Cambois Connection – Onshore Scheme

Environmental Statement Volume 2

Chapter 11 Hydrology and Hydrogeology

sse Renewables

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Basis of Report

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Acronyms

Acronym	Description
AEP	Annual Exceedance Probability
aOD	above Ordnance Datum
BGS	British Geological Survey
CEA	Cumulative Effects Assessment
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
CTMP	Construction Traffic Management Plan
CVA	Coastal Vulnerability Assessment
DEFRA	Department for Environment Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EEA	European Economic Area
EIA	Environmental Impact Assessment
ES	Environmental Statement
FRA	Flood Risk Assessment
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IEMA	Institute of Environmental Management and Assessment
Km	Kilometre
LLFA	Lead Local Flood Authorities
LNR	Local Nature Reserve
m	Metre
MAGIC	Multi-Agency Geographic Information for the Countryside
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MLWS	Mean Low Water Springs
MHWS	Mean High Water Springs

Acronym	Description
NCC	Northumberland County Council
NPPF	National Policy Planning Framework
NSL	North Sea Link
NTS	Non Technical Summary
PDE	Project Design Envelope
PPG	Planning Practice Guidance
rBWD	Revised Bathing Water Directive
SAAR	Standard Average Annual Rainfall
SAC	Special Area of Conservation
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWDS	Surface Water Drainage Strategy
uPBT	Ubiquitous, Persistent, Bioaccumulative and Toxic
WFD	Water Framework Directive

11. Hydrology and Hydrogeology

11.1. Introduction

1. This Chapter presents the assessment of the likely significant effects (as per the 'Environmental Impact Assessment (EIA) Regulations'[1]) on the environment arising from the Cambois Connection Onshore Scheme on hydrology and hydrogeology. Specifically, this Chapter considers the potential impact of the Onshore Scheme, landward of mean low water springs (MLWS) during the construction, maintenance, and decommissioning phases.

2. This Chapter has been informed by the following Chapters:

   - Onshore ES Chapter 9: Terrestrial Ecology and Ornithology;
   - Onshore ES Chapter 10: Geology and Soils;
   - Marine ES Chapter 8: Benthic Subtidal and Intertidal Ecology;
   - Marine ES Chapter 7: Physical Environment and Seabed Conditions[2]; and

3. A Water Framework Directive (WFD) Assessment has also been prepared for the Onshore Scheme as part of the application submission package.

4. The following technical appendices should be read in conjunction with this Chapter:

   - Technical Appendix 11.1 Flood Risk Assessment (Landfall and Cable Route) (Volume 3);
   - Technical Appendix 11.2 Flood Risk Assessment (Onshore Converter Station) (Volume 3);
   - Technical Appendix 11.3: Outline Surface Water Drainage Strategy (SWDS) (Volume 3); and
   - Technical Appendix 11.4: Coastal Vulnerability Assessment (CVA).

11.2. Purpose of this Chapter

5. This Chapter:

   - Presents the existing environmental baseline in relation to hydrology and hydrogeology, established from desk studies, site-specific surveys and feedback obtained during technical engagement with stakeholders;
   - Identifies any assumptions and limitations encountered in compiling the environmental information;
   - Presents the potential environmental impacts on hydrological and hydrogeological receptors arising from the Onshore Scheme, and reaches a conclusion on the likely significant effects based on the information gathered and the analysis and assessments undertaken; and

[1] For the Onshore Scheme, these are Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (as amended). For the Marine Scheme, this includes: The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2007 (as amended), The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, and The Marine Works (EIA) Regulations 2017.
[2] The ES for the Marine Scheme is available online at the Berwick Bank Wind Farm website (www.berwickbank.com). An electronic copy has been submitted to Northumberland County Council.

- Highlights any necessary monitoring and/or mitigation measures recommended to prevent, minimise, reduce or offset the likely significant adverse environmental effects of the Onshore Scheme on hydrological and hydrogeological receptors.

11.3. Study Area

6. The Onshore Scheme is located at Cambois, Blyth, south of the River Wansbeck and north of the River Blyth and encompasses around 188 ha of land.

7. The red line boundary for this area (hereafter referred to as 'the Site') is shown on Figure 1.2 and the Indicative Zones of Infrastructure are shown on Figure 5.1 (Volume 4).

8. The Study Area for the Onshore Scheme is the Site (refer to Volume 2, Chapter 5: Project Description), which extends west from the MLWS at Landfall to the Onshore Converter Station and south to the National Grid substation (west of the Port of Blyth), plus a buffer of up to 2 km where hydraulic connectivity to areas beyond the Study Area are possible.

9. The Study Area is shown on Figures 11.1 to 11.4 in Volume 4.

11.3.1. Intertidal Area

10. The Study Area for the Onshore Scheme includes the intertidal area. The intertidal area overlaps with the Marine topic of Physical Environment and Seabed Conditions (Chapter 7 of the Marine Scheme ES). An overall summary of likely significant effects associated with the intertidal area is also provided within the NTS for both the Onshore Scheme and Marine Scheme. This Chapter addresses any potential impacts on the hydrological and hydrogeological receptors arising from the Onshore Scheme (including where those impacts arise in the intertidal area). Chapter 7 and Appendix 3.5 of the Marine Scheme address potential impacts on the beach and intertidal physical environment and seabed conditions features arising from the Marine Scheme.

11. As detailed within this document, the Applicant's commitment to trenchless technology, e.g., Horizontal Directional Drilling (HDD), at the Landfall means that there is no potential for any direct interaction with the intertidal area for both the Marine Scheme and Onshore Scheme. The trenchless technology ducts will pass beneath the intertidal area from a point at least 250 m seawards of MLWS to a location onshore landwards of the dune system, and there is no above ground infrastructure located within the intertidal area.

11.4. Policy and Legislative Context

12. Policy and legislation in relation to hydrology and hydrogeology, is set out in detail in Chapter 2 of this ES. A summary of the policy and legislative provisions relevant to Hydrology and Hydrogeology are provided in Table 11-1 and Table 11-2 below.

Table 11-1 Summary of national and local planning policy relevant to hydrology and hydrogeology

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
Overarching National Policy Statement for Energy (EN-1)[3,4]	Paragraph 4.8.6 requires that applicants for new energy infrastructure must take into account the potential impacts of climate change using the latest UK Climate Projections and associated research available at the time, in order to ensure that appropriate mitigation or adaptation measures have been identified for the estimated lifetime of the new infrastructure.	The characterisation of the flood risk baseline and future baseline has been established using the EA Flood Map for Planning, the local authority SFRA and data from recent hydraulic models, which take into account climate change effects. This information is contained in Technical Appendix 11.1 Onshore Cable Corridor FRA and is covered in separate FRA reporting for the Onshore Converter Station in Technical Appendix 11.2 Onshore Converter Station FRA Flood risk has been considered for the life of the Onshore Scheme as detailed in Paragraph 145.
	Paragraph 5.7.4 requires that applications for energy projects of 1 hectare or greater in Flood Zone 1 and all energy projects located in Flood Zones 2 and 3 should be accompanied by a FRA. A FRA may also be required where there may be flooding issues other than from rivers and the sea (for example from surface water), or where the EA, 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. The minimum requirements for what should be included in an FRA are also outlined at paragraph 5.8.15 of Draft NPS EN-1.	FRA reporting undertaken in consultation with the EA and local authorities, compliant to NPS EN-1, paragraph 5.7.5: • Technical Appendix 11.1 Landfall and Onshore Cable Corridor FRA. • Technical Appendix 11.2 Onshore Converter Station FRA.

[3] Whilst it is acknowledged that the Onshore Scheme does not comprise or form part of an NSIP (please see Volume 2, Chapter 2: Policy and Legislative Context), NPSs are however a statement of government intention relating, in this case, to renewable energy projects, therefore can be taken into consideration during the preparation of the Onshore Scheme ES.
[4] A suite of draft revised Energy NPSs were published and consulted on by the UK Government in March 2023, and consultation closed on 23rd June. The consultation responses will be subject to consideration and the draft revised NPSs may now be revised before the NPSs are formally adopted. There is currently no date for the next stage of the review process and therefore this ES presents the extant adopted NPSs which have been considered during the preparation of this ES. It is however noted by the Applicant that the new draft NPSs state that they may be material considerations in other applications which are not considered under the Planning Act (2008), this includes the Marine Scheme. Further detail on the consideration of the draft NPSs in this ES is provided in Volume 2, Chapter 2 Policy and Legislation.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
	Paragraphs 5.7.7 to 5.7.8 require applicants to hold pre-application discussions with the EA and any other relevant bodies. Any concerns regarding flood risk should be discussed. The applicant should take all reasonable steps to agree ways in which the proposal might be amended, or additional information provided, which would alleviate concerns.	Consultation with the EA has been undertaken as part of the process, as summarised in Table 11 3.
	Paragraph 5.7.9 lists the requirements that the IPC should consider including where relevant: a FRA; application of the sequential test as part of the site selection; sequential approach at the site level to minimise risk; the proposal is in line with relevant local flood risk management strategies; priority has been given to the use of SuDs; in flood risk areas the proposals are appropriately flood resilient and resistant to flooding; that safe access/escape routes are included and land needed for future flood risk management is safeguarded.	FRA reporting has been undertaken in consultation with the EA and NCC which includes consideration of the sequential approach: • Technical Appendix 11.1 Landfall and Onshore Cable Corridor FRA. • Technical Appendix 11.2 Onshore Converter Station FRA. The Onshore Converter Station design includes a SuDS based surface water drainage scheme which will manage rainfall runoff from the proposed Onshore Converter Station and will not increase flood risk locally or in the wider area.
	Paragraph 5.15.3 requires applicants to undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment where it is considered that a project could have effects on the water environment. Paragraphs 5.15.5 to 5.15.7 ask the IPC to ensure that proposals have regard for RBMPs and meets the requirements of the WFD.	The baseline environment (Section 11.7) is described for the Study Area. An assessment of the impacts on water quality, resources and physical characteristics is provided in Section 11.11. The assessment of sensitivity for environmental receptors takes into consideration River Basin Management Plans (RBMPs) and Water Framework Directive (WFD) status. Table 11-9 sets out the parameters for defining receptor sensitivity and these criteria are applied in Section 11.11.
National Policy Statement for Renewable Energy Infrastructure (EN-3) (2011)	Paragraph 2.6.43 notes that where precise details of proposed developments are not known, the maximum potential adverse effects of the project should be considered.	Where options exist, the maximum height or footprint (referred to as the Maximum Design Scenario, or MDS) has been considered within this assessment as described in Section 11.8.1. The maximum realistic potential adverse effects have therefore been assessed.
	Paragraph 2.6.190 states that assessment should be undertaken for all stages of the lifespan of the proposed wind farm.	Environmental assessment has been undertaken for all stages of the lifespan of the proposed wind farm at Section 11.11.
Draft National Policy Statement for Renewable Energy Infrastructure (EN-3) (2023)	Paragraph 2.23.2 notes that where precise details of proposed developments are not known, the maximum potential adverse effects of the project should be considered.	Where options exist, the maximum height or footprint (referred to as the MDS has been assessed within this Chapter as described in section 11.8.1. The maximum realistic potential adverse effects have therefore been assessed.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
	Paragraph 2.24.5 states that assessment should be undertaken for all stages of the lifespan of the proposed wind farm.	Environmental assessment has been undertaken for all stages of the lifespan of the Onshore Scheme at section 11.11.
National Planning Policy Framework (NPPF)	Chapter 14 of the NPPF, Meeting the challenge of climate change, flooding and coastal change, along with the Planning Practice Guidance (PPG) which expands on policies contained in the NPPF, recommends a proactive strategy to mitigate and adapt to climate change and requires that flood risk, sustainability and water quality are considered. Chapter 15 of the NPPF, Conserving and enhancing the natural environment, along with guidance contained within PPG requires that account is taken of the potential for impact on water quality (in relation to water supply and the natural environment) and local hydrological regimes	The application of Chapters 14 and 15 of the NPPF to the Onshore Scheme are considered in Section 11.11, which considers the appropriate application of climate change allowances over the life of the project and sustainable drainage to manage water quality. Further detail is set out at: • Volume 3, Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment; and • Volume 3, Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment
Northumberland Local Plan 2016 – 2036	Policy WAT 1 – Water Quality In assessing development proposals, the Council will seek to ensure that all water bodies achieve 'good status' by 2021 in terms of their ecological balance and other relevant factors, preventing any deterioration in that status. This will be achieved in line with the Water Framework Directive and/or the Bathing Water Directive, having regard to local river basin management plans and the findings of the Northumberland Water Cycle Study, applying the ecosystem approach, through: a. Supporting development and/or landscape measures that maintain, or may result in enhanced water quality, including bathing water; b. Ensuring where possible that development will bring about an improvement to the water environment; c. Not supporting development if it would have an adverse impact on water quality in surface water bodies or it could disrupt the ground water movement or affect its chemical balance, including any wider impacts, taking full account, where appropriate, of the presence of minewater; d. Avoiding any reduction in the 'high status' of certain surface water bodies in the County, giving very close scrutiny to any development that may affect them; and e. Assessing the effects of development on designated Bathing Waters.	Water quality is assessed in detail in Volume 3, Technical Appendix 11.1 Onshore Cable Corridor Flood Risk Assessment and Volume 3, Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment, with assessment of impacts considered in section 11.11. A WFD Assessment has also been prepared for the Onshore Scheme as part of the application submission package.
	Policy WAT 3 – Flooding	Flooding is assessed in detail in Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment and Technical

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the ES
	1. In assessing development proposals the potential for both on and off-site flood risk from all potential sources will be measured… 2. Development proposals will be required to demonstrate how they will minimise flood risk to people, property and infrastructure from all potential sources by: a. Avoiding inappropriate development in areas at risk of flooding and directing the development away from areas at highest risk. d. Ensuring that built development proposals, including new roads, separate, minimise and control surface water run-off, using Sustainable Drainage Systems. 4. Any works relating to the above, which impact on natural water systems, should consider the wider ecological implications, applying the ecosystem approach, and link into green infrastructure initiatives wherever practicable.	Appendix 11.2 Onshore Converter Station Flood Risk Assessment, with assessment of impacts considered in section 11.11.
	Policy WAT 4 - Sustainable Drainage Systems 1. Water sensitive urban design, including Sustainable Drainage Systems (SuDS) will be incorporated into developments whenever necessary. 2. SuDS will be a requirement for any development where it is necessary to manage surface water drainage unless it can be clearly demonstrated: a. That SuDS are not technically, operationally or financially deliverable or viable and that any surface water drainage issues resulting from the development can be alternatively mitigated; or b. That the SuDS scheme will itself adversely affect the environment. 3. SuDS or other water sensitive urban design schemes should be devised to take account of predicted future conditions and, where appropriate,… improve water quality, benefit wildlife and/or contribute to the provision of an ecosystem service. 4. Arrangements must be put in place for the management and maintenance of SuDS over the lifetime of the development…	Sustainable Drainage Systems form part of the design of the Onshore Scheme and are assessed in Volume 3, Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment and Volume 3, Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment, with assessment of impacts considered in section 11.11.

Table 11-2 Summary of European and national legislation relevant to hydrology and hydrogeology

Relevant Legislation	Summary of Relevant Legislative Framework	How and Where Considered in the ES
European		
Water Framework Directive (2000/60/EC)	The Water Framework Directive (WFD) provides the foundation for the protection of the UK's water environment. The WFD seeks to protect all elements of the water cycle and to enhance the quality of groundwater, surface waters, estuaries, and coastal waters.	Impacts on the water environment are considered in section 11.11.1.
Groundwater Directive (2006/118/EC, including amendments to Annex II detailed under Directive 2014/80/EU)	The Groundwater Directive (GWD) is designed to combat groundwater pollution and sets out procedures for assessing quality of groundwater.	Impacts in relation to groundwater pollution are considered in section 11.11.1.
Floods Directive (2007/60/EC)	The Floods Directive requires assessment of all watercourses and coastlines to determine risk of flooding and action to take adequate and coordinated measures to reduce this flood risk.	Assessment of watercourses and coastlines in relation to flooding risk and preventative measures have been considered in Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment and Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment.
Revised Bathing Water Directive (rBWD) (2006/7/EC)	The Bathing Water Directive sets mandatory quality standards and monitoring obligations for bathing waters. The extant revised Bathing Water Directive (rBWD) provides more stringent standards than previous legislation and places an emphasis on providing information to the public.	Section 11.7.1.4 defines the local Bathing Water monitoring points and Section 11.11.1 includes assessment of risk to water quality on receptors including bathing waters.
National		
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017	This regulation transposes the WFD and aspects of the GWD into UK legislation.	Impacts on the water environment and in relation to groundwater pollution are considered in section 11.11.1. A WFD Assessment has also been prepared for the Onshore Scheme as part of the application submission package.
Environmental Permitting (England and Wales) Regulations 2016	This regulation consolidates and replaces the Environmental Permitting (England and Wales) Regulations 2010 and provide the implementing regulations for the environmental permitting regime.	The requirement for environmental permitting is included under the assessment of impacts in Section 11.11.

Relevant Legislation	Summary of Relevant Legislative Framework	How and Where Considered in the ES
Flood Risk Regulations 2009	This regulation transposes the EU Floods Directive into UK legislation and sets out requirements of the Environment Agency (EA) and local authorities in preparing assessments and mapping of flood risk for each river basin district in England and Wales	Flood risk is considered in Volume 3, Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment and Volume 3, Technical Appendix 11-2 Onshore Converter Station Flood Risk Assessment.
Flood and Water Management Act 2010	This Act includes provisions for the management of risk in connection with flooding and sets out requirements for Lead Local Flood Authorities (LLFA) in preparing strategies for local flood risk management.	Flood risk is considered in Volume 3, Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment and Volume 3, Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment.
Water Resources Act 1991	This Act regulates water resources, water quality and flood defence.	The requirement for permitting to protect environmental aspects covered by the Act is included under the assessment of impacts in section 11.11.

11.5. Consultation and Technical Engagement

13. A summary of the key issues raised during consultation and technical engagement activities undertaken to date, specific to Hydrology and Hydrogeology, is presented in Table 11-3 below, together with how these issues have been considered in the production of this Chapter. Further detail is presented within Volume 2, Chapter 4 of this ES: Stakeholder Engagement and Consultation.

Table 11-3 Summary of key consultation and technical engagement relevant to Hydrology and Hydrogeology

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Consultation on the Onshore Scheme: Scoping Opinion			
12/12/2022	Natural England – Consultation Response	The Environmental Statement should include a full assessment of the direct and indirect effects of the development on the features of special interest within the SSSI and identify appropriate mitigation measures to avoid, minimise or reduce any adverse significant effects. The assessment should take account of the risks of water pollution and how these can be managed or reduced. A number of water dependent protected nature conservation sites have been identified as failing condition due to elevated nutrient levels and nutrient neutrality is consequently required to enable development to proceed without causing further damage to these sites. The ES needs to take account of any strategic solutions for nutrient neutrality or Diffuse Water Pollution Plans, which may be being developed or implemented to mitigate and address the impacts of elevated nutrient levels.	Natural England's response to consultation has been addressed in section 11.11.
14/12/2022	EA– Consultation Response	The development raises some environmental concerns/issues regarding flood risk. The development may need to undertake further work to show how these issues can be satisfactorily addressed to ensure no adverse environmental impacts. We welcome that a Flood Risk Assessment is proposed to be completed as part of the EIA report.	As per the EA's request, flood risk has been assessed in Volume 3, Technical Appendix 11.1 Landfall and Onshore Cable Corridor Flood Risk Assessment and Volume 3, Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment.
Pre-application Consultation (NCC)			
24/02/2023	NCC pre-application advice response	We recommend the EIA is updated to include a section on Coastal Vulnerability. The scheme will require a Coastal Vulnerability Assessment. The policy from our Shoreline Management Plan is 21.5. Managed Retreat until 2025 then hold the line. Comments from SMP: *"Selective local works (hard points) to assist realignment and safeguard properties and assets – including use of existing revetment to aid this process. Manage the recession process elsewhere to ensure no breaching through dunes. Set any new development back from shore (buffer*	A Coastal Vulnerability Assessment is provided in Technical Appendix 11.4 (Volume 3).

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		*zone)".*To form a Coastal Vulnerability Assessment the applicant may wish to review the following data sources: - The Northumberland Shoreline Management Plan 2, Royal Haskoning (2009). - Cell 1 Regional Coastal Monitoring Programme Walkover Inspection Surveys - Cell 1 Regional Coastal Monitoring Programme Update Report 12: 'Partial Measures' Survey - Cell 1 Regional Coastal Monitoring Programme Analytical Report 12: 'Full Measures' Survey - Topographic Beach Profiles, North East Coastal Observatory (NECO). - Beach elevation data found from topographic surveys undertaken by the applicant. The Bruun Rule should be applied when considering the future profile of the beach and dunes.	
05/10/2023	Update meeting with NCC	Confirmation that a Coastal Vulnerability Assessment will be submitted as part of the outline planning application in accordance with feedback received from the LLFA, who confirmed that approach taken seemed appropriate and a key point to consider is ensuring that the cable would not come exposed therefore causing a risk to the public.	A Coastal Vulnerability Assessment (CVA) is provided in Technical Appendix 11.4, Volume 3.

11.6. Methodology to Inform Baseline

14. There are no published guidelines or criteria for assessing and evaluating effects on hydrology and hydrogeology within the context of an EIA.

15. Assessment of the baseline environment has involved the following approach:

- Completion of a detailed desk study to establish current baseline geological, hydrogeological and hydrological conditions;
- Validation of a desk study by a site walkover survey undertaken on 30/03/2023; and
- Consultation with stakeholders for data and information with regard to the site and any potentially sensitive environmental receptors.

16. The desk study was undertaken in order to:

- Determine hydrological and hydrogeological conditions within and adjacent to the Site; and
- Identify sensitive water dependent receptors which may potentially be impacted by the Onshore Scheme.

17. The assessment is based on publicly available data obtained from the Environment Agency (EA) and Northumberland County Council (NCC), as well as additional information supplied from stakeholders during the scoping and consultation progress.

11.6.1. Desktop Study

18. Information on hydrology and hydrogeology within the Study Area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 11-4 below.

Table 11-4 Summary of key desktop studies & datasets

Data	Source	Year	Author
Flood Zone mapping	EA data and data.gov.uk	2023	EA
Spatial flood defence data and mapping	EA data and data.gov.uk	2023	EA
Flood warning and flood alert areas	EA data and data.gov.uk	2023	EA
Main Rivers	EA data and data.gov.uk	2023	EA
Ordinary Watercourses	EA data and data.gov.uk	2023	EA
Groundwater Source Protection Zones (SPZ)	EA data and data.gov.uk	2023	EA
WFD surface water and groundwater classification data	EA data and data.gov.uk	2023	EA
Geology (artificial ground, superficial deposits, bedrock)	British Geological Survey (BGS) website: https://www.bgs.ac.uk/	2023	BGS
Borehole / well data	BGS website: https://www.bgs.ac.uk/	2023	BGS
Aquifer designation	BGS website: https://www.bgs.ac.uk/	2023	BGS
Groundwater Vulnerability	BGS website: https://www.bgs.ac.uk/	2023	BGS
Statutory and non-statutory environmental designations	Multi-Agency Geographic Information for the Countryside (MAGIC) website: https://magic.defra.gov.uk/MagicMap.aspx	2023	Defra
Soil type and character	Soilscapes website: https://www.landis.org.uk/soilscapes/	2023	Cranfield Soil and Agrifood Institute
Strategic Flood Risk Assessment (SFRA)	Level 1 Strategic Flood Risk Assessment	2010	NCC
Strategic Flood Risk Assessment (SFRA)	Northumberland Level 2 Strategic Flood Risk Assessment	2015	NCC

11.6.2. Site-specific Surveys

19. Site-specific surveys were undertaken to inform this Chapter. A summary of the surveys undertaken are outlined in Table 11-5 below.

Table 11-5: Summary of site-specific survey data

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date	Reference to Further Information
Hydrology Walkover	Hydrology and Hydrogeology Study Area	Walkover to assess local watercourses, potential for flooding and existing drainage regimes	SLR Consulting	30/03/2023	N/A

11.7. Baseline Environment

11.7.1. Overview of Baseline Environment

20. The hydrological and hydrogeological environment at the Study Area is considered in a number of sub-sections:

    - Hydrogeological setting: soils and geology; recharge mechanism; aquifer characteristics; groundwater levels and flow; water resources and abstractions; groundwater quality; and
    - Hydrological setting: surface water features and water dependant habitat; surface water quality, flood risk and surface water management.

21. This information has been used to develop a conceptual site model to assess potential impacts that may arise from the Onshore Scheme. This model has also been used to determine appropriate mitigation measures.

22. Flood Risk Assessment reports have also been prepared to support the planning application and are provided as Technical Appendix 1.1 Landfall and Onshore Cable Route Flood Risk Assessment and Technical Appendix 11.2 Onshore Converter Station Flood Risk Assessment (both in Volume 3).

11.7.1.1. Site Setting

23. The Onshore Scheme lies c.450 m to the south of Cambois, on land between the River Wansbeck in the north and the Sleek Burn and River Blyth in the south. The Site is located immediately north of the River Blyth Estuary along an area of open shoreline associated with the North Sea. Sleek Burn is present along the south-western boundary discharging into the Blyth Estuary.

24. The Site comprises predominantly grassland and woodland, with areas of the boundary overlapping into the estuarine areas of Sleek Burn. A large part of the site includes brownfield land which is partially developed as part of a new industrial use development, comprising of large hardstanding areas and associated drainage arrangements. The Site boundary also encompasses the existing marina on the River Blyth and development to the south of Brock Lane, including the Phase 1 Development of Northumberland Energy Park.

25. The Site encompasses approximately 188 ha and includes all aspects of the Onshore Scheme. The route of the preferred onshore cable corridor and location of the Onshore Converter Station will be refined as the detailed design emerges.

26. Topographic data for the Site suggests that the overall slope across the site falls south towards Sleek Burn and the River Blyth and east towards the North Sea. Within the Site, the highest elevation can

be found in a bund situated along the north-eastern extent, bound by Maw Burn. This area is elevated to 22.5 m above Ordnance Datum (aOD). Ground levels in the north-western extent of the site, adjacent to the A189 dual carriageway, fall from 14.8 m aOD to -2.2 m aOD around the Blyth Marina in the south-eastern extent of the Site. Ground levels also fall to -1 m aOD on the mapped area of tidal mud flats associated with the Sleek Burn at the estuary to the south of the Site.

11.7.1.2. Designated Sites

27. Areas of the Study Area are located in a Site of Special Scientific Interested (SSSI) associated with the Northumberland Shore SSSI, which protects the estuarine areas of the River Blyth and the intertidal zone along the North Sea coast in the eastern extent of the Site. This SSSI area covers approximately 1,926 ha (Natural England, 1992) and is designated for its biological interest. Designated sites are shown on Figure 9.1 in Volume 4 of this ES.

28. The Study Area extends into the Northumbria Coast Ramsar site and the Northumberland Marine Special Protection Areas (SPA), which are present along the open coast, south from the Blyth Marina basin. Ramsar sites are wetlands designated to be of international importance whereas SPAs are protected areas for birds in the UK classified under a number of regulations. This stretch of coast is deemed to support internationally important numbers of purple sandpiper and turnstone. The site also supports nationally important breeding colonies of little tern. The Northumbria Coast Ramsar site and the Northumberland Marine SPA are fragmented across the coastline and are also present c.1.7 km north of the Site along the coastline around North Seaton, north of the River Wansbeck.

29. The Study Area extends into the Coquet to St. Marys Marine Conservation Zone. Protected features along this zone are typically geological, corresponding to rock formations and sediment types. This designated area is therefore not considered to be water dependent.

30. There are no National Nature Reserves within 2 km of the Site however there is a Local Nature Reserve (LNR) within this area. LNRs are designated due to their importance for wildlife, geology, education or public enjoyment. Castle Island LNR is a woodland area on an island within the River Wansbeck, 1.4 km north-west of the Site.

11.7.1.3. Hydrogeological Setting

31. Review of Soilscapes (Cranfield Soil and AgriFood Institute (CSAI), 2023) dataset suggests that the soils at the site consist of *'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'.* This is supported by evidence of waterlogging and shallow ponding during the hydrological walkover.

32. Where development has already occurred (i.e., the brownfield land within the Site), it is likely these shallow soils have been reworked and instead comprise of made ground.

33. The superficial geology at the Site is presented in Figure 11.2 (Volume 4). This mapping shows superficial deposits of Tidal River or Creek Deposits in the south-western site (along Sleek Burn and River Blyth). Blown sand is identified in the east along the higher ground set back from the intertidal zone. Marine Beach deposits (Sand and Gravel) are also noted along the intertidal zone further east and adjacent to the Blown Sand (i.e., forming the beach). The remaining areas of the Site are underlain by Diamicton deposits.

34. The bedrock geology at the Site is mapped in Figure 11.1 (Volume 4). The bedrock geology is a combination of two Pennine Middle Coal Formations which is predominantly Sandstone however the lithology appears to change in the north-west and south west corner of the site to a formation of Mudstone, Siltstone and Sandstone.

35. The standard average annual rainfall (SAAR) for the Study Area, as reported at river flow and rainfall gauging stations closest to the Site are as follows:

    - Flow Gauging Station (National River Flow Archive (NRFA), 2023) 22006 – Blyth at Hartford Bridge, 6.2 km south-west of the Site:
        - 725 mm between 1941 and 1970
        - 696 mm between 1961 and 1990
    - Flow Gauging Station (NRFA, 2023a) 22009 – Wansbeck at Mitford, 11.5 km west of the Site:
        - 847 mm between 1941 and 1970
        - 794 mm between 1961 and 1990
    - Albemarle (Northumberland) Climate Station (Met Office, 2023) – 2.5 km south-west of the Site:
        - 710 mm between 1961 and 1990
        - 744.01 mm between 1990 and 2020

36. Infiltration rates across the Site are considered to be variable due to the presence of diamicton (clay substrate) across the Site. Infiltration is likely limited to areas of Blown Sand, Tidal River or Creek Deposits and Marine Beach Deposits, however, infiltration may also occur within sandy deposits associated with Diamicton that have been eroded from the bedrock.

37. It is expected that groundwater is naturally flowing towards the east through the Site towards the coast. Groundwater levels beneath the Site are likely in continuity with the tidal levels in the River Blyth and North Sea. It is unlikely that this groundwater is in continuity with the overlying diamicton and instead becomes confined below the clay substrate when the groundwater levels locally are higher.

38. The aquifer characteristics for the strata on and in the immediate vicinity of the Site are summarised below in Table 11-6 and illustrated in Figure 11.4 (Volume 4).

Table 11-6 Aquifer characteristics

Formation	Description	Aquifer Characteristic
Superficial Geology		
Glacial Till / Diamicton	Poorly sorted sediment suspended in an unconsolidated matrix of mud or sand. Borehole records locally indicate the diamicton is variable across the Site from 5 m to 25 m thick.	Secondary (undifferentiated)
Tidal River or Creek Deposits	Sediments of varying grain sizes from mud to salt but mainly silt and clay, deposited within channel in tidal flats and lagoons.	Secondary A
Blown Sand	Sand that has been transported via aeolian processes / wind.	Secondary A
Marine Beach Deposits	Shingle, sand, silt and clay; may be bedded or chaotic; beach deposits such as dunes, sheets or banks; associated with the marine environment.	Secondary A
Bedrock Geology		
Pennine Middle Coal Formations (Sandstone)	Interbedded Mudstone, Siltstone and pale grey Sandstone with coal seams.	Secondary A
Pennine Middle Coal Formations (Sandstone, Mudstone and Siltstone)	Interbedded Mudstone, Siltstone and pale grey Sandstone with coal seams.	Secondary A

39. The two Pennine Middle Coal Formations underlay the Site, however there is a marked difference between the lithology with regards to published mapping. Both structures are considered Secondary A aquifers (largely due to the presence of sandstone) and therefore will form a larger aquifer with likely horizontal and lateral flow (hydraulic conductivity) across the Site. Secondary A aquifers are defined as *'permeable layers capable of supporting water, and may form an important source of base flow to rivers'* (EA, 2017).

40. Groundwater vulnerability across the Site is considered medium to low which is considered representative of the poor permeability geology (diamicton) overlaying the majority of the Site (low vulnerability of groundwater). Permeable deposits have limited spatial extent but inherently increase the vulnerability of the receiving groundwater.

41. It is likely that any shallow groundwater within the diamicton is expressed locally from watercourses. We would note that these are likely very low and non-consistent. The upper reaches of Cow Gut on the site were noted to be dry (i.e., no baseflows) on the date of the site walkover. Small watercourses on Site (including Cow Gut and Maw Burn) are unlikely to be hydrologically connected to the regional groundwater table and therefore are predominantly sourced from rainfall runoff and overland flows.

42. Incident rainfall onto the Study Area will either run overland into adjacent watercourses, infiltrate via permeable geology into the regional groundwater table, or infiltrate into more permeable lenses in the diamicton and act as perched groundwater of which levels are inconsistent throughout the deposit.

Some rainfall on the partially developed brownfield land within the site will be managed by surface water drainage reticulation, which drain to local watercourses.

43. The EA does not hold any groundwater level data within 2 km of the Site.

44. In consideration of the geological setting (Secondary A aquifer situated along the open coast and at a tidal estuary) we would expect groundwater levels to potentially vary on a semi-diurnal cycle. The profile / variability in levels will however not be at the same range as the tide due to a lag / active response time on the groundwater table.

45. The quality of the groundwater is likely poor given the degree of saline intrusion which is likely to occur following interaction with the North Sea and known coal seams within the bedrock likely resulting in elevated levels of heavy metals. Mapping does not suggest these coal seams have been worked. Typically worked coal seams would have a detrimental impact on the chemical classification of the groundwater.

46. The Study Area does not fall within an operational groundwater catchment and therefore further information from monitored groundwater quality is not available.

47. Permitted groundwater abstractions and discharges provided by the EA are located in Figure 11.5

48. EA data shows there are only two abstractions within the Study Area, one groundwater abstraction and one surface water. These are both present to the south of the Site in Blyth, to the south of the River Blyth. The groundwater abstraction serves a pollution remediation process for the Coal Authority.

49. NCC and Northumbrian Water do not hold any records of private water supplies within 2 km of the Onshore Scheme.

50. The Study Area does not lie in a SPZ associated with a groundwater abstraction.

11.7.1.4. Hydrological Setting

51. Surface water features in the vicinity of the Study Area are shown on Figure 11.5.

52. The EA Catchment Data Explorer (EA, 2023) suggests the Study Area does not fall within an operational surface water catchment. This is because all of the watercourses on or in the vicinity of the Study Area are tidally influenced. Smaller watercourses such as Cow Gut and Maw Burn will be tidally influenced at the outfall (on lower lying land) however the reaches of the River Blyth, Sleek Burn and the River Wansbeck past the site are all tidally dominated and therefore saline.

53. Waterbodies on/in the vicinity of the Study Area include:

- North Sea – located to the east of the Site, the North Sea has a semi-diurnal tidal cycle and its tidal levels dominate local watercourses.
- River Wansbeck – located c.90 0m north of the Site flowing in a south easterly direction into the North Sea.
- River Blyth – located immediately south of the Site flowing east into the North Sea.
- Sleek Burn – located along the south-western boundary flowing south-east into the River Blyth and subsequently the North Sea.
- Cow Gut – ‘Ordinary Watercourse’ which rises to the west of the A189, beyond the western boundary of the Site, and is culverted beneath the highway to enter the Site in the north-western extent. Much of the channel has been re-routed through the Site following partial development of the brownfield land within the Site. The channel outfalls into the River Blyth at the marina (south-eastern site).

- Maw Burn – 'Ordinary Watercourse' in the northern extent of the Site, conveying flows in an easterly direction beneath the railway line and Unity Terrace (road) into the North Sea.

54. Review of The Department for Environment Food and Rural Affairs (Defra) Magic Mapping (Defra, 2023) indicates there are environmentally designated water dependant habitats adjacent to the Site (Northumberland Coast SPA and Northumberland Shore SSSI). These sites are designated due to their bird populations of purple Sandpiper and turnstone, as well as nationally important breeding colonies of little tern. Whilst not specifically water dependant habitat, the hydrology locally will influence the vegetation which at the time of carrying out this assessment is favourable for the above bird species.

55. It is understood that 'Ordinary Watercourses' on the Site are sourced from overland flows and are not in hydraulic continuity with the regional groundwater. Larger watercourses / 'Main Rivers' are at lower elevation and interact with groundwater within the bedrock / permeable superficial geology. Baseflows into the larger watercourses will have little influence on flow and levels in the channel given that these are tidally dominated.

56. The Blyth Estuary and Wansbeck Estuary are within the Northumbria Transitional and Coastal Waters Area and are assessed as part of WFD monitoring.

- Wansbeck Water Body (GB510302210100); and
- Blyth (N) Water Body (GB510302203200)

57. The Wansbeck water body is classed as having 'Moderate' ecological status but fails with regard to chemical status. The EA reports that for the 2019 assessment of chemical status there has been a change in assessment method and an increase in the evidence base. Due to these changes, all water bodies now fail chemical status and the assessment is not comparable to previous years assessments. The failures are due to four groups of global pollutants (Ubiquitous, Persistent, Bioaccumulative and Toxic (uPBTs)). There is little underlying change in chemical status for chemicals that are not uPBTs. Previous assessment of chemical status prior to 2019 indicated good status.

58. The Blyth (N) water body is classed as having 'Moderate' ecological status but fails with regard to chemical status. The fail in chemical status is due to the change in assessment method outlined above. Previous assessment of chemical status prior to 2019 indicated good status.

59. The EA is responsible for monitoring bathing waters in England. Monitoring locations in close proximity to the study area include:

- Blyth South Beach; and
- Newbiggin South.

60. The classification of the Bathing Waters detailed above, reported between 2018 and 2022, are Excellent for Blyth South Beach and Moderate for Newbiggin South (Excellent in 2018). Data for 2020 is missing due to lack of monitoring during Covid restrictions.

61. As the Study Area is situated within a tidally dominated area, it is not located in a WFD monitored surface water catchment area. There are however two operational catchments upstream of the Site whereby the River Blyth and Sleek Burn are considered fluvially dominated. These include:

- Sleek Burn / Hepscott Burn Source to Tidal Limit Water Body (GB103022076230); and
- Blyth from Pont to Tidal Limit Water Body (GB103022077052).

62. The Sleek Burn / Hepscott Burn Source to Tidal Limit water body in 2019 was classified as having Moderate ecological status but failed with regards to chemical elements. The fail in chemical status is

due to the change in assessment method outlined above. Previous assessment of chemical status prior to 2019 indicated good status.

63. The Blyth from Pont to Tidal Limit water body in 2019 also had 'Moderate' ecological elements and failed with regards to chemical elements. The fail in chemical status is due to the change in assessment method outlined above. Previous assessment of chemical status prior to 2019 indicated good status.

64. As identified in Figure 11.5 (Volume 4), there are 44 discharges located within the Study Area. These discharges are all to surface waters and are typically attributed to sewage (private and water company) or trade effluent into Sleek Burn, River Blyth, River Wansbeck or North Sea.

65. EA data identifies an existing surface water abstraction from the River Blyth estuary for the Offshore Renewable Energy Catapult Innovation entre.

11.7.2. Flood Risk Assessment

66. Flood risk assessment (FRA) reporting has been completed in accordance with the National Planning Policy Framework and the associated PPG. Separate Flood Risk Assessment reports have been prepared as part of the planning application which are included as Technical Appendix 11.1 and Technical Appendix 11.2 (Volume 3).

67. Based on the EA Flood Map for Planning, the majority of the Site lies in Flood Zone 1 and therefore is considered to be at low risk of flooding from fluvial or tidal sources. There are, however, areas of the Site, specifically along the open coast and adjacent or in the estuarine areas of Sleek Burn and the River Blyth, which are designated as Flood Zones 2 and 3. This flood risk is derived from tidal sources.

11.7.3. Future Baseline Scenario

68. This assessment also considers the 'do nothing scenario', focusing on the potential changes in the baseline for the lifetime of the Onshore Scheme if no development was to occur.

69. With regards to the hydrological and hydrogeological environment, the main changes from the current baseline scenario would relate to climate change. It is widely accepted that the UK climate is likely to become move variable with projected increases in peak rainfall allowances, sea level rise, wind speed and wave height which inherently increases the prevailing flood risk from all sources at the site.

70. Whilst there is uncertainty surrounding the future baseline environment, there are no other anticipated changes on the hydrological or hydrogeological environment throughout the anticipated lifetime of development besides climate change.

11.7.4. Data Assumptions and Limitations

71. The assessment is based on publicly available data obtained from the EA, NCC, and commercial data supply companies, as well as additional information supplied from stakeholders during the scoping and consultation stages.

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

- Flow data for watercourses and drainage channels;
- Bathing waters data for 2020 is missing due to lack of monitoring during Covid restrictions; and
- Water quality data for specific locations (surface and groundwater).

73. 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 to confirm desktop findings. The accessible information required in order to complete the assessment is considered sufficient to establish the baseline conditions within the Study Area.

74. Therefore, there are no data limitations that would affect the conclusions of this assessment and the baseline assessment is considered a robust and accurate representation of reality.

11.8. Key Parameters for Assessment

11.8.1. Maximum Design Scenario (MDS)

75. The maximum design scenario(s) summarised here 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 Chapter 5 Project Description of this ES. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (PDE) (e.g., different infrastructure layout), to that assessed here, be taken forward in the final design scheme.

76. Given that the maximum design scenario is based on the design option (or combination of options) that represents the greatest potential for change, confidence can be held that development of any alternative options within the design parameters will give rise to no worse effects than assessed in this impact assessment.

77. The boundary and extent of the Onshore Scheme have been the subject of discussions with NCC. There are some design details related to the Onshore Scheme that are still to be finalised due to further ground investigations required, ongoing engineering design work and the procurement of cable and converter station suppliers which will define the final specification. The Site boundary has been chosen to allow flexibility to accommodate design details which will be subject to future Reserved Matters application(s) to NCC.

Table 11-7 MDS specific to the Hydrology and Hydrogeology impact assessment

Potential Impact	MDS	Justification
Construction		
Onshore cables / cabling arrangement: increase in flood risk or change in groundwater or surface water quality	The MDS considers maximum dimensions using trenchless techniques at Landfall and open cut and trenchless techniques for HVDC and HVAC cables. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	Open trenching as a crossing option for small, 'ordinary watercourses' has been considered to represent the greatest potential for change to surface hydrology and effect on water quality. The MDS includes the maximum number of cables and assumes disturbance throughout the HVDC cable corridor and HVAC cable corridor.
Likely maximum number of joint bays and maximum dimensions: increase in flood risk or change in groundwater or surface water quality	The MDS considers maximum number and dimensions of joint bays. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	This has been adopted as the MDS as it assumes full disturbance across the HVDC and HVAC cable corridors.
Transition Joint Bays: increase in flood risk or change in groundwater or surface water quality	The MDS considers maximum number and dimensions of transition joint bays. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	The construction pit for the transition joint bay will be much larger than the transition joint bay itself. Typically, a concrete slab base would be formed within the transition joint bay construction pit to accommodate the transition joint bay and anchor block. In summary, the permanent infrastructure beneath ground typically consists: 1. Anchor block(s); 2. Concrete slab (covering the extent of the transition joint bay and anchor block); and 3. Transition joint bay This has been adopted as the MDS as it conservatively assumes the maximum amount of disturbance.
HVDC/HVAC cable and construction: increase in flood risk or change in groundwater or surface water quality	The MDS considers maximum number and dimensions of cable route construction compounds and materials storage areas. It is based on the maximum Onshore Scheme footprint and areas of	The assessment is based on the total amount of disturbance to the Site.

Potential Impact	MDS	Justification
	temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	
Construction phase access track: increase in flood risk or change groundwater or surface water quality	The MDS considers maximum number and dimensions of access tracks. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	Assumes the total amount of disturbance to the Site and therefore increased provision of drainage.
Cable materials management: increase in flood risk, natural drainage patterns and change in groundwater or surface water quality	The MDS considers maximum volume of materials to be imported / exported and maximum earthworks volumes for excavation, relay, disposal and import. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	Assumes the total amount of disturbance to the site and subsequent impact on flood risk, natural drainage patterns and water quality (from runoff).
Onshore Converter Station construction: increase in flood risk or change in groundwater or surface water quality	The MDS considers maximum number and dimensions of compound areas and associated earthworks. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	Consistent assumption of maximum disturbance and subsequent impact.
Construction duration HVDC/HVAC cable routes and Onshore Converter Station: increase in flood risk or change in groundwater or surface water quality over a set period of time	It is understood that the maximum duration of the construction works and sequencing of key construction activities is a total of 60 months on site for the Landfall, HVDC/HVAC cable routes and Onshore Converter Station works. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description.	It is assumed the receptors will only be affected during the construction phase for up to 60 months.
Operation and Maintenance		
Onshore Converter Station: increase in flood risk or change in groundwater or surface water quality	The MDS considers maximum dimensions for the Onshore Converter Station and maximum platform size and level. It is based on the maximum Onshore Scheme footprint and areas of temporary infrastructure detailed in Chapter 5: Project Description, along with a construction programme of 60 months.	Assumes the total amount of disturbance to the site. The MDS for the Onshore Converter Station requires the largest footprint for the design resulting in the largest possible area of disturbance and proposed impermeable land.

Potential Impact	MDS	Justification
Onshore Converter Station: new surface water drainage outfall to Sleek Burn	Outfall pipe for discharge of surface water drainage collected on the Onshore Converter Station site. Will include appropriate headwall / apron structure, non-return flap valve and energy dissipation measures. The outfall pipe will be sized to permit flow from the Onshore Converter Station drainage network during an appropriate design event with an allowance for future climate change.	Surface water drainage will require a new dedicated outfall to Sleek Burn. The MDS includes appropriate uplift in flow from the drainage system for climate change.
HVDC/HVAC cable route and Onshore Converter Station: routine maintenance work affecting surface watercourses and change in water quality	Routine maintenance to ensure operation and functionality of permanently onshore cables (which are buried), the Onshore Converter Station and all SuDS features installed at the site.	The MDS for water quality of main watercourses during operation is that chemicals and oils would be used in the routine maintenance of Onshore Converter Station. The HVDC and HVAC cables provide potential lateral pathways for water flow which could indirectly affect water quality.
Decommissioning		
Onshore Converter Station: Changes to flood risk and works affecting watercourses (including groundwater or surface water quality)	At the end of the operational lifetime of the Onshore Scheme, the operator of the Onshore Scheme will develop and agree a solution for the onward handling of the onshore infrastructure with the regulator. This decision will be based on the advice from the regulator at the time and informed by the prevailing environmental regulatory requirements at that time, and relevant good practice. However, the following is assumed for the purpose of worst-case decommissioning scenario for impact on hydrological and hydrogeological receptor: • Removal of all hardstanding areas associated with the Onshore Converter Station; • Buried cables to be de-energised with the ends sealed and left in place to avoid ground disturbance; and • Joint bays at Landfall to be left in place.	The MDS for flood risk following decommissioning of the Onshore Converter Station is the change in surfacing and removal of attenuation storage on land which may be considered compacted / impermeable. It would take the natural environment a period time to re-establish itself via vegetation to provide natural attention. The HVDC and HVAC cables remaining in situ provides potential lateral pathways for water flow which could indirectly affect water quality.

11.8.2. Impacts Scoped Out of the Assessment

78. All impacts agreed with NCC as scoped in following the EIA Scoping Report (BBWFL, 2022) are considered in this Chapter.

11.9. Methodology for Assessment of Effects

11.9.1. Overview

79. There are no published guidelines or criteria for assessing and evaluating effects on hydrology within the context of an EIA. The methodology sets out a list of criteria for evaluating the environmental effects and is outlined in Chapter 3: EIA Methodology.

80. As an impact assessment, this Chapter does not explicitly consider the risk of flooding but does consider how the proposals may alter flood risk within the Site and the potential for impact on off-site receptors. It should be noted that vulnerability to climate change was scoped out of the assessment in the Scoping Report. The flood risk to the Onshore Scheme is considered separately in the Landfall and onshore cable corridor FRA provided at Technical Appendix 11.1 and in the Onshore Converter Station FRA at Technical Appendix 11.2.

81. A qualitative risk assessment methodology has been used to assess the significance of the potential effects associated with the Onshore Scheme. Two factors have been considered using this approach: the sensitivity of the receiving environment and the potential magnitude of impact, should that potential impact occur. This approach provides a mechanism for identifying the areas where site specific mitigation measures are required and for considering the effectiveness of mitigation measures proposed to manage the risk presented by the Onshore Scheme. This approach also allows effort to be focused on reducing risk where the greatest benefit may result.

82. Effects assessed as minor adverse or less would be considered not significant in terms of the Town & Country Planning (Environmental Impact Assessment) Regulations 2017 (‘the EIA Regulations’. If the assessment results in moderate or major adverse effects, then this effect would be considered to be significant in EIA terms.

83. This approach provides a mechanism for identifying the areas where site specific mitigation measures will be required and for identifying mitigation measures appropriate to the risk presented by the Onshore Scheme. This approach also allows effort to be focused on reducing risk where the greatest benefit may result.

11.9.2. Impact Assessment Criteria

84. Determining the significance of effects is a two-stage process that involves defining the magnitude of the potential impacts and the sensitivity of the receptors. This section describes the criteria applied in this Chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. Unless stated otherwise the terms used to define magnitude and sensitivity are based on those used in the Sustainability and Environment Appraisal guidance (Standards for Highways, 2020).

85. The criteria for defining magnitude in this Chapter are outlined in Table 11-8 below.

Table 11-8 Definition of terms relating to the magnitude of an impact

Magnitude of Impact	Definition
High	Fundamental (long term or permanent) changes to the baseline hydrology, hydrogeology and water quality likely to cause exceedance of statutory objectives and/or breaches of legislation; severe damage to key characteristics, features or elements (adverse), such as: • wholesale changes to watercourse channel, route, hydrology or hydrodynamics; • changes to the site resulting in an increase in runoff with flood potential; • significant changes to erosion and sedimentation patterns; • major changes to the water chemistry or hydro-ecology; and • major changes to groundwater levels, flow regime and risk of groundwater flooding.
Medium	Material but non-fundamental and short to medium term changes to baseline hydrology, hydrogeology and water quality, not adversely affecting the overall integrity; partial loss of/damage to key characteristics, features or elements with/without exceedance of statutory objectives or with/without breaches of legislation (adverse), such as: • some fundamental changes to watercourses, hydrology or hydrodynamics. • changes to site resulting in an increase in runoff within system capacity; • moderate changes to erosion and sedimentation patterns; • moderate changes to the water chemistry of surface water and groundwater; and • moderate changes to groundwater levels, flow regime and risk of groundwater flooding.
Low	Detectable but non-material and transitory changes to the baseline hydrology, hydrogeology and water quality resulting in reversible or minor loss of, or alteration to key characteristics, features or elements (adverse), such as: • minor or slight changes to watercourses, hydrology or hydrodynamics; • changes to site resulting in slight increase in runoff well within the drainage system capacity; • minor changes to erosion and sedimentation patterns; • minor changes to the water chemistry of surface water and groundwater; and • minor changes to groundwater levels, flow regime and risk of groundwater flooding.
Negligible	Very minor or no perceptible changes to the baseline hydrology, hydrogeology and water quality, resulting in; impact of insufficient magnitude to affect the use/integrity (adverse), such as: • no alteration or very minor changes with no impact to watercourses, hydrology, hydrodynamics, erosion and sedimentation patterns; • no alteration or very minor changes to either groundwater or surface water chemistry; and • no alteration or very minor changes to groundwater recharge or flow mechanisms.

86. The criteria for defining sensitivity in this Chapter are outlined in Table 11-9 below. Whilst a sensitivity category of 'very high' is proposed as a potential category for sensitivity criteria within the Standards for Highways guidance, for the purposes of the assessment of hydrology, hydrogeology and flood risk effects, the categories within the range of 'high' to 'negligible' are considered to appropriately cover the potential receptors. Where a receptor could be placed within more than one category of value, professional judgement has been applied to determine which category is appropriate.

Table 11-9 Definition of terms relating to the sensitivity of the receptor

Value (Sensitivity of the Receptor)	Description
High	Receptor with high importance and rarity, international level, with no / negligible potential for substitution / replacement
	Receptor is of international ecological importance (e.g., Ramsar site, water based Special Protection Area (SPA), or Special Area of Conservation (SAC))
	Receptor is a watercourse or water body of good chemical status/ high ecological status and/ or high quality targets under the WFD
	Receptor is used for public water supply (including Drinking Water Protected Areas) from either groundwater or surface water source
	Receptor is at high risk from flooding above 3.3% Annual Exceedance Probability (AEP) and/or water body acts as an active floodplain or flood defence
	Receptor is a Principal Aquifer providing regionally important potable water supply and classified as SPZ
Medium	Receptor with medium importance and rarity, national or regional level, with limited potential for substitution
	Receptor is of national ecological importance (e.g., water based National Nature Reserve or SSSI)
	Receptor is a watercourse or water body of good chemical status/ moderate to good ecological status and/ or moderate to high quality targets under the WFD
	Receptor is used for private water supply or non-drinking water abstraction for agricultural use from either groundwater or surface water source
	Receptor is at moderate risk from flooding (3.3% AEP to 1% AEP) but does not act as an active floodplain or flood defence
	Receptor is a Principal or Secondary A Aquifer not designated as SPZ
Low	Receptor with low importance and rarity, local or district level, with potential for substitution
	Receptor is of local ecological importance (e.g., non-statutory water based County Wildlife sites)
	Receptor is a watercourse or water body with a chemical water quality status classed as of 'fail' or an ecological water quality status classed as 'poor' and/ or moderate quality targets under the WFD
	Receptor is a watercourse or water body supporting abstractions of limited sensitivity
	Receptor is at low risk from flooding (less than 1% AEP)
	Receptor is a Secondary A or Secondary B Aquifer

Value (Sensitivity of the Receptor)	Description
Negligible	Receptor with a very low importance and rarity, local scale (e.g., non-statutory water-based wildlife sites and areas of local importance for nature conservation; pond or surface water feature with no significant sensitivity to water based ecological or water supply function)
	Receptor is a watercourse or water body with a chemical water quality status classed as of 'fail' and an ecological water quality status classed as 'poor' and/ or moderate quality targets under the WFD
	Environmental equilibrium is stable and is resilient to changes that are greater than natural fluctuations, without detriment to its present character
	Receptor is not affected by the Onshore Scheme (e.g., it is remote from the application site or lies within a different and unconnected hydrological catchment or hydrogeological regime).
	Receptor is non-productive geology in terms of groundwater resource

87. The significance of the effect upon hydrological and hydrogeological receptors is determined by correlating the magnitude of the impact and the sensitivity of the receptor, as outlined in Table 11-10 below.

Table 11-10 Matrix used for the assessment of the significance of the effect

		Magnitude of Impact				
		No Change	**Negligible**	**Low**	**Medium**	**High**
Sensitivity of Receptor	**Negligible**	Negligible	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Negligible	Minor	Moderate	Major
	High	Negligible	Minor	Moderate	Major	Major

11.10. Measured Adopted as Part of the Onshore Scheme

88. As part of the project design process, a number of measures have been proposed to reduce the potential for impacts on the Study Area (see Table 11-11). These include measures which have been incorporated as part of the Onshore Scheme's design (referred to as 'designed in measures') and measures which will be implemented regardless of the impact assessment (referred to as 'tertiary mitigation'). As there is a commitment to implementing these measures, they are considered inherently part of the design of the Onshore Scheme and have therefore been considered in the assessment presented in section 11.11 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

Table 11-11: Measures adopted as part of the Onshore Scheme (designed in measures & tertiary mitigation)

Mitigation Measure	Form (Designed In Measures or Tertiary)	Justification
Project Design and Route Selection	Outline Design Commitments: • Routing of the HVDC and HVAC cable routes to minimise watercourse crossings, where possible.	Avoidance of potential impact to environmental receptors integral to design of the Onshore Scheme.
Construction Environmental Management Plan (CEMP)	An outline CEMP will be submitted as part of the planning application. Relevant Pollution Prevention Guidelines and CIRIA guidance, would be followed to reduce any potential risks of ground pollution A Soil Management Plan (SMP) will be developed and will be produced in advance of construction. The SMP will include measures to manage soil handling to prevent sediment entrainment.	Standard industry practice is to manage construction activities in line with a CEMP.
Construction Traffic Management Plan	A CTMP will set out the traffic management measures to be implemented during construction of the Onshore Scheme and how the movement of construction traffic will be monitored.	Standard industry practice is to manage construction traffic activities in line with a CTMP
Management of Flood Risk	The HVDC/HVAC cable routes and the construction haul roads will be designed to minimise land take and to avoid, where practicable, impacts on existing drainage networks and features; A Flood Emergency Response Plan will be developed to ensure safe working and evacuation at all times	Flood risk assessment reports (Technical Appendix 11-1 and Technical Appendix 11-2) have been prepared for the site which has identified an elevated flood risk from tidal sources associated with the North Sea, Sleek Burn and River Blyth at the Landfall location and along the edge of Sleek Burn. Recommendations from the flood risk assessment are to provide an Emergency Flood Response Plan for any construction works within the areas of site at risk which will utilise local flood warnings and site specific triggers for evacuation, ensuring safe working during all development phases.

Mitigation Measure	Form (Designed In Measures or Tertiary)	Justification
Standard Industry Practice	• All construction work will be undertaken in accordance with the CEMP which will be drafted having consideration of all relevant standards and practice guidance at the time of construction including, but not limited to: ○ Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors CIRIA (C532) (CIRIA, 2001); ○ Development and flood risk: guidance for the construction industry (C624) (CIRIA, 2004); ○ CIRIA – SuDS Manual (C753) (CIRIA, 2015); ○ The Environment Agency's approach to groundwater protection, version 1.2, February 2018 (EA, 2018); and ○ Code of Practice for Assessing and Managing Flood Risk in Development, BS8533 (BSI, 2017).	Standard industry practice is to manage construction activities in line with a CEMP which is in line with relevant national guidance.

11.11. Assessment of Effects

89. The potential impacts arising from the construction, operational and maintenance and decommissioning phases of the Onshore Scheme are listed in Table 11-7 along with the MDS against which each impact has been assessed.

90. An assessment of the likely significance of the effects of the Onshore Scheme on hydrological and hydrogeological receptors caused by each identified impact is given below. Each of these impacts considers the effects on the HVDC/HVAC cable route installation, Converter Station construction and Landfall installation.

11.11.1. Potential Effects During Construction

POLLUTION OF SURFACE WATER DUE TO DISTURBANCE OF SEDIMENTS AND/OR ACCIDENTAL SPILLS FROM CONSTRUCTION MACHINERY AND TRENCHING WORKS AND HDD

11.11.1.1. INTRODUCTION OF IMPACT

91. These activities have the potential to alter existing surface water and groundwater flows through excavation, storage and reinstatement of soils and superficial materials and through the installation of solid linear infrastructure.

92. Several sections of the HVDC and HVAC cable routes may involve or require crossing 'Ordinary Watercourses' or drainage ditches, as shown in Figure 11.5 (Volume 4). Along short sections of the routes, the HVDC and HVAC cables pass through land within a tidal floodplain, or land considered to be in the surface water floodplain (risk associated with the 'Ordinary Watercourses' which are not fluvially dominated) which discharge into designated sites.

93. Drilling, trenching and excavation techniques used within the construction phase of the cable route and Onshore Converter Station could result in erosion and mobilisation of sediment into watercourses resulting in turbid water and siltation following flooding or extreme heavy rainfall.

94. Spillages through the use of equipment, such as fuel leaks or drill fluid, in the construction phase could end up in surface waters following mobilisation from rainfall or flooding.

95. A FRA has been provided as Technical Appendix 11.1 to support the planning application of the HVDC/HVAC cable routes. A FRA for the Onshore Converter Station only has also been undertaken to support the planning application (Technical Appendix 11.2, Volume 3). Risks during the construction phase are limited to activities within areas shown to be at tidal risk (e.g., Landfall) and isolated areas inland which are potentially at risk of surface water flooding.

96. Excavated materials which are not being exported from site would be stockpiled temporarily in designated areas as defined by the Soil Management Plan (SMP). All designated stockpile areas would be a minimum of 10 m from any open watercourse features where practicable as informed by the Soil Management Plan which would be prepared post-consent as part of the CEMP. The potential for contaminants contained within the stockpiled materials to be leached into the water bodies, resulting in a reduction in the quality of the receiving waters, would be reduced through the implementation of embedded mitigation (section 11.10) following industry standard practice guidance. The SMP would be prepared as part of the CEMP.

97. The potential for contaminants associated with spills or leaks of stored oils, fuels or chemicals becoming mobilised into runoff or water features would be reduced through the implementation of

standard industry practice, discussed at section11.10. The pollution control measures will be defined within the CEMP and will include an Incident Response Plan, spillage management protocol, refuelling protocols and controls for the use and storage of chemical and potentially polluting substances.

98. Additionally, the CEMP for the Onshore Scheme will require an Emergency Flood Response Plan setting out provision for procedures to be put in place in the event of a flood warning or extreme weather warning. Through measures such as temporary cessation of works, relocation or securing of sensitive equipment and/or materials and evacuation of workforce personnel, the CEMP will reduce the likelihood of construction activities resulting in incidents detrimental to water quality occurring in the event of flooding and reduce the magnitude of impact of any such incidents.

99. The CEMP will also include measures to control runoff from the construction works. This could include sediment fences and silt traps when working in proximity to open watercourses, containment of storage areas (stockpiles) and treatment of any runoff from work areas or water from dewatering of open cut trenches. The implementation of these measures, which are already considered embedded mitigation (section 11.10), would prevent the potential deterioration in water quality associated with increased sediment loading affecting nearby tidal waters, surface watercourses and drainage diches and indirectly, designated sites, during cable and Converter Station construction works, especially during excavations or earthwork activities.

100. Embedded mitigation measures outlined in section 11.10 includes the implementation of spill procedures and spill kits. These measures, alongside appropriate construction surface water drainage systems including drainage features tailored to pollution mitigation (i.e., settlement ponds, silt traps) and the adoption of controls for the use and storage of chemical and potentially polluting substances, including designated refuelling areas, will minimise the potential for deterioration in water quality associated with spills or leaks of stored oils/fuels/chemicals or other polluting substances migrating into nearby water bodies and groundwaters. Spill kits will be located in proximity to potentially hazardous substances as any minor leaks can be rapidly mobilised following the onset of heavy rainfall. Containment of spillages and the cessation of works and relocation of sensitive infrastructure during flooding or extreme heavy rainfall is therefore critical in preventing impacts arising from spillages.

101. Following the implementation of the CEMP with regards to pollution control measures and industry standard guidance for construction surface water management, the likelihood of a pollution incident following from the installation of the Landfall, HVDC/HVAC cable routes or construction of the Converter Station is considered to be very low.

102. In the low probability event that a small pollution spill or sedimentation release was to occur, these would discharge offsite via the local surface water network and therefore via Cow Gut, Maw Burn or other smaller drainage ditches into Sleek Burn or North Sea. Monitored bathing waters and Designated sites (Northumberland Shore SSSI, Northumberland Marine SPA and Coquet / Berwick to St Marys Marine Conservation Zone (MCZ)) are present along the tidal estuary of Sleek Burn and North Sea and are the main receptors for runoff from the Onshore Scheme.

103. The likelihood of turbid water and sedimentation is considered very low due to the presence of in-situ embedded mitigation and controls throughout the construction phase of the HVDC/HVAC cables and Converter Station. Any pollution which may arise through the construction process would be minor, predominantly HDD drill fluid or fuel leaks from vehicles. Relevant pollution prevention guidance would be adopted at all times to minimise the likelihood of accidents and reduce the magnitude of impacts. Response to spillages are however reliant on mobilisation of appropriately trained site personnel to control and retain the affected area. The Incident Response Plan within the CEMP would require site personnel to be trained in spill control and management.

104. Watercourses on the Site are dominated by rainfall and are therefore not continuously in flow. In the low probability event that a pollution entered a surface watercourse (i.e., following a rainfall event), any pollutant would become diluted by both surface and tidal waters. The volume of a pollution incident would be small and likely untraceable in the estuary which serves the local designated sites.

11.11.1.2. MAGNITUDE OF IMPACT

105. The impact is predicted to be of local spatial extent, short term duration, intermittent (only following the low probability of a pollution incident, extreme rainfall and/or flooding) and high reversibility. It is predicted that the impact will affect receptors directly (surface watercourses) and indirectly (designated sites). The magnitude of impact to the receptors affected directly is considered to be Minor. For indirectly affected receptors, the magnitude will be significantly diluted, and the magnitude of impact is considered to be Negligible.

11.11.1.3. SENSITIVITY OF THE RECEPTOR

106. 'Ordinary Watercourses' which are present across the Site are deemed to be of medium vulnerability, have high recoverability and low value. They are predominantly surface watercourses with limited local importance flowing over non-productive geology and therefore are not sustained by year-round flow. The sensitivity of the receptor is therefore, considered to be Low.

107. There are a number of designated sites which are hydraulically connected to receptors of surface water runoff, and consequently pollution from the Onshore Scheme. These designated sites are typically designated due to their biological status however local conditions, such as hydrology and water quality, influence habitat for wildlife and bird populations. On this basis, local designated sites are considered of high value and are considered to have a High sensitivity.

108. Groundwater which is present beneath the Site is considered to be low vulnerability (i.e., unlikely to exist within the shallow layers) and of low value. The recoverability of the receptor is considered low as any groundwater within the diamicton would not be in hydraulic continuity laterally or vertically and therefore not freely flowing. Any spillage at the ground surface is unlikely to enter the groundwater water body.

109. Any groundwater presence within beach deposits or blown sands would already be of poor quality due to saline intrusion and any small spills would be significantly diluted by the sea. Small spills would become untraceable over time creating only short term and localised pollution effects on the regional groundwater system. On this basis, the sensitivity of the groundwater receptor is considered to be Negligible.

11.11.1.4. SIGNIFICANCE OF THE EFFECT

110. Overall, the magnitude of the impact is deemed to be Low and the sensitivity of the surface water receptor is considered to be Low. The effect will, therefore, be of **minor adverse significance**, which is **not significant** in EIA terms.

111. The sensitivity of designated sites is considered to be High due to their biological importance nationally. The receptor is considered to be at low reversibility as deterioration of the receptor is difficult / requires a long period of time to re-establish (i.e., breeding grounds for birds). Small pollution incidents on the Onshore Scheme will however be untraceable through dilution at the estuary and the potential magnitude of impact is considered to be Negligible. The effect will, therefore, be of **minor adverse significance**, which is **not significant** in EIA terms.

112. The magnitude of impact to groundwaters is deemed to be low and the sensitivity of the receptor is considered to be Negligible. The effect will, therefore, be of **negligible significance**, which is **not significant** in EIA terms.

11.11.1.5. SECONDARY MITIGATION AND RESIDUAL EFFECT

113. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

INTERACTION WITH THE WATER TABLE CAUSING MODIFICATIONS TO NATURAL DRAINAGE PATTERNS AND POTENTIAL INCREASE IN FLOOD RISK FROM INAPPROPRIATE DRAINAGE AND SURFACE WATER TREATMENT AROUND THE CONSTRUCTION WORKS

11.11.1.6. INTRODUCTION OF IMPACT

114. Construction activities associated with all construction and civil engineering activities for the Onshore Converter Station have the potential to interact with the shallow water table and alter the local hydrogeology which may increase the risk of groundwater flooding locally. Any groundwater emergence would discharge offsite via local watercourses. All watercourses on the site discharge into a tidal body and therefore any changes in the hydrological regime will have negligible impact on water levels, and consequently flood risk, in Sleek Burn River Blyth, and North Sea.

115. Interaction with the water table is not considered an impact for the construction compound, or inland areas of the HVDC and HVAC cable routes, both of which are underlain by diamicton geology. Due to the nature of the underlying geology (clay), there will be no shallow water table and therefore interaction with this would not be possible. Water may be present in permeable areas of the diamicton however these are likely localised and confined and not continuous across the strata. During trenching and excavation works, these flows can be pumped offsite via local watercourses (following settlement) without implications on the regional hydrogeology. Pumping from excavations would not be undertaken in storm conditions or when local watercourses are in full flow rates to ensure pump rates do not exceed the channel capacity. This therefore would not result in a detrimental impact on flood risk.

116. The Onshore Scheme is located adjacent to an area of open coast and therefore regional groundwater levels, particularly at a site level, will fluctuate with the incoming tidal level. Interaction with the water table will only occur at Landfall areas (more permeable geology) whereby the groundwater is hydrologically connected to the sea. Changes to the hydrogeological regime in this location would be unlikely due to the dominance of the tide impacting water levels. There would therefore be no implication on groundwater flood risk (i.e., which may typically occur through spring formation, etc) and any cabling installed through the Onshore Scheme will be designed in consideration of water resilience.

11.11.1.7. MAGNITUDE OF IMPACT

117. The impact is predicted to be of local spatial extent, short term duration and intermittent. It is predicted that the impact will affect the groundwater receptors directly and designated sites indirectly. The magnitude of impact to the receptors is Low.

118. It is also noted that Chapter 9: Terrestrial Ecology and Ornithology assesses residual effects on designated sites due to disturbance and changes to surface water flow as not significant.

11.11.1.8. SENSITIVITY OF THE RECEPTOR

119. Groundwater presence is not notable at the shallow layers across all inland areas and therefore has Negligible sensitivity.

120. Groundwater which is present at the Landfall is also considered to be of Negligible sensitivity and high recoverability due to its tidal dominance. Groundwater in this location is only of value to designated sites.

121. Designated sites present along the open coast and estuary are considered to be of low vulnerability with respect to groundwater as they are not considered water dependant and instead are designated for biological importance. Changes in drainage patterns as any flows within coastal or estuarine environments are dominated by the tide. The designated sites local to the Site are therefore considered to have Low sensitivity with respect to groundwater. This is a high value receptor which would not be impacted by small hydrogeological changes in the diamicton.

11.11.1.9. SIGNIFICANCE OF THE EFFECT

122. Overall, the magnitude of the impact is deemed to be Low and the sensitivity of the groundwater receptors are considered to be Negligible. The effect will, therefore, be of **negligible significance**, which is **not significant** in EIA terms.

123. The sensitivity of environmentally designated sites is considered to be Low sensitivity, with low reversibility as deterioration of the receptor is difficult / requires a long period of time to re-establish (i.e. breeding bird grounds). Changes to hydrogeology at the estuary in terms of drainage patterns will not be significant. The effect will, therefore, be of **minor adverse** significance, which is **not significant** in EIA terms.

11.11.1.10. SECONDARY MITIGATION AND RESIDUAL EFFECT

124. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

DISTURBANCE OF DEPOSITS IN THE STUDY AREA FROM CONSTRUCTION WORKS RESULTING IN MODIFICATIONS TO NATURAL DRAINAGE PATTERNS AND POTENTIAL INCREASE IN FLOOD RISK. THIS INCLUDES CHANGES TO SOIL QUALITY, COMPACTION AND EROSION

11.11.1.11. INTRODUCTION OF IMPACT

125. Trenching and earthworks will be required for the construction and installation of the HVDC and HVAC cables, and the proposed Converter Station, which involves the creation of a level development platform. These works will involve movement and stockpiling of materials across the site. Significant earthworks can inherently alter surface water catchment areas on the site which may result in increased runoff to surface water receptors, such as Maw Burn and Cow Gut. The levelling of the ground to create a level development platform may also result in soil compaction which may impact infiltration and throughflow, increasing runoff rates from the site. Where practicable, compaction would however be limited to specific areas of Onshore Scheme (i.e., the Onshore Converter Station and associated access tracks). In reality, the nature of the soils at the site (clay), has poor permeability, and therefore infiltration and throughflow is already extremely low. Compaction of the diamicton is unlikely to alter or change runoff rates from the existing site.

126. Any trenching works on the Site which involves the removal of ground and subsequent stockpiling will follow relevant procedures for surface water management as outlined in the CEMP. Where surface

water runoff has ponded within excavated trenches, this water will be pumped into an appropriate drainage receptor for settlement prior to discharge, to allow dry working conditions. The restriction of flows to greenfield rates into the receiving environment of either Maw Burn and Cow Gut will help to protect against flood risk being exacerbated downstream. It should be noted that both of these watercourses discharge into tidal areas offsite, and therefore the flow through the 'Ordinary Watercourses' will have a negligible impact on water levels in the Sleek Burn, River Blyth and North Sea.

127. Surface water drainage for the Onshore Converter Station will include consideration of detention basins which discharge all flows into the Sleek Burn as demonstrated in Technical Appendix 11.2. Prior to the construction of the Converter Station, the pond and associated drainage infrastructure will be installed at the Site which will protect against runoff into site watercourses from increasing during the construction phase.

128. At present, flows from the proposed Onshore Converter Station would discharge offsite via local watercourse networks (predominantly Cow Gut). The proposed discharge of flows into Sleek Burn will result in a minor reduction of runoff into Cow Gut. This reduction in flow is not considered to be detrimental to any biological elements of the watercourse as the river is only intermittently flowing and therefore water dependant habitat is not established in the channel. Cow Gut therefore would have capacity to receive the flows from the HVDC/HVAC cable route construction which have been offset through the re-routing of Converter Station drainage.

129. Areas of potential soil compaction, which effectively has consequential impacts on soil quality and hydraulic properties, would be limited to specific areas of the Onshore Scheme. This will however be minimised throughout the construction phase as much as practicable. Areas of the Site, including the subsurface soils which may be affected by soil compaction, will be drained via an onsite surface water drainage system from construction working areas, which will allow for there being negligible detrimental implications on surface water drainage. The implementation of an effective drainage system will reduce the impact of soil compaction; which becomes more notable during wet conditions. Consequently, any compaction which may occur would not impact flood risk locally.

130. Construction movement around the Site will be limited and form part of a Construction Traffic Management Plan (CTMP). Additional drainage provision or reworking of the soils will be implemented as required to alleviate any areas of compaction noted along the co-ordinated traffic route. It is thought that sufficient freeboard will be made available within the SuDS ponds to support the potential extra flow.

131. Changes to erosion and sedimentation patterns on surface and groundwater systems have been assessed in section 11.11.1.4 .

11.11.1.12. MAGNITUDE OF IMPACT

132. The impact is predicted to be of local spatial extent, short term duration and intermittent. It is predicted that the impact will affect the surface receptors directly however the magnitude of impact to the receptors is considered to be Low.

11.11.1.13. SENSITIVITY OF THE RECEPTOR

133. 'Ordinary Watercourses' which are present across the Site are deemed to be of Low sensitivity, with high recoverability due to their limited hydrological and biological value.

134. There are no other receptors considered to be affected by changes to drainage patterns due to the Onshore Scheme. Environmentally designated sites around tidal waters equally will not be impacted by increased flows from the Site.

11.11.1.14. SIGNIFICANCE OF THE EFFECT

135. Overall, the magnitude of the impact is deemed to be Low and the sensitivity of the surface water receptors are considered to be Low. The effect will, therefore, be of **minor adverse significance**, which is **not significant** in EIA terms.

11.11.1.15. SECONDARY MITIGATION AND RESIDUAL EFFECT

136. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

CONSTRUCTION AND DECOMMISSIONING EFFECTS ON RIVERBANKS – TEMPORARY OR PERMANENT DEPENDING ON THE SPECIFIC SUITE OF ACTIVITIES REQUIRED DURING CONSTRUCTION AND DECOMMISSIONING

11.11.1.16. INTRODUCTION OF IMPACT

137. The construction phase of the Onshore Scheme will involve works along the riverbank of the Sleek Burn and along the Landfall. Works will also be required along the HVDC/HVAC cable route around small 'Ordinary Watercourses' Cow Gut and Maw Burn.

138. Any works on the 'Main River' network or along sections of open coast (Sleek Burn, North Sea) will be subject to an environmental permit by the EA. This permit will require construction details including information regarding potential impacts, mitigation and best practice guidance. The permit will regulate any works to the riverbanks to reduce potential impact to the environment.

139. In addition to this, any works along, over, or below 'Ordinary Watercourses' would require to be regulated in accordance with an 'Ordinary Watercourse consent' to be granted by NCC, which would incorporate relevant mitigation measures as are considered appropriate.

140. These consents would be specific to the nature of works to be carried out during the timeline of development for both the construction and decommissioning phase.

11.11.1.17. MAGNITIUDE OF IMPACT

141. It is predicted that the impact on riverbanks during the construction and decommissioning phase of development would be direct, of an intermittent nature and of short duration. It is thought that any likely significant effects identified through the consenting process would be managed through industry standard good practice. The embedded mitigation is considered suitable and sufficient to reduce and manage the impact.

142. On this basis, the magnitude of impact would be Low.

11.11.1.18. SENSITVITY OF THE RECEPTOR

143. 'Ordinary Watercourses', Main Rivers' and sections of open coast are considered to be of Low sensitivity due to stringent regulatory controls throughout the construction phase as works will be required to obtain relevant permits and consents from the EA and NCC.

144. It is thought that impacts which may arise to designated sites located along sections of open coast and within the estuary are not hydrological but instead ecological factors which are assessed under Chapter 9: Terrestrial Ecology and Ornithology. Construction along riverbanks will seek to minimise all likely significant hydrological effects, however these are not specifically hydrologically designated sites, and the sensitivity is therefore considered to be Medium.

11.11.1.19. SIGNIFICANCE OF THE EFFECT

145. Overall, the magnitude of the impact is deemed to be Low and the sensitivity of 'Ordinary Watercourses', 'main rivers' and the Landfall area is also considered Low. The effect will, therefore, be **minor adverse significance**, which is **not significant** in EIA terms.

146. For environmentally designated sites along riverbanks, the potential impact is considered to be Low and the sensitivity of the receptor considered to be Medium. The effect will, therefore, be **minor adverse significance**, which is **not significant** in EIA terms.

11.11.1.20. SECONDARY MITIGATION AND RESIDUAL EFFECT

147. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

11.11.2. Potential Effects During Operation and Maintenance

INTERACTION WITH STREAMS AND THE WATER TABLE CAUSING MODIFICATIONS TO NATURAL DRAINAGE PATTERNS AND POTENTIAL INCREASE IN FLOOD RISK

11.11.2.1. INTRODUCTION OF IMPACT

148. The HVDC/HVAC cable routes would be buried underground. Full restoration of the land plus reinstatement of ground levels during the construction phase will provide for the former land use (i.e., existing conditions) to be retained. Drainage patterns would return to their pre-development, former state and therefore there would be no changes in flood risk arising from the operation and maintenance of the HVDC/HVAC cable routes.

149. At the Converter Station, a surface water drainage strategy (Technical Appendix 11.2) will be implemented at the Site during the construction phase to provide attenuation, filtration and conveyance of surface water. The surface water drainage will be in place throughout the proposed operational lifetime of the Converter Station and is sized to prevent flooding on site for all events up to and including a 1 in 100 annual probability rainfall event plus a 40% climate change uplift allowance, to account for changes in peak rainfall intensity throughout the anticipated lifetime of development. Discharge from the Converter Station drainage is into a tidal estuary and therefore has negligible impact on downstream flood risk. Runoff rates into the estuary will be predetermined with NCC prior to construction. On this basis there will be no implications on flood risk during the operational phase.

150. It is understood that flows from the current Converter Station area infiltrate to ground or flow overland into the Cow Gut watercourse. Once developed, the drained areas of the Converter Station site would be routed into Sleek Burn. This results in a minor reduction in flow to Cow Gut which effectively reduces the prevailing flood risk. Cow Gut is an intermittently flowing water body dominated by rainfall and subsequently surface water flow. On this basis, the likelihood of water dependant habitat is low and as such, reduction in flow is not considered detrimental to the watercourse. It is also noted that

Chapter 9: Terrestrial Ecology and Ornithology assesses residual effects on designated sits due to disturbance and changes to surface water flow as not significant.

151. Limited groundwater presence is noted along the majority of the HVDC/HVAC cable routes and beneath the proposed Converter Station due to impermeable diamicton geology. As discussed in section 11.7.1.3, there would be limited or no interaction with the water table within the diamicton having negligible impact on flood risk.

152. Due to the location of the Site (open coast), regional groundwater levels in tidal creek deposits or areas of blown sand (i.e., at the Landfall or estuary) are dominated by the tide. As noted in the construction phase, the siting of the Landfall in an area which interacts with the water table will have negligible impact on the tidal groundwater flood risk.

11.11.2.2. MAGNITUDE OF IMPACT

153. It is predicted that the impact on surface watercourses would primarily involve a small reduction in flow to Cow Gut. This would therefore be a direct impact, of an intermittent nature (i.e., following rainfall) and of long duration. There would be a slight change in hydrology following the reduction of contributing catchment area. On this basis, the magnitude of impact would be Low.

154. The impact on groundwater would equally be direct, of an intermittent nature but long duration (i.e., the works would be constantly interacting with water table daily throughout the Onshore Scheme lifetime). There would however be no perceptible changes to baseline hydrogeology and on this basis, the magnitude of impact to groundwater would be Negligible.

11.11.2.3. SENSITIVITY OF THE RECEPTOR

155. 'Ordinary Watercourses' on the Site are localised systems which are not reliant on continuously surface water or groundwater flows. The receptor is therefore considered to be of Low sensitivity.

156. Groundwater presence beneath the Site is considered to be of Negligible sensitivity to small changes in the flow regime (not quality).

11.11.2.4. SIGNIFICANCE OF THE EFFECT

157. Overall, the magnitude of the impact on 'Ordinary Watercourses' is deemed to be Low. The effect will, therefore, be **minor adverse significance**, which is **not significant** in EIA terms.

158. The magnitude of impact on groundwater is Negligible on a receptor with Negligible sensitivity. The effect will, therefore, be of **negligible significance**, which is **not significant** in EIA terms.

11.11.2.5. SECONDARY MITIGATION AND RESIDUAL EFFECT

159. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

INTERACTION BETWEEN THE ONSHORE SCHEME AND WATERCOURSES AND/OR PRIVATE WATER BODIES RESULTING IN A REDUCTION IN WATER QUALITY

11.11.2.6. INTRODUCTION OF IMPACT

160. Throughout the operational phase the HVDC/HVAC cable routes will remain in-situ with ground levels and vegetation initially reinstated to existing (pre-development) conditions. Once installed, the cable

routes will not interact with watercourses or other waterbodies as instead it will be lain beneath the base of any surface water features.

161. Once the cables are installed and ground reinstated, there will be no further works which may result in the mobilisation of sediment and turbid water. The cables will be installed within water resilient ducts with little to no leaching potential. On this basis, the HVDC/HVAC cable routes during the operational phase will have negligible impact on water quality.

162. Surface water drainage provided for the onshore Converter Station has been designed in line with pollution mitigation requirements (Technical Appendix 11.2). The Onshore Scheme proposes to use two ponds to provide filtration for any pollution which is shed from the Converter Station (very low hazard). The drainage design satisfies the requirements of the Simple Index Method, as outlined in The SuDS Manual, CIRIA C753, and provides the satisfactory pollution remediation for hydrocarbons, metals and total suspended solids. The surface water drainage infrastructure will be regularly maintained to ensure efficiency of the scheme. The likelihood of deterioration of water quality through the operational phase of the onshore Converter Station development is very low.

11.11.2.7. MAGNITUDE OF IMPACT

163. It is predicted that the impact on surface watercourses throughout the operational phase will be Negligible. Any changes that could occur (which are unlikely) would be consistent and for a long duration (i.e., at least the Onshore Scheme lifetime). The impact on groundwater sources is also considered Negligible with no perceptible changes to water chemistry or quality predicted.

11.11.2.8. SENSITIVITY OF THE RECEPTOR

164. The sensitivity of surface and groundwaters to negligible changes to water quality throughout the operational phase of development is considered Low.

165. Designated sites which are hydrologically connected to surface and groundwater sources are unlikely to be impacted by negligible changes in water quality as these are not water dependant sites. The sensitivity of the receptor is considered Medium due to their designated status.

11.11.2.9. SIGNIFICANCE OF THE EFFECT

166. The magnitude of impact on surface watercourses and groundwater is considered Negligible. Both receptors are considered to be of Low sensitivity and therefore the effect will be **of negligible significance**, which is **not significant** in EIA terms.

167. For environmentally designated sites, the potential impact is considered to be Low and the sensitivity of the receptor considered to be Medium. The effect will, therefore, be **minor adverse significance**, which is **not significant** in EIA terms.

11.11.2.10. SECONDARY MITIGATION AND RESIDUAL EFFECT

168. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

CHANGES TO THE SEDIMENT TRANSPORT REGIME RESULTING IN IMPACTS ON HYDROLOGICAL AND RIVERINE MORPHOLOGYAND THE INTERACTION BETWEEN THE SURFACE WATER DISCHARGE POINT ON THE SLEEK BURN AND RIVERINE MORPHOLOGY

11.11.2.11. INTRODUCTION OF IMPACT

169. All aspects of the HVDC/HVAC cable routes, including jointing bays, would be buried beneath the land surface along the cable routes and at the Landfall, with access via manholes at the surface. There would therefore be no impacts to the sediment transport regime, hydrology or morphology at the Landfall during operation and maintenance.

170. A new surface water outfall pipe will be required from the Onshore Converter Station drainage system into the Sleek Burn. It is assumed flows will enter the Sleek Burn adjacent to the existing North Sea Link (NSL) site outfall. Runoff from the site during periods of low tide will be managed at the outfall with an appropriately designed headwall structure and protection, incorporating energy dissipation measures and flow diffusion to minimise any potential for erosion or scour.

171. The Sleek Burn at the estuary is designated as an SSSI and a SPA, hence locating the outfall adjacent to the existing North Sea Link outfall will reduce the length of impacted riverbank.

172. The construction of the culvert will include an appropriately sized headwall comprising of standard construction materials (i.e., pre-cast concrete). The culvert and headwall will be constructed on top of a suitably designed foundation, formed within the riverbed, and will exit at a sufficient height (mAoD level) above sea levels to account for tidal effects and surcharge events. The foundation for the outfall pipe is likely to extend into the riverbed. Protection, such as rock armour, will be used at the outfall location to mitigate against the effects of scour due to tidal movements and/or during periods of high discharge. During periods of high tide, i.e., when the tidal creek deposits are not exposed, the tidal water will effectively dissipate the flow velocity at the base of the culvert. Reduction in velocity at the base of the culvert is essentially to prevent rapid erosion and gullying of the channel bed.

173. The culvert headwall and associated foundations will provide stabilisation of the riverbank within the affected area. Whilst the riverbank at the estuary is not typically associated with high velocity flow, erosion and scour which may occur through surface water discharge would be prevented, thus having limited impact on riverine morphology.

174. Surface water from the Site entering the Sleek Burn will be subject to appropriate pollution mitigation which will reduce total suspended soils within the surface water discharge. This is therefore unlikely to impact the sediment transport regime or turbidity of water.

175. Effects on intertidal habitats within the Sleekburn and Blyth Estuary are assessed in Chapter 9: Terrestrial Ecology and Ornithology. It is important to note that for licensable activities below MHWS on the Sleekburn, a Marine Licence will be required from the Marine Management Organisation (MMO) under the Marine and Coastal Access Act 2009. The Applicant is aware of all licensing requirements and will engage with the MMO to discuss this and formally apply in due course. The approach to obtaining a Marine Licence from the MMO separate to the planning application to NCC is required due to the lack of detailed design information associated with the outfall on the Sleekburn (noting also that the approach is consistent with that which was followed by the adjacent North Sea Link converter station development).

176. It is noted that there are discrete areas of coastal saltmarsh and mudflat habitats along the banks of the River Blyth and Sleek Burn Saltmarshes are categorised as higher sensitivity habitats under the Water Framework Directive (WFD) and a WFD Assessment has been submitted as part of the planning application submission to NCC.

11.11.2.12. MAGNITUDE OF IMPACT

177. Any changes to the sediment transport regime and riverine morphology as a result of development would be consistent and for a long duration (i.e., the Onshore Scheme lifetime).

178. It is predicted that the impact of potential changes to the sediment transport regime on surface watercourses that could occur (unlikely), would be consistent throughout the operational lifetime and therefore a long duration. The potential impact in relation to sediment transport and riverine morphology is considered to be Low.

179. The magnitude of impact on designated sites located in the estuary of the Sleek Burn is considered to be Low.

180. The proposed outfall will manage risk of impact to the sediment transport regime (e.g., foundations, headwalls, channel stabilisation works) to ensure the overall magnitude of impact remains low. The designated sites within the estuary are not water dependant however obtrusive headwalls into the channel and tidal creek deposits could affect the location of existing breeding ground habitats in the vicinity. This impact is assessed in Chapter 9: Terrestrial Ecology and Ornithology. The new outfall is unlikely to generate impact to the designated site and on this basis, the potential magnitude of impact is considered to be Low.

11.11.2.13. SENSITIVITY OF THE RECEPTOR

181. The sensitivity of surface water (i.e., the tidal estuary) to changes to the sediment transport regime is considered to be Low.

182. Designated sites which could be impacted are not considered water dependant and the Applicant notes that likely significant effects are not understood to be occurring as a result of works similar to the Onshore Scheme, at the NSL outfall. Any potential impacts would already be noticed through the development of the NSL outfall and associated drainage. Due to the designated status of the receptor, the sensitivity is considered to be Medium.

11.11.2.14. SIGNIFICANCE OF THE EFFECT

183. The magnitude of impact on surface watercourses is considered Low. The receptor is considered to be of Low sensitivity and therefore the effect will be **minor adverse significance**, which is **not significant** in EIA terms.

184. The magnitude of impact on designated sites is also considered Low. The receptor is of Medium sensitivity and therefore the effect will be **minor adverse significance**, which is **not significant** in EIA terms.

11.11.2.15. SECONDARY MITIGATION AND RESIDUAL EFFECT

185. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms.

11.11.3. Potential Effects During Decommissioning

186. No decision has been made regarding the final decommissioning plan for the Onshore Scheme, as it is recognised that industry standard practice, rules and legislation change over time. The detailed activities and methodology would be determined and agreed with the relevant planning authority later within the lifetime of the Onshore Scheme.

187. During the decommissioning phase, the impacts on hydrology, hydrogeology and flood risk will be similar or equivalent to those assessed for the construction phase. Good practice measures (similar to those outlined in the CEMP) would be employed during decommissioning and would be agreed with statutory authorities at the time of decommissioning through an appropriate decommissioning plan.

188. With regards to the buried onshore cables, it is proposed that these would be left in-situ during decommissioning, allowing the cables to remain in place is considered an acceptable option with minimal environmental impact.

189. The principal options for decommissioning of the HVDC and HVAC cables include:

- Leaving the cabled in-situ, trenched;
- Leaving the cabled in-situ and providing additional protection; and
- Remove sections of the cables.

190. For the purposes of a realistic worst-case assessment while the approach to decommissioning is developed by the applicant, it has been assumed for the purposes of this assessment that the cables would be pulled through the ducts and removed, with the ducts themselves left in situ. With regards to the Onshore Converter Station, it would be gradually dismantled with certain infrastructure removed for recycling or reuse. Following this, the area is likely to be remediated and restored.

191. Should complete removal of the HVDC and HVAC cables be required, the significance of effect is considered to result in similar impacts to those assessment as part of the construction phase of the Onshore Scheme. Complete removal of infrastructure represents the most significant adverse effects, and therefore if the other decommissioning options were to be progressed, they would have no more significant adverse effects.

192. It is anticipated that the onshore Converter Station would be gradually dismantled with certain infrastructure removed for recycling or reuse. Following this, the area is likely to be remediated and restored.

193. The decommissioning works of the onshore Converter Station may involve removal of some or all of the impermeable hard standing and restoration of greenfield land present prior to construction. The action would result in flood risk being returned to its pre-development state. Specific decommissioning requirements and potential concerns with regards to hydrology, hydrogeology and flood risk would be discussed with the relevant statutory consultees at the time.

11.12. Proposed Monitoring

194. No monitoring to test the predictions made within the assessment of this Chapter is considered necessary as no likely significant effects have been identified.

11.13. Cumulative Effects Assessment

11.13.1. Methodology

195. The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Onshore Scheme together with other relevant plans, developments and activities. Cumulative effects are therefore the complete set of effects arising from the Onshore Scheme together with the effects from a number of different developments, on the same receptor or resource. Please see Volume 2, Chapter 3 of the Onshore ES for detail on CEA methodology.

196. The developments selected are based upon the results of a screening exercise and the development of a 'long list' of cumulative developments relevant to the Onshore Scheme (see Volume 3, Technical Appendix 3.1). Each development has been considered on a case-by-case basis for screening in or out of this Chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved, to create the 'short list'. This approach was agreed during Scoping and further consultation and technical engagement undertaken with consultees, as detailed in Table 11-3.

197. The greatest potential for cumulative effects arises when the construction phase of another development overlaps with the construction phase of the Onshore Scheme. Cumulative effects are considered to have a likely significant effect only where such an overlap may exist, as activities that could be potentially detrimental to the hydrological and hydrogeological receptors are greatly reduced during the operational phase of developments.

198. It is appropriate to consider the Landfall area in further detail in the context of the Cambois Connection Marine Scheme. Based on the MDS for the Marine Scheme, a trenchless technique, such as HDD, will be deployed to bring the Offshore Export Cables ashore via ducts that will be installed from a point landward of MHWS to an exit point at least 250 m seaward of MLWS, thus completely bypassing the intertidal area. All construction works and infrastructure associated with the Onshore Scheme will be above MHWS, and landward of the dune system on Cambois beach, and therefore there is no potential for any direct interaction with the intertidal area. Given there will be no construction works associated with the Onshore Scheme within the intertidal area, there is no potential for any direct cumulative effects on hydrological and hydrogeological receptors within the intertidal area. Therefore, the Marine Scheme is not considered further within this CEA. Further detail on the Marine Scheme is provided in Volume 2, Chapter 5: Project Description.

199. The specific projects considered in for cumulative effects on hydrological and hydrogeological receptors are outlined in Table 11-12. These developments have been scoped out of the CEA for the assessment of impacts on hydrological and hydrogeological receptors. This is due to the following reasons:

    - the requirement for every developer / contractor to control any potential issues at source through the use of good practice and appropriate drainage design in line with national and local guidance to ensure no increase in runoff to fluvial watercourses above the exiting runoff rates; and
    - the tidal receptor being large enough to accept any surface water drainage input with no measurable impact on water levels.

200. On this, basis, there are no cumulative effects to on hydrological and hydrogeological receptors due to the Onshore Scheme in combination with other development / plans.

Table 11-12 List of other developments considered within the CEA for Hydrology and Hydrogeology

Development / Plan	Status	Distance from Study Area (km)	Description of Development / Plan	Dates of Construction	Dates of Operation	Overlap with the Onshore Scheme
Land At Former Power Station Site on Northern Side of Cambois. 21/00818/FULES	Consented	0 km (adjacent to boundary)	Erection of battery manufacturing plant with ancillary offices, together with associated development and infrastructure works (including site preparation works, ground modelling, drainage, landscaping, vehicular assess, cycle and pedestrian access, parking provision, substation and other associated works)	Not yet known	Not yet known	Large-scale development with potential for direct overlap. Construction likely to overlap spatially, however there is no information within the public.
Land North of Blyth Power Station Substation, East Sleekburn 22/00879/FUL	Consented	0 km (adjacent to boundary)	Erection of building for manufacturing of subsea cables, with ancillary offices and outdoor cable storage, together with associated development and infrastructure works including vehicular accesses off Brock Lane, landscaping and vehicular parking	Under construction	2027	Large-scale development with potential for direct overlap. Construction likely to overlap.
Land East of Sleekburn Business Centre, West Sleekburn 21/02506/HAZARD	Consented	0 km (adjacent to boundary)	Hazardous Substance Consent for the storage and use of: Cathode Active Material (Cobalt Lithium Manganese Nickel Oxide) (Powder) and Electrolyte (no more than 20% Lithium Hexaflourophosphate) (Liquid) Quantities: 1830 tonnes of Cathode Active Material and 3162 tonnes of Electrolyte	Not yet known	Not yet known	Large-scale development with potential for direct overlap.

11.14. Inter-Related Effects

201. Inter-related effects are the potential effects of multiple impacts, effecting one receptor or a group of receptors. Inter-related effects include interactions between the impacts of the different stages of the Onshore Scheme (i.e., interaction of impacts across construction, operation and maintenance and decommissioning), as well as the interaction between impacts on a receptor within an Onshore Scheme stage. A description of the likely inter-related effects arising from the Onshore Scheme on hydrological and hydrogeological receptors is provided below.

202. The potential of the onshore hydrology and hydrogeology effects to have secondary effects on other receptors and these are fully considered in the topic specific Chapters. These are:

- Ecological and ornithological receptors (Volume 2, Chapter 9) e.g., potential pollution of watercourse leading to effects on ecologically designated sites;
- Archaeological and cultural heritage receptors (Volume 2, Chapter 10) e.g., changes to the soil hydrology by the location of the Converter Station outfall in the location of cropmark remains.

203. The assessment of effects on hydrological and hydrogeological receptors, as presented in section 11.11 has already taken into account the potential for multiple impacts from the Onshore Scheme affecting particular receptors. Significant effects on hydrological and hydrogeological receptors resulting from the interaction of impacts across the construction, operation and maintenance and decommissioning phases are unlikely since changes would likely only occur for the construction phase, the potential for significant effects during operation and maintenance is low, and the decommissioning phase is temporally remote from the construction phase so that there would be no cross-phase impacts.

204. There are not anticipated to be any potential receptor led inter-related effects on single hydrological and hydrogeological receptors beyond those effects already assessed in section 11.11.

205. As such, inter-related effects are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phases. Therefore, these inter-related effects would not be significant in EIA terms.

11.15. Summary of Impacts, Mitigation Measures, Likely Significant Effects and Monitoring.

206. Information on Hydrology and Hydrogeology within a defined Study Area was collected through desktop review, site surveys and consultation. Table 11-13 presents a summary of the potential impacts, mitigation measures and the conclusion of likely significant effects in EIA terms in respect to hydrology and hydrogeology.

207. The potential hydrological and hydrogeological receptors in the Study Area comprise: the tidal and surface water floodplain; various watercourses, including ‘Main Rivers’ and ‘Ordinary Watercourses’ or drains; the near-shore tidal waters of the North Sea; transitional water of the River Blyth Estuary and Sleek Burn and underlying groundwater bodies. These receptors vary in their environmental sensitivity from low to high.

- Pollution of surface water due to disturbance of sediments and/or accidental spills from construction machinery and trenching works and trenchless techniques, such as HDD. These activities have the potential to alter existing surface and groundwater flows through excavation,

storage and reinstatement of soils and superficial materials, and installation of solid linear infrastructure;

- Interaction with the water table causing modifications to natural drainage patterns and potential increase in flood risk from inappropriate drainage and surface water treatment around the construction works;
- Disturbance of deposits in the onshore scoping area from construction works resulting in modifications to natural drainage patterns and potential increase in flood risk. this includes changes to soil quality, compaction, and erosion;
- The construction and decommissioning of the Onshore Scheme have the potential to create significant effects on riverbanks. These could be temporary or permanent depending on the specific suite of activities required during construction and decommissioning;
- Interaction with streams and the water table causing modifications to natural drainage patterns and potential increase in flood risk;
- Interaction between the Onshore Scheme and watercourses and/or private water bodies resulting in a reduction in water quality; and
- Potential for changes to the sediment transport regime resulting in impacts on hydrological and riverine morphology, particularly at Landfall, and the interaction between the surface water discharge point on the sleek burn and riverine morphology.

208. The assessed magnitude of the various identified impacts of the onshore elements of the Onshore Scheme on water quality, flood risk and river morphology varies from minor adverse to negligible (not significant in EIA terms). Overall, through the implementation of embedded mitigation, including the preparation of a CEMP, it is considered that the likely overall effect of the Onshore Scheme on water quality, flood risk and river morphology throughout the construction, operation and decommissioning phases is not significant in EIA terms.

209. There are no identified potential cumulative impacts on hydrological and hydrogeological receptors. Overall, it is concluded that there will be no likely significant cumulative effects from the Onshore Scheme alongside other developments / plans.

Table 11-13 Summary of potential likely significant environmental effects, mitigation and monitoring

Description of Impact	Phase			Receptor	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
	C	O	D							
Construction and decommissioning: Pollution of surface water due to disturbance of sediments and/or accidental spills from construction machinery and trenching works and HDD.	✓	×	✓	Surface watercourses	Low	Low	Minor adverse and not significant	None	Minor adverse and not significant	None
				Environmentally designated areas	Negligible	High	Minor adverse and not significant	None	Minor adverse and not significant	None
				Groundwater	Low	Negligible	Negligible adverse and not significant	None	Negligible	None
Construction and decommissioning: Interaction with the water table causing modifications to natural drainage patterns and potential increase in flood risk from inappropriate drainage and surface water treatment around the construction works.	✓	×	✓	Groundwater	Low	Negligible	Negligible adverse and not significant	None	Negligible	None
				Environmentally designated areas	Low	Low	Minor adverse and not significant	None	Minor adverse and not significant	None
Construction and decommissioning: Disturbance of deposits in the Study Area from construction works resulting in modifications to	✓	×	✓	'Ordinary Watercourses'	Low	Low	Minor adverse and not significant	None	Minor adverse and not significant	None

Description of Impact	Phase			Receptor	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
	C	O	D							
natural drainage patterns and potential increase in flood risk, including changes to soil quality, compaction and erosion.										
Construction and decommissioning: The construction and decommissioning of the onshore scheme could give rise to likely significant effects on riverbanks. These could be temporary or permanent depending on the specific suite of activities required during construction and decommissioning.	✓	×	✓	'Ordinary Watercourses'	Minor	Low	Minor adverse and not significant	None	Minor adverse and not significant	None
				Environmentally designated areas	Minor	Medium	Minor adverse and not significant	None	Minor adverse and not significant	None
Operation and maintenance: Interaction with streams and the water table causing modifications to natural drainage patterns and potential increase in flood risk.	×	✓	×	'Ordinary Watercourses'	Low	Low	Minor adverse and not significant	None	Minor adverse and not significant	None
				Groundwater	Negligible	Negligible	Negligible adverse and not significant	None	Negligible adverse and not significant	None
Operation and maintenance: Interaction between the onshore scheme and watercourses	×	✓	×	'Ordinary Watercourses'	Negligible	Low	Negligible adverse and not significant	None	Negligible adverse and not significant	None

Description of Impact	Phase C O D	Receptor	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
and/or private water bodies resulting in a reduction in water quality.		Groundwater	Negligible	Low	Negligible adverse and not significant	None	Negligible adverse and not significant	None
		Environmentally designated areas	Negligible	Medium	Minor adverse and not significant	None	Minor adverse and not significant	None
Operation and maintenance: Potential for changes to the sediment transport regime resulting in impacts on hydrological and riverine morphology, and the interaction between the surface water discharge point on the sleek burn and riverine morphology.	× ✓ ×	Surface Water	Low	Low	Minor adverse and not significant	None	Minor adverse and not significant	None
		Environmentally designated areas	Low	Medium	Minor adverse and not significant	None	Minor adverse and not significant	None

11.16. References

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