NORTH FALLS

Offshore Wind Farm

ENVIRONMENTAL STATEMENT

Chapter 9 Marine Water and Sediment Quality

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Glossary of Acronyms

AL	Action Level
BAC	Background Assessment Concentration
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CESAMP	Clean Seas Environmental Monitoring Programme
DCO	Development Consent Order
DESNZ	Department for Energy Security and Net Zero
EEA	European Economic Area
EEZ	Economic Exclusion Zone
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPP	Evidence Plan Process
EQS	Environmental Quality Standard
ERL	Effects Range low
ES	Environmental Statement
ETG	Expert Topic Group
GBS	Gravity Base Structures
GGOW	Greater Gabbard Offshore Windfarm
GWF	Galloper Offshore Windfarm
HDD	Horizontal Directional Drilling
km	Kilometre
MLWS	Mean low water springs
Mm^3	Million meters cubed
MMO	Marine Management Organisation
MPS	Marine Planning Statement
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
OCP	Offshore Converter Platform
OSP	Offshore Substation Platform
OSPAR	Oslo and Paris Conventions
PAH	Polyaromatic Hydrocarbons
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyls
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PSA	Particle Size Analysis
RWE	RWE Renewables UK Swindon Limited
SSC	Suspended Solids Concentrations
SSER	SSE Renewables Offshore Windfarm Holdings Limited
US	United States

WER	Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
WTG	Wind Turbine Generators
ZoI	Zone of Influence

Glossary of Terminology

Array area	The offshore wind farm area, within which the wind turbine generators, array cables, platform interconnector cable, offshore substation platform(s) and/or offshore converter platform will be located.
Array cables	Cables which link the wind turbine generators with each other, the offshore substation platform(s) and/or the offshore converter platform.
Cefas Action Levels	Guideline contaminant concentration levels used as part of a weight of evidence approach for decision-making on the suitability of dredged material for disposal to sea.
Climate change	A change in global or regional climate patterns. Within this chapter this usually relates to any long-term trend in mean sea level, wave height, wind speed etc, due to climate change.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the Environmental Impact Assessment (EIA) and information to support the Habitat Regulations Assessment (HRA).
Expert Topic Group	A forum for targeted engagement with regulators and interested stakeholders through the Evidence Plan Process.
Gravel	Loose, rounded fragments of rock larger than sand but smaller than cobbles. Sediment larger than 2mm (as classified by the Wentworth scale used in sedimentology).
Gravity Base Structures	Foundation option included within the design envelope which would use ballast to secure wind turbine structures and/or offshore substation(s) to the seabed.
Horizontal directional drill	Trenchless technique to bring the offshore cables ashore at the landfall.
Intertidal	The shore area between the level of mean high water springs (MHWS) and the level of mean low water springs (MLWS).
Landfall	The location where the offshore cables come ashore at Kirby Brook.
Offshore	Area seaward of nearshore in which the transport of sediment is not caused by wave activity.
Offshore cable corridor	The corridor of seabed from the array area to the landfall within which the offshore export cables will be located.
Offshore converter platform	Should an offshore connection to an HVDC interconnector cable be selected, an offshore converter platform would be required. This is a fixed structure located within the array area, containing HVAC and HVDC electrical equipment to aggregate the power from the wind turbine generators, increase the voltage to a more suitable level for export and convert the HVAC power generated by the wind turbine generators into HVDC power for export to shore via a third party HVDC cable.
Offshore export cables	The cables which bring electricity from the offshore substation platform(s) to the landfall, as well as auxiliary cables.
Offshore project area	The overall area of the array area and the offshore cable corridor.
Offshore substation platform(s)	Fixed structure(s) located within the array area, containing HVAC electrical equipment to aggregate the power from the wind turbine generators and increase the voltage to a more suitable level for export to shore via offshore export cables.
Platform interconnector cable	Cable connecting the offshore substation platforms (OSP) or / and offshore converter platform (OCP).
Preliminary Environmental Information Report (PEIR) offshore project area	The boundary encompassing the offshore cable corridor and former array areas, as considered within the PEIR.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the wind turbine generator foundations and OSP or / and OCP foundations as a result of the flow of water.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter.

Sediment transport	The movement of a mass of sediment by the forces of currents and waves.
Silt	Sediment particles with a grain size between 0.002mm and 0.063mm, i.e., coarser than clay but finer than sand.
Study area	Area where likely significant effects from the Project could occur, as defined for each individual ES topic.
Suspended sediment	The sediment moving in suspension in a fluid kept up by the upward components of the turbulent currents or by the colloidal suspension.
The Applicant	North Falls Offshore Wind Farm Limited (NFOW).
The Project or North Falls	North Falls Offshore Wind Farm, including all onshore and offshore infrastructure.
Wind Turbine Generator	Power generating device that is driven by the kinetic energy of the wind.

9 Marine Water and Sediment Quality

9.1 Introduction

1. This chapter of the Environmental Statement (ES) considers the likely significant effects of the North Falls Offshore Wind Farm (OWF) (hereafter 'North Falls' or 'the Project) on marine sediment and water quality. The chapter provides an overview of the existing environment for the proposed offshore project area, followed by an assessment of the likely significant effects for the construction, operation, and decommissioning phases of the Project.

2. This chapter has been written by Royal HaskoningDHV, with the assessment undertaken with specific reference to the relevant legislation and guidance, of which the principal policy documents with respect to Nationally Significant Infrastructure Projects (NSIPs) are the National Policy Statements (NPS). Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Effects Assessment (CEA) are presented in Section 9.4.4.

3. The assessment should be read in conjunction with following linked ES chapters (Volume 3.1) and appendices (Volume 3.3):

   - ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10);
   - ES Chapter 10 Benthic and Intertidal Ecology (Document Reference: 3.1.12);
   - ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13);
   - ES Chapter 12 Marine Mammals (Document Reference: 3.1.14);
   - ES Chapter 14 Commercial Fisheries (Document Reference: 3.1.16);
   - ES Appendix 10.1 Intertidal-Benthic Ecology Survey Report (Document Reference: 3.3.4); and
   - ES Appendix 21.2 Water Framework Directive Compliance Assessment (Document Reference: 3.3.28).

4. Additional information to support the marine water and sediment quality assessment includes:

   - Interpretation of survey data specifically collected for the Project including sediment data;
   - Sediment data collected for other linked projects;
   - Information presented in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10) which is based on numerical modelling and theoretical studies undertaken for Galloper Offshore Wind Farm (GWF) and Greater Gabbard Offshore Wind Farm (GGOW) and their associated ES chapters; and
   - Discussion and agreement with key stakeholders.

9.2 Consultation

5. Consultation with regard to marine water and sediment quality has been undertaken in line with the general process described in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8). The key elements to date have included the EIA scoping report and scoping opinion, consultation on the Preliminary Environmental Information Report (PEIR) and the technical consultation via the combined Seabed Expert Topic Group (ETG) (covering physical processes, marine water and sediment quality, benthic ecology and fish ecology) as part of the Evidence Plan Process (EPP).

6. Through the EPP, consultation regarding marine sediment and water quality has been conducted on the North Falls EIA Methodology – Marine Geology Oceanography Physical Processes Method Statement submitted to the ETG in June 2021. This document provided a method for the assessment of likely significant effects and proposed data collection and analysis to inform this topic.

7. The feedback received has been considered in preparing the ES. Table 9.1 provides a summary of how the consultation responses received to date have influenced the development of this chapter.

8. This ES chapter has been updated following the consultation on the PEIR to produce the final assessment submitted with the Development Consent Order (DCO) application.

Table 9.1 Consultation responses

Consultee	Date / Document	Comment	Response / where addressed in the ES
Natural England	29/07/2021 Scoping Opinion	North Falls array areas and export cable corridor overlap closed disposal sites. The interconnector cable overlaps the Inner Gabbard East disposal site. Construction (and decommissioning) activities could potentially release contaminated sediment or sediment that is not the same as the surrounding seabed during construction. Offshore surveys should be considered for the North Falls OWF site and offshore export cable corridor to determine if any contaminants from previous disposal activities are present.	For the offshore project area, the Scoping Report and PEIR included two array areas and an interconnector corridor. Following stakeholder feedback on the PEIR, the offshore project area has been revised as described in Section 9.3.1 and ES Chapter 4 Site Selection and Assessment of Alternatives (Document Reference: 3.1.6), with the previously defined northern array area and interconnector corridor removed. The southern array area (now the 'array area') has also been reduced in size. The revised array area overlaps the closed Galloper OWF and BritNed disposal sites. The offshore cable corridor continues to overlap the closed Warren Spring disposal site. Site-specific sediment data was collected. See Section 9.5.
Planning Inspectorate	29/07/2021 Scoping Opinion	Paragraph 86 of the Scoping Report (detailing the overarching assessment methodology for the EIA) states that study areas defined for each receptor are based on the Zone of Influence (ZoI) and relevant characteristics of the receptor (e.g., mobility / range). However, the Inspectorate notes that for many of the aspect chapters included, study areas and ZoIs have not been	The study area for marine water and sediment quality is outlined in Section 9.3.1.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		stated. Where this detail has been provided, it is not clear how these study areas relate to the extent of the impacts and likely significant effects associated with the Proposed Development, how they have been used to determine a ZoI, and what receptors have been identified within the ZoI. The Environmental Statement (ES) should provide a robust justification as to how study areas have been defined and why the defined study areas are appropriate for assessing potential impacts.	
Planning Inspectorate	29/07/2021 Scoping Opinion	Some aspect sections of the Scoping Report have identified specific receptors, whereas others identify broad categories of receptors only. Specific receptors should be identified within the ES, alongside categorisation of their sensitivity and value. Section 1.8.2.1 of the Scoping Report explains the generic approach to defining receptor sensitivity in order to assess the potential impacts upon each receptor. The inspectorate expects a transparent and reasoned approach to be applied to assigning receptor sensitivity to be defined and applied across the aspect chapters.	The definition of sensitivity is outlined in Table 9.7.
Planning Inspectorate	29/07/2021 Scoping Opinion	The ES should include details of difficulties (for example technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved.	Within each chapter assessment methodology, the limitations are stated where appropriate. For Chapter 9, assumptions and limitations of the assessment are presented in Section 9.4.6.
Planning Inspectorate	29/07/2021 Scoping Opinion	Section 1.7.2 and Table 1.4 of the Scoping Report explains that an Evidence Plan Process (EPP) with specialist stakeholders commenced in 2021 to agree the 'detailed methodologies for data collection and undertaking the impact assessments' in respect of certain aspects to be scoped into the ES. This approach to agreeing the finer details of the assessment is welcomed.	Noted.
Planning Inspectorate	29/07/2021 Scoping Opinion	Section 1.9.3 of the Scoping Report sets out the planning policy and legislation context for the Proposed Development. It would be beneficial for the aspect chapters of the ES to also include reference to aspect specific planning policy and legislation, where this has been used to inform the methodology used for assessment.	Aspect specific planning policy and legislation is outlined in Section 9.4.

Consultee	Date / Document	Comment	Response / where addressed in the ES
Planning Inspectorate	29/07/2021 Scoping Opinion	Any mitigation relied upon for the purposes of the assessment should be explained in detail within the ES. The likely efficacy of the mitigation proposed should be explained with reference to residual effects. The ES should also address how any mitigation proposed is secured, with reference to specific DCO requirements or other legally binding agreements.	Embedded mitigation is detailed in Section 9.3.3. A schedule of mitigation (Document Reference: 2.6) is provided with the DCO application, which outlines how mitigation is secured.
Planning Inspectorate	29/07/2021 Scoping Opinion	Based on the conclusions of the Galloper Wind Farm (GWF) in 2011, whose ZoI is stated to be similar to that of the Proposed Development, the Applicant proposes to scope transboundary effects in relation to Marine water and sediment quality out of the assessment. The Proposed Development is also 20km from the Economic Exclusion Zone (EEZ). The Inspectorate agrees that this matter can be scoped out of the ES.	Noted.
Planning Inspectorate	29/07/2021 Scoping Opinion	The ES should set out the spatial scope for the marine water and sediment quality chapter.	The study area for marine water and sediment quality is outlined in Section 9.3.1.
Planning Inspectorate	29/07/2021 Scoping Opinion	The ES should detail how the proposed site surveys have been used to support existing desk-based information on water quality, and further survey should be carried out, where necessary, to provide a robust baseline and support a sufficiently detailed assessment.	Please refer to Section 9.5 for a description of the existing environment and site-specific data.
Planning Inspectorate	29/07/2021 Scoping Opinion	The Inspectorate notes the potential for the use of Horizontal Directional Drilling (HDD) as a method for cable laying which could affect coastal locations. The ES should consider the potential for contamination of sediments and marine water quality from drilling fluids where significant effects are likely to occur.	Control of accidental release would be managed through pollution control measures within the Project Environmental Management Plan (PEMP) to be submitted with the DCO application (Document Reference: 7.6). Additionally, all chemicals used would be checked against the Oslo and Paris Conventions (OSPARs) List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR) (OSPAR, 2021) and therefore no significant effects are likely to occur. See Section 9.3.3 for further information on embedded mitigation.
Planning Inspectorate	29/07/2021 Scoping Opinion	The ES should consider the potential for significant effects on water quality from construction or operational discharges.	There are no planned discharges for the construction and operational phase. Unplanned/accidental discharges would be managed through pollution control measures within the PEMP to be submitted with the DCO application

Consultee	Date / Document	Comment	Response / where addressed in the ES
			(Document Reference: 7.6). Additionally, all chemicals used would be checked against the OSPARs List of Substances Used and Discharged Offshore which Are Considered to PLONOR (OSPAR, 2021) and therefore no significant effects are likely to occur. See Section 9.3.3 for further information on embedded mitigation.
Planning Inspectorate	29/07/2021 Scoping Opinion	The ES should include details of proposed mitigation measures to address effects, including any proposed measures to ensure that sediment and water quality does not deteriorate to the detriment of protected and/ or commercial fish and shellfish species. Cross-reference should be made to relevant assessments of the ES, e.g., Fish and Shellfish and Commercial Fisheries.	The impact assessment is presented in Section 9.6 and includes proposed mitigation measures where required. ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13) assesses the impacts of the Project on commercial fishing as a result of impacts on marine water and sediment quality. Interactions between ES chapters is described in Section 9.10.
MMO	29/07/2021 Scoping Opinion	All impacts relevant to sediment quality will be scoped in for further assessment, other than transboundary impacts. With regard to my specific remit, The Applicant will scope in "Remobilisation of existing contaminated sediments". The Marine Management Organisation (MMO) agree with this scoping decision.	Noted.
MMO	29/07/2021 Scoping Opinion	To establish a proxy baseline, The Applicant has used contaminant data from similar projects in the surrounding area, notably those which supported the licensing of GGOW. Whilst these data can be useful to inform the history of sediment quality in the area, their use should be informative only. In this regard, more weight should be applied to sediment data which The Applicant intends to generate through sediment sampling.	The baseline environment uses the site-specific sediment data. The information from previous projects is used as context only. See Section 9.5.1 for further information.
MMO	29/07/2021 Scoping Opinion	With regard to The Applicant's proposed EIA, they state that "Where concentrations are at, or below, Action Level 1, no additional assessment is considered necessary as the risk to water quality is considered to be low. Where concentrations fall close to, or above Action Level 2, then more quantitative assessment might be required". The MMO mostly agree with this statement, though defer final assessment until the data are generated and presented for review. However, The Applicant should note that only trace metals, organotins	Noted. Sediment data was compared against OSPAR assessment criteria and Cefas Action Levels (ALs). Given the levels of contamination (see Section 9.5.1) further consideration against additional or the revised ALs being considered under the recent Defra consultation (and reviewed in Mason *et al,* 2022) regarding the Gorham Test and individual polychlorinated biphenyls (PCBs) congeners, was not considered necessary.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		and Total 25 Polychlorinated biphenyls (PCBs) hold respective Action Level 2 (AL2) values. Where no appropriate AL2 is available, Cefas will utilise other resources such as Gorham-Test (1999) (for PAHs) and Canadian sediment quality guidelines (for PBDEs).	
MMO	29/07/2021 Scoping Opinion	The MMO have not been able to ascertain what the contaminant sampling will comprise. Whilst The Applicant does not necessarily need to inform the MMO what they intend to sample, they should endeavour to formulate their sampling strategy to be in line with OSPAR guidelines. Notably, the number of samples which will provide adequate spatial representation should adhere to OSPAR guidance, and analyses to be tested for should be relevant for their intended purpose, i.e., for example, testing for all listed 24 PAH analytes, rather than only the United Stated (US) 16 priority PAHs. A full list of analyses tested for can be found in the MMO Results Template	A Marine Management Organisation (MMO) accredited lab undertook the analysis (Section 9.4.2.1) and all polyaromatic hydrocarbons (PAH) parameters were included. Further detail is provided in Section 9.5.1.
MMO	29/07/2021 Scoping Opinion	Any analyses for contaminants must be completed by a laboratory which has been validated by the MMO, to ensure that methods used are appropriate	SOCOTEC is MMO accredited (Section 9.4.2.1).
MMO	29/07/2021 Scoping Opinion	The Applicant should note, however, that the OWF Array area and, potentially, the cable route, may need to be designated as disposal sites. The MMO could not locate any detail concerning this in the report provided.	Noted. An application to designate the North Falls offshore project area (the array area and the offshore cable corridor) as a disposal site for material arising due to construction activities, i.e., seabed preparation/ sandwave levelling (dredging) or drilling for foundations is being sought.
MMO	29/07/2021 Scoping Opinion	Cumulative and in-combination effects are mentioned in the report, but, as this is a scoping report, no formal assessment of the extent of such impacts is presented. This is acceptable	Noted.
Natural England	05/07/2021 ETG	Are cumulative impacts only operational or will the assessment consider construction at the same time as FEOW?	The assessment considers the potential for construction, operational and decommissioning CEA. See Section 9.8.
Natural England	05/07/2021 ETG	Will disposal be included in the list of construction activities?	As mentioned above, an application to designate the North Falls offshore project area as disposal site for material arising due to construction activities is being sought. The worst case scenario, that sediment would be dredged during foundation installation and returned to

Consultee	Date / Document	Comment	Response / where addressed in the ES
			the water column at the sea surface during disposal from the dredger vessel is considered within Impact 1 (Section 9.6.1.1).
MMO	30/11/2021 Letter titled 'Benthic Contaminants Survey data	MMO recommend that the applicant provide some justification as to their selection of samples for contaminant analysis in the ES. Whilst MMO agree that metals and PAHs are appropriate, and that organotins, OCs and Polybrominated diphenyl ethers (PBDE) are not, in this case, necessary, MMO recommend that PCBs be analysed ahead of the ES, due to their consistent presence within a range of marine biota in the North Sea, and to the importance of sediment as an input pathway for contaminants.	Sediment chemistry samples were taken from 26 of the 49 sample locations across the PEIR offshore project area (i.e., former array areas, interconnector and offshore cable corridor) to provide adequate spatial coverage. The specific location of these was determined based on a review of publicly available data and the findings of the geophysical data. Rationale for the location of each sample is provided in ES Appendix 10.1 Survey Report (Document Reference 3.3.4). The sampling was undertaken based on the PEIR offshore project area which fully encapsulates the revised offshore project area and so the sampling locations remain relevant. The samples were analysed for PCBs in addition to the other contaminants. The results show PCBs are present at levels below the limit of detection (LOD) and are presented in ES Appendix 10.1 Survey Report (Document Reference 3.3.4).
MMO	14/07/2023 Consultation Response Letter Section 4	The Applicant has undertaken sampling and analysis of material from across the array and cable areas (undertaken in May and August 2021), with 9 samples collected from the export cable area, and 10 samples from the array/interconnector cable area. The samples were analysed for levels of trace metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) by SOCOTEC, who are validated by the MMO to undertake such analyses. 39 samples were also collected for particle size analysis (PSA), which was undertaken by Fugro, who are validated by the MMO to undertake PSA.	Noted.
MMO	14/07/2023 Consultation Response Letter Section 4	The MMO notes that the sediment sampling undertaken is lower than that recommended by OSPAR, however the MMO is content that they provide sufficient spatial coverage, particularly considering the majority of material to be disturbed is sand (confirmed by the PSA results), which is considered to be at a lower risk of contamination than finer particle size fractions, and	Noted.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		that material will be redistributed within the same area.	
MMO	14/07/2023 Consultation Response Letter Section 4	The results of the sampling (provided in Tables 9.12 to 9.15 of the PEIR, and ES Appendix 10.1 Survey Report (Document Reference 3.3.4) show levels of trace metals in excess of Cefas Action Level 1 (AL1), namely for arsenic and nickel, with one sample also exceeding AL1 for copper. However, no samples approach or exceed their respective AL2. The PAH results show no exceedances of AL1, and the PCB results are all at or below the limits of detection. The MMO therefore agrees with the Applicant's conclusion that the likelihood of impact from the resuspension of contaminated sediment can be considered negligible.	Noted.
MMO	14/07/2023 Consultation Response Letter Section 4	In Table 9.1 of Chapter 9 (Marine Water and Sediment Quality), it is noted from previous MMO comments regarding the potential requirement for a disposal site, stating that "worst case is for material to be released at the surface in the location in which it was removed". The MMO is of the opinion that, although material will be maintained within the same area, a designation of a disposal site will be required for these works. This site would cover the array and cable areas, in order to comply with the UK's obligations under OSPAR and the London Convention and Protocol.	A site characterisation report is included within the DCO Application to inform licencing of the order limits as a disposal site (Document Reference: 7.30).
MMO	14/07/2023 Consultation Response Letter Section 4	Please note, this would only be required were it is anticipated that material will be removed from the water, however briefly this may be (i.e. bed levelling works carried out by means of plough dredging for example, may not be subject to the requirement of a disposal site, whereas removal via trailer suction dredging, for example, for release at the sea-surface would be subject to this requirement). In line with this requirement, annual disposal returns must be submitted to the MMO during the project's construction. A site Characterisation Report must be submitted to enable the MMO to designate one or more disposal sites.	

9.3 Scope

9.3.1 Study area

9. The study area for marine sediment and water quality has been defined on the basis of both the near-field (within the offshore project area) and far-field (beyond the offshore project area over which sediment plumes may extend) environment. The study area extends over the array area and the offshore cable corridor which links the array area to the landfall area at Kirby Brook on the Tendring Peninsula.

10. It should be noted that, subsequent to the PEIR, the offshore project area has been refined, with the previously defined northern array area and interconnector corridor removed from the offshore scope. The southern array area (now the 'array area') has also been reduced in size and the offshore cable corridor has been extended to meet the refined boundary of the array area. The offshore cable corridor was also reduced in width at the landfall, aligned with the onshore cable route. The baseline presented in this ES chapter has been updated to reflect the new offshore project area and it is therefore appropriate for the purposes of the baseline characterisation. The sediment sampling is described in ES Appendix 10.1 Survey Report (Document Reference: 3.3.4) and covers the PEIR offshore project area, which was larger than, and which fully encapsulates, the ES study area.

9.3.2 Realistic worst case scenario

11. The final design of North Falls will be confirmed through detailed engineering design studies that will be undertaken post-consent. To provide a precautionary but robust impact assessment at this stage of the development process, realistic worst case scenarios have been defined in terms of the likely significant effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for developments of this nature, as set out in Planning Inspectorate Advice Note Nine (2018). The Rochdale Envelope for a project outlines the realistic worst case scenario for each individual impact, so that it can be safely assumed that all other scenarios within the design envelope will have less impact. Further details are provided in ES Chapter 6 EIA Methodology (Document Reference: 3.1.10).

12. One area of optionality is in relation to the National Grid connection point (discussed further in ES Chapter 5 Project Description (Document Reference: 3.1.7)). The following grid connection options are included in the Project design envelope:

- Option 1: Onshore electrical connection at a National Grid connection point within the Tendring peninsula of Essex, with a project alone onshore cable route and onshore substation infrastructure;
- Option 2: Onshore electrical connection at a national grid connection point within the Tendring peninsula of Essex, sharing an onshore cable route and onshore duct installation (but with separate onshore export cables) and co-locating separate project onshore substation infrastructure with Five Estuaries; or
- Option 3: Offshore electrical connection, supplied by a third party.

13. The realistic worst case scenarios for the likely significant effects scoped into the EIA for the marine water and sediment quality assessment are summarised in Table 9.2. These are based on North Falls parameters described in ES Chapter 5 Project Description (Document Reference: 3.1.7), which provides further details regarding specific activities and their durations.

14. For marine water and sediment quality, Options 1 and 2 would be the same, and these represent the worst case scenario described in Table 9.2 and assessed in Section 9.6. For Option 3 there would be no project export cables to shore. Within the array area, under Options 1 and 2 there would be up to two offshore substation platforms (OSPs); whereas for option 3 there would be one offshore converter platform (OCP) and up to one OSP, i.e., under all scenarios there would be a maximum of two platforms, with no change to the worst case foundation infrastructure.

Table 9.2 Realistic worst case scenarios

Element of the project infrastructure	Parameter	Worst case	Notes
Construction			
Impact 1: Increase in suspended sediment associated with seabed preparation, foundation installation for the turbines, array cables and platform interconnector cables	Volume of sediment disturbed	Sediment displaced during seabed preparation for Wind Turbine Generators (WTGs) and OSP/OCP foundations: Seabed preparation area for gravity base structures (GBS) of 70m diameter each x 57 WTG x average 5m sediment depth = 1,096,809m^3 Two OSPs/OCP seabed preparation x average 5m sediment depth = 38,485m^3 Worst case scenario volume of sediments disturbed during WTG/OSP/OCP seabed preparation: 1,135,294m^3 (1.14Mm^3) Volume of sediments disturbed during the installation of array cables and platform interconnector cable: Array cable sandwave levelling = 27,293,114m^3 Array cable burial – 170km length with average 1m trench width x average 1.2m burial depth = 204,000m^3 Platform interconnector cable sandwave levelling = 1,436,480m^3 Platform interconnector cable burial – 20km length with average 1m trench width x average 1.2m burial depth = 24,000m^3 Worst case scenario volume of sediments disturbed during the installation of array cables and platform interconnector cable: 28,957,594m^3 (28.96Mm^3)	Seabed preparation may be required. The worst case scenario assumes that sediment would be dredged and returned to the water column at the sea surface during disposal from the dredger vessel. Sandwave levelling may be required prior to offshore cable installation. Any excavated sediment due to sandwave levelling would be disposed of within the North Falls offshore project area, meaning there will be no net loss of sediment from the site. A range of burial techniques are being considered as described in Section 5.6.7 in ES Chapter 5 Project Description (Document Reference: 3.1.7) and are included in the worst case scenario.

Element of the project infrastructure	Parameter	Worst case	Notes
		Total worst case scenario volume associated with seabed preparation, foundation installation and array cables = 30,092,888m^3 (30.1Mm^3)	
Impact 2: Increase in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSP/OCP	Volume of drill arisings	Worst case scenario volume of sediments disturbed due to drill arisings at 10% of largest wind turbines = 34,728m^3 (based on 34 of the largest turbines) Drill arisings at 1 x monopile OSPs/OCP = 11,451m^3 (Based on 50% of the OSPs/OCP needing drilling). Worst case scenario volume of sediments disturbed due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP = 46,179m^3 NB, drill arising would not occur in the event that the GBS is used and therefore this parameter cannot be added to the maximum seabed levelling for GBS described above.	Assumes drilling at up to 10% wind turbine locations (average 45m drill depth, 17m drill diameter) Assumes drilling at one OSP location (45m drill depth, 18m drill diameter)
Impact 3: Increase in suspended sediment due to offshore export cable installation	Volume of sediment disturbed	Export cable sandwave levelling = 1,544,891m^3 Export cable burial = 125.4km length with average 1m trench width x max 1.2m burial depth = 150,480m^3 Worst case scenario volume of sediments disturbed due to export cable installation = 1,695,371m^3 (1.7Mm^3)	A range of burial techniques are being considered as described in Section 5.6.7 in ES Chapter 5 Project Description (Document Reference: 3.1.7) and are included in the worst case scenario. The offshore HDD exit location will be subtidal zone, c. 1.5km from mean low water springs (MLWS). Sediment displacement assumes a box shaped dimension.
Impact 4: Deterioration in water quality related to release of sediment bound contaminants	Total volume of sediment disturbed	The worst case total volume of sediment disturbed during the construction of North Falls is 31.8Mm^3. Maximum suspension of sediments as described above.	The total suspended sediment from installation of foundations, array cables, and offshore export cables.

Element of the project infrastructure	Parameter	Worst case	Notes
		No significant contaminated sediments were recorded in the offshore project area.	NB, drill arising would not occur in the event that the GBS is used and therefore this parameter cannot be added to the maximum seabed levelling for GBS
Operation			
Impact 1: Increase in suspended sediment associated with cable repairs and reburial	Volume of sediment disturbed	Unplanned repairs and reburial of cables may be required during O&M, the following estimates are included: Reburial of c.2.75% of array cable length (170km) is estimated over the life of the project (24m disturbance width and average 1.2m depth) = 134,640m^3 Reburial of c.2.75% of platform interconnector cable (20km) is estimated over the life of the project (24m disturbance width and average 1.2m depth) = 15,840m^3 Reburial of c. 4% of offshore export cable (125.4km) is estimated over the life of the project (24m disturbance width and average 1.2m depth) = 144,460.8m^3 Five array cable repairs are estimated over the project life. 600m section removed x 24m disturbance width x average 1.2m depth = 86,400m^3 Four offshore export cable repairs are estimated over the project life. 600m section removed x 24m disturbance width x average 1.2m depth = 69,120m^3 Anchored vessels placed during the cable repairs included above = 4,914m^2 Maintenance of offshore infrastructure would be required during O&M. An estimated 177 major component replacement activities may be required per year, using jack up vessels and/or anchoring = 292,050m^2	This represents the maximum estimated total area of seabed disturbance from unplanned repairs and reburial of cables that may be required during O&M.

Element of the project infrastructure	Parameter	Worst case	Notes
		Five UXO clearance operations over the lifetime of the Project with a crater footprint estimate of up to $350m^2 = 1{,}750m^2$	
Impact 2: Deterioration in water quality resulting from the resuspension of contaminated sediment due to maintenance activities	Total volume of sediment disturbed	As above	As above
Decommissioning			
Impact 1: Increases in suspended sediment associated with removal of foundations and array cables	Volume of sediment disturbed	Foundations Cutting of piles below the seabed surface: 480 pin-piles of 6m diameter 57 wind turbines x 8 piles 2 OSPs/OCP x 12 piles Or 59 monopiles of 17m diameter (57 wind turbines + 2 OSPs/OCP) Or Removal of largest foundations (GBS): 57 wind turbines x 65m diameter 2 OSPs/OCP x 65m diameter Or A mixture of the range of foundation types included in the design envelope. Array cables	No decision has yet been made regarding the final decommissioning arrangements for the offshore project infrastructure. It is also recognised that legislation and industry good practice change over time. However, the following infrastructure is likely to be removed, reused or recycled where practicable: Turbines including monopile, steel jacket and GBS foundations; OSPs including topsides and steel jacket foundations; and Offshore cables may be removed or left in situ depending on available information at the time of decommissioning. The following infrastructure is likely to be decommissioned in situ depending on available information at the time of decommissioning, however where it represents the worst case scenario (e.g., for disturbance) removal is assessed: Scour protection; Offshore cables may be removed or left in situ; and Crossings and cable protection. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. Decommissioning arrangements will be detailed in a Decommissioning Plan, which will be prepared in accordance with the Energy Act 2004.

Element of the project infrastructure	Parameter	Worst case	Notes
Impact 2: Increases in suspended sediment associated with removal of the offshore cables	Volume of sediment disturbed	Up to 170km of array cable (removal to be determined in consultation with key stakeholders as part of the decommissioning plan)	As above
Impact 3: Deterioration in water quality associated with release of sediment bound contaminants	Volume of sediment disturbed	<u>Platform interconnector cables:</u> Up to 20km of array cable (removal to be determined in consultation with key stakeholders as part of the decommissioning plan) <u>Export cables</u> Up to 125.4km of export cable (removal to be determined in consultation with key stakeholders as part of the decommissioning plan) Maximum suspension of sediments as described above. No significant contaminated sediments were recorded in the offshore project area	As above

9.3.3 Summary of mitigation embedded in the design

15. This section outlines the embedded mitigation relevant to the marine water and sediment quality assessment, which has been incorporated into the design of North Falls (Table 9.3). No further mitigation is proposed for marine water and sediment quality.

Table 9.3 Embedded mitigation measures

Parameter	Mitigation measures embedded into North Falls design
Accidental pollution	Committed to the use of industry good practice techniques and due diligence regarding the potential for pollution throughout all construction, operation and maintenance, and decommissioning activities. The outline PEMP secures this commitment and is provided with DCO application (Document Reference: 7.6). The final PEMP would be agreed with the MMO prior to construction and would include, for example, measures to control accidental release of drilling fluids whilst ensuring that any chemicals used are listed on the OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR) (OSPAR, 2021).
Sediment release	Micro-siting will be used where practicable to reduce the requirements for seabed preparation prior to foundation and cable installation.

9.4 Assessment methodology

9.4.1 Legislation, guidance and policy

16. This section provides an overview of the relevant legislation, guidance and policy of relevance to marine water and sediment quality. See ES Chapter 3 Policy and Legislation (Document Reference: 3.1.5) for other relevant legislation associated with the Project.

9.4.1.1 National Policy Statements

17. The assessment of likely significant effects upon Chapter 9 Marine Water and Sediments Quality has been made with specific reference to the relevant legislation and guidance, of which the principal policy documents with respect to the Nationally Significant Infrastructure Projects (NSIPS) are the National Policy Statements (NPS). Those relevant to the Projects are:

- Overarching NPS for Energy (EN-1) (Department for Energy Security & Net Zero (DESNZ), 2023a)
- NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023b)

18. The specific assessment requirements for Chapter 9 Marine Sediment and Water Quality, as detailed in the NPS, are summarised in Table 9.4 together with an indication of the section of the ES chapter where each is addressed.

Table 9.4 NPS assessment requirements

NPS Requirement	NPS Reference	ES Reference
Overarching NPS for Energy (EN-1)		
Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters coastal and marine waters.	Paragraph 5.16.1	The likely significant effects of the Project on water quality are assessed in Section 9.6 and in the Water Environment Regulations (WER) Compliance Assessment found in ES Appendix 21.2 Water Environment

NPS Requirement	NPS Reference	ES Reference
		Regulations Compliance Assessment (Document Reference 3.3.28).
During the construction, operation, and decommissioning phases, development can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats (see Section 4.2) and could result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and the Marine Strategy Regulations 2010.	Paragraph 5.16.2	The likely significant effects of the Project on water quality are assessed in Section 9.6 and in the WER Compliance Assessment (ES Appendix 21.2 Water Environment Regulations Compliance Assessment, Document Reference 3.3.28). The risk of spills and leaks of fluid would be managed through pollution control measures within the PEMP (see Section 9.3.3). Additionally, all chemicals used would be checked against the OSPAR List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment (PLONOR) (OSPAR, 2021). The effects on protected species and habitats as a result of changes to marine water and sediment quality and physical process are assessed in the following: ES Chapter 10 Benthic and Intertidal Ecology (Document Reference: 3.1.12); ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13); ES Chapter 12 Marine Mammals (Document Reference: 3.1.14); Marine Conservation Zone Assessment (Document Reference: 7.3); and Report to Inform Appropriate Assessment (Document Reference: 7.1.1).
Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment, and how this might change due to the impact of climate change on rainfall patterns and consequently water availability across the water environment, as part of the ES or equivalent.	Paragraph 5.16.3	The existing environment for marine water and sediment quality is described in Section 9.5. Consideration of how this may change in the future e.g., due to climate change is discussed in Section 9.5.3.
The applicant should make early contact with the relevant regulators, including the local authority, the Environment Agency and Marine Management Organisation, where appropriate, for relevant licensing and environmental permitting requirements.	Paragraph 5.16.4	Early consultation with regard to marine water and sediment quality has been undertaken and indication of how consultees' comments have been addressed is presented in Section 9.2.
The ES should in particular describe: • the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges • existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant	Paragraph 5.16.7	The likely significant effects of the Project on water quality, including impacts on relevant water bodies or protected areas are assessed in Section 9.6 and in the WER Compliance Assessment in ES Appendix 21.2 Water Environment Regulations Compliance Assessment (Document Reference: 3.3.28).

NPS Requirement	NPS Reference	ES Reference
existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Abstraction Licensing Strategies) and also demonstrate how proposals minimise the use of water resources and water consumption in the first instance • existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics • any impacts of the proposed project on water bodies or protected areas (including shellfish protected areas) under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and source protection zones (SPZs) around potable groundwater abstractions ● • how climate change could impact any of the above in the future ● • any cumulative effects		Consideration of how the existing environment may change in the future e.g., due to climate change is discussed in Section 9.5.3. Cumulative effects are assessed in Section 9.8. Assessment of effects on onshore water resources is provided in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23).
The risk of impacts on the water environment can be reduced through careful design to facilitate adherence to good pollution control practice. For example, designated areas for storage and unloading, with appropriate drainage facilities, should be clearly marked.	Paragraph 5.16.9	Table 9.3 outlines the commitment to adhere to industry good practice techniques and due diligence for pollution control.
The Secretary of State will need to give impacts on the water environment more weight where a project would have an adverse effect on the achievement of the environmental objectives established under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.	Paragraph 5.16.12	The WER assessment of likely significant effects of North Falls is included in ES Appendix 21.2 Water Environment Regulations Compliance Assessment (Document Reference: 3.3.28). This concludes there will be no significant adverse effects on the achievement of the environmental objectives of the WER.
The SoS must also consider duties under other legislation including duties under the Environment Act 2021 in relation to environmental targets and have regard to the policies set out in the Government's Environmental Improvement Plan 2023.	Paragraph 5.16.13	The Project's compliance with relevant legislation is described in the Planning Statement submitted with the DCO application. With regards to marine water and sediment quality, a summary of the other relevant legislation is outlined in Section 9.4.1.2.
The Secretary of State should be satisfied that a proposal has regard to current River Basin Management Plans and meets the requirements of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (including regulation 19). The specific objectives for particular river basins are set out in River Basin Management Plans. The Secretary of State must refuse development consent where a project is likely to cause deterioration of a water body or its failure to achieve good status or good potential, unless the requirements set out in Regulation 19 are met. A project may be approved in the absence of a qualifying Overriding Public Interest test only if there is sufficient certainty that it will not cause	Paragraph 5.16.14	The WER assessment of likely significant effects of North Falls is included in ES Appendix 21.2, Water Environment Regulations Compliance Assessment (Document Reference: 3.3.28). This concludes there will be no significant adverse effects on the achievement of the environmental objectives of the WER. River Basement Management Plans are considered in Section 9.5.2 and ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23).

NPS Requirement	NPS Reference	ES Reference
deterioration or compromise the achievement of good status or good potential.		
The Secretary of State should consider proposals to mitigate adverse effects on the water environment and any enhancement measures put forward by the applicant and whether appropriate requirements should be attached to any development consent and/or planning obligations are necessary.	Paragraph 5.16.16	The effects on water quality during the construction, operation and decommissioning phases of North Falls are considered either 'minor adverse' or 'negligible' and therefore, no additional mitigation measure is proposed, beyond the embedded mitigation presented in Section 9.3.3.
NPS for Renewable Energy Infrastructure (EN-3)		
The construction, operation and decommissioning of offshore energy infrastructure (including the preparation and installation of the cable route) can affect the following elements of the physical offshore environment, which can have knock on impacts on other biodiversity receptors: • Water quality – disturbance of the seabed sediments or release of contaminants can result in direct or indirect effects on habitats and biodiversity, as well as on fish stocks thus affecting the fishing industry • Waves and tides – the presence of the turbines can cause indirect effects through change to wave climate and tidal currents on flood defences, marine ecology and biodiversity, marine archaeology and potentially coastal recreation activities • Scour effect – the presence of wind turbines and other infrastructure can result in a change in the water movements within the immediate vicinity of the infrastructure, resulting in scour (localised seabed erosion) around the structures. This can indirectly affect navigation channels for marine vessels, marine archaeology and impact biodiversity and seabed habitats • Sediment transport – the resultant movement of sediments, such as sand across the seabed or in the water column, can indirectly affect navigation channels for marine vessels, could affect sediment supply to sensitive coastal sites and impact biodiversity and seabed habitats • Suspended solids – the release of sediment during construction, operation and decommissioning can cause indirect effects on marine ecology and biodiversity; • Sandwaves – the modification/clearance of sandwaves can cause direct physical and ecological effects both at the seabed and within the water column due to disturbance and suspension of	Paragraph 2.8.111	Effects on water quality as a result of disturbance of seabed sediments or release of contaminants is assessed in Section 9.6. Effects on waves, tides, scour, sediment transport, suspended solids, sandwaves and water column processes around the structures is assessed in ES Chapter 8 Marine geology, oceanography and physical processes (Document Reference: 3.1.10). The effects on marine ecology as a result of changes to marine water and sediment quality and physical process are assessed in the following chapters: ES Chapter 10 Benthic and Intertidal Ecology (Document Reference: 3.1.12); ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13); ES Chapter 12 Marine Mammals (Document Reference: 3.1.14).

NPS Requirement	NPS Reference	ES Reference
sediment, and potentially indirect effects (e.g., changes to seabed morphology in water depths where waves can influence the seabed, which can in turn affect wave climate and sediment transport; and • Water column – wind turbine structures can also affect water column features such as tidal mixing fronts or stratification due to a change in hydrodynamics and turbulence around structures.		

19. Other UK policies and plans of relevance to this chapter are the Marine Policy Statement (MPS) (HM Government, 2011) and the East Inshore and East Offshore Marine Plans (HM Government, 2014). These documents guide decision making with regard to marine developments and signpost the relevant legislation to be followed. These are discussed further in ES Chapter 3, Policy and Legislative Context (Document Reference: 3.1.5).

9.4.1.2 National legislation

20. There are a number of pieces of national legislation applicable to the assessment of marine sediment and water quality. These include:

- Environment Act (2021);
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Marine Strategy Regulations 2010;
- Bathing Water Regulations 2013; and

9.4.1.3 International Commitments

21. Other international commitments made by the UK include compliance with:

- The International Convention for the Prevention of Marine Pollution by Ships (MARPOL Convention) 73/78.
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972", the "London Convention"
- And the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic 1992 (OSPAR)

22. Further detail is provided in ES Chapter 3 Policy and Legislative Context (Document Reference: 3.1.5).

9.4.1.4 Guidance

23. There is no specific guidance available for the impact assessment of marine sediment and water quality. Where the data available supports it, sediment quality guidelines used by OSPAR Commission 2014, and the Marine Management Organisation (MMO) have been used.

24. With respect to OSPAR, assessments are undertaken using Background Assessment Concentration (BAC) and the United States (US) Environmental Protection Agency's (EPA) Effects Range-Low (ERL). The ERL value is defined as the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects. Adverse effects on organisms are rarely observed when concentrations fall below the ERL value. BACs are statistical tools defined in relation to the background concentrations which enable statistical testing of whether observed concentrations can be considered to be near background concentrations. Relevant BACs and ERLs are provided in Table 9.5.

25. In the UK, licensing authorities for dredge material disposal to sea, regulate the activity using guidelines, part of which require characterisation of the sediments for disposal to enable the consideration of potential adverse environmental effects. To undertake this assessment, regulating authorities apply ALs (sediment quality criteria) for contaminants on a primary list. These ALs are then used as part of a 'weight of evidence' approach to decision making on the disposal of dredged material. There are two levels – Action Level 1 (AL1) and Action Level 2 (AL2). Contaminant levels below AL1 are generally assumed to be of no concern and are unlikely to influence the licensing decision. Contaminant levels between Level 1 and 2 generally trigger further investigation of the material, and contaminants in dredged material above AL2 are generally considered unsuitable for sea disposal (MMO, 2015).

26. Although the majority of the material assessed against these standards arises from a specific activity i.e., dredging and disposal activities, they are also considered a good way of undertaking an initial risk assessment with respect to determining risks to marine waters from other marine activities as part of the EIA and associated WER compliance assessments. If, overall, levels do not generally exceed AL1 then contamination levels are considered to be low risk in terms of the potential for impacts on water quality. This approach is recommended by the Environment Agency in their WER compliance assessment guidance 'Clearing the Waters for All' for example (Environment Agency, 2017). Relevant values are presented in Table 9.5.

Table 9.5 Sediment quality guidelines used in this assessment

Contaminant	Units	OSPAR		Cefas	
		BAC	ERL	AL1	AL2
Arsenic	mg/kg	25	8.2[1]	20	100
Cadmium		0.31	1.2	0.4	5
Chromium		81	81	40	400
Copper		27	34	40	400
Mercury		0.07	0.15	0.3	3

[1] The ERLs for arsenic and nickel are below the OSPAR Background Concentrations of 25 and 36 mg/kg respectively; arsenic and nickel concentrations are only assessed against the BAC

Contaminant	Units	OSPAR BAC	OSPAR ERL	Cefas AL1	Cefas AL2
Nickel		36	21	20	200
Lead		38	47	50	500
Zinc		122	150	130	800
Acenaphthene	µg/kg	-	-	100	-
Acenaphthylene		-	-	100	-
Anthracene		5	85	100	-
Benz(a)anthracene		16	261	100	-
Benzo(a)pyrene		30	430	100	-
Chrysene		20	384	100	-
Dibenzo(a,h)anthracene		-	-	10	-
Fluoranthene		39	600	100	-
Fluorene		-	-	100	-
Naphthalene		8	160	100	-
Phenanthrene		32	240	100	-
Pyrene		24	665	100	-
Benzo(ghi)perylene		80	85	100	-
Indeno[1,2,3-cd]pyrene		103	240	100	-
Benzo(b)fluoranthene		-	-	100	-
Benzo(e)pyrene		-	-	100	-
Benzo(k)fluoranthene		-	-	100	-
C1-Naphthalene		-	-	100	-
C2-Phenanthrene		-	-	100	-
C2-Napthalene		-	-	100	-
C3-Napthalene		-	-	100	-

9.4.2 Data sources

9.4.2.1 Site-specific

27. To provide site-specific and up to date information on which to base the impact assessment, a geophysical survey was undertaken within the PEIR offshore project area (i.e., the former array areas, interconnector cable corridor and the offshore cable corridor) was completed between May and August 2021 (Fugro, 2021a,b). A benthic survey of the PEIR offshore project area was also undertaken between May and August 2021 (Fugro, 2021c provided in ES Appendix 10.1 Survey Report (Document Reference 3.3.4), where grab sampling was undertaken, and samples sent for Particle Size Analysis (PSA) and chemical contaminant analysis for the following parameters:

- Trace metals;
- PAHs; and
- PCBs.

28. Chemical analysis was undertaken by SOCOTEC, in line with the MMO accreditation scheme regarding sediment sampling for disposal to sea licensing.

9.4.2.2 Other available sources

29. Information to support this ES has been drawn from the existing environment and effects assessment presented in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10) regarding predicted plumes as well as a series of data sources and associated studies as detailed in Table 9.6.

Table 9.6 Other available data and information sources

Data Set	Spatial Coverage	Year	Notes
Clean Seas Environmental Monitoring Programme (CESAMP) – water quality reported in OSPAR (2023).	UK Seas – water quality	Various	The Quality Status Report 2010 (OSPAR, 2023) describes the current status and trends in water quality for regional seas including the North Sea.
Benthic survey – grab samples and particle size analysis (Centre for Marine and Coastal Studies, 2014)	GGOW array area and offshore cable route	November 2004 and April 2005	None
Benthic survey – grab samples and particle size analysis (Centre for Marine and Coastal Studies, 2014)	GWF array area and offshore cable route	December 2009	None
Bathing water profiles (Environment Agency, 2022)	England	Updated annually	Water quality at designated bathing water sites in England are assessed by the Environment Agency between May and September. Data is published by the Environment Agency online.
Environment Agency Catchment Data Explorer (Environment Agency, 2023)	Rivers, estuaries and coastal waters around England.	Updated at each River Basin Planning round	Database for information related to river basin management plans (RBMP) in England. Contains information on river basin districts and catchments and WER compliance data.

9.4.3 Impact assessment methodology

30. ES Chapter 6 EIA Methodology (Document Reference: 3.1.8) explains the general impact assessment methodology applied to North Falls. The following sections describe the methods used to assess the likely significant effects on marine sediment and water quality.

31. The assessment of likely significant effects is based on expert judgement, guidance, the approach outlined in the North Falls Scoping Report (Royal HaskoningDHV, 2021), as well as from feedback gained through the Scoping Opinion, Evidence Plan Process, and through consultation carried out under Section 42 of the Planning Act 2008. A matrix approach has been used to guide

the assessment. An explanation of how this is applied within the marine sediment and water quality assessment is set out below.

32. The data sources summarised in Section 9.4.2 were used to characterise the existing environment. Each impact, which has been identified using expert judgement and through the Scoping Process, is then assessed in terms of its significance using the methods described below.

9.4.3.1 Definitions

33. For each potential impact, the assessment identifies receptors within the study area which are sensitive to that impact and implements a systematic approach to understanding the impact pathways and the level of impacts (i.e., magnitude) on given receptors.

34. The sensitivity of a receptor, in this case marine water quality, is dependent upon its:

- Tolerance to an effect (i.e., the extent to which the receptor is adversely affected by a particular effect);
- Adaptability (i.e., the ability of the receptor to avoid adverse impacts that would otherwise arise from a particular effect); and
- Recoverability (i.e., a measure of a receptors ability to return to a state at, or close to, that which existed before the effect caused a change).

Table 9.7 Definition of sensitivity for water quality

Sensitivity	Definition
High	The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and/or has a very low capacity to accommodate any change to current water quality status, compared to baseline conditions.
Medium	The water quality of the receptor supports high biodiversity and/or has low capacity to accommodate change to water quality status.
Low	The water quality of the receptor has a high capacity to accommodate change to water quality status due, for example, to large relative size of the receiving water and capacity for dilution. Background concentrations of certain parameters already exist.
Negligible	Specific water quality conditions of the receptor are likely to be able to tolerate proposed change with very little or no impact upon the baseline conditions detectable.

35. Topic specific definitions of magnitude are provided in Table 9.8. The magnitude of an effect is dependent upon its:

- Scale (i.e., size, extent or intensity);
- Duration
- Frequency of occurrence; and
- Reversibility (i.e., the capability of the environment to return to a condition equivalent to the baseline after the effect ceases).

Table 9.8 Definition of magnitude for water quality

Magnitude	Definition
High	Large scale change to key characteristics of the water quality status of the receiving water feature. Water quality status degraded to the extent that a permanent or long term change occurs. Inability to meet (for example) Environmental Quality Standard (EQS) is likely.
Medium	Medium scale changes to key characteristics of the water quality status taking account of the receptor volume, mixing capacity, flow rate, etc. Water quality status likely to take considerable time to recover to baseline conditions.
Low	Noticeable but not considered to be substantial changes to the water quality status taking account of the receiving water features. Activity not likely to alter local status to the extent that water quality characteristics change considerably or EQSs are compromised.
Negligible	Although there may be some impact upon water quality status, activities predicted to occur over a short period. Any change to water quality status would be quickly reversed once activity ceases.

9.4.3.2 Significance of effect

36. The assessment of significance of an effect is a function of the sensitivity of the receptor and the magnitude of the impact (see ES Chapter 6 EIA Methodology (Document Reference: 3.1.8) for further details). The determination of significance is guided by the use of a significance of effect matrix, as shown in Table 9.9. Definitions of each level of significance are provided in Table 9.10.

37. Should major or moderate effects be identified within the assessment, these would be regarded within this chapter as significant. Should the assessment indicate any likely significant effect, mitigation measures would be identified, where practicable, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall significance of effect to determine a residual effect upon a given receptor.

Table 9.9 Significance of effect matrix

		Adverse magnitude				Beneficial magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 9.10 Definition of impact significance

Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a national, regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.

Significance	Definition
Negligible	No discernible change in receptor condition.
No change	No impact, therefore, no change in receptor condition.

9.4.4 Cumulative effects assessment methodology

38. The CEA considers other plans, projects and activities that may result in cumulation with North Falls. As part of this process, the assessment considers which of the residual impacts assessed for the Project have the potential to contribute to a cumulative impact, the data and information available to inform the cumulative assessment and the resulting confidence in any assessment that is undertaken. ES Chapter 6 EIA Methodology (Document Reference: 3.1.8) provides further details of the general framework and approach to the CEA.

39. For marine water and sediment quality, these activities include construction of other offshore wind farms, large coastal defence/protection schemes and subsea cables installation.

9.4.5 Transboundary effects assessment methodology

40. The transboundary assessment considers the potential for transboundary effects to occur on marine sediment and water quality as a result of North Falls; either those that might arise within the Exclusive Economic Zone (EEZ) of European Economic Area (EEA) states or arising on the interests of EEA states e.g., a non-UK fishing vessel. ES Chapter 6 EIA Methodology (Document Reference: 3.1.8) provides further details of the general framework and approach to the assessment of transboundary effects.

41. Due to the distance of North Falls from the EEZ it is unlikely that sediment plumes will extend past the EEZ boundary. Combined with findings from the GWF transboundary assessment (ABPmer, 2011a; Royal Haskoning, 2011) transboundary impacts are unlikely to occur and therefore transboundary impacts are scoped out of further assessment in accordance with the scoping opinion (Planning Inspectorate, 2021).

9.4.6 Assumptions and limitations

42. Given the limited data regarding site-specific offshore water quality, information from more general monitoring programmes such as those undertaken by OSPAR, and WER water body status have been used to inform this assessment.

43. This limitation is not considered to significantly affect the certainty or reliability of the impact assessments presented in Section 9.6.

9.5 Existing environment

9.5.1 Sediment quality

9.5.1.1 Physical characteristics

44. The physical characteristics of the sediments at risk of being disturbed are important because this influences the increase in sediment concentrations in

the water column, geographical spread and the period of suspension within the water column. Lighter sediments such as silt are more readily remobilised if disturbed and stay suspended over longer periods, allowing greater geographical dispersal. Heavier sediment types like sand require greater kinetic energy to be resuspended and, due to their greater mass, fall back to the seabed, hence geographic spread is more limited (Jones *et al.,* 2016).

45. Additionally, sediment grain size is important to inform assessment of the risk of contamination because finer grained materials (silts and clays) function as a sink for contaminants and therefore have a greater potential to retain contaminants than larger grained materials (Horowitz, 1987).

46. As outlined in Section 9.4.2.1, a benthic survey was undertaken between May and August 2021 covering the former offshore project area (see Section 9.3.1). The sites sampled for PSA are shown in (ES Figure 8.8, Document Reference: 3.2.4) and a summary of the findings in the remaining study area is presented in Table 9.11.

47. Overall, sediments across the offshore project area comprised a mix of gravel, sand and mud with percentages of fines being highest at stations along the nearshore section of the offshore cable corridor. Sand was the predominant sediment type in the array area.

Table 9.11 Summary of PSA analysis

Area	Summary description
North Falls array area	The dominant sediment type in the North Falls array is medium sand (16-74% content in all samples). The mud content is less than 18% in 100% of the samples. Samples in the north and north-west of the array had a high proportion of gravel (1.84-41.8%).
Offshore cable corridor	The dominant sediment type in the export cable corridor is medium sand (2-51% content in all samples). The mud content is less than 5% in 26% of the samples and less than 78% in 100% of the samples. The samples with the highest mud content were located in the nearshore section of the offshore cable corridor (average mud content of 59.4%).

9.5.1.2 Chemical characteristics

48. Sediment samples were also sent for chemical analysis, the locations are shown in ES Figure 9.1 (Document Reference: 3.2.5). Results were compared to sediment guidelines as outlined in Section 9.4.1 and the output is presented in Table 9.12 for metals and Table 9.13 for PAHs. PCB data indicated that the samples were at or below the detection limits and therefore are not presented in the tables. All data is available in Appendix 10.1 Survey Report (Document Reference 3.3.4).

Table 9.12 Sediment sample results for metals within the offshore cable corridor and array area. Yellow indicates exceedance of AL1 or BAC. Orange indicates exceedance of both BAC and AL1. There are no exceedances of AL2 or ERL

	Sample reference												Cefas		OSPAR	
	Offshore cable corridor										Array area					
	ST01	ST03	ST05	ST07	ST11	ST15	ST17	ST19	ST21	ST36	ST41	ST43	AL1	AL2	BAC	ERL
Arsenic	30.2	9.7	19.6	16.1	23.5	17.5	33	10.5	33.1	26.3	14.9	8.8	20	100	25	-
Cadmium	0.13	0.08	0.23	<0.04	<0.04	<0.04	0.16	0.07	0.1	0.16	<0.04	<0.04	0.4	5	0.31	1.2
Chromium	17.4	14.2	26.5	8.6	6.8	4.9	9.6	15.3	13.8	14	4.4	4.2	40	400	81	81
Copper	12.9	6.9	18	5	0.01	6.1	8.4	<0.5	33.6	5.6	2.4	2.5	40	400	27	34
Mercury	0.07	0.03	0.07	0.01	<0.01	0.04	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.3	3	0.07	0.15
Nickel	16.1	9.1	25.9	6.1	4.6	4.2	11.9	8.9	13.8	10.8	3.5	3.5	20	200	36	-
Lead	17.1	10.3	18	8.4	9.6	4.1	6.2	8.9	8.7	5.3	2.6	2.4	50	500	38	47
Zinc	62	35.5	89.1	33.6	31.9	18.6	26.6	35.8	32.9	26.6	13	11.9	130	800	122	150

Table 9.13 Sediment sample results for PAHs within the offshore cable corridor and array area. Cefas Action Level 1 is 100µg/kg for all PAHs with the exception of Dibenzo(ah)anthracene which is 10µg/kg. There are no exceedances of Cefas AL1. Yellow indicates exceedance of the OSPAR BAC

PAH (units µg/kg)	Sample reference												Cefas	OSPAR	
	Offshore cable corridor									Array area					
	ST01	ST03	ST05	ST07	ST11	ST15	ST17	ST19	ST21	ST36	ST41	ST43	AL1	BAC	ERL
Acenaphthene	2.33	4.77	1.41	<1	<1	<1	<1	1.54	<1	<1	<1	<1	100	-	-
Acenaphthylene	2.94	4.17	1.28	<1	<1	<1	<1	1.21	<1	<1	<1	<1	100	-	-
Anthracene	5.01	10.1	2.58	<1	<1	<1	<1	2.97	1.93	27.3	<1	<1	100	5	85
Benzo(a)anthracene	16.9	26.5	8.19	2.03	1.66	<1	<1	8.43	5.32	3.89	<1	<1	100	16	261
Benzo(a)pyrene	21.2	33.8	10.7	2.72	1.65	<1	1.01	11.1	6.8	2.54	<1	<1	100	30	430
Benzo(b)fluoranthene	30.5	45.8	16.5	3.16	1.38	<1	1.3	14.2	9.25	3.54	<1	<1	100	-	-
Benzo(e)pyrene	27.7	43.9	15.4	4.28	1.29	<1	1.76	13.4	9.03	2.54	<1	<1	100	-	
Benzo(ghi)perylene	26.4	42.4	15.2	3.93	1.54	<1	1.5	13.3	8.69	2.9	<1	<1	100	80	85
Benzo(k)fluoranthene	13.8	22.4	7.41	2.19	<1	<1	<1	6.29	5.18	1.9	<1	<1	100	-	-
C1-Naphthalene	56.3	96.9	35.4	9.25	2.07	1.01	2.78	25.7	11.3	4.53	<1	<1	100	-	-
C2-Phenanthrene	40	66.7	23.7	5.81	3.7	<1	1.99	17.6	9.33	5.03	<1	<1	100	-	-
C2-Napthalene	53.9	94.6	34.3	8.25	1.73	<1	2.92	26.3	11.7	3.16	<1	<1	100	-	-
C3-Napthalene	47.2	83.7	32.1	6.43	1.78	<1	2.56	21.2	9.84	2.42	<1	<1	100	-	-
Chrysene	22	33.6	10.5	2.53	1.65	<1	<1	10.5	6	5.22	<1	<1	100	20	384
Dibenzo(ah)anthracene	4.76	7.92	2.29	<1	<1	<1	<1	2.35	1.56	<1	<1	<1	10	-	-
Fluoranthene	33.2	58.8	15.8	4.38	2.13	<1	1.57	18.4	12.4	6.83	<1	<1	100	39	600

PAH (units µg/kg)	Sample reference												Cefas	OSPAR	
	Offshore cable corridor									Array area					
	ST01	ST03	ST05	ST07	ST11	ST15	ST17	ST19	ST21	ST36	ST41	ST43	AL1	BAC	ERL
Fluorene	4.62	9.47	2.92	<1	<1	<1	<1	2.5	1.22	6.79	<1	<1	100	-	-
Indeno(1,2,3-cd)pyrene	24.1	39.1	13.5	3.85	1.29	<1	1.55	12.6	8.33	2.61	<1	<1	100	103	240
Naphthalene	19	31.4	11.6	3.37	1.28	1.01	1.39	9.13	4.99	2.18	<1	<1	100	8	160
Perylene	13.9	24.5	8.26	1.68	<1	<1	<1	6.75	4.16	1.21	<1	<1	100	-	-
Phenanthrene	30.7	60	18.2	4.45	1.1	<1	1.56	15.8	8.76	12	<1	<1	100	32	240
Pyrene	31.4	53.8	16	4.17	3.24	<1	1.67	16.8	11.7	5.86	<1	<1	100	24	665

49. Of the metals analysed, arsenic was above Cefas AL1 at five stations within the offshore project area, including four along the export offshore cable corridor (ST01, ST11, ST17 and ST21) and one in the former northern array area (ST36). The arsenic concentrations at four stations were also above OSPAR BAC. Given the exceedances of the sediment quality guidelines, results have been considered against regional information available for arsenic to provide context.

50. Whalley *et al*. (1999) analysed archived samples from historical surveys and combined the data with results for the Dogger Bank to examine the distribution of total arsenic in sediments from the western North Sea and Humber Estuary. This identified a range of concentrations falling between 14 to 70mg/kg. Historically, the Humber has been subjected to large point discharges of arsenic from industrial sources and samples collected during various North Sea surveys have identified numerous areas with high raw arsenic concentrations, particularly off north Yorkshire and the Humber Estuary.

51. However, the same study demonstrated that after normalisation against iron, the levels of arsenic in these historical samples were much reduced in significance but that there were elevated arsenic concentrations present in sediments from the outer Thames and off north east Norfolk. Although arsenical waste disposal could explain the high arsenic concentrations in sediments from the outer Thames, the causes for those off north east Norfolk were considered to be unclear. The authors hypothesize that the circulation pattern of the North Sea might lead to the suggestion that arsenic from the Humber is being transported to this area but evidence to support this theory is not available. An alternative explanation offered by the authors is that drilling could have brought arsenic-rich marine shales to the surface, since the affected area coincides with the main group of English North Sea gas fields.

52. The arsenic concentrations within sediments in North Falls study area (range between 8.8 and 33.1mg/kg) are within the range reported by Whalley *et* al. (1999) and therefore do not represent excessive levels for the region. This is supported by studies undertaken as part of the GGOW investigations which revealed elevated levels of arsenic in some samples across the GGOW site (GGOW, 2005) along with Norfolk Vanguard, East Anglia TWO and East Anglia THREE, all in the southern North Sea, had similar findings in their surveys (Norfolk Vanguard, 2012, East Anglia THREE, 2016, East Anglia TWO, 2019).

53. Concentrations of nickel were above Cefas AL1 at one station (ST05) within the offshore project area, in the nearshore section of the offshore cable corridor. The remaining metals had concentrations below their respective sediment quality guidelines.

54. With respect to PAHs, the majority of the samples did not exceed sediment quality guidelines. The exception were the three sample locations near the coast (ST01, ST03 and ST05), and two in offshore locations; one within the offshore cable corridor (ST19) and one in the array area (ST36) which exceeded OSPAR BAC for a number of individual PAHs, but all were marginal. No samples exceeded Cefas AL1.

9.5.2 Water quality

9.5.2.1 Suspended solids concentrations (SSC)

55. SSCs were measured at four locations as part of the metocean data collection at GGOW in 2011. The maximum concentration was recorded as 85mg/l with a mean concentration of 20mg/l (ABPmer, 2011b).

56. Cefas (2016) published average SSCs between 1998 and 2015 for the seas around the UK (ES Figure 8.14, Document Reference: 3.2.4). The average SSC in the vicinity of the array area for the period 1998-2015 was approximately 7-15mg/l (ES Figure 8.14, Document Reference: 3.2.4). The average SSC in the vicinity of the offshore cable corridor is 15mg/l offshore, ranging to 100mg/l close to the landfall location (ES Figure 8.14, Document Reference: 3.2.4).

9.5.2.2 Designated sites

57. The offshore cable corridor runs through the WER Essex coastal water body (GB650503520001) (see ES Figure 9.2, Document Reference: 3.2.5). The Essex coastal waterbody is a 'heavily modified' water body due to flood and coastal protection management and is currently classified to have an overall status of 'moderate' (Environment Agency, 2023). Classification for physico-chemical parameters is considered moderate due to dissolved inorganic nitrogen concentrations in the water. In the River Basin Management Plan, reasons for the elevated inorganic nitrogen concentrations are listed as diffuse pollution (arable land and therefore field runoff), and point sources associated with sewage discharges. In terms of chemical contaminants, the waterbody is at 'fail' status and is associated with concentrations of mercury and its compounds and Polybrominated diphenyl ethers (PBDE). The WER Compliance assessment of likely significant effects of North Falls on this water body is included in Appendix 21.2, Water Environment Regulations Compliance Assessment (Document Reference: 3.3.28).

58. There are nine designated bathing waters within the Essex coastal WER water body (see ES Figure 9.2, Document Reference: 3.2.5). Holland is located adjacent to the offshore cable corridor/landfall area and Frinton is located approximately 1.2km to the north. Both Holland and Frinton are classified as having excellent bathing water quality (Department for Environment, Food and Rural Affairs, 2023).

9.5.3 Future trends in baseline conditions

59. The existing environment within the study area has been largely shaped by a combination of the physical processes which exist within the southern North Sea (ES Chapter 8 Marine Geology Oceanography and Physical Processes, Document Reference: 3.1.10) and anthropogenic inputs (which influence pollutant levels). These processes will continue to influence the area in the future although any release of pollutants should continue to reduce due to better regulation and diffuse pollution control initiatives.

60. Long term established patterns may be affected by climate change driven sea-level rise and increased storms. This may be most noticeable along the coastline, where water quality (e.g., increasing suspended sediments) may be affected by increased storms etc.

61. The above trend is expected, with or without the development of North Falls.

9.6 Assessment of significance

9.6.1 Likely significant effects during construction

62. During the construction phase of North Falls, there is the potential for foundations and cable installation activities to disturb sediment, potentially resulting in increases in SSCs. These likely significant effects are considered in construction impacts 1 to 4. The worst case scenario is discussed in Section 9.3.2.

9.6.1.1 Impact 1: Increases in suspended sediment associated with seabed preparation for the installation of foundations, array and platform interconnector cables

63. Potential increases in SSCs could occur as a result of dredging to prepare the seabed for turbine installation and subsequent release of sediment at the sea surface as overflow from the dredger. Increases in SSC could also occur as a result of array cable and platform interconnector cable installation. It is anticipated that the array cable and platform interconnector cable could be installed via ploughing, jetting, trenching, or a combination of these techniques, depending on ground conditions along the specific cable route. Other installation methods could also be considered.

9.6.1.1.1 Magnitude of impact

64. As discussed in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10), due to the predominance of medium and coarse-grained sand across the North Falls offshore project area, the sediment disturbed by the drag head of the dredger at the seabed would remain close to the bed and settle rapidly. With respect to sediment released at the water surface, it is predicted that sediments would fall rapidly (minutes or tens of minutes) to the seabed as a highly turbid dynamic plume immediately upon its discharge within a few tens of metres along the axis of tidal flow.

65. Some of the finer sand fraction from this release and the very small proportion of mud present is likely to stay in suspension for longer and form a passive plume which would become advected by tidal currents. Due to the sediment sizes present, this is likely to exist as a measurable but modest concentration plume (tens of mg/l) for around half a tidal cycle (up to six hours). Sediment would eventually settle to the seabed in proximity to its release (within a few hundred metres up to around a kilometre along the axis of tidal flow) within a short period of time (hours to days). Whilst lower SSCs would extend further, along the axis of predominant tidal flows, the magnitude of change to water quality would be indistinguishable from background levels. The magnitude of the impact is therefore predicted to be low.

9.6.1.1.2 Sensitivity of receptor

66. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

9.6.1.1.3 Significance of effect

67. Due to the low magnitude of the impact and low sensitivity of the receptor, the effect is assessed as negligible adverse significance, which is not significant in EIA terms.

9.6.1.2 Impact 2: Increases in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP

68. During drilling (if required), sediments below the seabed would be disturbed and released within the North Falls array area close to each foundation. The disposal of any sediment would occur within the North Falls array area close to each foundation.

69. This process would cause localised and short term increases in SSC at the point of discharge which would then be transported by tidal currents in suspension.

9.6.1.2.1 Magnitude of impact

70. Most of the sediment released during drilling would be sand or aggregated clasts and therefore would fall immediately to the seabed in close proximity to the foundation. Where fines are released, ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10) indicates that concentrations would be very low (less than 10mg/l) away from the immediate release locations and therefore within the range of natural variability. Additionally, sediment concentrations arising from one foundation installation are unlikely to persist for sufficiently long for them to interact with subsequent foundation installations. The magnitude of the impact is therefore predicted to be low.

9.6.1.2.2 Sensitivity of receptor

71. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

9.6.1.2.3 Significance of effect

72. Due to the low magnitude of the impact and low sensitivity of the receptor, the effect is assessed as negligible adverse significance, which is not significant in EIA terms.

9.6.1.3 Impact 3: Increases in suspended sediment associated with installation of the offshore export cables

73. The detail of the offshore export cabling is dependent upon the final project design and installation methods may include ploughing, jetting, trenching, or a combination of these techniques, depending on ground conditions along the specific cable route. Other installation methods could also be considered.

74. The installation of the offshore export cable has the potential to disturb the shallow sub-seabed (to an average depth of 1.2m) and a width of up to 24m. The trench will extend from the HDD exit location to the OSP(s)/OCP, which will be located on the seabed at approximately 1 to 8m depth. Table 9.2 summarises the worst case scenario sediment releases.

9.6.1.3.1 Magnitude of impact

75. Using the conceptual evidence-based assessment presented in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference

3.1.10), it is likely that the increase in concentrations would be greatest in the shallowest sections of the offshore cable corridor, but in these locations the background concentrations are also greater than in deeper waters, with values approximately 100mg/l recorded in the vicinity of the coast at Orfordness (Cefas, 2016).

76. The HDD exit point will be in the subtidal zone, c. 1.5km from MLWS. The cable exit point would require excavation of a trench to bury the nearshore portion of the offshore cable on the seaward side of the landfall HDD. This excavation has the potential to increase SSCs close to shore.

77. During the excavation process the SSCs will be elevated above prevailing conditions but are likely to remain within the range of background nearshore levels (which will be high close to the coast because of increased wave activity) and lower than those concentrations that would develop during storm conditions. Also, once installation is completed, the high energy nearshore zone is likely to rapidly disperse the suspended sediment (i.e., over a period of a few hours) in the absence of any further sediment input. The magnitude of the impact is therefore predicted to be low.

9.6.1.3.2 Sensitivity of receptor

78. The landfall is adjacent to a designated bathing water, however as for the offshore waters, the nearshore section of the offshore cable corridor has a high capacity to accommodate change through dilution of any water quality impacts. The sensitivity is therefore considered to be medium, recognising the importance of the bathing water.

9.6.1.3.3 Significance of effect

79. Due to the low magnitude of the impact and medium sensitivity of the receptor, the effect is assessed as minor adverse significance, which is not significant in EIA terms.

9.6.1.4 Impact 4: Deterioration in water quality associated with release of sediment bound contaminants

80. Site-specific data collected to inform the EIA indicates that, with the exception of arsenic, sediment contaminant concentrations are low (Section 9.5.1.2). Where exceedances of sediment guidelines occur, these are generally marginal (i.e., only just above the lower guideline level value). With respect to arsenic, contextual information available indicates that these levels are close to the range identified as being typical for the area.

81. Additionally, sediments are not predicted to remain in suspension for long periods of time given that the seabed material is predominantly sand/gravel and as such the risk of exposure to the water column for partitioning to occur is also reduced.

9.6.1.4.1 Magnitude of impact

82. Given the low levels of contamination described above, the magnitude of impact is predicted to be negligible.

9.6.1.4.2 Sensitivity of receptor

83. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to

accommodate change due to its size and ability to dilute any alterations to water quality parameters.

9.6.1.4.3 Significance of effect

84. Due to the negligible magnitude of the impact and low sensitivity of the receptor, the effect is assessed as negligible adverse significance, which is not significant in EIA terms.

9.6.2 Likely significant effects during operation

9.6.2.1 Impact 1: Increase in suspended sediment resulting from cable repairs/ reburial

85. Disturbance of sediments by maintenance activities that impact the seabed (e.g., cable repair, reburial or replacement) has the potential to re-suspend sediment and increase SSC.

86. Cable repairs and reburial could be needed over the operational lifetime of North Falls. It is estimated that reburial of c.2.75% of array cable length (170km) and c.4% of offshore export cable length (125.4km) could be required over the life of the Project. In addition, five array cable repairs and four export cable repairs could be required over the life of the Project.

9.6.2.1.1 Magnitude of impact

87. As set out in the worst case scenario in Table 9.2, the anticipated length of cables required to be repaired or reburied at any one time represents a small proportion of the length of cabling associated with North Falls. As such, the disturbance area for reburial and repairs of cables is predicted to be extremely small in comparison to the construction assessment. As with construction, coarse sediment would settle rapidly to the seabed and fine sediment would remain in suspension for longer periods but be indistinguishable from background levels.

88. The scale of these effects will therefore be small, infrequent and of short-term duration; and of a lower magnitude than during the construction phase. The magnitude of the impact is therefore predicted to be negligible.

9.6.2.1.2 Sensitivity of receptor

89. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

9.6.2.1.3 Significance of effect

90. Due to the negligible magnitude of the impact and low sensitivity of the receptor, the effect is assessed as negligible adverse significance, which is not significant in EIA terms.

9.6.2.2 Impact 2: Deterioration in water quality resulting from the resuspension of contaminated sediment due to maintenance activities

91. Sample data collected to inform this ES indicates some elevated levels of contaminants within the sediments, however these are within the range identified as being typical for the area (Section 9.5.1.2).

9.6.2.2.1 Magnitude of impact

92. Given the low levels of contaminants present, coupled with the low volumes of sediments expected to be disturbed during the maintenance activities, the magnitude of effect is predicted to be negligible.

9.6.2.2.2 Sensitivity of receptor

93. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

9.6.2.2.3 Significance of effect

94. Due to the negligible magnitude of the impact and low sensitivity of the receptor, the effect is assessed as negligible adverse significance, which is not significant in EIA terms.

9.6.3 Likely significant effects during decommissioning

95. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.

96. The scope of the decommissioning works would most likely involve removal of the accessible installed components. This is outlined in ES Chapter 5 Project Description (Document Reference: 3.1.7) and the detail would be agreed with the relevant authorities at the time of decommissioning. Offshore, this is likely to include removal of all of the wind turbine components and part of the foundations (those above seabed level), and removal of some or all of the array and export cables. Scour and cable protection may be left in situ.

97. The worst case scenario arising from the decommissioning of the Project is listed in Table 9.2.

98. During the decommissioning phase, there is potential for:

- Increases in suspended sediment associated with removal of foundations and array cables;
- Increases in suspended sediment associated with removal of the export cables; and
- Deterioration in water quality associated with release of sediment bound contaminants.

9.6.3.1.1 Magnitude of impact

99. The magnitude of impact from decommissioning activities would be less than those identified for the construction phase as seabed preparation is not required, which is the main source of suspended sediment, and the decommissioning works would otherwise be a reverse of the installation process.

100. As with construction, coarse sediment would settle rapidly to the seabed and fine sediment would remain in suspension for longer periods but be

indistinguishable from background levels. The scale of these effects will therefore be small, infrequent and of short-term duration.

101. Due to the low level of contaminant's assessed in the offshore project area (Section 9.5.1.2), any changes in water quality associated with the removal of seabed structures and the potential release of sediment bound contaminants would quickly subside in the water column, returning to background levels.

102. The magnitude of impact is therefore predicted to be negligible.

9.6.3.1.2 Sensitivity of receptor

103. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

9.6.3.1.3 Significance of effect

104. Due to the negligible magnitude of the impact and low sensitivity of the receptor, the effect is assessed as negligible adverse significance for all three decommissioning impacts, which is not significant in EIA terms.

9.7 Potential monitoring requirements

105. No monitoring is proposed in relation to marine water and sediment quality given that all of the likely significant effects considered will result in either negligible or, at worse, minor adverse effects on marine water quality.

9.8 Cumulative effects

9.8.1 Identification of potential cumulative effects

106. The first step in the CEA process is the identification of which residual effects assessed for North Falls on their own have the potential for a cumulative effect with other plans, projects and activities. This information is set out in Table 9.14.

Table 9.14 Potential cumulative effects

Impact	Potential for cumulative effect	Rationale
Construction		
Impact 1: Increases in suspended sediment associated with seabed preparation for the installation of foundations, and array cables	Yes	Effects will occur at isolated locations for a time-limited duration and are local in nature, however, due to nearby projects (see Table 9.15), cumulative effects must be assessed.
Impact 2: Increases in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP	Yes	
Impact 3: Increases in suspended sediment associated with installation of offshore export cables	Yes	
Impact 4: Deterioration in water quality associated with release of sediment bound contaminants	No	Given the absence of significant contamination present, there is no potential for cumulative effects.

Impact	Potential for cumulative effect	Rationale
Operation		
Impact 1: Increase in suspended sediment resulting from cable repairs/reburial	No	Impacts will be highly localised around the maintenance activities, short-term and intermittent, therefore there is no potential for cumulative effects.
Impact 2: Deterioration in water quality resulting from the resuspension of contaminated sediment due to maintenance activities	No	
Decommissioning		
Impact 1: Increases in suspended sediment associated with removal of foundations and array cables	Yes	Effects will occur at isolated locations for a time-limited duration and are local in nature, however, due to nearby projects (see Table 9.15), cumulative effects must be assessed.
Impact 2: Increases in suspended sediment associated with removal of the export cables	Yes	
Impact 3: Deterioration in water quality associated with release of sediment bound contaminants	No	Given the absence of significant contamination present, there is no potential for cumulative effects.

9.8.2 North Falls, Five Estuaries and other projects

107. The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative effects for inclusion in the CEA (described as 'project screening'). This information is set out in Table 9.15 below, together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to North Falls, status of available data and rationale for including or excluding from the assessment.

108. The Project screening has been informed by the development of a CEA project list which forms an exhaustive list of plans, projects and activities within the study area relevant to North Falls. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

Table 9.15 Summary of projects considered for the CEA in relation to Marine Water and Sediment Quality (project screening)

Project	Status	Construction Period	Closest Distance from the array area (km)	Distance from the offshore cable corridor (km)	Confidence in Data	Included in the CEA (Y/N)	Rationale
NeuConnect Interconnector	Construction	2023-2028	2.5 km	0 km	High	Yes	The NeuConnect Interconnector bisects the North Falls offshore cable corridor and there is potential for temporal overlap of cable installation activities.
BritNed Interconnector	Operational since 2009	N/A	0 km	9.3 km	High	No	The BritNed Interconnector passes through the south of the array area but has been operational since 2009. There is therefore no potential for cumulative impact on the identified receptors.
Nautilus Interconnector	Pre-application	2025-2028	Cable route unknown	Cable route unknown	Low	No	Insufficient information available to assess.
South & East Anglia (SEA) Link	Pre-application	2026-2030	5.4	0	High	Yes	The emerging preferred and alternative routes for Sea Link intersect with the North Falls offshore cable corridor. Therefore, there is potential for cumulative effects, subject to the final location and programme for the interconnector.
Tarchon Energy Interconnector	Pre-planning	2027-2030	Cable route unknown	Cable route unknown	Low	No	Insufficient information available to assess.
Commercial fisheries	Ongoing	N/A	0 km	0 km	Medium	No	No potential cumulative effects on water quality are likely due to the highly localised and intermittent nature, and subsequent extent of suspended sediment plumes, of any operational maintenance activities.
Greater Gabbard offshore wind farm	Operational since 2012	N/A	0 km	3.9 km	High	No	
Galloper offshore wind farm	Operational since 2018	N/A	0 km	6.4 km	High	No	
Five Estuaries	In planning	Late 2020s	0 km (0.04m)	12.9 km	High	Yes	Potential for some interaction between the dredging plumes from the cable/foundation installation from Five Estuaries with North Falls.

Project	Status	Construction Period	Closest Distance from the array area (km)	Distance from the offshore cable corridor (km)	Confidence in Data	Included in the CEA (Y/N)	Rationale
							Following construction, cumulative effects on water quality are unlikely due to the highly localised and intermittent nature, and subsequent suspended sediment plumes, of any operational maintenance activities.
Thanet offshore wind farm	Operational since 2010	N/A	24.9 km	36.2 km	High	No	Any ongoing effects of maintenance activity from these offshore wind farms will be highly localised and therefore, given the distance from the North Falls offshore project area, there is no pathway for significant cumulative effects. This approach is in keeping with the GWF EIA, where it was agreed with Cefas and Defra that no assessment of cumulative effects was required with other Round 2 sites in the Thames strategic area (except GGOW).
London Array offshore wind farm	Operational since 2013	N/A	20.6 km	15.5 km	High	No	
Gunfleet Sands offshore wind farm	Operational since 2010	N/A	39 km	6 km	High	No	
Outer OTE aggregate exploration and option area 528/2	Unknown	2016-2024	8.4 km	14 km	Low	No	Suspended sediment from North Falls construction would settle to the seabed in proximity to its release (within a few hundred metres up to around a kilometre along the axis of tidal flow), therefore there is no pathway for significant cumulative effects with this aggregate site.
Thames D aggregates production agreement area 524	Production agreement secured 2022	2022-2036	0 km	10.3 km	Medium	Yes	There is potential for some interaction between the dredging plumes from the aggregate exploration and option areas and plumes from cable/foundation installation. Following construction, cumulative effects on water quality are unlikely due to the highly localised and intermittent nature, and subsequent suspended sediment plumes, of any operational maintenance and decommissioning activities.

Project	Status	Construction Period	Closest Distance from the array area (km)	Distance from the offshore cable corridor (km)	Confidence in Data	Included in the CEA (Y/N)	Rationale
Shipwash aggregate production agreement area 507	Operational since 2016	2016-2031	19.6 km	9.8 km	Medium	No	Sites which were operational at the time of the North Falls characterisation surveys are a component of the baseline environment.
Southwold East aggregates production agreement area 430	Operational since 2012	2012-2025	50.1km	48.4 km	Medium	No	
North Inner Gabbard aggregate production agreement area 498	Operational since 2015	2015-2030	24.7km	24 km	Medium	No	
Longsand aggregate production agreement area 508	Operational since 2014	2014-2029	13.9km	5.8 km	Medium	No	
Longsand aggregate production agreement area 509	Operational since 2015	2015-2030	13.8km	2.1 km	Medium	No	
Longsand aggregate production agreement area 510	Operational since 2015	2015-2030	9.5km	3.5 km	Medium	No	
North Falls East aggregate production agreement area 501	Operational since 2017	2017-2032	13.2 km	5.3 km	Medium	No	

9.8.3 Assessment of cumulative effects

109. As outlined above, there is potential for cumulative effects on water quality due to increases in suspended sediment during construction and decommissioning of the Project with other nearby plans and projects.

110. The NeuConnect and SeaLink Interconnectors bisect the North Falls offshore cable corridor and there is potential for temporal overlap of cable installation activities. Also, the Five Estuaries export cable corridor follows a similar route to North Falls' and may overlap with North Falls construction programme. The cable routes of the Nautilus and Tarchon Energy Interconnectors are not yet known and therefore there is insufficient information to assess.

111. The worst case scenario from a marine water and sediment quality perspective would be for all projects to be constructed at the same time. This would provide the greatest opportunity for interaction of sediment plumes during their construction.

112. In addition, the array area is adjacent to production agreement area 524. The worst case scenario would therefore also include aggregate extraction during the construction of North Falls, Five Estuaries and the interconnector cables.

113. Results from monitoring of plume dispersal from dredging activities undertaken by Oakwood Environmental (1999) and numerical modelling studies undertaken for the Outer Thames MAREA, concluded that SSCs outside the licenced dredging areas were less than 20mg/l above background levels (except at the boundary, where they were within the range of natural variability) (HR Wallingford, 2010).

114. The sediment recorded in the North Falls offshore project area is typical of the wider study area and therefore, as for North Falls alone, the majority of suspended sediment arising from each project would fall rapidly to the seabed once the activity is complete and sediment plumes would be rapidly dispersed to within background levels.

115. Considering the short-term nature of discernible sediment plumes the potential cumulative impact would be of low magnitude.

116. Water quality in the offshore area is considered to be of low sensitivity because it is not within a confined area and therefore has a high capacity to accommodate change due to its size and ability to dilute any alterations to water quality parameters.

117. It is therefore considered that the cumulative effect on water quality of all projects constructing and decommissioning in this area at the same time would be of minor to negligible adverse significance (see Table 9.19).

9.9 Transboundary effects

118. Due to the distance of North Falls from the EEZ and given that there will not be a significant effect on water quality, transboundary impacts are scoped out of further assessment in accordance with the scoping opinion (Planning Inspectorate, 2021).

9.10 Interactions

119. Interactions exist between the marine water and sediment quality topic and several other topics that have been considered within this ES. Table 9.16 provides a summary of the principal interactions, related chapters and signposts to where those issues have been addressed in this chapter.

Table 9.16 Marine Water and Sediment Quality interactions

Topic and description	Related chapter (Volume 3.1)	Where addressed in this chapter	Rationale
Construction			
Effects on the water column (increases in suspended sediment and presence of sediment bound contaminants)	Chapter 11 Fish and Shellfish Ecology Chapter 14 Commercial Fisheries Chapter 10 Benthic and Intertidal Ecology	Sections 9.6.1.1, 9.6.1.2 and 9.6.1.3 (installation of foundations, array and export cable) Section 9.6.1.4 (presence of sediment bound contaminants)	Sediment could be contaminated and could cause disturbance to fish and benthic species through smothering.
Operation			
Effects on the water column (increases in suspended sediment and presence of sediment bound contaminants)	Chapter 11 Fish and Shellfish Ecology Chapter 14 Commercial Fisheries Chapter 10 Benthic and Intertidal Ecology	Section 9.6.2.1 (cable repairs/reburial) Section 9.6.2.2 (presence of sediment bound contaminants)	Sediment could be contaminated and could cause disturbance to fish and benthic species through smothering.
Decommissioning			
Interactions for impacts during the decommissioning phase will be the same as those outlined above for the construction phase.			

9.11 Inter-relationships

120. The impacts identified and assessed in this chapter have the potential to interrelate with each other. The areas of potential inter-relationships between impacts are presented in Table 9.17. This provides a screening tool for which impacts have the potential to interrelate. Table 9.18 provides an assessment for each receptor (or receptor group) as related to these impacts.

121. Within Table 9.18 the impacts are assessed relative to each development phase (i.e., construction, operation or decommissioning) to see if (for example) multiple construction impacts affecting the same receptor could increase the significance of effect upon that receptor. Following this, a lifetime assessment is undertaken which considers the potential for impacts to affect receptors across all development phases.

Table 9.17 Inter-relationships between impacts - screening

Potential interrelationships between impacts				
Construction				
	Impact 1: Increases in suspended sediment associated with seabed preparation for the installation of foundations, array and platform interconnector cables	Impact 2: Increases in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP	Impact 3: Increases in suspended sediment associated with installation of the offshore export cables	Impact 4: Deterioration in water quality associated with release of sediment bound contaminants
Impact 1: Increases in suspended sediment associated with seabed preparation for the installation of foundations, array and platform interconnector cables		Yes	Yes	Yes
Impact 2: Increases in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP	Yes		Yes	Yes
Impact 3: Increases in suspended sediment associated with installation of the offshore export cable	Yes	Yes		Yes
Impact 4: Deterioration in water quality associated with release of sediment bound contaminants	Yes	Yes	Yes	
Operation				
	Impact 1: Increase in suspended sediment resulting from cable repairs/reburial	Impact 2: Deterioration in water quality resulting from the resuspension of contaminated sediment due to maintenance activities		
Impact 1: Increase in suspended sediment resulting from cable repairs/reburial		Yes		

Potential interrelationships between impacts				
Impact 2: Deterioration in water quality resulting from the resuspension of contaminated sediment due to maintenance activities	Yes			
Decommissioning				
	Impact 1: Increases in suspended sediment associated with removal of foundations and array cables	Impact 2: Increases in suspended sediment associated with removal of the export cables	Impact 3: Deterioration in water quality associated with release of sediment bound contaminants	
Impact 1: Increases in suspended sediment associated with removal of foundations and array cables		Yes	Yes	
Impact 2: Increases in suspended sediment associated with removal of the export cables	Yes		Yes	
Impact 3: Deterioration in water quality associated with release of sediment bound contaminants	Yes	Yes		

Table 9.18 Inter-relationships between impacts – phase and lifetime assessment

Receptor	Highest significance level				
	Construction	Operation	Decommissioning	Phase assessment	Lifetime assessment
Marine water quality	Negligible	Negligible	Negligible	No greater impact than individually assessed impact. The impacts are considered to have negligible adverse magnitude of effect on the receptor. Given that each impact will be managed with standard and good practice methodologies it is considered that there would either be no interactions or that these would not result in greater impact than assessed individually.	No greater impact than individually assessed impact.

9.12 Summary

122. This chapter has provided a characterisation of the existing environment for marine water and sediment quality based on both existing and site-specific survey data, which has established that the potential likely significant effects on water quality during the construction, operation and decommissioning phases of North Falls are considered either 'minor adverse' or 'negligible'.

123. No significant potential cumulative impacts have been identified for marine water and sediments quality due to North Falls along with other plans and projects.

124. Interactions between the marine water and sediment quality with other topics, due to increases in suspended sediment and presence of sediment bound contaminants, during construction, operation and decommissioning include:

- ES Chapter 11 Fish and Shellfish Ecology (Document Reference: 3.1.13);
- ES Chapter 14 Commercial Fisheries (Document Reference: 3.1.16); and
- ES Chapter 10 Benthic and Intertidal Ecology (Document Reference: 3.1.12).

125. Transboundary impacts have been scoped out of further assessment in accordance with the scoping opinion (Planning Inspectorate, 2021) due to the distance of North Falls from the EEZ and given that there will be no significant effect on water quality.

126. Inter-relationships amongst the impacts of different phase of the development and lifetime have been assessed as negligible. With the adoption of good practice methodologies, it is considered that there would either be no interactions or that these would not result in greater impact than assessed individually.

Table 9.19 Summary of likely significant effects impacts on Marine Water and Sediment Quality

Potential impact	Receptor	Sensitivity	Magnitude of impacts	Pre-mitigation of effect	Additional mitigation measures proposed	Residual effect
Construction						
Impact 1: Increases in suspended sediment associated with seabed preparation for the installation of foundations, array cables and platform interconnector cables	Water quality	Low	Low	Negligible	N/A	Not Significant Negligible
Impact 2: Increases in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP	Water quality	Low	Low	Negligible	N/A	Not Significant Negligible
Impact 3: Increases in suspended sediment associated with installation of the offshore export cables	Water quality	Medium	Low	Minor	N/A	Not Significant Minor
Impact 4: Deterioration in water quality associated with release of sediment bound contaminants	Water quality	Low	Negligible	Negligible	N/A	Not Significant Negligible
Operation						
Impact 1: Increase in suspended sediment resulting from cable repairs/reburial	Water quality	Low	Negligible	Negligible	N/A	Not Significant Negligible
Impact 2: Deterioration in water quality resulting from the resuspension of contaminated sediment due to maintenance activities	Water quality	Low	Negligible	Negligible	N/A	Not Significant Negligible
Decommissioning						
Impact 1: Increases in suspended sediment associated with removal of foundations and array cables	Water quality	Low	Negligible	Negligible	N/A	Not Significant Negligible
Impact 2: Increases in suspended sediment associated with removal of the export cables	Water quality	Low	Negligible	Negligible	N/A	Not Significant Negligible

Potential impact	Receptor	Sensitivity	Magnitude of impacts	Pre-mitigation of effect	Additional mitigation measures proposed	Residual effect
Impact 3: Deterioration in water quality associated with release of sediment bound contaminants	Water quality	Low	Negligible	Negligible	N/A	Not Significant Negligible
Cumulative effects						
Impact 1: Increases in suspended sediment associated with seabed preparation for the installation of foundations, and array cables	Water quality	Low	Negligible	N/A	N/A	Not Significant (Negligible)
Impact 2: Increases in suspended sediment due to drill arisings for installation of piled foundations for wind turbines and OSPs/OCP	Water quality	Low	Negligible	N/A	N/A	Not Significant (Negligible)
Impact 3: Increases in suspended sediment associated with installation of offshore export cables	Water quality	Medium	Minor	N/A	N/A	Not Significant (Minor)
Impact 4 Increases in suspended sediment associated with removal of foundations and array cables	Water quality	Low	Negligible	N/A	N/A	Not Significant (Negligible)
Impact 5: Increases in suspended sediment associated with removal of the export cables	Water quality	Medium	Minor	N/A	N/A	Not Significant (Minor)

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North Falls Offshore Wind Farm Limited

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