances to support the NPPF. New guidance requires that FRAs and strategic flood risk assessments, assess both the central and upper end allowances - see Table 2.8 to understand the potential range of impacts.

Table 2.8: Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline).

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

2.7.10.4 Guidance is also provided on increases in river flows as a consequence of climate change. The guidance provides central, upper central and higher central climate allowance bands which should be utilised within the assessment of flood risk for sites in Flood Zones 2, 3a and 3b (see Table 2.9). For developments at flood risk, consideration should be given to the flood zone within which the development is located and the appropriate flood risk vulnerability classification to inform a suitable climate change allowance.

Table 2.9: Peak river flow allowance by river basin district (use 1961 to 1990).

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Anglian.	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

2.7.10.5 Table 2.10 below summaries potential sea level rise over various epochs for the East and East Midlands area.

Table 2.10: Sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline).

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115	Cumulative rise 1990 to 2115 (m)
East, East Midlands, London, south east.	4 (140 mm)	8.5 (255 mm)	12 (360 mm)	15 (450 mm)	1.21 m

2.7.10.6 As stated above, the Environment Agency has set out objectives for all waterbodies to achieve WFD 'Good' status by 2027, with many of the measures needed to achieve the improvement in status either already in place or will be in place by 2021.

2.7.10.7 It has therefore been determined that the surface waters within the hydrology and flood risk study area will be assessed based on a precautionary 'Good' status, in line with the Environment Agency objectives to improve the water quality of waterbodies. If the target status 'Good' is not achieved by 2021 it is assumed that the impact from the construction and operation/maintenance of Hornsea Three would be reduced due to lower waterbody sensitivity. The approach taken is therefore determined to present a robust assessment of all waterbodies within the hydrology and flood risk study area.

2.7.11 Data limitations

2.7.11.1 The assessment is based on publicly available data obtained from the Environment Agency, Norfolk County Council, North Norfolk District Council, Broadland District Council and South Norfolk District Council, Norfolk Rivers IDB and commercial data supply companies, as well as additional information supplied from stakeholders during the scoping and consultation stages.

2.7.11.2 The assessment is limited by a lack of detailed information on:

- Flow data for watercourses and drainage channels;
- Private water supply plans; and
- Water quality data for specific locations.

2.7.11.3 Overall a moderate to high level of certainty has been applied to the study. Where available, catchment data regarding water quality has been used to inform the assessment, with a hydrological site walkover undertaken for all Environment Agency designated main river crossings within the hydrology and flood risk study area. The information accessible in order to complete the assessment is considered sufficient to establish the baseline within the Hornsea Three hydrology and flood risk study area, therefore, there are no data limitations that would affect the conclusions of this assessment.

2.8 Key parameters for assessment

2.8.1 Maximum design scenario

2.8.1.1 The maximum design scenarios identified in Table 2.11 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in the project description (volume 1, chapter 3: Project Description). Effects of greater significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope, to that assessed here be taken forward in the final design scheme.

Table 2.11: Maximum design scenario considered for the assessment of potential impacts on hydrology and flood risk.

Potential impact	Maximum design scenario	Justification
Construction phase		
The impacts of construction may lead to increased flood risk.	<u>Hornsea Three landfall</u> Open cut techniques installing up to eight cables with a corridor up to 20 m either side of each cable. The width of the corridor at landfall would be up to 20 m either side of each cable. Up to eight transition joint bays of total up to 2,000 m^2 (250 m^2 x 8). <u>Onshore export cable corridor</u> Temporary onshore cable corridor is 80 m wide and 55 km long (including 60 m wide permanent onshore cable corridor (wider where obstacles occur)). Up to six cable trenches (each containing one circuit) each trench is 5 m wide and 2 m deep. Depth of stabilised backfill up to 1.5 m. Up to 330 junction bays and link boxes. Closest separation distance between junction bay and link box: 750 m. Up to 74,250 m2 area required for junction bays (based on 330 junction bays (each junction bay is 9 m x 25 m)). Up to 2,970 m2 area required for link boxes (based on 330 link boxes (each link box: is 3 m x 3 m)). Up to two temporary haul roads 5 m wide (7 m wide at passing places). Majority of watercourse crossings using open cut techniques. <u>Onshore HVDC converter/HVAC substation</u> Permanent area of site is 128,000 m^2 (including area which may be used for landscaping) plus a temporary works area of 100,000 m^2. The transmission option with the greatest number of buildings and largest footprint is the HVDC converter station – up to five buildings. The main building (single building scenario) for the HVDC converter station will have a footprint of 11,250 m^2 (75 m x 150 m). Dimensions for the multiple building scenario would be reduced proportionately but the overall footprint would be the same. <u>Onshore HVAC booster station</u> Permanent area of site is 25,000 m^2 plus a temporary works area up to 25,000 m^2. Building scenario with the largest footprint - single building with area of 4,500 m^2 (150 m length and 30 m width) and height up to 12.5 m.	The maximum design scenario for flood risk at the Hornsea Three landfall would result from the use of open cut techniques at the landfall as this involves trenching through the cliffs which currently provides a natural flood defence. Open trenching has the potential to disrupt or damage the integrity of the natural flood defence and increasing the impacts of coastal erosion. The HVAC transmission presents the maximum design scenario at the Hornsea Three landfall due to the greater number of cables and therefore, a wider corridor and trench are required. The maximum design scenario for flood risk on the onshore export cable corridor is the HVAC transmission due to the greater number of cable trenches required and therefore, the greatest area of land disturbance. The use of open cut crossings represents the maximum design scenario for flood risk due to the change in the channel dimensions and pumping. The maximum design scenario for flood risk in terms of the onshore HVAC booster station is associated with the HVAC transmission as the booster station is not required for the HVDC transmission. The maximum design scenario for flood risk at the onshore HVDC converter/HVAC substation is the HVDC transmission as it requires the largest footprint for single and multiple building options resulting in the largest possible area of disturbance and flood storage.
The impacts of trenchless techniques may affect major surface watercourses.	HDD crossings across major surface watercourses. A HDD compound would be located at both ends of the HDD crossing each with a footprint of up to 4,900 m^2 (70 m x 70 m) with permeable surfacing.	The maximum design scenario for indirect effects to surface water quality would result from the use of trenchless techniques (e.g. HDD). Trenchless crossing techniques present a risk of indirectly contaminating surface watercourses where they are hydraulically connected with surface runoff caused by spillages and the movement of sediment.
The impacts of open cut, ducting and culverts may affect surface watercourses.	Up to six backfilled, ducted open cut trenches including a temporary culvert of an appropriate size.	The maximum design scenario for disturbance to surface water resources would result from the use of open cut, ducting and culverts. The HVAC transmission represents the maximum design scenario due to the greater number of cables required as this would result in the largest possible area of disturbance to surface water resources.

Potential impact	Maximum design scenario	Justification
The impacts of construction may affect drainage pipeline infrastructure.	Onshore export cable corridor Temporary onshore cable corridor is 80 m wide and 55 km long (including 60 m wide permanent onshore cable corridor (wider where obstacles occur)). Up to six cable trenches (each containing one circuit) each trench is 5 m wide and 2 m deep. Depth of stabilised backfill up to 1.5 m. Up to 330 junction bays and link boxes. Closest separation distance between junction bay and link box: - 750 m. Up to 74,250 m^2 area required for junction bays (based on 330 junction bays (each junction bay is 9 m x 25 m)). Up to 2,970 m^2 area required for link boxes (based on 330 link boxes (each link box: is 3 m x 3 m)). Up to two temporary haul roads 5 m wide (7 m wide at passing places).	The maximum design scenario for disturbance or damage to drainage pipeline infrastructure would be the HVAC transmission due to the greater number of cable trenches required and therefore the greatest area of land disturbance. The construction of the cable trenches, link boxes and junction bays may result in the removal or temporary blockage of existing drainage pipeline infrastructure. A loss of the drainage network would lead to the backing up of gullies and surface water systems leading to potential surcharging and flood risk.
The impacts of construction may affect field drainage and irrigation.	Onshore export cable corridor Temporary onshore cable corridor is 80 m wide and 55 km long (including 60 m wide permanent onshore cable corridor (wider where obstacles occur)). Up to six cable trenches (each containing one circuit) each trench is 5 m wide and 2 m deep. Depth of stabilised backfill up to 1.5 m. Up to 330 junction bays and link boxes. Closest separation distance between junction bay and link box: - 750 m. Up to 74,250 m^2 area required for junction bays (based on 330 junction bays (each junction bay is 9 m x 25 m)). Up to 2,970 m^2 area required for link boxes (based on 330 link boxes (each link box: is 3 m x 3 m)). Up to two temporary haul roads 5 m wide (7 m wide at passing places). Onshore HVDC converter/HVAC substation Permanent area of site is 128,000 m^2 (including area which may be used for landscaping) plus a temporary works area of 100,000 m^2. The transmission option with the greatest number of buildings and largest footprint is the HVDC converter station – up to five buildings. The main building (single building scenario) for the HVDC converter station will have a footprint of 11,250 m^2 (75 m x 150 m). Dimensions for the multiple building scenario would be reduced proportionately but the overall footprint would be the same. Onshore HVAC booster station Permanent area of site is 25,000 m^2 plus a temporary works area of 25,000 m^2. Building scenario with the largest footprint - single building with area of 4,500 m^2 (150 m length and 30 m width) and height up to 12.5 m.	The maximum design scenario for disturbance or damage to field drainage would be the HVAC transmission due to the greater number of cable trenches required and the construction of the onshore HVAC booster station (and therefore, the greatest area of land disturbance). The construction of the cable trenches, link boxes and junction bays may result in the removal or temporary blockage of existing field drainage. The construction of the onshore HVAC booster station and onshore HVDC converter/HVAC substation may result in the permanent removal of existing field drainage infrastructure. The HVDC transmission represents the maximum design scenario for the permanent removal of existing field drainage as it is has the biggest building footprint. A loss of the drainage network would lead to the backing up of field drainage channels and surface water systems leading to potential surcharging and flood risk.
Operation and maintenance phase		
The impacts of operation and maintenance may lead to increased flood risk.	Onshore HVDC converter/HVAC substation Permanent area of site is 128,000 m^2 (including an area which may be used for landcaping) plus a temporary works area of 100,000 m^2.The transmission option with the greatest number of buildings and largest footprint is the HVDC converter station – up to five buildings. The main building (single building scenario) for the HVDC converter station will have a footprint of 11,250 m^2 (75 m x 150 m). Dimensions for the multiple building scenario would be reduced proportionately but the overall footprint would be the same. In the absence of detailed design it has been assumed that the entire permanent footprint of the onshore HVDC converter/HVAC substation site will be constructed of impermeable material. Onshore HVAC booster station Permanent area of site is 25,000 m^2. Building scenario with the largest footprint - single building with area of 4,500 m^2 (150 m length and 30 m width) and height up to 12.5 m. In the absence of detailed design it has been assumed that the entire permanent footprint of the onshore HVAC booster station site will be constructed of impermeable material.	The maximum design scenario for flood risk is the HVAC transmission as it requires the construction of the onshore HVAC booster station. The maximum design scenario for flood risk at the onshore HVDC converter/HVAC substation would be the HVDC transmission as it has the biggest building footprint and area of impermeable surfacing.

Potential impact	Maximum design scenario	Justification
The impacts of routine maintenance operations may affect main surface watercourses.	Routine maintenance of the onshore HVDC converter/HVAC substation and HVAC booster station. Permanent onshore cable corridor area is 3,300,000 m^2 (60 m wide and 55 km long).	The maximum design scenario for water quality of main watercourses during operation is that chemicals and oils would be used in the routine maintenance of the onshore HVDC converter/HVAC substation. An onshore HVAC booster station would also be required for the HVAC transmission (in addition to a HVAC substation) which would also require maintenance and therefore, represents the maximum design scenario. The onshore export cable provides lateral pathways for water flow which could indirectly affect water quality.
The impacts of routine maintenance operation may affect minor surface watercourses.	Routine maintenance of the onshore HVDC converter/HVAC substation and HVAC booster station. Permanent onshore cable corridor area is 3,300,000 m^2 (60 m wide and 55 km long).	The maximum design scenario for water quality of minor watercourses during operation is that chemicals and oils would be used in the routine maintenance of the onshore HVDC converter/HVAC substation. An onshore HVAC booster station would also be required for the HVAC transmission in addition to a HVAC substation and therefore, represents the maximum design scenario. The onshore export cable provides lateral pathways for water flow which could indirectly affect water quality.
Decommissioning phase		
The impacts of decommissioning may affect temporary flood risk.	Removal of the link boxes, onshore HVDC converter/HVAC substation and onshore HVAC booster station including areas of hardstanding.	The maximum design scenario for flood risk on the surrounding environment during decommissioning is the removal of the link boxes, onshore HVDC converter/HVAC substation and onshore HVAC booster station. The removal of attenuation storage associated with the onshore HVDC converter/HVAC substation and onshore HVAC booster station could affect flood risk as it would take the natural environment a period of time to re-establish itself and regenerate to providing natural attenuation.
The impacts of decommissioning may affect main surface watercourses.	Removal of the onshore HVDC converter/HVAC substation and onshore HVAC booster station including areas of hardstanding. Buried cables would be de-energized with the ends sealed and left in place to avoid ground disturbance.	The maximum design scenario for water quality of main watercourses during decommissioning is the removal of the onshore HVDC converter/HVAC substation and onshore HVAC booster station as this presents the greatest disturbance and potential risk of sediment and contaminants being released. The maximum design scenario for water quality of main watercourses during decommissioning is that the onshore export cable remains in situ. The onshore export cable provides lateral pathways for water flow which could indirectly affect water quality.
The impacts of decommissioning may affect minor surface watercourses.	Removal of the onshore HVDC converter/HVAC substation and onshore HVAC booster station including areas of hardstanding. Buried cables would be de-energized with the ends sealed and left in place to avoid ground disturbance.	The maximum design scenario for water quality of main watercourses during decommissioning is the removal of the onshore HVDC converter/HVAC substation and onshore HVAC booster station as this presents the greatest disturbance and potential risk of sediment and contaminants being released. The maximum design scenario for water quality of minor watercourses during decommissioning is that the onshore export cable remains in situ. The onshore export cable provides lateral pathways for water flow which could indirectly affect water quality.

2.9 Impact assessment criteria

2.9.1.1 The criteria for determining the significance of effects is a two stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts on those receptors. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude are based on those used in the Design Manual for Road and Bridges (DMRB) methodology (DMRB, 2009), which is described in further detail in volume 1, chapter 5: Environmental Impact Assessment Methodology.

2.9.1.2 The criteria for defining sensitivity in this chapter are outlined in Table 2.12 below.

Table 2.12: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	Definition used in this chapter
Very High	Receptor is high value or critical importance to local, regional or national economy. Receptor is highly vulnerable to impacts that may arise from the project and recoverability is long term or not possible. Surface water: WFD Current Overall Status of High. Flood risk: Land within Flood Zone 3 or more than one hundred residential properties protected from flooding by flood defence infrastructure or by natural floodplain storage.
High	Receptor is of moderate value with reasonable contribution to local, regional or national economy. Receptor is generally vulnerable to impacts that may arise from the project and recoverability is slow and/or costly. Surface water: WFD Current Overall Status of Good. Flood risk: Land within Flood Zone 3 and/or 2 or between one and one hundred residential properties or industrial premises protected from flooding by flood defence infrastructure or by natural floodplain storage.
Medium	Receptor is of minor value with small levels of contribution to local, regional or national economy. Receptor is somewhat vulnerable to impacts that may arise from the project and has moderate to high levels of recoverability. Surface water: WFD Current Overall Status of Moderate. Flood risk: Flood plain within Flood Zone 2 and/or 1 or limited constraints and a low probability of flooding of residential and industrial properties.
Low	Receptor is of low value with little contribution to local, regional or national economy. Receptor is not generally vulnerable to impacts that may arise from the project and/or has high recoverability. Surface water: WFD Current Overall Status of Poor. Flood risk: Flood plain within Flood Zone 2 and/or 1 or limited constraints and a very low probability of flooding of residential and industrial properties.
Negligible	Receptor is of negligible value with no contribution to local, regional or national economy. Receptor is not vulnerable to impacts that may arise from the project and/or has high recoverability. Surface water: WFD Current Overall Status of Bad. Flood risk: Area outside flood plain (Flood Zone 1) or flood plain with very low probability of flooding industrial properties.

2.9.1.3 The criteria for defining magnitude in this chapter are outlined in Table 2.13 below.

Table 2.13: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition used in this chapter
Major	Total loss of ability to carry on activities. Impact is of extended temporal or physical extent and of long term duration (i.e., approximately 50 years duration).
	Significant observable degradation in water resource quality and/or increase in flood risk (i.e., approximately 50 years duration).
Moderate	Loss of or alteration to significant portions of key components of current activity. Impact is of moderate temporal or physical extent and of medium term duration (i.e., less than 20 years).
	Observable degradation in water resource quality and/or increase in flood risk (i.e., less than 20 years).
Minor	Small reduction in baseline conditions, leading to a reduction in level of activity that may be undertaken. Impact is of limited temporal or physical extent and of short term duration (i.e., up to 3 years).
	Degradation in water resource quality and/or slight increase in flood risk (i.e., up to 3 years).
Negligible	Very small reduction in baseline condition. Physical extent of impact is negligible and of short term duration (i.e., less than 2 years).
	No observable degradation in water resource quality and/or flood risk (i.e., less than 2 years).
No change	No change from baseline conditions.

2.9.1.4 The significance of the effect upon hydrology and flood risk is determined by correlating the magnitude of the impact and sensitivity of the receptor. The particular method employed for this assessment is presented in Table 2.14. Where a range of significance is presented in Table 2.14 the final assessment for each effect is based upon expert judgement.

2.9.1.5 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

Table 2.14: Matrix used for the assessment of the significance of the effect.

		Magnitude of impact				
		No change	***Negligible***	***Minor***	***Moderate***	***Major***
Sensitivity of receptor	***Negligible***	Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
	Low	Negligible	Negligible or minor	Negligible or minor	Minor	Minor or moderate
	Medium	Negligible	Negligible or minor	Minor	Moderate	Moderate or major
	High	Negligible	Minor	Minor or moderate	Moderate or major	Major or substantial
	Very high	Negligible	Minor	Moderate or major	Major or substantial	Substantial

2.10 Assessment of significance

2.10.1 Measures adopted as part of Hornsea Three

2.10.1.1 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential impacts for hydrology and flood risk (see Table 2.15). This approach has been employed iin order to demonstrate commitment to measures by including them in the design of Hornsea Three and have therefore been considered in the assessment presented in section 2.10. These measures are considered standard industry practice for this type of development. Assessment of sensitivity, magnitude and therefreo, significance includes implementation of these measures. The construction measures set out below will be contained within a Code of Construction Practice which will accompany the Environmental Statement.

Table 2.15: Designed-in measures adopted as part of Hornsea Three.

Measures adopted as part of Hornsea Three	Justification
Construction	
<u>Surface water drainage scheme</u> The proposed development of the onshore HVDC converter/HVAC substation and HVAC booster station will result in the construction of low permeability surfacing, increasing the rate of surface water run-off from the site. A surface water drainage scheme is required to ensure the existing run-off rates to the surrounding water environment are maintained at pre development rates. The detailed design of the surface water drainage scheme would be based on a series of infiltration/soakaway tests carried out on site and the attenuation volumes outlined in supporting FRAs (volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment). The tests will be undertaken prior to construction and in accordance with the BRE Digest 365 Guidelines. The strategy will ensure that the current mean annual run-off rate at the onshore HVDC converter/HVAC substation and HVAC booster station is maintained at the current 1 in 1 year run-off rate, and is monitored to ensure that the agreed rate of discharge is maintained. Measures to mitigate against water pollution will also apply to the onshore HVDC converter/HVAC substation and HVAC booster station, and will include measures as set out for the onshore export cable router below to minimise the risk of water pollution.	To address the requirements of NPS EN-1, the NPPF, Environment Agency and Norfolk County Council surface water run-off requirements.
<u>Flood control measures</u> Cable trenching and construction site access road widening across surface water courses will require measures to ensure that the water quality and flow rates are unaffected either directly or indirectly. The onshore export cable route and the construction site access roads will be designed to minimise land take and to avoid, where possible, impacts on existing drainage networks and features. The onshore construction compounds and construction access and haul roads would comprise permeable gravel overlying a permeable geotextile membrane of an appropriate standard. Where the onshore export cable crosses smaller watercourses and land drainage, measures would be discussed with the relevant stakeholders (e.g. construction access roads installed over pre-installed culverts). Open cut and HDD crossing techniques will be discussed with the Environment Agency following submission of the PEIR. Cable entry and exit points within transition pits, junction bays and link boxes will be sealed with an appropriate water proofing material to mitigate flood risk. At the western section of the Hornsea Three landfall, construction measures would be adopted to provide the same level of flood protection during construction. Drainage would be installed either side of the onshore export cable route to ensure existing land drainage flow is maintained, altered and channelled by the corridor. Surface water flowing into the trenches during the construction period will be pumped via settling tanks or ponds to remove sediment and potential contaminants, before being discharged into local ditches or drains via temporary interceptor drains. Where gradients on site are significant, cable trenches will include a hydraulic brake (bentonite or natural clay seals) to reduce flow along trenches and hence reduce local erosion. Any field drainage intercepted during the cable installation will either be reinstated following the installation of the cable or diverted to a secondary channel. Any works undertaken will be in agreement with the appropriate stakeholders.	To control flood risk.

Measures adopted as part of Hornsea Three	Justification
Pollution prevention measures: Refuelling of machinery will be undertaken within designated areas where spillages can be easily contained. Machinery will be routinely checked to ensure it is in good working condition. Any tanks and associated pipe work containing oils and fuels will be double skinned and be provided with intermediate leak detection equipment. The following specific mitigation measures for the protection of surface water during construction activities will be implemented: • Management of construction works to comply with the necessary standards and consent conditions as identified by the Environment Agency; • A briefing highlighting the importance of water quality, the location of watercourses and pollution prevention included within the site induction; • Areas with prevalent run-off to be identified and drainage actively managed (e.g. through bunding and/or temporary drainage); • Areas at risk of spillage, such as vehicle maintenance areas and hazardous substance stores (including fuel, oils and chemicals) to be bunded and carefully sited to minimise the risk of hazardous substances entering the drainage system or the local watercourses. • Additionally the bunded areas will have impermeable bases to limit the potential for migration of contaminants into groundwater following any leakage/spillage. Bunds used to store fuel, oil etc. to have a 110% capacity; • Disturbance to areas close to watercourses reduced to the minimum necessary for the work; • Excavated material to be placed in such a way as to avoid any disturbance of areas near to the banks of watercourses and any spillage into the watercourses; • Construction materials to be managed in such a way as to effectively minimise the risk posed to the aquatic environment; • All plant machinery and vehicles to be maintained in a good condition to reduce the risk of fuel leaks; • Drainage works to be constructed to relevant statutory guidance and approved via the LLFA prior to the commencement of construction; and • Consultation with the Environment Agency to be ongoing throughout the construction period to promote best practice and to implement proposed mitigation measures.	To prevent pollution of water courses and address stakeholder concerns for the construction of the onshore elements of Hornsea Three.
Best practice measures All construction work will be undertaken in accordance with the Outline CoCP, and good practice guidance including, but not limited to: • Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors CIRIA (C650); • CIRIA – SuDS Manual (CIRIA, 2015); • No discharge to surface watercourses will occur without permission from the Environment Agency (SuDS Manual); • Wheel washers and dust suppression measures to be used as appropriate to prevent the migration of pollutants (SuDS Manual); • Regular cleaning of roads of any construction waste and dirt to be carried out (SuDS Manual); and • A construction method statement to be submitted for approval by the responsible authority (SuDS Manual).	To accord with guidance and best practice for construction works.
Operation	
Operational practices to incorporate measures to prevent pollution and increased flood risk, to include emergency spill response procedures, clean up and remediation of contaminated water run-off.	To reduce the risk of surface water pollution.
Decommissioning phase	
Decommissioning practices to incorporate measures to prevent pollution and increased flood risk, to include emergency spill response procedures, and clean up and remediation of contaminated soils. Exposed cables ducts will be sealed with an appropriate water proofing material to mitigate flood risk.	To protect surface water based on guidance that will be appropriate at the time of decommissioning.

2.10.1.2 In some cases there may be additional mitigation measures required that are not "built in" to the project design ahead of the assessment. These are to be discussed in the sections on Further Mitigation and Future Monitoring sections below.

2.10.2 Construction Phase

2.10.2.1 The impacts of the onshore construction of Hornsea Three have been assessed on hydrology and flood risk. The environmental impacts arising from the construction of Hornsea Three are listed in Table 2.11 above along which the maximum design scenario against which each construction phase impact has been assessed.

2.10.2.2 A description of the potential effect on hydrology and flood risk receptors caused by each identified impact is given below.

Impacts of construction may lead to increased flood risk.

Magnitude of impact

2.10.2.3 Open cut techniques have been defined as the maximum design scenario at the Hornsea Three landfall. At the eastern section of the Hornsea Three landfall, the coastal cliff face acts as an natural flood defence. Assuming that open cut techniques are used at this section of the Hornsea Three landfall a temporary gap would be created in the coastal cliff face, potentially disrupting or damaging the integrity of the natural flood defence. The works would alter a key component of an activity (i.e. flood defence) which may lead to increased coastal erosion and impacts on tidal bodies. The magnitude of impact is predicted to be of local spatial extent, medium term duration and reversible. The impact is therefore predicted to be **moderate.**

2.10.2.4 At the western section of the Hornsea Three landfall, the shingle beach provides a natural flood defence. The use of open cut techniques across the beach may create a pathway for flood water and lead to a slight increase in flood risk, in-land. However, the construction process would include measures to control tidal flood risk, which would be confirmed during the refinement of the project description in the Environmental Statement. The magnitude of impact is predicted to be of local spatial extent, short term duration and reversible. The impact magnitude is therefore predicted to be **minor.**

2.10.2.5 In other parts of the hydrology and flood risk study area, impacts on flood risk would arise from any temporary change in run-off over the areas affected during construction, such as construction compounds, haul roads, construction access roads and the onshore export cable corridor. Construction methodologies (as set out in Table 2.15) will be implemented to ensure the risk of flooding is not increased (e.g. permeable gravel overlying a permeable geotextile membrane of an appropriate standard for construction compounds, haul roads and construction access roads and drainage features to maintain land drainage flow). In terms of crossings, all major crossings (such as major roads, rivers and rail crossings) would be undertaken using HDD techniques (full details provided within the volume 1, chapter 3: Project Description). Methodologies for other crossings will be discussed with the Environment Agency following the submission of the PEIR and will be reported in the Environmental Statement.

2.10.2.6 The impacts on flood risk from the temporary change in runoff are only likely to affect the surrounding local receptors and, assuming that designed-in and construction measures (see Table 2.15) are implemented, there is unlikely to be any observable degradation in flood risk. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.10.2.7 The eastern section of the Hornsea Three landfall comprises cliffs which provide a natural flood defence to areas in-land and also influences the process of coastal erosion. The cliffs have a local and regional importance and are vulnerable to impacts that may arise as a result of Hornsea Three. The cliffs are therefore considered to have a sensitivity of **medium**.

2.10.2.8 The western section of the Hornsea Three landfall comprises a shingle beach which provides a natural flood defence. It has a local importance and a high recoverability and therefore is considered to have a **low** sensitivity.

2.10.2.9 Over 90% of the hydrology and flood risk study area is shown as Flood Zone 1 (i.e. low probability of flooding) and is not directly at risk of flooding. However, there are localised areas of the hydrology and flood risk study area shown as Flood Zones 2 and 3 (see volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones. The onshore cable corridor search area, onshore HVDC converter/HVAC substation and HVAC booster station are situated within a mainly rural area, with limited residential properties within the surrounding area. The land adjoining the hydrology and flood risk study area is of low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

2.10.2.10 The overall significance of the effect on flood risk at the eastern section of the Hornsea Three landfall is assessed as **moderate**. At the western section of the Hornsea Three landfall, the overall significance of the effect, taking into account the mitigation measures from Table 2.15, is assessed as **minor**.

2.10.2.11 The overall significance of the effect on flood risk based in the remainder of the hydrology and flood risk study area, which includes the integration of measures adopted in Table 2.15, is assessed as **negligible**.

2.10.2.12 The effect will, therefore, be of **moderate adverse** significance at the eastern section of the Hornsea Three landfall, which is significant in EIA terms. For the western section of Hornsea Three landfall the effect will, therefore, be of **minor adverse** significance and the rest of the hydrology and flood risk study area, the effect will be of **negligible** significance, which is not significant in EIA terms.

Further mitigation

2.10.2.13 As part of the iterative design process, measures would be considered following the submission of the PEIR to mitigate the potential impacts to the natural flood defences.

2.10.2.14 Opportunities would be investigated, such as the use of HDD techniques (or similar) at the eastern section of the Hornsea Three landfall, in order to reduce the potential damage to the natural flood defences. The magnitude of impact would be **minor** and the significance of the residual effect is considered to be **minor adverse**, which is not significant in EIA terms.

Impacts of trenchless techniques may affect major surface watercourses.

Magnitude of impact

2.10.2.15 The impacts on major watercourses from construction activities involving the use of trenchless techniques and associated machinery could lead to an increase in turbid run-off and spillages/leaks of fuel, oil etc. affecting nearby watercourses. There is the potential for this to impact on water quality of the watercourses and therefore cause a reduction in the WFD classification.

2.10.2.16 Similarly, the onshore export cable route corridor itself could act as a drainage channel, leading to run-off from construction areas affecting nearby watercourses. However, the construction process will include measures to intercept run-off and ensure that discharges from the site are controlled in quality and volume causing no degradation in WFD classification. This may include the use of settling tanks or ponds to remove sediment, temporary interceptors and a hydraulic brake. These measures are included in Table 2.15 and will be discussed with the Environment Agency following submission of the PEIR. The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.10.2.17 The sensitivity of water bodies is dependent on the nature of the specific watercourse. WFD classification obtained from the Environment Agency website and mapping for water quality (see catchment data explorer http://environment.data.gov.uk/catchment-planning) shows that the main rivers 'crossed' are considered to be of 'moderate' status based on water quality data obtained via the Environment Agency and the criteria set out in Table 2.13. As noted in Section 2.7.8, assuming all watercourses have achieved 'Good' status at the time when construction begins, the surface watercourses within the hydrology and flood risk study area will be assessed with a WFD status of 'good'. The watercourses crossed via trenchless techniques are considered to be highly vulnerable in relation to WFD classification status, but of moderate recoverability and moderate value in relation to the local economy. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.10.2.18 The overall significance of effects on main watercourses crossed by trenchless techniques which includes the integration of measures adopted in Table 2.15 is considered to be **minor adverse**.

2.10.2.19 Effects in relation to run-off from construction sites and spillages for main watercourses which includes the integration of measures adopted in Table 2.15 would be of **minor adverse** significance.

2.10.2.20 The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Impacts of open cut, ducting and culverts may affect surface watercourses.

Magnitude of impact

2.10.2.21 The use of open cut techniques to construct the onshore export cable route has the potential to cause adverse impacts on surrounding watercourses and receptors. The use of heavy vehicles and the removal of sediment may lead to an increase in turbid runoff, reducing the water quality (in turn WFD classification) in surrounding watercourses.

2.10.2.22 A number of minor watercourses and drains would be crossed by the onshore export cable route and by up to two temporary haul roads associated with the installation process and construction access roads (Table 2.11). Appropriate methods to cross the watercourses would be discussed with the relevant stakeholders (e.g. Environment Agency, IDB and the Local Lead Flood Authority) following the submission of the PEIR. These measures may include the installation of a pre-installed culvert pipe in the watercourse under the construction access road and haul road. The pipe would be of suitable size to accommodate the water volumes and flows, or temporary bridging may be installed. The access and haul roads would be removed at the end of the construction programme. The construction works would be undertaken in accordance with a methodology for the crossing of watercourses agreed with the Environment Agency. This will include measures to ensure that watercourses, including their banks, are reinstated to their previous condition where possible.

2.10.2.23 Activities on site during construction could lead to an increase in turbid run-off, spillages/leaks of fuel, oil etc. and an alteration in surface water flow pathways that could affect nearby watercourses. Similarly, the cable route itself could act as a drainage channel, leading to run-off from construction affecting nearby watercourses. However, the construction process would include measures to intercept run-off and ensure that discharges from the site are controlled in quality and volume causing no degradation in WFD classification. This may include the use of settling tanks or ponds to remove sediment, temporary interceptors and a hydraulic brake. These measures are included in Table 2.15 and will be discussed with the Environment Agency following submission of the PEIR.

2.10.2.24 The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.10.2.25 Minor watercourses' WFD status is determined by the WFD classifications of surrounding main waterbodies. Based on the Environment Agency objectives for WFD status, all minor watercourses along the onshore cable route are considered to have a 'good' status. Taking this into consideration, the minor watercourses are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.10.2.26 The effects on the minor watercourses that would be crossed using open cut, ducting and culverts which include the integration of measures adopted in Table 2.15 are considered to be of minor significance.

2.10.2.27 The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Impacts of construction may affect drainage pipeline infrastructure.

Magnitude of impact

2.10.2.28 The impact on drainage pipeline infrastructure from open cut techniques during the construction phase could temporarily disrupt local drainage infrastructure, impacting on water quality, potential flow rates and local water supply networks.

2.10.2.29 The routing of the onshore cable corridor search area has taken into account the location of major services utilities (see volume 1, chapter 4: Site Selection and Consideration of Alternatives), however the presence of local drainage infrastructure cannot be discounted. For example, the hydrology characterisation survey of the main river crossing locations identified the presence of an Anglian Water service pipe in the vicinity of the River Yare.

2.10.2.30 The refinement of the onshore cable corridor will include discussions with Anglian Water to identify the location of drainage pipeline infrastructure. Micro-routing or appropriate construction techniques will be employed where required.

2.10.2.31 Any impacts of construction which affect drainage supply infrastructure are likely to cause temporary disruption of water supply to residents/businesses in the local surrounding area. This would comprise a small reduction in the baseline conditions leading to a reduction in the level of activity undertaken (i.e. water supply). However, the impact would be of limited temporal extent and short term duration. It is predicted that any impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.10.2.32 Drainage pipeline infrastructure comprises water supply pipelines operated by Anglian Water, which are considered to have a moderate value and contributes to the local and regional economy. It is vulnerable to the construction impacts of Hornsea Three and its recoverability may be costly. The sensitivity of the receptor is therefore considered to be **high**.

Significance of the effect

2.10.2.33 The significance of effects on pipeline drainage which includes the integration of measures adopted in Table 2.15 is considered to be **minor**. This is due to the short term duration of the impact and that receptors in the local area (i.e. local residents and businesses) would be affected with regards to water supply.

2.10.2.34 The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Impacts of construction may affect field drainage and irrigation.

Magnitude of impact

2.10.2.35 The impact on field drainage and irrigation from open cut techniques and the installation of link boxes and jointing bays during the construction phase could temporarily affect surface water flow pathways, impacting on water quality and potential flow rates.

2.10.2.36 The permanent removal of field drains within the onshore HVAC booster station and onshore HVDC converter/HVAC substation sites may cause a backup on surrounding field drains, in turn increasing the flood risk to the site and surrounding receptors. However, the construction process would include measures to seal cable entry and exit points within transition pits and link boxes with an appropriate water proofing material to mitigate flood risk. Measures would also be included to restore field drainage following the installation of the onshore export cable. These measures are included in Table 2.15.

2.10.2.37 With the incorporation of appropriate construction mitigation techniques and surface water management scheme (at the onshore HVAC booster station and onshore HVDC converter/HVAC substation sites) the impact is predicted to be of local spatial extent with a minor shift away from existing hydrological environment of local receptors, short term duration, intermittent occurrence and reversible with field drains to be re-established where appropriate. It is predicted that any impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.10.2.38 Field drains are considered to be of moderate vulnerability along the route section, moderate to high recoverability and minor value. The sensitivity of the receptor, is therefore considered to be **medium**.

Significance of the effect

2.10.2.39 The significance of effects on pipeline drainage which includes the integration of measures adopted in Table 2.15 is considered to be minor.

2.10.2.40 The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Future monitoring

2.10.2.41 The need for monitoring of HDD operations at main rivers will be discussed with the Environment Agency and/or Natural England.

2.10.3 Operational and maintenance phase

2.10.3.1 The impacts of the onshore operation and maintenance of Hornsea Three have been assessed on hydrology and flood risk conditions. The environmental impacts arising from the operation and maintenance of Hornsea Three are listed in Table 2.11 along with the maximum design scenario against which each operation and maintenance phase impact has been assessed.

2.10.3.2 A description of the potential effect on hydrology and flood risk receptors caused by each identified impact is given below.

Impacts of operation and maintenance may lead to increased flood risk.

Magnitude of impact

2.10.3.3 The proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation have been subject to an FRA (volume 6, annex 2.1: Onshore HVAC Booster Station and Onshore HVDC Converter/HVAC Substation Flood Risk Assessment) in order to meet the requirements of planning policy and best practice. The onshore HVAC booster station and onshore HVDC converter/HVAC substation sites would be designed to ensure no increase in the rate of run-off. With the incorporation of mitigation measures and the surface water management plan outlined within the FRA, it has been determined that there will be no chance from the baseline hydrological environment. The magnitude is therefore, considered to be **no change**.

2.10.3.4 As the onshore export cable route will be underground and will incorporate drainage either side of the cable corridor to ensure existing land drainage flow is maintained, it is determined that there will be no increase in flood risk due to operation and maintenance of the cable.

Sensitivity of receptor

2.10.3.5 The proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation sites have been assessed as within Flood Zone 1 and therefore not directly at risk of flooding from all sources. However, increased low permeability surfacing could directly impact flood risk on adjoining land. The land adjoining the proposed development is of low flood risk vulnerability within the rural landscape, high recoverability and low value with limited residential, commercial or industrial properties in the vicinity. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

2.10.3.6 As the onshore HVAC booster station and onshore HVDC converter/HVAC substation have been assessed as having a low impact within an area at low risk of flooding and therefore low sensitivity, the overall significance of effect which includes the integration of measures adopted in Table 2.15 is considered to be negligible.

2.10.3.7 It has been determined that there will be no increase in flood risk due to the onshore export cable route.

2.10.3.8 The effect will, therefore, be of **negligible** significance which is not significant in EIA terms.

The impacts of routine maintenance operations may affect main surface watercourses.

Magnitude of impact

2.10.3.9 The operation of the onshore HVAC booster station and onshore HVDC converter/HVAC substation will involve routine maintenance. Maintenance may involve the use of chemicals, oils and greases and therefore, there is the potential for spillages to occur which may affect the water quality of main surface watercourses.

2.10.3.10 The onshore export cable provides a lateral pathway for the movement of water which could indirectly affect water quality.

2.10.3.11 With the incorporation of mitigation measures outlined in Table 2.15, the impact is predicted to be of local spatial extent only impacting on surrounding receptors, short term duration, intermittent occurrence and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.10.3.12 The main watercourses in the study area are assessed to be of high vulnerability, moderate to high recoverability and minor value based on the Environment Agency's WFD classification. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.10.3.13 Taking into account the measures integrated as part of the project outlined in Table 2.15 the effects are considered to be of minor significance.

2.10.3.14 The effect will, therefore, be of **minor adverse** significance which is not significant in EIA terms.

The impacts of routine maintenance operations may affect minor surface watercourses.

Magnitude of impact

2.10.3.15 The operation of the onshore HVAC booster station and onshore HVDC converter/HVAC substation will involve routine maintenance. Maintenance may involve the use of chemicals, oils and greases and therefore, there is the potential for spillages to occur which may affect the water quality of minor surface watercourses.

2.10.3.16 The onshore export cable provides a lateral pathway for the movement of water which could indirectly affect water quality.

2.10.3.17 With the incorporation of mitigation measures outlined in Table 2.15, the impact is predicted to be of local spatial extent only impacting surrounding receptors, short term duration, intermittent occurrence with maintenance occurring annually and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.10.3.18 Minor watercourses WFD status is taken from WFD classifications of surrounding Main waterbodies. Based on the Environment Agency objectives for WFD status, all minor watercourses along the onshore cable route are considered to have a 'good' status. The minor watercourses are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.10.3.19 Taking into account the measures integrated as part of the project outlined in Table 2.15, the effects are considered to be of minor significance only effecting local rural receptors.

2.10.3.20 The effect will, therefore, be of **minor adverse** significance which is not significant in EIA terms.

Future monitoring

2.10.3.21 The need for monitoring of the HVAC booster station and HVDC converter/HVAC substation will be discussed with the Environment Agency and, if required, details of the proposed monitoring will be included within the Environmental Statement.

2.10.4 Decommissioning phase

2.10.4.1 The impacts of the onshore decommissioning of Hornsea Three have been assessed on hydrology and flood risk receptors. The environmental effects arising from the decommissioning of Hornsea Three are listed in Table 2.11 along with the maximum design scenario against which each decommissioning phase impact has been assessed.

2.10.4.2 A description of the potential effect on hydrology and flood risk receptor caused by each identified impact is given below.

Impacts of construction may lead to increased flood risk.

Magnitude of impact

2.10.4.3 The decommissioning of the onshore HVAC booster station and onshore HVDC converter/HVAC substation will involve the demolition of buildings and the removal of foundations and the attenuation storage provided during construction and operation. The natural attenuation of the sites will be restored over time. Where feasible, the structure of the link boxes may also be removed.

2.10.4.4 The impacts are predicted to be of local spatial extent, short term duration, intermittent and high reversibility indicating that any impacts on decommissioning which affect flood risk vulnerability are likely to only affect the surrounding local receptors. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.10.4.5 Over 90% of the hydrology and flood risk study area is shown as Flood Zone 1 with localised areas of Flood Zone 2 and 3. The onshore cable corridor search area, onshore HVDC converter/HVAC substation and HVAC booster station are situated within a mainly rural area, with limited residential properties within the surrounding area. The land adjoining the proposed development is of low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

2.10.4.6 The overall significance of the effect on flood risk based on the situation, which includes the integration of measures adopted in Table 2.15 and decommissioning methods to manage tidal flood risk, is assessed as **minor**.

2.10.4.7 The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

The impacts of decommissioning may affect main surface watercourses.

Magnitude of impact

2.10.4.8 Following the operational lifespan of the development it is assumed that the waterbodies along the onshore cable route will have a WFD classification status of 'good'.

2.10.4.9 During decommissioning, the dismantling of the onshore HVDC converter/HVAC substation and the HVAC booster station has the potential to cause adverse impacts on surrounding watercourses and receptors. The use of heavy vehicles and the removal of sediment may lead to an increase in turbid runoff, reducing the water quality (in turn WFD classification) in surrounding watercourses.

2.10.4.10 Other activities on site could lead to an alteration in surface water flow pathways that could affect nearby watercourses. Similarly, the cable route itself could act as a drainage channel, leading to run-off from decommissioning areas to affect nearby watercourses. However, the decommissioning process would include measures to intercept run-off and ensure that discharges from the site are controlled in quality and volume causing no degradation in WFD classification. This may include the use of settling tanks or ponds to remove sediment, temporary interceptors and a hydraulic brake.

2.10.4.11 With the incorporation of mitigation measures set out in Table 2.15 the impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility indicating that any impacts on decommissioning which affect flood risk vulnerability are likely to only affect the surrounding local receptors. The magnitude is therefore, considered to be **negligible.**

Sensitivity of receptor

2.10.4.12 The sensitivity of water bodies is dependent on the nature of the specific watercourse. As mentioned within section 2.7.8 the main rivers 'crossed' are considered to be of 'moderate' status. Based on the Environment Agency objectives for WFD status, all main watercourses along the onshore cable route are considered to have a 'good' status. The watercourses crossed by the onshore export cable route are considered to be highly sensitive in relation to WFD classification status, of moderate value and reasonable contribution in relation to the local economy. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.10.4.13 Taking into account the measures integrated as part of the project outlined in Table 2.15 the effects are considered to be of minor significance.

2.10.4.14 The effect will, therefore, be of **minor adverse** significance which is not significant in EIA terms.

The impacts of decommissioning may affect minor surface water courses.

Magnitude of impact

2.10.4.15 During decommissioning the dismantling of the onshore HVDC converter/HVAC substation and HVAC booster station has the potential to cause adverse impacts on surrounding watercourses and receptors. Activities on site and the use of heavy vehicles may lead to an increase in turbid runoff, reducing the water quality (in turn WFD classification) in surrounding watercourses.

2.10.4.16 With the incorporation of mitigation measures set out in Table 2.15 the impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility indicating that any impacts on decommissioning which affect flood risk vulnerability are likely to only affect the surrounding local receptors. The magnitude is therefore, considered to be **negligible.**

Sensitivity of receptor

2.10.4.17 Minor watercourses WFD status is taken from WFD classifications of surrounding Main waterbodies. Based on the Environment Agency objectives for WFD status, all minor watercourses along the onshore cable route are considered to have a 'good' status. The minor watercourses are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.10.4.18 Taking into account the measures integrated as part of the project outlined in Table 2.15 the effects are considered to be of minor significance.

2.10.4.19 The effect will, therefore, be of **minor adverse** significance which is not significant in EIA terms.

Future monitoring

2.10.4.20 No future monitoring is proposed.

2.11 Cumulative Effect Assessment methodology

2.11.1 Screening of other projects and plans into the Cumulative Effect Assessment

2.11.1.1 The Cumulative Effect Assessment (CEA) takes into account the impact associated with Hornsea Three together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise undertaken as part of the 'CEA long list' of projects (see volume 4, annex 5.2: Cumulative Effects Screening Matrix and annex 5.3: Location of Schemes). Each project on the CEA long list has been considered on a case by case basis for scoping in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

2.11.1.2 In undertaking the CEA for Hornsea Three, it is important to bear in mind that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside Hornsea Three. For example, relevant projects and plans that are already under construction are likely to contribute to cumulative impact with Hornsea Three (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors. For this reason, all relevant projects and plans considered cumulatively alongside Hornsea Three have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the CEA to present several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each Tier in the decision making process when considering the potential cumulative impact associated with Hornsea Three (e.g. it may be considered that greater weight can be placed on the Tier 1 assessment relative to Tier 2). An explanation of each tier is included below:

- Tier 1: Hornsea Three considered alongside other project/plans currently under construction and/or those consented but not yet implemented, and/or those submitted but not yet determined and/or those currently operational that were not operational when baseline data was collected, and/or those that are operational but have an on-going impact;
- Tier 2: All projects/plans considered in Tier 1, as well as those on relevant plans and programmes likely to come forward but have not yet submitted an application for consent (the PINS programme of projects is the most relevant source of information, along with the planning register held by the relevant local planning authority). Specifically, this Tier includes all projects where the developer has submitted a Scoping Report; and

- Tier 3: All projects/plans considered in Tier 2, as well as those on relevant plans and programmes likely to come forward but have not yet submitted an application for consent (the PINS programme of projects is the most relevant source of information). Specifically, this Tier includes all projects where the developer has advised PINS in writing that they intend to submit an application in the future but have not submitted a Scoping Report.

2.11.1.3 The specific projects scoped into this CEA and the Tiers into which they have been allocated, are outlined in Table 2.16 ordered on the distance of each specific project from the onshore elements of Hornsea Three (as defined in 2.1.1.1). The projects included as operational in this assessment have been commissioned since the baseline studies for this project were undertaken and as such were excluded from the baseline assessment.

Table 2.16: List of other projects and plans considered within the CEA.

Tier	Hornsea Three Phase	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
1	Construction.	PF/13/1026 Creation of 20 hard standings (former rally field Area A) for the siting of 20 woodland lodges with associated access and infrastructure. Demolition of chicken sheds (Area B), change of use of land and creation of hard standings for the siting of 17 static caravans with associated access and infrastructure.	<1 km	Approved 01-Nov-13	2019	No	Yes
1	Construction.	PF/14/0177 Installation of landfall transition pit and buried electrical cable system (revisions to previously approved scheme) and changes to the construction configuration at the landfall.	<1 km	Approved 06/10/2014	2017	No	Yes
1	Construction.	2014/2611 The erection of 890 dwellings; the creation of a village heart to feature an extended primary school, a new village hall, a retail store and areas of public open space; the relocation and increased capacity of the allotments; and associated infrastructure including public open space and highway works.	<1 km	Approved 01-Nov-16	2018	Yes	Yes
1	Construction.	C/7/2014/7030 (I) For a southern extension to Mangreen Quarry and ancillary works with progressive restoration to agriculture and nature conservation by the importation of inert restoration materials; (II) Retention of existing consented facilities at Mangreen Quarry; (III) Establishment of crossing point over Mangreen Lane; and (IV) Proposed variation to approved restoration scheme at Mangreen Quarry.	<1 km	Approved 02-Oct-15	2017	No	Yes
1	Construction.	C/7/2014/7030 (I) For a southern extension to Mangreen Quarry and ancillary works with progressive restoration to agriculture and nature conservation by the importation of inert restoration materials; (II) Retention of existing consented facilities at Mangreen Quarry; (III) Establishment of crossing point over Mangreen Lane; and (IV) Proposed variation to approved restoration scheme at Mangreen Quarry.	<1 km	Approved 02-Oct-15	2019	No	Yes
1	Construction.	2013/0092 Outline application for up to 20 residential units and associated highways works with all matters reserved.	<1 km	Approved 20-Mar-14	2020	No	Yes
1	Construction.	2013/0086 Outline application including means of access for residential development and ancillary works.	<1 km	Approved 30-Apr-14	N/A	No	Yes

Tier	Hornsea Three Phase	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
1	Construction..	2015/2630 Residential Development for 8no. dwellings, car parking and amenity space including 2no. affordable dwellings which form part of planning reference 2015/0253.	<1 km	Approved 30-Aug-16	2017	No	Yes
1	Construction.	2012/1836 Outline application for residential development (20 Dwellings) and associated infrastructure works, including highway improvement works at the Mill Road/School Lane/Burnthouse Lane junction.	<1 km	Approved 29-Apr-14	N/A	No	Yes
1	Construction.	2015/1594 Residential development of 95no dwellings with associated open space and infrastructure.	<1 km	Approved 18-Dec-15	2018	Yes	Yes
1	Construction.	20151644 Demolition of 4 Existing Units and Development of 10 Residential Units, Together with Associated Access (Outline).	<1 km	Approved 10/06/2016	2022	Yes	Yes
1	Construction.	2015/1681 Reserved matters for appearance, layout, scale and landscaping of the first phase of development for 126 dwellings in relation to outline permission 2011/1804.	<1 km	Approved 18-Feb-16	2018	Yes	Yes
1	Construction.	2015/1697 Erection of 27 dwellings, access, roads, open space, parking areas and associated works.	<1 km	Approved 27-Jun-16	2019	No	Yes
1	Construction.	PF/14/0328 Erection of extension to provide twelve supported residential units.	<1 km	Approved 20/05/2014	2019	No	Yes
1	Construction.	PF/14/0859 Erection of sixteen dwellings.	<1 km	Approved 19/06/205	2017	No	Yes
1	Construction.	PO/16/0253 Erection of up to 215 dwellings, employment land (A3, A4, B1, B2, B8, C1, C2, D1 and D2 class uses), public open space and provision of roundabout and vehicular link road from Cromer Road (A148) to Heath Drive with associated landscaping and infrastructure (Outline application).	<1 km	Approved 15-Aug-16	2018	Yes	Yes

Tier	Hornsea Three Phase	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
1	Construction.	2015/2082 Outline application for the residential development 10 dwellings.	<1 km	Approved 22-Jun-16	2021	No	Yes
1	Construction.	2012/1429 Residential development (Use Class C3) of 9 dwellings including 2 affordable homes, landscaping, associated access onto Low Road, and associated carriageway works to Low Road; and provision of a village green space adjacent to the Keswick Parish Room.	1 km	Approved 21-Mar-13	2018	Yes	Yes
1	Construction.	C/7/2010/7016 Continued recycling of former building materials and use of concrete batching plant until 31 May 2029: Site entrance improvements including hardening of site access road: Hardening of remainder of concrete batching compound: Highway improvements: Construction of car park and footpath: Erection of estate fencing around ice house: Restoration of the site in accordance with an improved restoration scheme by 31 May 2030 with public access to former quarry and adjoining land and woodland for informal recreational purposes.	1 km	Approved 05-Mar-12		No	Yes
2	Construction, Operation and Decommissioning.	EN010079 Norfolk Vanguard is a proposed offshore windfarm with an approximate capacity of 1800MW off the coast of Norfolk.	<1 km	Currently at Pre-Application Stage Application expected to be submitted to the Planning Inspectorate in Q2 2018	2020	Yes	Yes
2	Construction.	PF/15/1223 Erection of twenty two residential units (Class C3) with associated highway and landscape works.	<1 km	Undecided Awaiting Decision as of 24/01/2017 Decision Target Date 01/02/2017	2020	No	Yes
2	Construction	20170052 Greater Norwich Food Enterprise Zone	<1 km	Pending Consideration (when checked on 02-Feb-17)	2017	Yes	Yes
2	Construction	2016/0764 Outline Application for Proposed employment development consisting of B1, B2 and B8 uses, associated access and landscaping; and proposed link road between the A140 and the B1113 with some matters reserved	<1 km	Pending Consideration when checked on 24-Jan-17	2021	Yes	Yes
2	Construction	PM/16/1204 Reserved matters submission of appearance, landscaping, layout and scale; for erection of 214 dwellings, public open space, highway and other infrastructure, in respect of outline planning application PO/16/0253	<1 km	Undecided Awaiting Decision as of 24/01/2017 Target Decision Date: 29/11/2016	2019	Yes	Yes

2.11.1.4 A review of approved and proposed developments within a 1 km buffer from the onshore elements of Hornsea Three has been undertaken.

2.11.2 Maximum design scenario

2.11.2.1 The maximum design scenarios identified in Table 2.17 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative impact presented and assessed in this section have been selected from the details provided in the Hornsea Three project description (volume 1, chapter 3: Project Description), as well as the information available on other projects and plans, in order to inform a 'maximum design scenario'. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope, to that assessed here be taken forward in the final design scheme.

Table 2.17: Maximum design scenario considered for the assessment of potential cumulative impacts on hydrology and flood risk.

Potential impact	Maximum design scenario	Justification
Construction phase		
The impacts of construction may affect flood risk.	Tier 1 C/7/2014/7030, 2014/2611, PF/13/1026 and PO/16/0253. Tier 2 EN010079 Tier 3 - N/A	The construction phases of these schemes potentially overlap with the construction phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect in relation to surface water runoff on hydrology and flood risk receptors.
The impacts of trenchless techniques may affect major surface watercourses.	Tier 1 C/7/2014/7030, 2014/2611, PF/13/1026 and PO/16/0253. Tier 2 EN010079 Tier 3 - N/A	The construction phases of these schemes potentially overlap with the construction phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect on the potential deterioration of local surface watercourses through turbid runoff.
The impacts of open cut, ducting and culverts may affect surface watercourses.	Tier 1 C/7/2014/7030, 2014/2611, PF/13/1026 and PO/16/0253. Tier 2 EN010079 Tier 3 - N/A	The construction phases of these schemes potentially overlap with the construction phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect on the potential deterioration of local surface watercourses through turbid runoff.
The impacts of construction may affect drainage pipeline infrastructure.	Tier 1 C/7/2014/7030, 2014/2611, PF/13/1026 and PO/16/0253. Tier 2 EN010079 Tier 3 - N/A	The construction phases of these schemes potentially overlap with the construction phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect on hydrology and flood risk receptors.
The impacts of construction may affect field drainage and irrigation.	Tier 1 C/7/2014/7030, 2014/2611, PF/13/1026 and PO/16/0253. Tier 2 EN010079 Tier 3 - N/A	The construction phases of these schemes potentially overlap with the construction phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect on hydrology and flood risk receptors.
Operation and maintenance phase		
The impacts of operation may affect flood risk.	Tier 1 – N/A Tier 2 EN010079 Tier 3 – N/A	The operation and maintenance phase of these schemes overlap with the operation and maintenance phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect in relation to an increase in less permeable surfacing on hydrology and flood risk receptors.
The impacts of routine maintenance operations may affect main surface watercourses.	Tier 1 – N/A Tier 2 EN010079 Tier 3 – N/A	The operation and maintenance phase of these schemes overlap with the operation and maintenance phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect in relation to an increase in pollution incidents on main watercourses.
The impacts of routine maintenance operations may affect minor surface watercourses.	Tier 1 – N/A Tier 2 EN010079 Tier 3 – N/A	The operation and maintenance phase of these schemes overlap with the operation and maintenance phase of Hornsea Three. When considering these schemes in combination with Hornsea Three, there may be a cumulative affect in relation to an increase in pollution incidents on local minor watercourses.
Decommissioning phase		
The impacts of decommissioning may affect temporary flood risk.	Tier 1 – N/A Tier 2 EN010079 Tier 3 – N/A	The decommissioning phase of this scheme may overlap with the decommissioning phase of Hornsea Three. When considering the scheme in combination with Hornsea Three, there may be a cumulative affect in relation to an increase in local surface runoff and flooding on hydrology and flood risk receptors.
The impacts of decommissioning may affect main surface watercourses.	Tier 1 – N/A Tier 2 EN010079 Tier 3 – N/A	The decommissioning phase of this scheme may overlap with the decommissioning phase of Hornsea Three. When considering the scheme in combination with Hornsea Three, there may be a cumulative affect in relation to an increase in turbid runoff affecting the WFD status of local main surface watercourses.

Potential impact	Maximum design scenario	Justification
The impacts of decommissioning may affect minor surface watercourses.	Tier 1 – N/A Tier 2 EN010079 Tier 3 – N/A	The decommissioning phase of this scheme may overlap with the decommissioning phase of Hornsea Three. When considering the scheme in combination with Hornsea Three, there may be a cumulative affect in relation to an increase in turbid runoff affecting the WFD status of local minor surface watercourses.

2.12 Cumulative Effect Assessment

2.12.1.1 A description of the significance of cumulative effects upon hydrology and flood risk arising from each identified impact is given below.

2.12.2 Construction Phase

Impacts of construction may lead to increased flood risk.

Tier 1/Tier 2

Magnitude of impact

2.12.2.1 A number of cumulative schemes are present within the hydrology and flood risk study area. A review of the schemes against the Environment Agency Flood Zone Maps indicate that two of the schemes (PF/14/0117 and EN010079) are partially situated within an area defined as Flood Zone 3, and therefore at higher risk of flooding. However, as over 90% of the hydrology and flood risk study area is situated within Flood Zone 1 it is unlikely that these schemes would cause cumulative flood risk impacts on the construction of the onshore elements of Hornsea Three and/or the surrounding area.

2.12.2.2 The impact is predicted to be of local spatial extent and of short term duration during the construction period. It is also considered that the impact will be intermittent during the construction period and will be of high reversibility. Over 90% of the Hornsea Three project is located within Flood Zone 1. It is predicted that the impact will affect surrounding local receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.12.2.3 Increased low permeability surfacing could directly impact flood risk on adjoining land. The land adjoining Hornsea Three is of low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of Effect

2.12.2.4 The overall significance of the effect on flood risk based on the scenario which includes measures adopted in Table 2.15 and those incorporated within the cumulative assessed projects under the NPPF and PPG (i.e. detailed drainage scheme and surface water management strategy) is deemed to be **negligible**.

2.12.2.5 Overall, it is predicted that the sensitivity of the receptor is considered to be no change and the magnitude is deemed to be low. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

The impacts of trenchless techniques may affect major surface watercourses.

Tier 1/Tier 2

Magnitude of impact

2.12.2.6 The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **negligible**.

2.12.2.7 The impact to main watercourses takes into account the WFD classification and is predicted to be of local spatial extent, medium term duration, intermittent occurrence and high reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.12.2.8 The sensitivity of watercourses is dependent on the nature of the specific watercourse. WFD classification obtained from the Environment Agency website and mapping for water quality (Table 2.6) shows that the main rivers 'crossed' are considered to be of medium sensitivity based on water quality data supplied by the Environment Agency. The watercourses crossed via trenchless techniques are considered to be highly vulnerable, but of moderate to high recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of Effect

2.12.2.9 The overall significance of effects on main watercourses crossed by trenchless techniques which includes the integration of measures adopted in Table 2.15 is considered to be **minor adverse** significance, which is not significant in EIA terms.

The impacts of open cut, ducting and culverts may affect surface watercourses.

Tier 1/Tier 2

Magnitude of impact

2.12.2.10 The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.12.2.11 Minor and ordinary watercourses are generally considered to be of low to medium sensitivity based on Environment Agency WFD classifications. The minor and ordinary watercourses are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of effect

2.12.2.12 The effects on the minor watercourses that would be crossed without trenchless technology and includes the integration measures adopted in Table 2.15 are considered to be of **minor adverse** significance.

The impacts of construction may affect drainage pipeline infrastructure.

2.12.2.13 **Tier 1/Tier 2**

Magnitude of impact

2.12.2.14 Direct impacts may occur to drainage pipeline infrastructure present along the route due to construction activities, dependent on the proximity of the infrastructure in relation to Hornsea Three. Cumulative impacts would therefore only occur where development limits coincide.

2.12.2.15 The impact with the integration of measures adopted in Table 2.15 is predicted to be of local spatial extent, of short term duration, of intermittent occurrence and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.12.2.16 Drainage pipeline infrastructure comprises water supply pipelines operated by Anglian Water, which are considered to be of moderate vulnerability and high value, impacting the local and regional economy. The sensitivity of the receptor is therefore considered to be **high**.

Significance of Effect

2.12.2.17 The overall significance of the effect on drainage pipeline infrastructure based on the situation which includes the integration of measures adopted in Table 2.15 is deemed to be minor.

2.12.2.18 Overall, it is predicted that the sensitivity of the receptor is considered to be high and the magnitude is deemed to be minor. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

The impacts of construction may affect field drainage and irrigation.

Tier 1/Tier 2

Magnitude of impact

2.12.2.19 The impact is predicted to be of local spatial extent, short term duration, of intermittent occurrence and reversible. It is predicted that any impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

2.12.2.20 Field drainage and irrigation which form part of the hydrological environment are deemed to be of moderate vulnerability, moderate to high recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effects

2.12.2.21 The overall significance of the effects of disturbance or contamination of filed drains based on the situation which included the integration of measures adopted in Table 2.15 is considered to be minor.

2.12.2.22 The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

2.12.3 Operation and maintenance phase

Impacts of operation and maintenance may lead to increased flood risk.

Tier 2

2.12.3.1 Following the installation of the buried cables no impacts on the hydrological and/or flood risk baseline are anticipated.

Magnitude of impact

2.12.3.2 Direct impacts may occur to the HVAC booster station and HVDC converter station site due to the operation and maintenance activities dependent on the size of the development and the appropriate incorporation of mitigation techniques. Cumulative impact would only occur where development coincide that do not incorporate an appropriate drainage network and appropriate surface water management strategy.

2.12.3.3 The development will be designed to ensure no increase in the rate of run-off. The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **no change**.

Sensitivity of receptor

2.12.3.4 The proposed development area has been assessed as not directly at risk of flooding. However, increased low permeability surfacing could directly impact flood risk on adjoining land. The land adjoining the proposed development is of low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effects

2.12.3.5 The proposed development area has been assessed as having a low impact within an area at low risk of flooding and therefore, low sensitivity. The overall significance of effect which includes the integration of measures adopted in Table 2.15 is considered to be negligible.

2.12.3.6 The effect will, therefore, be of **negligible significance** which is not significant in EIA terms.

The impacts of routine maintenance operations may affect main surface watercourses.

Tier 2

Magnitude of impact

2.12.3.7 During the operational and maintenance phase the main impacts would be the accidental spillage of oils and/or chemicals. The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.12.3.8 The main watercourses in the study area are assessed to be of high vulnerability, moderate to high recoverability and moderate value based on the Environment Agency's WFD classification. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.12.3.9 Taking into account the measures integrated as part of the project (as outlined in Table 2.15) the effects are considered to be of minor significance.

2.12.3.10 The effect will, therefore, be of **minor adverse** significance which is not significant in EIA terms.

The impacts of routine maintenance operations may affect minor surface watercourses.

Tier 2

Magnitude of impact

2.12.3.11 During the operational and maintenance phase the main impacts would be the accidental spillage of oils and/or chemicals. The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

2.12.3.12 Minor and ordinary watercourses are generally considered to be of low to medium sensitivity based on Environment Agency WFD classifications. The minor and ordinary watercourses are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

2.12.3.13 Taking into account the measures integrated as part of the project outlined in Table 2.15 the effects will therefore, be of minor significance.

2.12.3.14 The effect will therefore be of **minor adverse** significance, which is not significant in EIA terms.

2.12.3.15 It is assumed that each development would be constructed in line with the requirements of the NPPF and PPG ID7 – Flood Risk and Coastal Change, (and where relevant the NPSs) requiring that new developments attenuate surface water run-off to where practicable to the greenfield run-off rate.

2.12.3.16 Any works undertaken within 9 m of a watercourse and/or flood defence will require consent. For the consent to be provided the developer is required to demonstrate that the risk of flooding during the lifetime of the development could be mitigated to a level acceptable to the Environment Agency, LLFA and/or IDB. Therefore, it is unlikely developments within the immediate vicinity of Hornsea Three would cause an increase in flood risk. Therefore, the cumulative impacts on hydrology and flood risk are not predicted to be significant.

2.12.4 Decommissioning phase

2.12.4.1 It has been assumed that the onshore HVAC booster station and onshore HVDC converter/HVAC substation would be removed and that the onshore export cable would remain in-situ. No additional effects above those detailed under the construction and operation and maintenance phase are predicted. It is therefore determined that the cumulative effects from decommissioning of Hornsea Three would be of minor adverse significance to negligible, which is not significant in EIA terms.

2.13 Transboundary effects

2.13.1.1 A screening of transboundary impacts has been carried out and is presented in volume 4, annex 5.3: Transboundary Impacts Screening Note. This screening exercise identified that there was no potential for significant transboundary effects with regard to hydrology and flood risk conditions from Hornsea Three upon the interests of other EEA States.

2.14 Inter-related effects

2.14.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, operational and decommissioning) to interact to create a potentially greater effect on a receptor than if just assessed in isolation in these three key project stages (e.g., construction phase noise, operational noise and noise during decommissioning and dismantling at the onshore HVAC booster station and HVDC converter/HVAC substation site); and
- Receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor or receptor group. As an example, all effects on a given receptor such as local residents – construction dust and noise, increased traffic and visual change etc. may interact to produce a greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

2.14.1.2 A description of the likely inter-related effects arising from Hornsea Three on hydrology and flood risk conditions is provided in chapter 12: Inter-Related Effects (Onshore).

2.15 Conclusion and summary

2.15.1.1 Preliminary results of the EIA identify that over 90% of the hydrology and flood risk study area is shown on Environment Agency flood maps as Flood Zone 1 (i.e. low probability of flooding) and is not directly at risk of flooding. However, there are localised areas of Flood Zone 2 and 3 (see volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones. An FRA has been prepared for the onshore HVAC booster station and the onshore HVDC converter/HVAC substation.

2.15.1.2 The hydrology and flood risk study area includes a number of catchments associated with Environment Agency designated main rivers and ordinary watercourses (see volume 6, annex 2.2: Environment Agency and IDB Watercourses and Flood Zones). Some of these rivers are associated with designated ecological habitats or are designated for their own ecological importance (see chapter 3: Ecology and Nature Conservation). HDD methods or similar will be considered to cross main rivers (see volume 1, chapter 3: Project Description).

2.15.1.3 In the eastern section of the Hornsea Three landfall cliffs provide natural flood defences, however the open cut construction methods would damage the integrity of the flood defences and lead to a moderate adverse effect. Opportunities to use HDD methods (or similar) in this location would be investigated following the submission of the PEIR to avoid or minimise the impacts of open cut. Elsewhere in the hydrology and flood risk study area, the implementation of measures set out in Table 2.15 would mitigate any potential adverse effects in terms of flood risk and surface water quality in order that they are not significant in EIA terms (i.e. minor adverse effects).

2.15.1.4 A summary of the findings of the EIA that have been completed to date and which relate to hydrology and flood risk are presented in Table 2.18.

2.16 Next Steps

2.16.1.1 The next steps towards producing the Environmental Statement involve the incorporation of design information for the onshore HVAC booster station and the onshore HVDC converter/HVAC substation into the FRA and the development of a surface water management strategy.

2.16.1.2 A preliminary hydrological note has been produced in which each major water crossing has been assessed in relation to potential crossing techniques, any hydrological and/or ecological vulnerabilities and potential recommendations. Work on the hydrological note is ongoing and the outcome will be incorporated into the Environmental Statement to greater inform the potential adverse effects of the crossing locations in relation to main and ordinary waterbodies. An onshore crossing schedule will also be included in the Environmental Statement which will identify potential crossing methodologies to be used for each watercourse.

2.16.1.3 Mitigation measures and crossing methodologies for watercourses will be discussed with the Environment Agency, LLFA and IDB following submission of the PEIR and will be reported in the Environmental Statement.

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Table 2.18: Summary of potential environmental effects, mitigation and monitoring.

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Construction Phase							
The impacts of construction may affect flood risk.	Construction measures, surface water drainage scheme, best practice measures (see Table 2.15).	Negligible – remainder of onshore elements Minor – Hornsea Three landfall western section Moderate – Hornsea Three landfall eastern section	Low – Hornses Three landfall western section and remainder of onshore elements Medium - Hornsea Three landfall western section	Negligible Minor adverse - Hornsea Three landfall western section Moderate adverse – Hornsea Three landfall eastern section	Consideration of HDD or similar techniques at Hornsea Three landfall.	Minor adverse	None
The impacts of trenchless techniques may affect major surface watercourses.	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.15).	Negligible	High	Minor adverse	None	N/A	The need for monitoring HDD operations at main rivers will be discussed with the EA.
The impacts of open cut, ducting and culverts may affect surface watercourses.	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.15).	Negligible	High	Minor adverse	None	N/A	None
The impacts of construction may affect drainage pipeline infrastructure.	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.15).	Minor	High	Minor adverse	None	N/A	None
The impacts of construction may affect field drainage and irrigation.	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.15).	Minor	Medium	Minor adverse	None	N/A	None
Operation and Maintenance Phase							
The impacts of operation and maintenance may affect flood risk.	Operational measures (see Table 2.15).	No change	Low	Negligible	None	N/A	None
The impacts of route maintenance operation may affect main surface watercourses.	Operational measures (see Table 2.15). Monitoring of the discharge from the onshore HVAC booster station and onshore HVDC converter/HVAC substation will be carried out to ensure that the agreed rate of discharge and water quality is maintained.	Negligible	High	Minor adverse	None	N/A	The need for monitoring of the discharge from the onshore HVAC booster station and onshore HVDC converter/HVAC substation will be discussed with the Environment Agency. If required, details of the monitoring will be set out in the Environmental Statement.

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
The impacts of route maintenance operation may affect minor surface watercourses.	Operational measures (see Table 2.15).	Negligible	High	Minor adverse	None	N/A	The need for monitoring of the discharge from the onshore HVAC booster station and onshore HVDC converter/HVAC substation will be discussed with the Environment Agency. If required, details of the monitoring will be set out in the Environmental Statement.
Decommissioning Phase							
The impacts of decommissioning may affect temporary flood risk.	Decommissioning measures (see Table 2.15).	Minor	Low	Minor adverse	None	N/A	None
The impacts of decommissioning may affect main surface watercourses.	Decommissioning measures (see Table 2.15).	Negligible	High	Minor adverse	None	N/A	None
The impacts of decommissioning may affect minor surface watercourses.	Decommissioning measures (see Table 2.15).	Negligible	High	Minor adverse	None	N/A	None

2.17 References

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