MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 2, Chapter 1: Physical processes

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Glossary

Term	Meaning
Applicants	Morgan Offshore Wind Limited (Morgan OWL) and Morecambe Offshore Windfarm Ltd (Morecambe OWL).
Baseline	The status of the environment without the Transmission Assets in place.
Bathymetry	The measurement of depth of water in the oceans.
Climate Change	A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.
Commitment	This term is used interchangeably with mitigation and enhancement measures. The purpose of commitments is to avoid, prevent, reduce or, if possible, offset significant adverse environmental effects. Primary and tertiary commitments are taken into account and embedded within the assessment set out in the ES.
Cumulative Effects	The combined effect of the Transmission Assets in combination with the effects from other proposed developments, on the same receptor or resource.
Development Consent Order	An order made under the Planning Act 2008, as amended, granting development consent.
Deemed Marine Licence	See Marine Licence
Depth of Closure	Use in this document refers to the ‘outer’ depth of closure which marks the water depth at the transition between the lower shoreline and offshore. Offshore of this location the influence of wave action on cross-shore sediment transport is on average insignificant compared to other influences.
Depth of Lowering	This is the minimum burial depth recommended for protection from the external threats such as fishing and changes to the seabed. It is the direct output of the cable burial risk assessment.
Ebb tide	The tidal phase during which the water level is falling.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process.
Expert Working Group	A forum for targeted engagement with regulators and interested stakeholders through the Evidence Plan process.
Fetch	Length in the wind direction of the marine area where water waves are generated by wind.
Flood tide	The tidal phase during which the water level is rising.
Generation Assets	The generation assets associated with the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm include the offshore

Term	Meaning
	wind turbines, inter-array cables, offshore substation platforms and platform link (interconnector) cables to connect offshore substations.
Habitats Regulations	The Conservation of Habitats and Species Regulations 2017 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended).
Highest Astronomical Tide	The highest tidal height predicted to occur under average meteorological conditions and any combination of astronomical conditions.
Intertidal area	The area between Mean High Water Springs and Mean Low Water Springs.
Intertidal Infrastructure Area	The temporary and permanent areas between MLWS and MHWS.
Inter-related Effects	Inter-related effects arise where an impact acts on a receptor repeatedly over time to produce a potential additive effect or where a number of separate impacts, such as noise and habitat loss, affect a single receptor.
Landfall	The area in which the offshore export cables make landfall (come on shore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area at Lytham St. Annes between Mean Low Water Springs and the transition joint bays inclusive of all construction works, including the offshore and onshore cable routes, intertidal working area and landfall compound(s).
Littoral currents	Flow derived from tide and wave climate.
Lowest Astronomical Tide	The lowest tidal height predicted to occur under average meteorological conditions and any combination of astronomical conditions.
Marine licence	The Marine and Coastal Access Act 2009 requires a marine licence to be obtained for licensable marine activities. Section 149A of the Planning Act 2008 allows an applicant for to apply for 'deemed marine licences' in English waters as part of the development consent process.
Maximum design scenario	The realistic worst-case scenario, selected on a topic-specific and impact specific basis, from a range of potential parameters for the Transmission Assets
Mean High Water	The highest water level reached during and average tide.
Mean High Water Springs	The height of mean high water during spring tides in a year.
Mean Low Water Springs	The height of mean low water during spring tides in a year.
Mean Sea Level	The average tidal height over a long period of time.
Mitigation measures	This term is used interchangeably with Commitments. The purpose of such measures is to avoid, prevent, reduce or, if possible, offset significant adverse environmental effects.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore and onshore infrastructure connecting the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm to the national grid. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds.

Term	Meaning
	Also referred to in this report as the Transmission Assets, for ease of reading.
Morecambe Offshore Windfarm: Generation Assets	The offshore generation assets and associated activities for the Morecambe Offshore Windfarm.
Morecambe Offshore Windfarm: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morecambe Offshore Windfarm: Generation Assets to the National Grid.
Morecambe OWL	Morecambe Offshore Windfarm Limited is owned by Copenhagen Infrastructure Partners' (CIP) fifth flagship fund, Copenhagen Infrastructure V (CI V).
Morgan Offshore Wind Project: Generation Assets	The offshore generation assets and associated activities for the Morgan Offshore Wind Project.
Morgan Offshore Wind Project: Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morgan Offshore Wind Project: Generation Assets to the National Grid.
Morgan OWL	Morgan Offshore Wind Limited is a joint venture between JERA Nex bp (JNbp) and Energie Baden-Württemberg AG (EnBW).
National Policy Statement(s)	The current national policy statements published by the Department for Energy Security and Net Zero in 2023 and adopted in 2024.
Neap tide	Tide that occurs when the sun and moon are at right angles to each other and the gravitational pull of the sun partially cancels out the pull of the moon on the ocean.
Offshore export cables	The cables which would bring electricity from the Generation Assets to the landfall.
Offshore Permanent Infrastructure Area	The area within the Transmission Assets Offshore Order Limits (up to MLWS) where the permanent offshore electrical infrastructure (i.e. offshore export cables) will be located.
Offshore Wind Leasing Round 4	The Crown Estate auction process which allocated developers preferred bidder status on areas of the seabed within Welsh and English waters and ends when the Agreements for Lease are signed.
Offshore Order Limits	See Transmission Assets Order Limits: Offshore (below)
Offshore substation platform(s)	A fixed structure located within the wind farm sites, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Preliminary Environmental Information Report	A report that provides preliminary environmental information in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. This is information that enables consultees to understand the likely significant environmental effects of a project and which helps to inform consultation responses.
Ramsar sites	Wetlands of international importance that have been designated under the criteria of the Ramsar Convention. In combination with Special Protection Areas and Special Areas of Conservation, these sites contribute to the national site network.
Residual current	The net flow over the course of the tidal cycle. This is effectively the driving force of the sediment transport.

Term	Meaning
Ribble Estuary designations	Defined as those designated sites within the Ribble Estuary relevant to the Physical Processes Chapter, comprising: Ribble Estuary Site of Special Scientific Interest, Ribble and Alt Estuaries Ramsar site and Ribble and Alt Estuary Special Protection Area.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
Sandwave	A sedimentary structure that forms transverse to the direction of tidal flow.
Scoping Opinion	Sets out the Planning Inspectorate's response (on behalf of the Secretary of State) to the Scoping Report prepared by the Applicants. The Scoping Opinion contains the range of issues that the Planning Inspectorate, in consultation with statutory stakeholders, has identified should be considered within the Environmental Impact Assessment process.
Scoping Report	A report setting out the proposed scope of the Environmental Impact Assessment process. The Transmission Assets Scoping Report was submitted to The Planning Inspectorate (on behalf of the Secretary of State) for the Morgan and Morecambe Offshore Windfarms Transmission Assets in October 2022.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations due to the flow of water.
Sedimentation	The process of settling or being deposited as a sediment.
Significant wave height	Mean wave height (trough to crest) of the highest third of the waves.
Slack tide	Tidal phase at which the current turns from flood to ebb (high-water slack tide) or from ebb to flood (low-water slack tide).
Spatial extent	Geographical area over which the impact may occur.
Special Areas of Conservation	A site designation specified in the Conservation of Habitats and Species Regulations 2017. Each site is designated for one or more of the habitats and species listed in the Regulations. The legislation requires a management plan to be prepared and implemented for each SAC to ensure the favourable conservation status of the habitats or species for which it was designated. In combination with Special Protection Areas and Ramsar sites, these sites contribute to the national site network.
Special Protection Areas	A site designation specified in the Conservation of Habitats and Species Regulations 2017, classified for rare and vulnerable birds, and for regularly occurring migratory species. Special Protection Areas contribute to the national site network.
Spring tide	Tide that occurs when the sun and moon are directly in line with the Earth and their gravitational pulls on the ocean reinforce each other.
Statutory consultee	Organisations that are required to be consulted by an applicant pursuant to section 42 of the Planning Act 2008 in relation to an application for development consent. Not all consultees will be statutory consultees (see non-statutory consultee definition).
Study area	This is an area which is defined for each environmental topic which includes the Transmission Assets Order Limits as well as potential spatial and temporal considerations of the impacts on relevant

Term	Meaning
	receptors. The study area for each topic is intended to cover the area within which an impact can be reasonably expected.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
Suspended Particulate Matter	Particles that are suspended in the water column.
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above).
Transmission Assets Order Limits	The area within which all components of the Transmission Assets will be located, including areas required on a temporary basis during construction and/or decommissioning (such as construction compounds).
Transmission Assets Order Limits: Offshore	The area seaward of Mean Low Water Springs (MLWS) within which all components of the Transmission Assets will be located. Including areas required on a temporary basis during construction and/or decommissioning. Also referred to in this report as the Offshore Order Limits, for ease of reading.
Transmission Assets Scoping Boundary	The term used to define the boundary used at the time the Scoping Report was submitted.
Turbidity	The quality of being cloudy, opaque, or thick with suspended matter.
Wave height	The distance from trough to crest of a wave.

Acronyms

Acronym	Meaning
BODC	British Oceanographic Data Centre
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
CEFAS	Centre for Environment Fisheries and Aquaculture Science
CSIP	Outline Offshore Cable Specification and Installation Plan(s)
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
DML	Deemed Marine Licence
DoC	Depth of Closure
ECMWF	European Centre for Medium-range Weather Forecast
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EPP	Evidence Plan Process
ES	Environmental Statement

Acronym	Meaning
EWG	Expert Working Group
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Assessment
IEMA	Institute of Environmental Management and Assessment
JNCC	Joint Nature Conservation Committee
LNG	Liquified Natural Gas
MBES	Multibeam Echosounder
MCZ	Marine Conservation Zone
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
NCERM	National Coastal Erosion Risk Mapping
NEQ	Net Explosive Quantity
NPS	National Policy Statement
OSP	Offshore Substation Platform(s)
PEIR	Preliminary Environmental Information Report
SAC	Special Area of Conservation
SMP	Shoreline Management Plan
SPA	Special Protection Area
SPM	Suspended Particulate Matter
SSC	Suspended sediment concentrations
SSSI	Site of Special Scientific Interest
TJB	Transition Joint Bays
UK	United Kingdom

Units

Unit	Description
º	Degrees (angle from true north)
%	Percentage
km	Kilometres (distance)
m	Metres (distance)

Unit	Description
$m^3/d/m$	Cubic metres transported per day per metre width of transport path (i.e. perpendicular to direction of transport)
mg/l	Milligrams per litre (concentration)
mm	Millimetres (distance)
m/hour (m/h)	Metres per hour (rate)
m/s	Metres per second (speed)

1. Physical processes

1.1 Introduction

1.1.1 Overview

1.1.1.1 This chapter of the Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) undertaken for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. For ease of reference, the Morgan and Morecambe Offshore Wind Farms: Transmission Assets project is referred to in this chapter as the 'Transmission Assets'. This ES accompanies the application to the Planning Inspectorate for development consent for the Transmission Assets.

1.1.1.2 The purpose of the Transmission Assets is to connect the Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Windfarm: Generation Assets (referred to collectively as the 'Generation Assets') to the National Grid. A description of the Transmission Assets can be found in Volume 1, Chapter 3: Project description of the ES.

1.1.1.3 This chapter considers the potential impacts of the Transmission Assets on physical processes, seaward of Mean High Water Springs (MHWS) during the construction, operation and maintenance, and decommissioning phases, which are likely to give rise to potential significant effects, as well as relevant mitigating measures, where applicable. The potential impacts of the Transmission Assets landward of MHWS are addressed in Volume 3: Effects on the onshore environment; specifically in Volume 3, Chapter 1: Geology, hydrogeology and ground conditions and Volume 3, Chapter 2: Hydrology and flood risk.

1.1.1.4 This ES chapter:

- identifies the key legislation, policy and guidance relevant to physical processes;
- details the EIA scoping and consultation process undertaken to date for physical process;
- confirms the study area for the assessment, the methodology used to identify baseline environmental conditions and sets out the existing and future environmental baseline conditions, established from desk studies, surveys and consultation;
- identifies the scope of the assessment;
- details the in-built mitigation and/or monitoring measures which prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process;
- defines the project design parameters used to inform for the impact assessment;
- identifies the impact assessment methodology and presents an assessment of the potential impacts likely to give rise to significant

effects in relation to the construction, operation and maintenance and decommissioning phases of the Transmission Assets on physical processes (and where relevant the impacts likely to give rise to significant effects of physical processes on the Transmission Assets); and

- identifies any cumulative, transboundary and/or inter-related effects in relation to the construction, operation and maintenance and decommissioning phases of the Transmission Assets on physical processes.

1.1.1.5 This chapter also draws upon additional information to support the assessment contained within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES which is comprised of:

- Mona Offshore Wind Project, Environmental Statement, Volume 6, Annex 1.1: Physical processes technical report; and
- Morgan Offshore Wind Project: Generation Assets, Environmental Statement, Volume 4, Annex 1.1: Physical Processes Technical Report.

1.1.1.6 The physical processes assessment was undertaken using an evidence based conceptual approach agreed though the consultation processes. The conceptual approach, outlined further in section 1.9.5, was supported by a number of appropriate studies and modelling campaigns including but not limited to:

- Detailed project specific morphological seabed study (which included an assessment of historical datasets and modelling (ABPmer 2023))
- Morgan Offshore Wind Project: Generation Assets (which included modelling of cable protection and crossings)
- Mona Offshore Wind Project
- Awel y Môr Offshore Windfarm

1.1.1.7 The information available from these project studies coupled with detail relating to the location and design of cable protection, outlined in section 1.5.4, was seen as appropriate to support the assessment without the requirement for further project specific modelling.

1.2 Legislative and policy context

1.2.1 Legislation

1.2.1.1 The full legislative context for the Transmission Assets is set out in Volume 1, Chapter 2: Policy and legislation context of the ES.

Marine and Coastal Access Act 2009

2.1.1.1 Parts 3 and 4 of the Marine and Coastal Access Act 2009 introduced a new marine planning and licensing system for overseeing the marine environment and a requirement to obtain a marine licence for certain activities and works at sea. Section 149A of the Planning Act 2008 allows applicants for development consent to apply for ‘deemed marine licences’ as part of the consenting process.

2.1.1.2 Part 5 of the Marine and Coastal Access Act 2009 enables the designation of Marine Conservation Zones (MCZs) in England and Wales as well as UK offshore areas. Consideration of MCZs is required for any marine licence application or application for development consent which includes a deemed marine licence, with this directly relevant to the Transmission Assets overlapping with the Fylde MCZ.

Habitats Regulations

2.1.1.3 In England and Wales, the Conservation of Habitats and Species Regulations 2017 (onshore and out to 12 nautical miles (nm)) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (between 12 nm and 200 nm), collectively referred to as “the Habitats Regulations”, are the principal means by which the Habitats Directive (Council Directive 92/43/EEC) and certain elements of the Wild Birds Directive (Directive 2009/147/EC) are transposed into UK law. The Habitats Regulations remain in force following the United Kingdom’s departure from the EU, subject to certain amendments. These regulations require the assessment of significant effects on internationally important nature conservation sites, including:

- Special Areas of Conservation (SACs) or candidate SACs;
- Special Protection Areas (SPAs) or potential SPAs; and
- Sites of Community Importance.

2.1.1.4 These designated sites have been given full consideration within this chapter of the ES, with relevant designated sites outlined in section 1.5.2, and considered as key receptors within the assessment of effects in section 1.10 and section 1.12.

2.1.1.5 Sites designated under the United Nations Convention on Wetlands of International Importance (signed in Ramsar, 1979) are protected by UK government policies which mandate the treatment of Ramsar Sites in the same manner as sites protected under the Birds and Habitats Directives.

1.2.2 Planning policy context

1.2.2.1 The Transmission Assets will be located in English offshore waters (beyond 12 nautical miles (nm) from the English coast) and inshore waters (within 12 nautical miles (nm) from the English coast), with the onshore infrastructure located wholly within England. As set out in Volume 1, Chapter 1: Introduction of the ES, the Secretary of State for Energy Security and Net Zero (formerly Business, Energy and Industrial Strategy) has directed that the Transmission Assets are to be treated as development for which development consent is required under the Planning Act 2008, as amended.

National Policy Statements

1.2.2.2 There are currently six energy National Policy Statements (NPSs), three of which contain policy relevant to offshore wind development and the Transmission Assets, specifically:

- overarching NPS for Energy (NPS EN-1) which sets out the United Kingdom (UK) Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero 2023a);
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero 2023b); and
- NPS for Electricity Networks Infrastructure (NPS EN-5) (Department for Energy Security & Net Zero 2023c).

1.2.2.3 Although NPS: EN-1, EN-3, and EN-5 all contain policy relevant to offshore wind development, only NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the physical processes assessment, thus NPS-EN5 is not considered further within this chapter. **Table 1.1** sets out a summary of the policies within the NPSs, relevant to physical processes. A National Policy Statement Tracker (document reference J26) has been submitted alongside the Application as a supporting document, which lists all policy provisions relevant to the Transmission Assets and where and how they are addressed within the Application.

Table 1.1: Summary of the NPS EN-1 and NPS EN-3 requirements relevant to this chapter

Summary of NPS EN-1 provision	How and where considered in the ES
Where relevant, applicants should undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures [Section 5.6, paragraph 5.6.10].	The evidence based assessment undertaken in **section 1.10** is informed by modelling studies undertaken for Morgan Offshore Wind Project: Generation Assets and Mona Offshore Wind Project, included within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. The results of the assessment of effects and cumulative effects assessment presented in **section 1.10** and **section 1.12** respectively, did not identify any significant effects on designated receptors, therefore no mitigation further to those measures that are built into the project have been proposed.
The ES should include an assessment of the effects on the coast, tidal rivers and estuaries. In particular, applicants should assess: • the impact of the proposed project on coastal processes and geomorphology, including by taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicants must demonstrate how the impacts will be managed to	The impacts on coastal processes is assessed in **section 1.10** whilst future baseline conditions are discussed in **section 1.5.4.23**. Assessments of specific ecological receptors have been included for benthic ecology (Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES), fish and shellfish ecology (Volume 2, Chapter 3: Fish and shellfish ecology of the ES), marine mammals (Volume 2, Chapter 4: Marine mammals of the ES), offshore ornithology (Volume

Summary of NPS EN-1 provision	How and where considered in the ES
minimise adverse impacts on other parts of the coast; • the effects of the proposed project on marine ecology, biodiversity protected sites and heritage assets; • how coastal change could affect flood risk management infrastructure, drainage and flood risk; • The effects of the proposed project on maintaining coastal recreation sites and features; and • The vulnerability of the proposed development to coastal change, taking account of climate change, during the project's operational life and any decommissioning period [Section 5.6, paragraph 5.6.11].	2, Chapter 5: Offshore ornithology of the ES). The potential impacts that may give rise to significant effects resulting in changes to physical processes within protected sites of ecological importance (identified in **section 1.5.2**) has been assessed within **section 1.10**. The potential impacts that may give rise to significant effects on marine heritage assets as a result of the Transmission Assets have been identified and assessed in Volume 2, Chapter 8: Marine archaeology of the ES. The impact of coastal change on socio-economic receptors located on the coast has been explored within Volume 3, Chapter 2: Hydrology and flood risk of the ES. Effects on coastal recreation sites are assessed in Volume 2, Chapter 9: Other Sea users of the ES, whilst the effects on marine ecology are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES. Climate change and the impact of the proposed development are discussed in **section 1.5.4.23**.
For any projects involving dredging or deposit of any substance or object into the sea, the applicants should consult the Marine Management Organisation (MMO) and Historic England, or Natural Resources Wales (NRW) in Wales. Where a project has the potential to have a major impact in this respect, this is covered in the technology specific NPSs. For example, EN-4 looks further at the environmental impacts of dredging in connection with Liquified Natural Gas (LNG) tanker deliveries to LNG import facilities [Section 5.6, paragraph 5.6.12].	Impacts to suspended sediment concentrations and physical processes as a result of construction activities and the presence of infrastructure in the marine environment have been appropriately mitigated by those in-built measures presented in **Table 1.13,** so that no significant effect shall arise. A full list of commitments is presented in Volume 1, Annex 5.3: Commitments Register of the ES. The MMO have been involved in stakeholder consultation from the outset as detailed in **section 1.3**. NRW have played an important role in stakeholder consultation as although the Transmission Assets are not located in Welsh waters NRW were informed throughout the consultation process. The Consultation Report (document reference E1) contains a full list of consultee stakeholders and consultation responses.
The applicants should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Protected Areas (MPAs). These could include Marine Conservation Zones (MCZs), habitat sites including Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) with marine features, Ramsar sites, Sites of Community Importance and Sites of Special Scientific Interest (SSSIs). Applicants should also identify any effects on the special character of Heritage Coasts [Section 5.6, paragraph 5.6.13].	Designated sites and features of importance within and surrounding the study area have been identified and are discussed in **section 1.5.2**. Potential impacts have also been identified and the significance of likely significant effects to physical processes receptors such as designated sites and seabed features, has been assessed in **section 1.10**.
Applicants should propose appropriate mitigation measures to address adverse physical changes to the coast, in consultation with the MMO, the EA or NRW,	A number of in-built mitigation measures are included as commitments within the Transmission Assets, which have been developed through

Summary of NPS EN-1 provision	How and where considered in the ES
LPAs, other statutory consultees, Coastal Partnerships and other coastal groups, as it considers appropriate. Where this is not the case, the Secretary of State should consider what appropriate mitigation requirements might be attached to any grant of development consent [Section 5.6, paragraph 5.6.15].	consultation with relevant stakeholders and engineering design. Within this chapter compliance with regulation, guidance and mitigation measures are addressed within the commitments presented in **Table 1.13**. A full list of commitments is presented in Volume 1, Annex 5.3: Commitments Register of the ES. The results of the assessment of effects and cumulative effects assessment presented in **section 1.10** and **section 1.12** respectively, did not identify any significant effects on designated receptors, therefore no mitigation further to those measures that are built into the project have been proposed.

Summary of NPS EN-3 provision	How and where considered in the ES
Applicant assessments are expected to include predictions of the physical effects arising from modifications to hydrodynamics (waves and tides), sediments and sediment transport, and seabed morphology that will result from the construction, operation and decommissioning of the required infrastructure [Section 2.8, paragraph 2.8.112].	Numerical modelling used to support the ES is found within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES; which is comprised of: • Mona Offshore Wind Project, Environmental Statement, Volume 6, Annex 1.1: Physical processes technical report; and • Morgan Offshore Wind Project: Generation Assets, Environmental Statement, Volume 4, Annex 1.1: Physical Processes Technical Report. These modelling studies informed the assessment of effects that is presented for construction, operation and maintenance, and decommissioning in **section 1.10**. Additionally, data was drawn from a range of data sources to identify the impacts on physical processes (**Table 1.6**).
Assessments should also include effects such as the scouring that may result from the proposed development and how that might impact sensitive species and habitats [Section 2.8, paragraph 2.8.113]	The effect of primary scour to the seabed as a result of the Transmission Assets has been scoped out of the assessment as scour protection is provided. The only infrastructure capable of resulting in scour under the scope of the Transmission Assets relates to that of cable protection. However, cable protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour, to such a degree that it will not impact upon seabed morphology. Secondary scour has been considered within the assessment and Cumulative Effects Assessment (CEA) of the ES, as seen within **section 1.10** and **section 1.12**. The potential impacts to sensitive species and habitats are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES.
Applicants should undertake geotechnical investigations as part of the assessment, enabling the design of appropriate construction techniques to	Geophysical surveys and other site-specific resources have been used to support the assessment, as described in **Table 1.6**. The project

Summary of NPS EN-3 provision	How and where considered in the ES
minimise any adverse effects [Section 2.8, paragraph 2.8.124].	description has been refined between the PEIR and ES particularly with respect of site preparation by further analysis of geotechnical data as presented in Volume 1, Chapter 3: Project description of the ES. Further supporting embedded mitigation measures are presented in **Table 1.13.**
Applicant assessment of the effects of installing offshore transmission infrastructure across the intertidal/coastal zone should demonstrate compliance with mitigation measures in any plan-level Habitats Regulations Assessment (HRA) including those prepared by The Crown Estate as part of its leasing round, and include information where relevant about: • any alternative landfall sites that have been considered by the applicant during the design phase and an explanation of final choice; • any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice; • potential loss of habitat; • disturbance during cable installation, maintenance/repairs and removal (decommissioning); • increased suspended sediment loads in the intertidal zone during installation and maintenance/repairs; • predicted rates at which the intertidal zone might recover from temporary effects, based on existing monitoring data; and • protected sites [Section 2.8, paragraph 2.8.119]	The identification of alternative landfall sites has been considered within Chapter 4: Site selection and consideration of alternatives of the ES. The potential loss of subtidal habitat is considered in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES. Within this chapter compliance with regulation, guidance and mitigation measures are addressed within the commitments in **Table 1.13**. A full list of commitments is presented in Volume 1, Annex 5.3: Commitments Register. The installation of cables is described within Volume 1, Chapter 3: Project description of the ES. An Outline Cable Burial Risk Assessment (document reference J14) and Burial Assessment Study has been developed, which forms part of the outline Offshore Cable Specification and Installation Plan(s) (CSIP) (document reference J15), to further describe burial depths, cable protection, monitoring and layout with respect to navigation. The assessment of potential construction, operation and maintenance, and decommissioning impacts are described in **section 1.10** and includes the impact of increased suspended sediment loads and subsequent deposition during all project phases. Consideration of increased suspended sediment loads and subsequent deposition during all project phases in relation to European sites is detailed in the HRA Stage 1 Screening Report (document reference E3) and the Information to support appropriate assessment parts 1-3 (document reference E2.1-2.3). It is noted that changes to bathymetry due to depressions left by jack-up vessels will be very limited and are scoped out of the assessment with justification presented **Table 1.12**.
Applicant assessment of the effects on the subtidal environment should include: • loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes, e.g. sandwave/boulder/UXO clearance; • environmental appraisal of inter-array and other offshore transmission and	The project description has been refined with respect to further project definition as presented in Volume 1, Chapter 3: Project description of the ES. This refinement includes that the Offshore Substation Platforms (OSPs) relating to the Generation Assets and are not included in the Transmission Assets ES as outlined in the MDS table presented in **Table 1.14.** It Should also be

Summary of NPS EN-3 provision	How and where considered in the ES
installation/maintenance methods, including predicted loss of habitat due to predicted scour, and scour/cable protection and sandwave/boulder/UXO clearance; • habitat disturbance from construction and maintenance/repair vessels' extendable legs and anchors; • increased suspended sediment loads during construction and from maintenance/repairs; and • predicted rates at which the subtidal zone might recover from temporary effects [Section 2.8, paragraph 2.8.126].	noted that there are no inter-array cables associated with the Transmission Assets. The effects of loss of habitat and disturbance are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES. Unexploded Ordnance (UXO) clearance for the Transmission Assets and for other projects in the region can cause increased SSCs and indentations on the seabed. However, these effects would be local, temporary and recoverable and, as such, effects are negligible and were initially scoped out of the assessment; notwithstanding this, these have been assessed in **section 1.10** in response to requests from Natural England during examination. It is noted that changes to bathymetry due to depressions left by jack-up vessels are expected to be very limited and are scoped out of the assessment with justification presented in **Table 1.12.** The assessment of potential construction, operation and maintenance, and decommissioning impacts relating to Transmission Assets infrastructure are described in **section 1.10** and includes the impact of increased suspended sediment loads and subsequent deposition. Predicted rates of subtidal recovery are presented in as presented in Volume 1, Chapter 3: Project description of the ES. Additionally, the recoverability of seabed features in the subtidal zone such as sandwaves are considered within **section 1.10**.
Where a potential offshore wind farm is proposed close to existing operational offshore infrastructure or has the potential to affect activities for which a licence has been issued by Government, the applicants should undertake an assessment of the potential effect of the proposed development on such existing or permitted infrastructure or activities [Section 2.8, paragraph 2.8.197]. The assessment should be undertaken for all stages of the lifespan of the proposed wind farm in accordance with the appropriate policy and guidance for offshore wind farm EIAs [Section 2.8, paragraph 2.8.198]. Applicants should use marine plans (paragraph 2.8.27 of this NPS and Section 4.5 of EN-1) in considering which activities may be most affected by their proposal and thus where to target their assessment [Section 2.8, paragraph 2.8.199].	Existing and permitted developments and plans which are not considered to be part of the baseline environment were considered through a cumulative CEA scoping exercise, those projects identified from the CEA screening processes are presented in **Table 1.19** with the CEA assessment presented in **section 1.12**. This assessed the potential impacts that could rise in a significant effect alongside the Transmission Assets and Generation Assets. Impacts where considered throughout all phases of the Transmission Assets. Legislative requirements for offshore wind farms are considered within Volume 1, Chapter 2: Policy and legislation context of the ES. The CEA was carried out in accordance with these procedures as detailed in **section 1.12**.
Applicants should engage with interested parties in the potentially affected offshore sectors in the pre-application phase of the proposed offshore wind farm, with an aim to resolve as many issues as possible	Key comments have been raised and discussed during consultation activities and engagement specific to physical processes. A summary of the key comments and responses have been provided

Summary of NPS EN-3 provision	How and where considered in the ES
prior to the submission of an application [Section 2.8, paragraph 2.8.200].	in **section 1.3, Table 1.5**. A comprehensive list of all consultation responses received and can be accessed in the Consultation Report (document reference E1).
Applicants are expected to have considered the best ecological outcomes in terms of potential mitigation. These might include: • avoidance of areas sensitive to physical effects; • consideration of micro-siting of both the array and cables; • alignment and density of the array; • design of foundations; • ensuring that sediment moved is retained as locally as possible; • the burying of cables to a necessary depth; • using scour protection techniques around offshore structures to prevent scour effects or designing turbines to withstand scour, so scour protection is not required or is minimised [Section 2.8, paragraph 2.8.224]. Applicants should consult the statutory consultees on appropriate mitigation and monitoring [Section 2.8, paragraph 2.8.225].	In the first instance through the cable routing of the offshore export cables and selection of landfall relating to the Transmission Assets, the applicant has sought to avoid areas that would be most susceptible to construction, operation and maintenance, and decommissioning activities (such as cable installation). This is presented in Chapter 4: Site selection and consideration of alternatives of the ES. A number of in-built mitigation measures are included as commitments within the Transmission Assets, which have been developed through consultation with relevant stakeholders and engineering design. Within this chapter compliance with regulation, guidance and mitigation measures are addressed within the commitments presented in **Table 1.13**. It should be noted that no foundation structures, inter-array cables or interconnector cables are included within the Transmission Assets, this is in line with refinements made to the project description with further project definition as presented in Volume 1, Chapter 3: Project description of the ES.
Applicants must always employ the mitigation hierarchy, in particular to avoid as far as is possible the need to find compensatory measures for coastal, inshore and offshore developments affecting SACs SPAs, and Ramsar sites and/or MCZs. It is essential that applicants involve SNCBs, other statutory environmental bodies (e.g. Historic England) and Defra, in conjunction with the relevant regulators, as early as possible in the planning process to enable discussions of what is and isn't a significant and/or adverse effect, subsequent implications, and, if required, mitigation and/or compensation [Section 2.8, paragraph 2.8.213]. At the earliest possible stage alternative ways of working and use of technology should be employed to avoid environmental impacts. For example, construction vessels may be rerouted to avoid disturbing seabirds. Where impacts cannot be avoided, measures to reduce and mitigate impacts should be employed, for example using trenching techniques or noise abatement technology [Section 2.8, paragraph 2.8.214].	In line with the mitigation hierarchy a range of project approaches and parameters were outlined in Volume 1, Chapter 3: Project description of the ES. A number of in-built mitigation measures are included as commitments within the Transmission Assets, which have been developed through consultation with relevant stakeholders, as **section 1.3, Table 1.5,** and detailed engineering design. Within this chapter compliance with regulation, guidance and mitigation measures are addressed within the commitments presented in **Table 1.13**. A full list of commitments is presented in Volume 1, Annex 5.3: Commitments Register of the ES. One such commitment is CoT54, Offshore Cable Specification and Installation Plan(s) (CSIP) will include for cable burial to be the preferred option for cable protection, where practicable.

Marine policy

North West Inshore and North West Offshore Marine Plans 2021

1.2.2.4 **Table 1.2** sets out a summary of the specific policies set out in the North West Inshore and North West Offshore Marine Plan (HM Government, 2021) relevant to this chapter, a Planning Statement (document reference J28) has been submitted alongside the application which collates compliance with relevant marine plans.

Table 1.2: Summary of inshore and offshore marine plan policies relevant to this chapter

Policy	Key Provisions	How and where considered in the ES
NW-CAB-1	Preference should be given to proposals for cable installation where the method of protection is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicants. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures.	Details of the project design criteria are detailed in Volume 1 Chapter 3: Project description of the ES. A number of in-built mitigation measures are included as commitments within the Transmission Assets, which have been developed through consultation with relevant stakeholders, as **section 1.3, Table 1.5,** and detailed engineering design. Within this chapter compliance with regulation, guidance and mitigation measures are addressed within the commitments presented in **Table 1.13**. A full list of commitments is presented in Volume 1, Annex 5.3: Commitments Register of the ES. One such commitment is CoT54, pertaining to cable burial as a preferred form of cable protection.
NW-Marine Protected Area (MPA)-1	Proposals that may have adverse impacts on the objectives of marine protected areas must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse impacts, with due regard given to statutory advice on an ecologically coherent network.	In the first instance through the cable routing of the offshore export cables and selection of landfall relating to the Transmission Assets, the applicant has sought to avoid areas that would be most susceptible to construction, operation and maintenance, and decommissioning activities (such as cable installation). This is presented in Chapter 4: Site selection and consideration of alternatives of the ES. MPA designated sites and features of importance within the study area have been identified in **section 1.5.2** with adopted in-built mitigating measures detailed in **section 1.7** including CoT47 which limits the length of cable protection in the MCZ and states “external cable protection will only be used where deemed to be essential, e.g. for cable crossings or in the instance that adequate burial / reburial is not possible for any section of the route through the Fylde MCZ.”, as detailed in **Table 1.13.** The project refinement and detailed assessment of geophysical surveys has

Policy	Key Provisions	How and where considered in the ES
		identified that the volume of sandwave clearance required within the MCZ is significantly reduced from that proposed in the PEIR, as presented in **Table 1.14**. No significant effects arising from increased suspended sediments and subsequent deposition of sediment as a result of cable installation, repair/reburial, or removal have been identified for physical processes receptors such as MPAs assessed in **section 1.10**. Likewise, no significant effects to physical processes such as waves, tides and sediment transport arising from the use of cable protection are anticipated to arise with respect to MPAs as presented in **section 1.10**.
NW-MPA-4	Proposals that may have significant adverse impacts on designated geodiversity must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse impacts so they are no longer significant.	In the first instance through the cable routing of the offshore export cables and selection of landfall relating to the Transmission Assets, the applicant has sought to avoid areas that would be most susceptible to construction, operation and maintenance, and decommissioning activities (such as cable installation). This is presented in Chapter 4: Site selection and consideration of alternatives of the ES. Designated sites and sites of interest due to geological importance within the study area have been identified in **section 1.5.2** with adopted measures detailed in **section 1.7**. No significant effects arising from increased suspended sediments and subsequent deposition of sediment as a result of cable installation, repair/reburial, or removal have been identified for physical processes receptors including geodiversity assessed in **section 1.10**. Likewise, no significant effects to physical processes such as waves, tides and sediment transport arising from the use of cable protection are anticipated to arise with respect to receptors including geodiversity, such as subtidal sands and sandbank features as presented in **section 1.10**.
NW-BIO-1	Proposals that may have significant adverse impacts on the distribution of priority habitats and priority species must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse impacts so they are no longer significant d) compensate for significant adverse impacts that cannot be mitigated.	In the first instance through the cable routing of the offshore export cables and selection of landfall relating to the Transmission Assets, the applicant has sought to avoid areas that would be most susceptible to construction, operation and maintenance, and decommissioning activities (such as cable installation). This is presented in Chapter 4: Site selection and consideration of alternatives of the ES. Sites identified as Habitats Directive Annex I habitats within the study area have been

Policy	Key Provisions	How and where considered in the ES
		identified in **section 1.5.2** with adopted measures detailed in **section 1.7**. No significant effects arising from increased suspended sediments and subsequent deposition of sediment as a result of cable installation, repair/reburial, or removal have been identified for physical processes receptors such as Annex I habitats assessed in **section 1.10**. Likewise, no significant effects to physical processes such as waves, tides and sediment transport arising from the use of cable protection are anticipated to arise with respect to Annex I habitats.
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will, in order of preference: a) avoid b) minimise c) mitigate – adverse cumulative and/or in-combination effects so they are no longer significant.	In the first instance through the cable routing of the offshore export cables and selection of landfall relating to the Transmission Assets, the applicant has sought to minimise cumulative effects due to construction, operation and maintenance, and decommissioning activities (such as cable installation). This is presented in Chapter 4: Site selection and consideration of alternatives of the ES. A CEA has been undertaken applying a methodology outlined in **section 1.11**. No significant cumulative effects relating to increased suspended sediments and subsequent deposition of sediment as a result of cable installation, repair/reburial, or removal have been identified for physical processes receptors such as designated sites have been identified for physical processes receptors assessed in **section 1.12**. Likewise, no significant cumulative effects to physical processes such as waves, tides and sediment transport arising from the use of cable protection are anticipated to arise with respect to designated sites.

North West Shoreline Management Plan

1.2.2.5 The assessment of potential changes to physical processes has been made with consideration to the specific policies set out in the North West Shoreline Management Plan (SMP) (Halcrow Group Ltd., 2010). Key provisions are set out in **Table 1.3** along with details as to how these have been addressed within the assessment where appropriate.

Table 1.3: Summary of SMP policies relevant to Physical Processes

Location	SMP Summary	How an Where considered within the ES
Ribble Estuary	The SMP recommends a policy of Hold the Line via the maintenance and improvement of defences across the subcell, up to 2060. In some stretches	The impacts to physical processes, seabed morphology and the associated potential impacts to physical features

Location	SMP Summary	How an Where considered within the ES
(11b1)	of the subcell. Managed Realignment is recommended within this time period, namely, Hesketh Outmarsh East, Hutton Marsh and Hutton Marsh to Penwortham Golf Course. A strategy of No Active Intervention is proposed at Naze Point to Warton Bank due to insufficient risk to assets. In the longer term a policy of Managed Realignment is recommended at Crossens Pumping Station to Hesketh Outmarsh West, Hesketh Outmarsh East to White Bridge Rufford, White Bridge, Rufford to Old Railway Embankment, Old Railway Embankment to Hutton Marsh, Hutton Marsh, and Freckleton Marsh to Naze Point in the interests of combatting flood risk.	and adjacent shorelines are considered in isolation and cumulatively with those of other developments in **section 1.10** and **section 1.12** respectively.
St Annes to Rossall Point (11b2)	The SMP recommends a policy of Hold the Line via the maintenance and improvement of defences across the subcell, up to 2110 due to its economic viability when considering the assets at risk. In the short term a strategy of Managed Realignment between St Annes and Squires Gate is recommended to adopt appropriate dune management techniques.	

1.2.3 Relevant guidance

1.2.3.1 **Table 1.4** sets out a summary of the guidance relevant to physical processes baseline characterisation, including spatial and temporal scales for offshore wind farm developments.

Table 1.4: Guidance relevant to physical processes baseline methodology

Title	Source	Year	Author
Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards: Phase III: Expectations for data analysis and presentation at examination for offshore wind applications	https://naturalengland.blog.gov.uk/	2022	Natural England
Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards: Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications	https://naturalengland.blog.gov.uk/	2021	Natural England
Physical processes guidance to inform EIA baseline survey, monitoring and numerical modelling requirements for major development projects with respect to marine, coastal and estuarine environments, GN041	https://naturalresources.wales/?lang=en	2020	Natural Resources Wales
Natural England and the Joint Nature Conservation Committee (JNCC) advice	https://data.jncc.gov.uk/	2019	Natural England

Title	Source	Year	Author
on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas			
Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects Parts 1 and 2	https://www.gov.ie/en/	2018	Department of Energy and Climate Change
Manx Marine Environmental Assessment Physical Environment Hydrology, Weather and Climate, Climatology	https://www.gov.im/	2018	Isle of Man Government Kennington and Hiscott
Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects	https://naturalresources.wales/?lang=en	2018	Natural Resources Wales
Advice to Inform Development of Guidance on Marine, Coastal and Estuarine Physical Processes Numerical Modelling Assessments. NRW Report No 208	https://naturalresources.wales/?lang=en	2017	Natural Resources Wales Pye et al
Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects	https://cieem.net/	2017	Barnes, M.D.
Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects	https://www.pnnl.gov/	2012	Centre for Environment Fisheries and Aquaculture Science (CEFAS)
Coastal Process Modelling for Offshore Windfarm Environmental Impact Assessment	https://www.marinedataexchange.co.uk/	2009	Collaborative Offshore Wind Energy Research into the Environment Lambkin et al
Guidelines in the use of metocean data through the lifecycle of a marine renewables development	https://www.researchgate.net/	2008	Cooper et al

1.3 Consultation

1.3.1 Scoping

1.3.1.1 On 28 October 2022, the Applicants submitted a Scoping Report to the Secretary of State, which described the scope and methodology for the technical studies being undertaken to provide an assessment of any likely significant effects for the construction, operation and maintenance, and decommissioning phases of the Transmission Assets.

1.3.1.2 Following consultation with the appropriate statutory bodies, the Planning Inspectorate (on behalf of the Secretary of State) provided a Scoping Opinion on 8 December 2022.

1.3.2 Evidence plan process

1.3.2.1 Following scoping, consultation and engagement with interested parties specific to physical processes has continued. An Evidence Plan Process (EPP) was developed for the Transmission Assets, which sought to ensure engagement with the relevant aspects of the EIA process throughout the pre-application phase. The development and monitoring of the Evidence Plan and its subsequent progress was undertaken by the EPP Steering Group. The Steering Group comprises the Planning Inspectorate, the Applicants, the Marine Management Organisation, Natural England, Historic England, the Environment Agency and the Local Planning Authorities as the key regulatory and bodies.

1.3.2.2 As part of the EPP, Expert Working Groups (EWGs) were set up to discuss and agree topic specific issues with the relevant stakeholders.

1.3.2.3 The Benthic Ecology, Fish and Shellfish Ecology and Physical Processes EWG met during March 2023 when the Transmission Assets project was introduced along with presenting the initial baseline and assessment approach for discussion. An additional EWG took place in July 2023 in which preliminary findings of the initial assessment and CEA outputs were presented. Following on from Preliminary Environmental Information Report (PEIR) review a further meeting was held in February 2024, as presented in **Table 1.5**.

1.3.3 Statutory Consultation Responses

1.3.3.1 The preliminary findings of the EIA process were published in the Preliminary Environmental Information Report (PEIR) in October 2023. The PEIR was prepared to provide the basis for formal consultation under the Planning Act 2008. This included consultation with statutory and non-statutory bodies under section 42 and 47 of the Planning Act 2008, as presented in **Table 1.5.**

1.3.4 Summary of consultation responses received

1.3.4.1 A summary of the key items raised specific to physical processes is presented in **Table 1.5**, together with how these have been considered in the production of this chapter. It should however be noted that formal responses were provided for **all** consultation responses received and can be accessed in the Consultation Report (document reference E1).

Table 1.5: Summary of key consultation comments raised during consultation activities undertaken for the Transmission Assets relevant to physical processes

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
December 2022	Planning Inspectorate – Scoping	Regarding changes to bathymetry due to depressions left by jack-up vessels: Whilst the Inspectorate acknowledges that the Scoping Report indicates a limited and short-term, reversible effect, no justification is provided to scope out impacts from jack-up vessel spud-cans and footprints on the sedimentary regime. There is also no evidence that additional scour from depressions would not give rise to significant effects. The Inspectorate therefore does not agree this matter can be scoped out. Based on the information provided within the Scoping Report indicating that scour protection will be installed as a committed mitigation measure, the Inspectorate is in agreement that an assessment of (primary) scour can be scoped out for the operational phase. It is however noted that secondary scour is proposed to be scoped into the assessment. The Scoping Report does not make reference to the scour of seabed sediments during the construction and decommissioning stages. For clarity, the Inspectorate considers that this should be scoped in to the assessment. The Inspectorate is therefore not in agreement that changes to bathymetry (as a result of the use of jack-up vessels only) can be scoped out of the assessment.	As presented in **Table 1.12,** monitoring studies undertaken for the effects of depressions left by jack-up vessels in the Barrow Offshore Wind Farm, also located in the east Irish Sea, concluded that depressions were almost entirely infilled within a year of construction (BoWind, 2008).Given the short timescale of recovery, and the fact that impacts to bathymetry and subsequently physical processes such as waves, tides and sediment transport are negligible, this impact pathway has been scoped out, as agreed through the EPP.
		Scoping Report paragraph 4.4.5.9 (in Scoping Report part 1) states that seabed levelling may be required but this is not mentioned in the physical processes chapter. The ES should assess any likely significant secondary effects that this may have on changes to the current/flow regime, wave regime and sediment transport regime and any morphological changes. Impacts from dredging and disposal of material should also be assessed, where significant effects are likely to occur. Any disposal method should be described and should include the estimated volume of material to be disposed of.	The description of seabed preparation has been refined and further detail is presented in Volume 1, Chapter 3: Project description of the ES. The assessment methodology includes assessment of activities where significant effects may occur, outlined in **section 1.9.** No significant effects arising from increased suspended sediments and subsequent deposition of sediment as a result of cable installation, repair/reburial, or removal have been identified for physical processes receptors such as designated sites assessed in **section 1.10**.

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
			Likewise, no significant effects to physical processes such as waves, tides and sediment transport arising from the use of cable protection are anticipated to arise.
		The table outlining physical processes impacts scoped into the assessment (Table 3.3 of the Scoping Report) indicates that for some impacts, a qualitative assessment only will be provided. Paragraphs 3.1.7.2 and 3.1.7.3 of the Scoping Report indicate that this is because modelling has already been undertaken for the Morecambe generation assets. The ES should consider the need for additional modelling as the transmission assets cover a significantly larger area than the Morecambe (and Morgan) generation assets and interact with coastal features at the landfall point. The extent of such modelling should be agreed with the Expert Working Group (EWG) where possible.	The description of seabed preparation has been refined and further detail is presented in Volume 1, Chapter 3: Project description of the ES. The assessment methodology includes assessment of activities where significant effects may occur, outlined in **section 1.9**. Numerical modelling used to support the ES is found within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. Agreement with the evidence based approach was agreed upon with stakeholders in subsequent EWG meetings.
		The Inspectorate considers that during construction, there will be activities with potential to cause changes in physical processes e.g. laying cable protection and piling. As construction is anticipated to last three/four years, changes in physical processes may occur during this time. Therefore, the Inspectorate does not agree to scope this matter out. The ES should assess impacts to physical processes during construction and decommissioning where significant effects are likely to occur.	All impacts have been assessed through all project phases as outlined in **section 1.9**, with the assessment of effects examining all project phases as presented in **section 1.10**. Likewise, the cumulative effects in relation to physical processes are examined for all phases in **section 1.12**.
		The Scoping Report states that marine mammals are known to forage in tidal areas where water conditions are turbid and visibility conditions are poor and there is large natural Suspended Sediment Concentration (SSC) variability within the study area. It further notes that sediments are expected to rapidly dissipate over one tidal excursion. Given the length of the transmission assets, the Inspectorate considers there is insufficient information in the Scoping Report on how the impact range is expected to be	This impact is assessed throughout all project phases as outlined in **section 1.9**, with the assessment of effects examining all project phases as presented in **section 1.10**. Likewise, the cumulative effects in relation to physical processes are examined for all phases in **section 1.12**.

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		localised and dissipated over one tidal excursion therefore the Inspectorate is unable to scope this matter out.	
		The Applicants propose to scope out alterations to sediment transport pathways affecting aggregate extraction areas during construction and decommissioning as alterations to sediment transport pathways would only occur during the operation and maintenance phase of the Proposed Development. However, part 1, paragraph 4.4.5.9 (Project description) of the Scoping Report states that seabed levelling may be required during the construction phase. The ES should assess any likely significant effects that this may have on changes to the sediment transport regime and aggregate extraction areas.	This impact is assessed throughout all project phases as outlined in **section 1.9**, with the assessment of effects examining all project phases as presented in **section 1.10**. Likewise, the cumulative effects in relation to physical processes are examined for all phases in **section 1.12**.
December 2022	The Marine Maritime Organisation (MMO) – Scoping	The MMO notes Table 3.3 in document 6 contains a comprehensive list of impacts that are scoped in for the installation, operation, and removal of the transmission gear. These included; increase in suspended sediments, impacts to the wave regime, impacts to the tidal regime, and various impacts to sediment transport. The MMO is satisfied this list covers the potential impacts of the project on the physical environment.	Approach to assessment has been agreed by the MMO, see **section 1.6**. The assessment of effects having examined all project phases as presented in **section 1.10**. Likewise, the cumulative effects in relation to physical processes are examined for all phases in **section 1.12**.
		Two impacts with regard to physical processes have been scoped out of the Environmental Impact Assessment; changes to bathymetry due to depressions left by jack-up vessels and scour of seabed sediments during the operation and maintenance phase. Given the seabed substrate, the MMO agree with the applicants that the depressions created by the jack-up barge can be scoped out. Given the use of scour protection, the MMO are satisfied that scour around the operational infrastructure can be scoped out also.	Approach to assessment has been agreed by the MMO, see **section 1.6**. The assessment of effects having examined all project phases as presented in **section 1.10**. Likewise, the cumulative effects in relation to physical processes are examined for all phases in **section 1.12**.
		The MMO notes that a wide range of data/information sources has been identified in Table 3.1 (Physical processes datasets and reports). In addition, the MMO notes a range of recent site-specific geophysical and metocean surveys. The MMO is	Approach to baseline environment has been agreed by MMO, see **section 1.5**. The full list of desktop studies for baseline assessment as agreed with MMO are

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		satisfied these will provide a strong foundation to the Environmental Impact Assessment.	presented in **Table 1.6**, a full list of site-specific survey information is presented in **Table 1.8**.
		The MMO note that the only mitigation identified is the use of scour protection. The precise details will be important, but at this stage such mitigative action seems reasonable given the project.	Noted, further measures outlined in **Table 1.13**. As described in **Table 1.13,** CoT54 states that cable burial will be the preferred option for cable protection, where practicable.
		The potential impacts of the project are captured in Table 3.3 (Physical processes). In addition to this, the MMO would like to emphasize the importance of considering the impact to beach morphology at the landing site and the subsequent impacts within the sediment cell.	Approach to assessment has been agreed by stakeholder, **section 1.6**. In line with the project definition as presented in Volume 1, Chapter 3: Project description of the ES the cable landing will either be undertaken using direct pipe trenchless techniques or, in the case of trenching, all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs), as per CoT114, outlined in **Table 1.13**. Trenching depths have been determined in line with beach drawdown studies (ABPmer 2023) to reduce potential impacts on beach morphology.
December 2022	Isle of Man Government – Scoping	The TSC would like to draw the applicant's attention to the Manx Marine Environmental Assessment (MMEA) which provides a useful overview of the islands marine environment and should be taken into account as part of both the transboundary and possibly the also the cumulative impacts assessment as part of this application. More detail will be provided below in respect of specific areas of the MMEA that should be reviewed.	Noted. This document was included in the desktop studies for baseline assessment presented in **Table 1.6.**
December 2022	Natural England – Scoping	It is vital that the marine and coastal physical processes within, and in the vicinity of, the proposed development are well understood in order to provide robust estimates of the temporal and spatial scale of changes to hydrodynamic and sediment	The assessment methodology in **section 1.9** includes assessment of activities where likely significant effects may occur. With further project definition the potential impacts relating to activities such as seabed

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		transport regimes and to the subtidal, intertidal and supratidal environments. This should describe both contemporary conditions as well as longer-term historical change. Little information is provided on seabed preparation activities (e.g. sandwave clearance, material disposal) and the impacts on sediment transport patterns and morphological change, due to the early stage of the project. Natural England reserve the right to make future detailed comments once further information is known, this could include scoping in of additional impacts.	preparation have been refined as presented in Volume 1, Chapter 3: Project description of the ES. No significant effects arising from increased suspended sediments and subsequent deposition of sediment as a result of cable installation, repair/reburial, or removal have been identified for physical processes receptors such as designated sites assessed in **section 1.10**. Likewise, no significant effects to physical processes such as waves, tides and sediment transport arising from the use of cable protection are anticipated to arise.
		It would be beneficial to have a mapped display of the deployed metocean buoys, including both site-specific deployment as well as historic data from Ormonde Offshore Wind Farm and the proposed Round 3 Irish Sea Offshore Wind Farm Development Zone.	The mapped location of metocean buoys, including sit-specific deployment within the Morgan Offshore Wind Project: Generation Assets and historic metocean data is presented in the baseline environment, **section 1.5.4** and Figure 1.3 (Volume 2, Chapter Figures).
		The evidence presented set out variation in the tidal currents across the study area, further evidence on the tidal currents and current directions, for both flood and ebb currents would be beneficial. It would be beneficial to have a mapped display of this information. This would support a clear baseline of the hydrodynamics within the study area.	This information is presented in the baseline environment, **section 1.5.4**. Tidal currents during the flood and ebb phases for both spring and neap tides are displayed within **Diagram 1.2** – **1.5**.
		We seek clarity on the presence of any sandwave features within the area. In understanding any potential impacts it would be beneficial to have a clear understanding of sandwave height, wave lengths and migratory rates.	Presence of sandwaves has since been informed by geophysical and grab sample surveys with the baseline data being presented in **section 1.5.4**. The location and orientation of these sandwaves can be seen in Figure 1.4 (Volume 2, Chapter Figures).
		Little information is provided on seabed preparation activities, due to the early stage of the project. Natural England reserve the right to make future detailed comments once further information is known, this could include scoping in of additional impacts. Further discussion would be welcomed through EWGs.	The assessment methodology in **section 1.9** includes assessment of activities where likely significant effects may occur. With further project definition the potential impacts relating to activities such as seabed preparation have been refined as presented in

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			Volume 1, Chapter 3: Project description of the ES. Agreement with the approach used within the physical processes assessment was agreed with Natural England during the EWG process.
December 2022	Natural Resources Wales (NRW) - Scoping	Whilst NRW (A) have limited comments to make at this stage of the Morgan and Morecambe Transmissions Assets process, we would like to remain a consultee for later stages of the project primarily in view of physical processes, mobile species and the potential for cumulative and in-combination impacts.	The minutes taken of the EWG meetings were circulated to NRW, along with any appropriate additional information.
		With reference to Figure 3.1: The Transmission Assets physical processes study area, NRW (A) agree that the zone of influence has been correctly determined. Whilst NRW (A) do not have any further comments to make with respect to Physical Processes at this stage, we would like to be consulted at later stages of the process due to the potential for SSC plumes to advect into Welsh waters, which may therefore impact sensitive receptors as a result of the cable laying activities.	Agreement of approach noted, study area refined as discussed in **section 1.4**. The minutes taken of the EWG meetings were circulated to NRW, along with any appropriate additional information.
		NRW (A) note that the physical processes study area and thus the zone of influence for benthic subtidal habitats for the transmission assets, falls party within Welsh waters, as outlined in Figure 4.1. Whilst NRW (A) do not have any comments to make with respect to Benthic Subtidal Ecology at this stage of the process, we would like to be consulted on the EIA and HRA once the Export Cable Route has been further refined.	The minutes taken of the EWG meetings were circulated to NRW, along with any appropriate additional information.
March 2023	EWG consultation meeting 1 In attendance: MMO, Centre for Environment Fisheries and	The scope and study area for physical processes were presented. The evidence base and modelling studies available to inform the baseline characterisation and assessments was outlined along with the approach to both the impact assessment and CEA.	No comments were raised regarding baseline physical processes, data sources or the proposed assessment methodology therefore the baseline environment (**section 1.5**), assessment of effects (**section 1.10**) and CEA (**section 1.12**) were prepared in line with that presented.

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	Aquaculture Science (Cefas), Environment Agency and Natural England.	In line with scoping responses no issues were raised with respect to baseline physical processes, data sources or the proposed assessment methodology.	
July 2023	EWG consultation meeting 2 In attendance: MMO, Cefas, Environment Agency, Natural England and Cumbria Wildlife Trust.	The refined physical processes study area was presented along with the range of parameters investigated. An overview of the baseline and the preliminary outcomes were described. This included a description of the receptors and their sensitivities and physical processes as potential pathways for impacts assessed in the context of other disciplines. The approach to Transmission Assets CEA in relation to Morgan and Morecambe as whole project assessments was given. MMO gave general agreement to the baseline, initial assessment outputs and initial CEA outputs.	Agreement with baseline, initial assessment outputs and initial CEA outputs shown therefore the baseline environment (**section 1.5**), assessment of effects (**section 1.10**) and CEA (**section1.12**) were progressed in line with that presented.
November 2023	Natural England – Section 42	Fylde MCZ – concerns relating to: • Cable installation • Sandwave clearance • Cable protection • O&M activities Further recommendation to mitigate impacts for permanent habitat loss. We advise that where possible, the avoid, reduce, mitigate hierarchy should be employed to reduce environmental impacts (please see: Environmental considerations for offshore wind and cable projects – 52965454 Nature conservation considerations and environmental best practice for subsea cables for English Inshore and UK offshore waters,	An Outline Cable Burial Risk Assessment (document reference J14) has been developed, which forms part of the Outline Offshore Cable Specification and Installation Plan (CSIP) (document reference J15), submitted with the application, as per of CoT45, outlined in **Table 1.13**. Commitments relating to the usage and scale of cable protection are included in **Table 1.13**, with the full list of commitments included in Volume 1, Annex 5.3: Commitments Register. The assessment methodology in **section 1.9** includes assessment of activities where likely significant effects may occur. With further project definition the potential impacts relating to activities such as seabed preparation have been refined as presented in Volume 1, Chapter 3: Project description of the ES.

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		We advise that if the level of interaction with Fylde MCZ cannot be avoided, the next stage of the mitigation hierarchy would be for the project to minimise the amount of cable protection within the designated site. We highlight that other projects such as the original Sheringham Shoal and Dudgeon OWF did not require cable protection, therefore further exploration of cable protection requirements is needed within Fylde MCZ, as well as development of design and installation measures that will increase the likelihood of successful burial. A Cable Burial Risk Assessment (CBRA) should be developed and submitted at the time of Application to understand the level of risk and inform those design and installation measures. If the project cannot avoid or reduce the level of interaction with Fylde MCZ, we strongly advise that the developer takes all feasible steps to reduce the level of cable protection and embeds the need to mitigate for processes impacts in the project design. We also advise that the submitted ES should include a commitment to remove cable protection from the MCZ as part of the decommissioning plan. At present there are existing methodologies in the market, which with refinements in the future should allow the recovery of external cable protection. These were explored for the Sheringham Shoal and Dudgeon Offshore Windfarm Extension Projects. Further recommendation to mitigate impacts for sandwave clearance. The area impacted by sandwave clearance within Fylde MCZ is large. We recommend the use of best practice methods to reduce the area impacted by disposal including: • all efforts to avoid areas of sandwaves or minimise the need for sandwave clearance by micro-siting should be explored;	The effects of loss of habitat and disturbance are assessed in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES. In the first instance through the cable routing of the offshore export cables and selection of landfall relating to the Transmission Assets, the applicant has sought to avoid areas that would be most susceptible to construction, operation and maintenance, and decommissioning activities (such as cable installation). This is presented in Volume 1, Chapter 4: Site selection and consideration of alternatives of the ES. Efforts have been made to reduce the amount of sandwave clearance required within the Fylde MCZ, the parameters of which have been included within the MDS in Table 1.13. In total sandwave clearance within the MCZ occurs along 5% of the offshore export cable route. The techniques used for sandwave clearance will mobilise sediment in the direct vicinity of its original location, with no sediment being removed from the sediment cell. Likewise, cable protection within the MCZ has been limited to 3% of the total cable route as described in CoT47 in **Table 1.13**. It will also be designed to be removable on decommissioning with the requirement for removal agreed with stakeholders and regulators at the time of decommissioning, as described in CoT109 in **Table 1.13**. That cable protection that is placed within the MCZ will be designed to be removable on decommissioning with the requirement for removal agreed with stakeholders and regulators at the time of decommissioning, as described in CoT109 in **Table 1.13**.

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		• disposal of sediment should be within an area of similar sediment type and remain in the same sediment system; • the use of a fall pipe (also referred to as a downpipe) to dispose of material as close to the seabed as possible to increase accuracy of disposal compared to surface release; and • dispose of material up drift of the cable route to allow infill to occur as quickly as possible following cable route installation.	
		The Maximum Design Scenario’s (MDS) for sandwave clearance and other seabed preparation activities (within and outside of protected areas) is large. While we support the use of sandwave levelling as a form of mitigation measure to reduce the likelihood of using cable protection; there is a considerable amount of sandwave clearance and seabed preparation footprint proposed. We advise that all efforts should be made to avoid areas of sandwaves or minimise the need for clearance by micro- routing cables. Therefore, we encourage refinement of the MDS as much as possible using project specific acoustic data. Full consideration should also be given to relocation of any disposal material and impacts that may have. We advise where possible disposal is within area of similar sediment type and within the same sediment system.	The project design has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. The assessment methodology includes assessment of activities where significant effects may occur, outlined in **section 1.9**. The techniques used for sandwave clearance will be mobilise sediment in the direct vicinity of its original location, with no sediment being removed from the sediment cell. Further details are provided in Volume 1, Chapter 3: Project description of the ES.

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		Where the cable corridor crosses an area of high-density boulders and coarse material, we recommend the developer considers micro-siting if there is capacity within the planned cable corridor. We note that the developer has stated boulder clearance would occur within the footprint of installation activities. All efforts to avoid areas of boulders or minimise the need for boulder clearance by micro-siting should be explored through a boulder clearance methodology and stated within the Application. Placement of boulders should be carefully considered to minimise impact on sediment movement.	The description of seabed preparation including boulder clearance has been refined and is presented in Volume 1, Chapter 3: Project description of the ES. As boulder clearance will take the form of sidecasting, the activity will not result in significant increases in SSC or changes to the seabed characteristics or physical processes.
		Natural England have concerns relating to the lack of future data analysis to test predictions made within the impact assessment. 1.8.2.8 of the Physical Processes Chapter states following seabed preparation and cable installation, the sediment is expected to recover to its baseline state through wave and tidal action, which would also allow the associated communities to recover into these areas. However, 1.8.2.14 states recovery of sediments will be site specific and will be influenced by currents, wave action and sediment availability (Desprez, 2000). Concern about impacts on key receptors. Given recoverability is site specific, the geophysical survey reports should review whether the seabed has recovered from cabling work. We advise that the project should have adequate scope to include long term impact monitoring in order to monitor recovery of the seabed. Appropriate survey design and power analysis should be conducted to ensure that adequate data is collected for long term comparisons of the effect of change compared to baseline data.	The dynamic nature of sediment transport and sandwave movement within the study area has been described and supported by relevant desk studies in **Table 1.6**. One such supporting document is the project specific 'Assessment of Seabed Level Vertical Variability for Morgan Offshore Wind Farm, Morphodynamic Characterisation, Morphological Analysis and Prediction of Future Seabed Levels.' (ABPmer (2023). Post construction monitoring undertaken for the Barrow Offshore Wind Farm, also located in the East Irish Sea, examined natural trench infill, one year post construction. The conclusion of the monitoring report with respect to cable trenching presented that within one year of construction, the cable trench had almost completely infilled through natural processes (BoWind, 2008).

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			Physical processes monitoring will be considered in the outline Offshore In Principle Monitoring Plan (IPMP) (document reference J20) submitted with the application and will consider effects of sediment transport and sediment transport pathways on cable burial to ensure that buried cable remains adequately buried.
		Volume 1, Chapter 3: Project description of the PEIR, outlines that the offshore export cable will be installed by Horizonal Directional Drilling, or equivalent trenchless technique. From experience on other windfarms Horizontal Directional Drilling (HDD) can fail on occasion, the applicant should ensure that the worst case scenario at landfall takes this into consideration. This should consider impacts on Lytham St. Annes Dunes SSSI with a sufficient baseline collected to assess impact post construction and identify remedial measures where needed.	Cable installation at landfall does not rely on HDD, with direct pipe trenchless techniques and open-cut trenching techniques considered within Volume 1, Chapter 3: Project description of the ES. The worst case scenario for landfall examines both open-cut trenching and trenchless techniques as presented in **section 1.10**. The Lytham St. Annes Dunes SSI was not considered as it does not fall within the Transmission Assets Order Limits: Offshore Order Limits or the Transmission Assets: Intertidal Infrastructure Area.
		The developer states that models and data from the Morgan Offshore Wind Project: Generation Assets PEIR have been used to infer the Transmission Assets PEIR. However, modelling output results and schematics have not been included in this Assessment, despite the transmission assets being subject to a separate application. We advise that the developer provides the model outputs for The Morgan and Morecambe Transmission Assets, either within the text or as a separate Annex.	The assessment undertaken was an evidence-based conceptual study, as agreed through the scoping process during the EWG meetings. Therefore, modelling of the Transmission Assets was not undertaken. The numerical modelling used to support the ES is presented in Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES.
		Some key parameters for Morgan and Morecambe Transmission Assets are clearly defined, while others are vaguely defined due to the lack of technical annexes and/or supporting information from modelling outputs for Morgan and Morecambe Transmission.	Numerical modelling used to support the ES is found within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. The project description has been refined with respect to further project definition as presented in Volume 1,

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		We advise that parameters and MDS are clearly defined in the final ES, and that model outputs for The Morgan and Morecambe Transmission Assets are provided, either within the text or as a separate Annex.	Chapter 3: Project description of the ES. This refinement includes that the Offshore Substation Platforms (OSPs) relating to the Generation Assets and are not included in the Transmission Assets ES as outlined in the MDS table presented in **Table 1.14**.
		We note that there is a possibility that all or part of the OSPs could be classed as part of the Generation Assets or the Transmission Assets. We advise that this optionality should ideally be resolved prior to the application and assessed within the relevant ES. The applicant to clarify which aspect of the proposed project the OSPs fall under (i.e. Generation or Transmission Assets), this should then be refined and assessed within the relevant ES.	This has been noted and the OSPs have been classed as part of the Generation Assets Development consent order (DCO) and Deemed Marine License (DML) Applications only and removed from the Transmission Assets DCO and DML Application.
		We note that the MDS for sandwave clearance is based on the assumption that up to 60% of the cable route and 60% of foundation locations may require sandwave clearance. These are exceptionally large areas when compared to other offshore windfarm projects. We strongly recommend effort is taken to refine down this substantial MDS for sandwave clearance in the final application. We advise that site-specific geophysical survey data should be used to refine the MDS. The extent and location of sediment disturbance (area, volume) should be provided for affected MPAs/features (e.g. Fylde MCZ). Natural England also queries how will the sediment be retained within designated sites to ensure that the subtidal mud and sand will fully recover i.e., have the same structure and function.	The assessment methodology in **section 1.9** includes assessment of activities where likely significant effects may occur. Activities such as seabed preparation have been refined and further detail is presented in Volume 1, Chapter 3: Project description of the ES. The MDS for sandwave clearance, as presented in **Table 1.14**, has been updated to state that up to 9% of the cable route may require sandwave clearance with 5% of sandwave clearance of export cable within the Fylde MCZ. Specific parameters for sandwave clearance, including within the MCZ, is outlined in the MDS in **Table 1.14**
		It seems that some parameters associated with sandwave clearance have not been included, without these it is not clear how the figures for sandwave clearance and seabed preparation were derived. The developer mentions 60% of the cable route and 60% of the foundations may need sandwave clearance. We	The description of seabed preparation has been refined and further detail is presented in Volume 1, Chapter 3: Project description of the ES. The assessment

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		suggest all parameters (i.e. length/width/area/depth) should be included in the MDS tables. We advise the developer to consider additional parameters for inclusion in Table 3.5 to provide clarity around the sandwave volume MDS figures, namely: • the length of cable route requiring sandwave clearance (km); • width of sandwave clearance disturbance corridor (m); • indicative depth of sandwave clearance dredging (m); • area of seabed disturbed by sandwave clearance (m2); and • seabed preparation areas for foundations (m2).	methodology includes assessment of activities where significant effects may occur, outlined in **section 1.9**.
		The MDS for OSPs is high when compared to other projects of a similar scale (i.e. six OSPs, one booster station). We advise that this is refined. We note that for the Morgan Offshore Wind Project, the developer has included two different MDS options for OSPs. Natural England advise that the preferred option would be to have one large OSP rather than four small OSP as this will have a smaller footprint and therefore least impact on the seabed. Clarify and refine OSP parameters for the ES submission. Include seabed preparation parameters for the areas for foundations.	This has been noted and the OSPs have been classed as part of the Generation Assets DCO Applications only and removed from the Transmission Assets DCO Application.
		It is not clear whether secondary scour has been included in the project description and MDS parameters. The project description only refers to scour protection. We advise that secondary scour protection impacts are scoped in and included in the MDS parameters. If they are included within the project description, this should be clearly stated and defined in the submitted ES.	Secondary scour which can arise as a result of the presence of cable protection, as outlined in the MDS in **Table 1.14,** has been considered within the assessment and CEA of the ES, as per **section 1.10** and **section 1.12**.

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		The MDS for width of export cable protection is 10 m, is this per cable or in total (i.e. six cables)? Please clarify.	The project description has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. The MDS for width of offshore export cable, as presented in **Table 1.14,** now states a value of 10 m per cable for cable protection associated with ground conditions and up to 30 m at assets crossing (20 m for asset crossing in the MCZ).
		The parameters for cable crossings have not been defined in this Chapter, NE acknowledges the developer needs to confirm crossings with the asset owner. However, when this information is known, please provide further information on MDS parameters for cable crossing (i.e. indicative number of crossings, specific locations, overlap with MPAs etc) and methodology in line with best practise guidance. The potential interruption of sediment transport and resulting morphological change due to the presence of cable crossings near sensitive receptors and pathways should also be considered in the ES. Please provide further information on cable crossings in the submitted ES, in line with best practice guidance as set out in Natural England's Best Practice Guidance Phase III. If any MPAs, sensitive features, or sensitive areas of seabed are likely to be impacted by cable crossings, then the extent of the impact and location should be stated.	The project design has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. Further information regarding the locations and use of cable crossings is presented within Volume 1, Annex 3.1: Offshore Crossing Schedule of the ES (document reference F1.3.1).
		It remains unclear if or how much cable protection will be required within Fylde MCZ. We advise that a detailed cable burial risk assessment is provided as part of the Application. This should include an outline burial cable specification and installation plan which has a pollution and contingency plan. Provide a cable burial risk assessment as part of the Application.	Cable protection within the MCZ may be up to 3% of the total cable route for ground conditions with parameters for crossing of assets in Volume 1, Chapter 3: Project description of the ES. An Outline Cable Burial Risk Assessment (document reference J14) has been developed, which forms part of the outline CSIP (document reference J15). Further information regarding the locations and use of cable crossings is presented within Volume 1, Annex 3.1: Offshore

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			Crossing Schedule of the ES (document reference F1.3.1).
		The information on indicative MDS for cable crossing dimensions or potential locations of cable crossings is unclear. Natural England advises that further information on cable crossings, including MDS parameters and an indicative schematic is provided in the submitted ES. This should show MDS cable crossing cross-section and plan, and also a map identifying potential cable crossing locations, if possible.	The project design has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. Further information regarding the locations and use of cable crossings is presented within Volume 1, Annex 3.1: Offshore Crossing Schedule of the ES (document reference F1.3.1).
		There are site-specific surveys referenced throughout the chapter which have not been provided with the PEIR reports. It would be useful to see these reports: Gardline (2022); XOcean (2022); and Fugro (2022). Please provide these reports or a link to them through the ETG.	All data will be uploaded to MEDIN and issued to United Kingdom Hydrographic Office in due course.
		We note that Westminster Gravels will be renewing their aggregate extraction licence in Area 457 in Liverpool Bay (please see: EIA/2023/00003). Currently this proposal is in early EIA scoping stages, the ES is expected to be submitted in Q2 2024. Consideration may need to be given to this proposal in the submitted CEA.	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list for physical processes is presented in **section 1.11**, **Table 1.19** (see also Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES). Ultimately this project was included within the CEA as it did overlap with the CEA physical processes study area.
		We note that the Mersey Tidal Power Project has been scoped out in the screening matrix of the PEIR. However, this may need to be given further consideration as the project progresses.	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list for physical processes is presented in **section 1.11**, **Table 1.19** (see also Volume 1, Annex 5.5: Cumulative

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		Consideration may need to be given to this proposal in the submitted CEA.	screening matrix and location plan of the ES). Ultimately this project was not included within the CEA as it did not overlap with the CEA physical processes study area, therefore having no pathway to form a cumulative impact with respect to physical processes.
		We do not agree that scour of seabed should be scoped out of the assessment. We advise that scour of seabed should be included in the submitted assessment, in line with best practice guidance as set out in Natural England's Best Practice Guidance Phase III.	The only infrastructure capable of resulting in primary scour under the scope of the Transmission Assets relates to that of cable protection for which scour protection measures are included. These cable protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour, to such a degree that it will not impact upon seabed morphology. Secondary scour however, has been considered within the assessment and CEA of the ES, now assessed within **Section 1.10** and **Section 1.12**.
		We acknowledge that numerical modelling has been used to quantify the changes in physical processes due to the installation of the Morgan and Morecambe Transmission Assets. We are broadly in agreement with the modelling approach, however, advise that the model outputs for Transmission Assets are presented. The submitted ES should present the Transmission Asset model outputs.	The assessment undertaken was an evidence-based conceptual study, as agreed though the scoping process. Therefore, modelling of the Transmission Assets was not undertaken. Numerical modelling used to support the ES is found within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES which is comprised of: • Mona Offshore Wind Project, Environmental Statement, Volume 6, Annex 1.1: Physical processes technical report; and • Morgan Offshore Wind Project: Generation Assets, Environmental Statement, Volume 4, Annex 1.1: Physical Processes Technical Report.
		The developer states that models and data from the Morgan Offshore Wind Project: Generation Assets PEIR have been used to infer the Transmission Assets PEIR. However, modelling	The assessment undertaken was an evidence-based conceptual study, as agreed though the scoping process. Therefore, modelling of the Transmission

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		output results and schematics have not been included in this Assessment. We advise that the model outputs for the Transmission Assets should be provided within the Chapter or as a separate Annex. This will be a separate application to the Generation assets and should be able to be read as a standalone document. We advise that the developer provides the model outputs for the Morgan and Morecambe Transmission Assets in the submitted ES, either within the text or as a separate Annex.	Assets was not undertaken. Numerical modelling used to support the ES is found within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES which is comprised of: • Mona Offshore Wind Project, Environmental Statement, Volume 6, Annex 1.1: Physical processes technical report; and • Morgan Offshore Wind Project: Generation Assets, Environmental Statement, Volume 4, Annex 1.1: Physical Processes Technical Report.
		It is noted that plough dredging may be undertaken as part of the seabed preparation activities. However, this hasn't been included in the modelling. It would be preferable to see a model simulation of plough dredging in the submitted ES to understand potential SSCs, sedimentation footprint and plume distance from this methodology.	The assessment undertaken was an evidence-based conceptual study, as agreed though the scoping process. Therefore, modelling of the Transmission Assets was not undertaken. Plough dredging does not represent a maximum design scenario, dredge and dumping however does, therefore the modelling supporting the assessment does represent the MDS.
		Results from the assessment of different construction activities within the Transmission Assets study area have been summarised broadly in terms of changes to SSC dispersion and sediment deposition thickness. However, the model outputs for each construction activity within the Transmission study area and schematics should also be provided. The submitted ES should provide model output of elevated SSCs and associated levels of sediment deposition for: • Drilling of monopile foundations/pin piles for jacket foundations • Seabed preparation by dredging prior to foundation and cable installation • Cable burial	It should be noted that this report uses an evidence based conceptual report supported by modelling undertaken for other nearby projects. The numerical modelling used to support the ES is found Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. This technical annex provides model outputs for elevated SSCs, deposition and changes to physical processes within the Transmission Assets, that can be used to inform the impacts owing to the construction, operation and maintenance, and decommissioning of the Transmission Assets.

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		(i.e., the MDS for sediment release for each activity).	
		We recommend the developer includes figures to illustrate sediment deposition footprints associated with installation activities overlaid with designated conservation sites within the study area. Please provide such figures in the submitted ES.	It should be noted that this report using an evidence based conceptual report supported by modelling undertaken for other projects. The numerical modelling used to support the ES is found Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES which is comprised of: • Mona Offshore Wind Project, Environmental Statement, Volume 6, Annex 1.1: Physical processes technical report; and • Morgan Offshore Wind Project: Generation Assets, Environmental Statement, Volume 4, Annex 1.1: Physical Processes Technical Report. This technical annex provides model outputs for elevated SSCs, deposition and changes to physical processes within the Transmission Assets, that can be used to inform the impacts owing to the construction, operation and maintenance, and decommissioning of the Transmission Assets.
		We welcome the Project's commitment CoT47 and note that this will include measures to limit the extent of cable protection within the Fylde MCZ, whilst the preferred option for cable protection is cable burial. However, it is not currently stated or assessed whether cable protection is anticipated to affect any MPAs (namely Fylde MCZ and Ribble MCZ) or sensitive features. We advise that the impacts of cable protection on MPAs or sensitive features are a key consenting risk for the project, and this should be reflected in the level of assessment in the submitted ES. If any MPAs or sensitive features are likely to be impacted by cable protection, then the extent of the impact and location should be stated.	Cable protection within the MCZ may be up to 3% of the total cable route as per CoT47, as described in **Table 1.13**. It will however be designed to be readily removable and mitigated in line with CoT109 as described in **Table 1.13**. Additionally, in response to comments from Natural England and MMO during the course of examination, the Applicants have also committed to no rock dumping within the Fylde MCZ as a condition of the draft DCO. Further information regarding the locations and use of cable crossings is presented within Volume 1, Annex 3.1: Offshore Crossing Schedule of the ES (document reference F1.3.1).

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
			This comment therefore falls in line with the commitments and approach proposed within the ES. Further information regarding the commitments for the Transmission Assets can be found in Volume 1, Annex 5.3: Commitments Register of the ES. The impact of cable protection within the MCZ is assessed within the assessment of effects in **section 1.10.**
		Impacts to sediment transport pathways due to the presence of physical structures. CoT47 states that no foreign material will be placed on the bed's surface in the inter- tidal region and low profile/tapered armouring would be employed in shallow water should this be required. CoT47 should be defined and extended to the depth of closure based on average significant wave heights.	This comment aligns with the commitments and approach proposed within the ES, as described in Volume 1, Annex 5.3: Commitments Register of the ES, with measures (commitments) adopted for the Transmission Assets presented within **Table 1.13.** Noting that in response to comments from Natural England and MMO during the course of examination, the Applicants have made a further commitment; CoT133 states that "No cable/scour protection shall be ~~permanently~~ deployed in the intertidal area between MLWS and MHWS during the construction and operation and maintenance phases." Where practicable the requirements will be compliant with the Maritime and Coastguard Agency (MCA) navigation guidance which includes that there will be "…No more than a 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the offshore export cable corridor route without prior written approval from the licencing authority in consultation with the MCA and Trinity House.", as per CoT45 outlined in **Table 1.13**.
		The assessment states that for several impacts, the precise magnitude of impacts will be dependent on location and detailed design prior to ES submission. However, it is noted that the	The project design has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. In line with the refinement the MDS

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		magnitude of impact and significance of effect has been concluded as 'low adverse' or 'negligible adverse'. We advise that the full suite of parameters and precise magnitude of impacts are assessed in the ES to improve the robustness of the assessment.	presented in **Table 1.14** provides the parameters and justification for assessment for physical processes.
		For the Transmission Assets the magnitude and areas affected by cable protection will be specific to the location, i.e. water depth, orientation to tidal flow and length of continuous protection. From the modelling undertaken for the Mona and Morecambe Offshore Wind Project PEIR it may be concluded that Fylde MCZ and designated areas associated with the Ribble Estuary may be affected if cable protection is placed within these areas. Additionally, the effects of cable protection within the nearshore will be mitigated with the use of low profile tapered mattressing to be detailed in the CSIP. The area which should be exempt to cable protection to prevent impacts on sediment transport should be further defined and extended to the depth of closure based on average significant wave heights and secured appropriately in the application. The depth of cable burial should be defined in the CSIP and agreed in order to prevent the need for cable protection. There should be a commitment made in the DCO to remove cable protection from the 'nearshore' as part of the decommissioning plan. Any cable protection used should be designed to be removeable to prevent permanent impacts.	The project design has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. Cable protection within the MCZ may be up to 3% of the total cable route as described in CoT47 in **Table 1.13**. It will however be designed to be removable on decommissioning with the requirement for removal agreed with stakeholders and regulators at the time of decommissioning, as described in CoT109 in **Table 1.13**. This comment therefore falls in line with the commitments and approach proposed within the ES. Further information regarding the commitments list can be found in Volume 1, Annex 5.3: Commitments Register. The impact of cable protection within the MCZ is assessed within the assessment of effects in **section 1.10**. There is however a commitment, CoT47, outlined in **Table 1.13**, to limit the extent of cable protection within the Fylde MCZ, "…Within the Fylde MCZ, external cable protection will only be used where deemed to be essential, e.g. for cable crossings or in the instance that adequate burial / reburial is not possible for any section of the route through the Fylde MCZ…". Where cable protection is required it will be designed to be removable on decommissioning as described in CoT109 in **Table 1.13**. Additionally, the

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
			Applicants have also committed to no rock dumping within the Fylde MCZ as a condition of the draft DCO. Further information regarding the locations and use of cable crossings is presented within Volume 1, Annex 3.1: Offshore Crossing Schedule of the ES (document reference F1.3.1).
		We note that the tiered system used within the cumulative impact assessment is based on a three-tier approach. Natural England and JNCC (2022) has developed a tiered approach for scoping projects into cumulative/in-combination assessments. Please see Natural England's Best Practice Guidance Phase III.	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list is presented in **section 1.11**, **Table 1.19** and the assessment undertaken in line with best practice.
		1.8.2.10 of the Physical Processes Chapter states in areas with relatively low levels of sediment transport and areas with higher fine sediment content (e.g. muddy sands and sandy muds) trenches were observed, although these were relatively shallow features. Further option to mitigate impacts-Micro- siting the cable route into areas which are most likely to recover i.e. avoiding areas with higher fine sediment content within Fylde MCZ.	The project design has been refined and further detail presented in Volume 1, Chapter 3: Project description of the ES. Given the east-west split of sediment classification within the Fylde MCZ, with fine sand and mud regions lying parallel to the coast, the potential for micro siting to avoid finer seabed material within the cable corridor is limited (Gardline, 2022). Further information regarding sediment classification within the MCZ is presented in Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES. Further information regarding the locations of cable crossings is presented within Volume 1, Annex 3.2: Offshore Crossing Schedule of the ES (document reference F1.3.2).
		The modelling for an increase in suspended sediments has not been provided, and the physical processes chapter only references to the work done by the Generation Assets. The submitted ES should present the model outputs for changes to SSC from each aspect of the proposed development.	It should be noted that this report using an evidence based conceptual report supported by modelling undertaken for other projects. The numerical modelling used to support the ES is found within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES which is comprised of:

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
			• Mona Offshore Wind Project, Environmental Statement, Volume 6, Annex 1.1: Physical processes technical report; and • Morgan Offshore Wind Project: Generation Assets, Environmental Statement, Volume 4, Annex 1.1: Physical Processes Technical Report. This technical annex provides model outputs for elevated SSCs, deposition and changes to physical processes within the Transmission Assets study area, that can be used to inform the impacts owing to the construction, operation and maintenance, and decommissioning of the Transmission Assets.
		We acknowledge that a matrix approach to determining the significance of effects on ecological features, is commonly used. However, this method often relies on value- rather than evidence-based judgements. The subjective evaluation of magnitude of impact and sensitivity/importance of receptors through expert judgement has led to many impact magnitudes and receptor importance/sensitivities being downgraded across topics in the PEIR. We also note that any effect that is concluded to be of moderate or major significance in the PEIR, is deemed to be 'significant' in EIA terms, whereas effects concluded to be of negligible or minor significance, are deemed 'not significant' in EIA terms. This cut-off could exclude any effect concluded to be less than moderate, in turn, this could lead to errors in assessing cumulative effects adequately.	Clarification with respect to determination of magnitude of cumulative effect and how this informed significance of effect has been added into the cumulative effect assessment methodology in **section 1.11**. The significance of effect for cumulative impacts is determined by adding the magnitudes of projects together and assessing against the sensitivity of receptors, and not by adding the significance of individual projects.
		The area impacted by sandwave clearance within Fylde MCZ is large. We recommend careful application of the mitigation hierarchy by the use of best practice methods to reduce the area impacted by disposal through, as set out in our detailed comments.	The project refinement and detailed assessment of geophysical surveys has identified that the volume of sandwave clearance required is significantly reduced from that proposed in the PEIR, as presented in **Table** 1.14.

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		All efforts to avoid areas of boulders or minimise the need for boulder clearance by micro-siting should be explored through a boulder clearance methodology and stated within the Application, and the potential impacts of boulder placement on sediment movement carefully assessed.	The description of seabed preparation has been refined and further detail is presented in Volume 1, Chapter 3: Project description of the ES. The assessment methodology includes assessment of activities where significant effects may occur, outlined in **section 1.9**. As boulder clearance is will take the form of sidecasting, the activity will not result in significant increases in SSC or changes to the seabed characteristics or physical processes.
		From experience on other windfarms, HDD can fail on occasion. Therefore, the applicant should ensure that the worst case scenario at landfall takes this into consideration. This should consider impacts on Lytham St. Annes Dunes SSSI with a sufficient baseline collected to assess impact post construction.	The MDS for cable installation within the intertidal area pertains to open trenching and mechanical trenching as assessed within **section 1.10**.
November 2023	Ørsted Burbo Bank – Section 42	It is important to ensure that all environmental impacts of the Morgan and Morecambe Transmission Assets are properly and fully assessed including any potential cumulative or in combination effects with Burbo Bank Extension.	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list for physical processes is presented in **section 1.11**, **Table 1.19** (see also Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES).
		We welcome the opportunity to discuss further the following cumulative and in- combination impacts: • Cumulative and in-combination effects – these are an area of concern due to the nature of the increased development in a congested area of sea, particularly in relation to shipping and navigation, ornithology, and marine mammals, as well as seabed morphology. • Further displacement of fisheries and established co-existence relationships	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list for physical processes is presented in **section 1.11**, **Table 1.19** (see also Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES). Cumulative effect assessments have been included for benthic ecology (Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES), fish and shellfish ecology (Volume 2, Chapter 3: Fish and shellfish ecology of the ES), marine mammals (Volume 2, Chapter 4: Marine mammals of the ES), ornithology

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
			(Volume 2, Chapter 5: Offshore ornithology of the ES), commercial fishing (Volume 2, Chapter 6: Commercial fisheries of the ES), shipping and navigation (Volume 2, Chapter 7: Shipping and navigation of the ES), marine archaeology (Volume 2, Chapter 8: Marine archaeology of the ES), and other sea users (Volume 2, Chapter 9: Other sea users of the ES) in their respective chapters.
		The PEIR does not appear to provide information on the proposed approach when dealing with ongoing cumulative environmental monitoring and survey programmes, and MWL would welcome the opportunity to receive more information on this.	Physical processes monitoring is considered in the outline Offshore In Principle Monitoring Plan (IPMP) (document reference J20). It will be submitted with the application and will consider effects of sediment transport and sediment transport pathways on cable burial to ensure that buried cable remains adequately buried.
November 2023	Isle of Man Government – Section 42	The TSC would draw the applicant's attention to the Manx Marine Environmental Assessment (MMEA) which provides a useful overview of the Island's marine environment and should be taken into account as part of both the transboundary and possibly also the cumulative impacts assessment as part of this application. More detail will be provided below in respect of specific areas of the MMEA that should be reviewed. In addition to this broad statement, the TSC has provided specific comments, over subsequent pages, in relation to the individual chapters of the PEIR, and collated on behalf of various contributors within the responsible Departments of the Isle of Man Government	The Manx Marine Environmental Assessment has been considered with the ES as a relevant data source and has been utilised and referenced within the desktop study in **Table 1.6.** It should be noted that the territorial waters of the Isle of Man were considered as part of the baseline environment and thus not assessed as a transboundary receptor within **section 1.13**.
November 2023	Natural Resources Wales (NRW) – Section 42	NRW (A) note that on the listed projects included for assessment of cumulative effects, the Offshore elements of EniHynet should be included and that Isle of Man offshore wind farm Mooir Vannin is also due to be constructed by 2030 so should also be included.	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list for physical processes is presented in **section 1.11**, **Table 1.19** (see also Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES). Both the

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
			Eni Hynet – Carbon Capture Project and the Mooir Vannin Offshore Wind Farm have been included and assessed within the CEA as presented in **section 1.12.**
November 2023	Walney (UK) Offshore Windfarms Limited – Section 42 Ørsted West of Duddon Sands – Section 42	It is important to ensure that all environmental impacts of the Morgan and Morecambe Transmission Assets are properly and fully assessed including any potential cumulative or in combination effects with Walney 1 and 2.	The list of projects considered within the CEA has been updated in line with developments three months prior to application submission. The revised CEA list for physical processes is presented in **section 1.11**, **Table 1.19** (see also Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES). The Walney 1 and 2 Offshore Wind Farms form part of the existing baseline however proposed maintenance activities are considered within the assessment.
		We would welcome the opportunity to discuss further the following cumulative and in-combination impacts: • Cumulative and in-combination effects – these are an area of concern due to the nature of the increased development in a congested area of sea, particularly in relation to shipping and navigation, ornithology, and marine mammals, as well as seabed morphology. • Further displacement of fisheries and established co-existence relationships. • Temporary habitat disturbance/loss associated with the Transmission Assets alongside the Morgan Offshore Wind Farm Generation Assets and other tier 2 and tier 3 projects.	Cumulative effect assessments have been included for benthic ecology (Volume 2, Chapter 2: Benthic subtidal and intertidal ecology of the ES), fish and shellfish ecology (Volume 2, Chapter 3: Fish and shellfish ecology of the ES), marine mammals (Volume 2, Chapter 4: Marine mammals of the ES), ornithology (Volume 2, Chapter 5: Offshore ornithology of the ES), commercial fishing (Volume 2, Chapter 6: Commercial fisheries of the ES), shipping and navigation (Volume 2, Chapter 7: Shipping and navigation of the ES), marine archaeology (Volume 2, Chapter 8: Marine archaeology of the ES), and other sea users (Volume 2, Chapter 9: Other sea users of the ES) in their respective chapters.
November 2023	Northwest Wildlife Trust – Section 42	Given the proximity to Welsh waters and Isle of Man, we expect there to be full consideration of transboundary effects and cumulative impacts across borders. The Irish Sea is a busy regional sea, under significant pressure and the cumulative and in-combination effects on the marine environment from building offshore infrastructure on such a large scale could have	Transboundary effects have been considered within **section 1.13**. Note the Isle of Man is a Crown Dependency of the UK and is not within the European Economic area as is considered under Regulation 32 of the Infrastructure Planning (EIA) Regulations 2017. The Isle of Man therefore plays an integral part of the planning policy

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		significant impacts on the marine environment if not managed correctly.	and consultation process. This is considered within the Assessment of Effects in **section 1.10**.
November 2023	MMO and CEFAS – Section 42	MMO requests the inclusion of the seabed mobility discussed in the Coughlan et al. (2021) paper.	Acknowledged. The study was taken into account as part of the ES list of desk studies and has been included in **section 1.5.1** and the baseline environment presented in **section 1.5.4**.
		Only a sample of the geophysical survey has been presented in Table 1.10 and thus the geographic scope, quality and interpretation has not been assessed. This should be assessed and included within the ES. This must be clarified.	Site specific surveys have informed the baseline environment. Those studies relevant to physical processes have been presented in **Table 1.8**. These data sources are referred to throughout the chapter where relevant.
		With regards to Section 1.9.2.17, MMO queries how many simultaneous dredging/disposal operations are expected at any one time and whether any suspended sediment plumes coalesce?	Information regarding the construction programme and possible cumulative effects within the project scope due to the simultaneous undertaking of activities has been assessed in **section 1.10**.
		Within Section 1.9.5.13, the planned cable routes, the sediment transport direction and bedform in the Cable assessment document (when this is produced), should be shown as a series of maps within the ES.	Detailed bathymetry and bedforms along the cable route are presented in Figure 1.4 (Volume 2, Chapter Figures).
		MMO advises that further details of the offshore punchout location and any released fluids is required within Section 1.9.6.1.	Cable installation at landfall does not rely on HDD, with direct pipe trenchless techniques and open-cut trenching techniques considered within Volume 1, Chapter 3: Project description of the ES.
February 2024	EWG consultation meeting 3 In attendance: MMO, Cefas, Environment Agency and Natural England.	The feedback from the Section 42 responses was presented across three overarching themes: the scope of the assessment, the project description and the CEA. Noting that secondary scour is scoped into the assessment. It was proposed that waves, tides and offshore sediment transport would be assessed collectively as one overarching seabed morphology assessment (nothing further being scoped out).	The project description has been refined with respect to further project definition as presented in Volume 1, Chapter 3: Project description of the ES. This refinement includes that the Offshore Substation Platforms (OSPs) relating to the Generation Assets and are not included in the Transmission Assets ES as outlined in the MDS table presented in **Table 1.14.** It

Date	Consultee and type of response	Comments raised	Response to comments raised and/or where considered in this chapter
		It was noted by Natural England that the project design should consider a range of engineering options and implement the most appropriate particularly with respect to cable protection suited to areas with active sediment transport regimes and to consider alternative options to the use of jack-up vessels.	Should also be noted that there are no inter-array cables associated with the Transmission Assets. In line with the mitigation hierarchy a range of project approaches and parameters are outlined in Volume 1, Chapter 3: Project description of the ES. In line with CoT45, an Outline Offshore Cable Specification and Installation Plan (CSIP) (document reference J15) is submitted with the Application. The CSIP (document reference J15) also includes an Outline Cable Burial Risk Assessment (document reference J14). No issues were raised with regards to an overarching seabed morphology assessment, therefore the assessments presented in **section 1.10** and **section 1.12** were undertaken on this basis.

1.4 Study area

1.4.1.1 For the purposes of this chapter the Transmission Assets Order Limits: Offshore is defined as the area encompassing elements of the Transmission Assets below Mean Low Water Springs (MLWS). Whilst the Intertidal Infrastructure Area is defined as the temporary and permanent areas between MLWS and MHWS. The physical processes study area (hereafter referred to as the study area) is defined as the Transmission Assets Red Line Boundary for PEIR plus a buffer of one spring tidal excursion. This defines a study area illustrated in Figure 1.1 (Volume 2, Chapter Figures) and is the predicted physical processes Zone of Influence for the Transmission Assets, i.e., the maximum distance suspended sediments would travel from the Offshore Order Limits in one tidal cycle prior to deposition on slack water or being carried back on the returning tide. The Offshore Order Limits has been reduced in size since the publication of the PEIR, as can be seen in Figure 1.1 (Volume 2, Chapter Figures) however in line with a conservative approach, the study area remains unchanged. The study area was agreed through the EPP processes and falls in line with the approach adopted for Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets (hereafter referred to collectively as the Generation Assets).

1.4.1.2 The study area has been defined by undertaking dispersion modelling using the models developed for the Morgan Generation Assets modelling study as presented in Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. The resulting study area therefore takes account of the variation in tidal flow magnitude and directionality across the region.

1.5 Baseline environment

1.5.1 Desk study

1.5.1.1 A comprehensive desk-based review was undertaken to inform the baseline for physical processes. The existing studies and datasets referred to as part of the desk-based review are summarised in **Table 1.6**.

1.5.1.2 The physical processes baseline, defined in terms of bathymetry, tidal currents, wave climate and sediment transport characteristics is outlined in **section 1.5.4**.

Table 1.6: Summary of desk study sources used

Title	Source	Year	Author
Morgan Offshore Wind Project: Generation Assets Environmental Statement (ES) - volume 4, annex 1.1: Physical processes technical report	Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES	2023	BP/EnBW
Morecambe Offshore Generation Assets Environmental Statement (ES) – Volume 5 Chapter 7 Marine Geology, Oceanography and Physical Processes	https://morecambeoffshorewind.com/	2024	Royal HaskoningDHV
Mona Offshore Wind Project Environmental Statement (ES) - volume 4, annex 1.1: Physical processes technical report	Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES	2023	BP/EnBW
Assessment of Seabed Level Vertical Variability for Morgan Offshore Wind Farm, Morphodynamic Characterisation, Morphological Analysis and Prediction of Future Seabed Levels.	Morgan Offshore Wind Limited	2023	ABPmer
Geological Ground Model Morgan: Morgan Windfarm Development Irish Sea	Morgan Offshore Wind Limited	2023	Bp/EnBW
European Marine Observation and Data Network (EMODnet) – Seabed classification	https://www.emodnet-geology.eu/	2023	EMODnet
EMODnet– Bathymetry data	https://www.emodnet-bathymetry.eu/	2023	EMODnet
EMODnet – Metocean data	https://map.emodnet-physics.eu/	2023	EMODnet
Designated sites (SPAs and SACs)	JNCC mapping data (https://jncc.gov.uk/mpa-mapper/)	2023	JNCC
Designated sites (SSSIs)	Defra Spatial Data Download	2023	Defra
Designated Ramsar sites	Map (ramsar.org)	2023	Ramsar
Department for Environment Food and Rural Affairs – Bathymetry data	https://environment.data.gov.uk/DefraDataDownload	2022	Department for Environment, Food and Rural Affairs (Defra)
The Environment Agency National LiDAR Programme	National LIDAR Programme - data.gov.uk	2022	Environment Agency
National Oceanic and Atmospheric Administration –Atmospheric data	DHI Metocean Data Portal	2022	National Oceanic and Atmospheric Administration

Title	Source	Year	Author
National Network of Regional Coastal Monitoring Programmes	https://coastalmonitoring.org/cco/	2022	Coastal Channel Observatory
CEFAS – wave data	https://wavenet.cefas.co.uk/map	2022	CEFAS
ABPmer Data explorer	https://www.seastates.net/explore-data/	2022	ABPmer
Atlas of UK Marine Renewable Energy Resources	https://www.renewables-atlas.info/	2022	ABPmer
British Geological Survey – sediment sample data	https://mapapps2.bgs.ac.uk/geoindex_offshore	2022	BGS
Admiralty Tide Tables	United Kingdom Hydrographic Office	2022	United Kingdom Hydrographic Office
Marine Environmental Data Information Network (MEDIN) Seabed Mapping Programme	Admiralty Marine Data Portal	2022	MEDIN
Integrated Mapping for the Sustainable Developments of Ireland's Marine Resource (INFOMAR) Seabed Mapping Programme	Geological Survey Ireland (GSI) and Marine Institute	2022	INFOMAR
Long term wind and wave datasets	European Centre for Medium-range Weather Forecast (ECMWF)	2022	ECMWF
Awel y Môr Offshore Windfarm PEIR and ES	Awel y Môr Offshore Wind Farm Ltd.	2021 & 2022	RWE Renewables
UK tide gauge network and database of current observation	British Oceanographic Data Centre (BODC)	2021	BODC
A new seabed mobility index for the Irish Sea: Modelling seabed shear stress and classifying sediment mobilisation to help predict erosion, deposition, and sediment distribution	https://research.bangor.ac.uk/	2021	Couglan et al
Manx Marine Environmental Assessment: Chapter 2 – Physical Environment	https://www.gov.im/about-the-government/departments/infrastructure/harbours-information/territorial-seas/manx-marine-environmental-assessment/	2018	Department of Environment, Food and Agriculture: Isle of Man
Race Bank Offshore Wind Sandwave Recovery Report	https://infrastructure.planninginspectorate.gov.uk/	2018	Ørsted
UK Climate Projections (UKCP)	Met Office	2018	Met Office
Suspended Sediment Climatologies around the UK.	Department for Business, Energy & Industrial Strategy	2016	Cefas
Review of aggregate dredging off the Welsh coast	HR Wallingford	2016	HR Wallingford

Title	Source	Year	Author
A user-friendly database of coastal flooding in the UK from 1915-2014	Scientific Data (journal)	2015	Haigh et al.
Geology of the seabed and shallow subsurface: The Irish Sea.	British Geological Survey	2015	Mellett et al.
Burbo Bank Extension Offshore Windfarm Environmental Statement	https://www.marinedataexchange.co.uk/	2013	Ørsted
Walney Extension Offshore Wind Farm Environmental Statement	https://www.marinedataexchange.co.uk/	2013	Ørsted
Irish Sea Zone Hydrodynamic measurement campaign	Marine Data Exchange	2010 to 2013	EMU Ltd (now Fugro Ltd)
Natural Variability of Turbidity in the Regional Environmental Assessment (REA) Areas.	https://www.marinedataexchange.co.uk/	2011	MALF
North West England and North Wales SMP22 - SMP2	http://www.hoylakevision.org.uk/wp-content/uploads/2012/11/SMP2 Main.pdf	2011	Halcrow Group Ltd
Metocean Data collection for the Ormonde offshore wind project.	Marine Data Exchange	2011	Geotechnical Engineering and Marine Surveys (GEMS)
Cell Eleven Tidal and Sediment Study Phase 2	https://coastalmonitoring.org/	2010	Halcrow Group Ltd
Cell Eleven Regional Monitoring Strategy (CERMS)	https://coastalmonitoring.org/	2010	Halcrow Group Ltd
Walney 1 & 2 Offshore Windfarm Environmental Statements	https://www.marinedataexchange.co.uk/	2006	Ørsted
West of Duddon Sands Offshore Windfarm Environmental Statement	https://www.marinedataexchange.co.uk/	2006	RSK Environment Ltd
DTI Strategic Environmental Assessment Area 6, Irish Sea, seabed and surficial geology and processes	British Geological Survey	2005	Holmes and Tappin
Ormonde Offshore Windfarm Environmental Statement	https://www.marinedataexchange.co.uk/	2005	Rudall Blanchard Associates
Barrow Offshore Windfarm Environmental Statement	https://www.marinedataexchange.co.uk/	2005	Royal HaskoningDHV
Sand banks, sand transport and offshore wind farms	https://tethys.pnnl.gov/publications/sand-banks-sand-transport-offshore-wind-farms-technical-report	2005	Kenyon and Cooper
Hydrography of the Irish Sea, SEA6 Technical Report	UK Government	2005	Howarth M.J.

Title	Source	Year	Author
British Oceanographic Data Centre	National Oceanography Centre	various	National Oceanography Centre

1.5.2 Designated sites

1.5.2.1 All designated sites within the study area and qualifying interest features that could be affected by the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are set out in **Table 1.7** and shown in Figure 1.2 (Volume 2, Chapter Figures).

Table 1.7: Designated sites and relevant qualifying interests

Designated site	Distance to the Transmission Assets (nearest point)	Relevant qualifying interest
Fylde (MCZ)	0 km	Protected feature. • Subtidal sand. • Subtidal mud.
Ribble and Alt Estuaries (SPA)	0 km	Protected feature. • Tidal flats and saltmarsh supporting internationally important populations of wintering waterbirds.
Ribble and Alt Estuaries (Ramsar)		
Ribble Estuary (SSSI)		
Bathing Waters	Blackpool 0 km (adjacent) Lytham St. Annes 0 km	• Water Quality.
Shell Flat and Lune Deep (SAC)	5.72 km	Protected feature. • Sandbanks which are slightly covered by sea water all the time (Annex I habitat). • Reefs (Annex I habitat).
West of Walney (MCZ)	5.85 km	Protected feature. • Subtidal sand. • Subtidal mud. • Sea-pen and burrowing megafauna communities.
West of Copeland (MCZ)	6.32 km	Protected feature. • Subtidal sand. • Subtidal coarse sediment. • Subtidal mixed sediments. • Sandbanks (Annex 1 habitat).

1.5.3 Site-specific surveys

1.5.3.1 In order to inform the ES, site-specific surveys were undertaken. It is noted that the Offshore Order Limits encompasses the Generation Assets and therefore site-specific surveys undertaken for these projects are also applicable to the Transmission Assets. A summary of the surveys undertaken to inform the physical processes impact assessment is outlined in **Table 1.8**.

Table 1.8: Site-specific surveys of relevance to physical processes

Survey type	Extent of survey	Sensitivity/value	Survey contractor	Date
Geophysical survey	Transmission Assets: cable corridor	The geophysical survey elements consisted of multi-beam echo sounder (MBES), digital sound velocity (DSV) sensor, side scan sonar	Gardline Ltd	2022

Survey type	Extent of survey	Sensitivity/value	Survey contractor	Date
		system (SSS), Sub-Bottom Profiler (SBP) & 2D Ultra High Resolution Seismic (2D UHRS) sensor. The environmental survey elements included the collection of seabed imagery along with grab samples. The geotechnical survey elements included cone penetration testing (CPT) and boreholes.		
Environmental Baseline Surveys and Habitat Assessments	Morgan Offshore Wind Project: Generation Assets	Geophysical, geotechnical and environmental survey to determine characteristics of seabed sediment, characterise benthic communities (infauna and epifauna) and identification of any environmentally significant habitats (e.g. potential Habitats Directive Annex I and priority marine features). The geophysical survey elements consisted of MBES, digital sound velocity (DSV) sensor, side scan sonar system (SSS), Sub-Bottom Profiler (SBP) & 2D Ultra High Resolution Seismic (2D UHRS) sensor. The environmental survey elements included the collection of seabed imagery along with grab samples. The geotechnical survey elements included cone penetration testing (CPT) and boreholes.	Gardline Ltd	2021
Geophysical survey	Morgan Offshore Wind Project: Generation Assets	Geophysical survey to establish bathymetry, seabed sediment and identify seabed features. Deployment included MBES with multibeam backscatter.	XOCEAN Ltd	2022
Metocean survey	Morgan Offshore Wind Project: Generation Assets	Metocean and floating lidar deployments to ascertain wind, wave and tidal currents.	Fugro	2022
Geophysical survey	Morecambe Offshore Windfarm: Generation Assets	Geophysical survey to establish bathymetry, seabed	MMT	2021

Survey type	Extent of survey	Sensitivity/value	Survey contractor	Date
		sediment and identify seabed features.		
Grab sample survey	Morecambe Offshore Windfarm: Generation Assets	Grab sampling at 50 locations to determine sediment type and particle size.	Ocean Ecology Ltd	2022

1.5.4 Baseline environment

Bathymetry

1.5.4.1 The Offshore Order Limits feature a relatively linear decrease in seabed level from east to west, that begins to rise again in the north west extent as it comes into proximity of the Isle of Man, as presented in **Diagram 1.1**. Depths within the Offshore Order Limits range to a maximum depth of *c*. 54 m Mean Sea Level (MSL), occurring within the Morgan Offshore Wind Project: Generation Assets area, which is intersected by a deep corridor from south west to north east.

1.5.4.2 Sandwave features are present within the Offshore Order Limits , as illustrated in Figure 1.4 (Volume 2, Chapter Figures) which presents detailed bathymetric data. The figures shows that sandwaves within the area have a general north – south orientation and largely occur within the Morgan Offshore Wind Project: Generation Assets and within the west section of the offshore export cable corridor route for the Offshore Order Limits. Sandwaves within the Morgan Offshore Wind Project: Generation Assets can have crest heights of 5 m, as informed by the analysis presented in the 'Assessment of Seabed Level Vertical Variability for Morgan Offshore Wind Farm, Morphodynamic Characterisation, Morphological Analysis and Prediction of Future Seabed Levels' (ABPmer, 2023). In the export cable corridor and the Morecambe Offshore WindFarm: Generation Assets, both the presence and crest heights of sandwaves are reduced, with heights generally limited to *c*. 1 m.

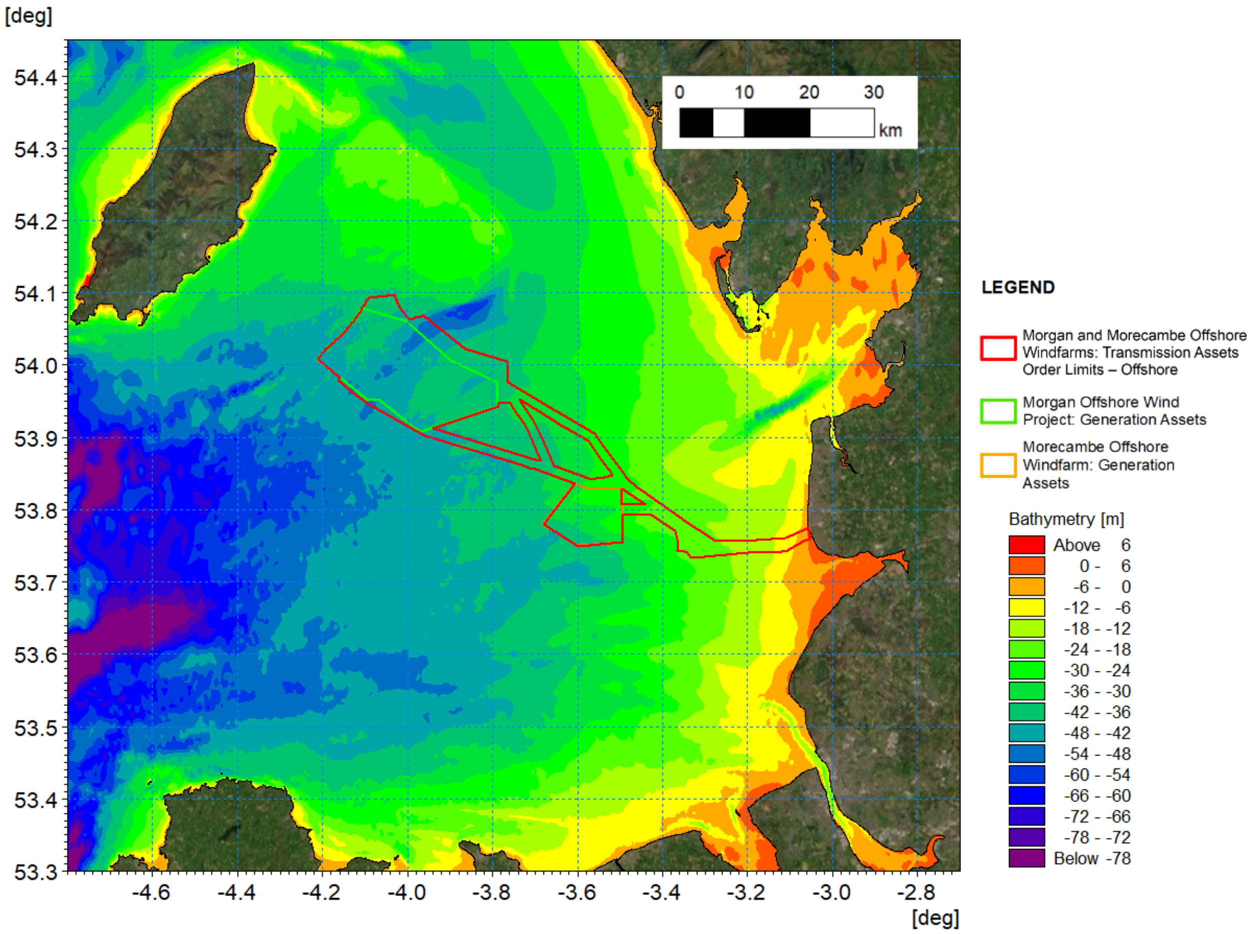

Diagram 1.1: Bathymetry within the east Irish Sea (not to scale)

Hydrography

1.5.4.3 The United Kingdom Hydrographic Office (UKHO, 2022) states that the mean tidal range at the Standard Port of Holyhead is approximately 3.65 m whilst at Douglas it is approximately 4.55 m. The tidal characteristics are shown in **Table 1.9** and are given in metres referenced to Chart Datum (CD).

Table 1.9: Tidal Levels at Standard Ports

Tidal level (m CD)	Holyhead (m CD)	Douglas (m CD)
Lowest Astronomical Tide	0.0	-0.3
Mean Low Water Springs (MLWS)	0.7	0.8
Mean Low Water Neaps (MLWN)	2.0	2.4
Mean Sea Level (MSL)	3.3	3.8
Mean High Water Neaps (MHWN)	4.4	5.4
MHWS	5.6	6.9
Highest Astronomical Tide	6.3	7.9

1.5.4.4 Semi-diurnal tides are the dominant physical process in the Irish Sea coming from the Atlantic Ocean through both the North Channel and St Georges Channel. The tidal range in the Irish Sea is highly variable with a range greater than 10 m on the largest spring tides, the second largest in Britain.

1.5.4.5 Tidal currents in the Irish Sea are strongest around the north of Anglesey with a mean spring peak flow of 2.8 m/s. Tidal currents in the Irish Sea are also strong between the Isle of Man and Scotland with a mean spring peak flow of 2 m/s. Tidal currents within the Offshore Order Limits are lower as presented in **Diagram 1.2** and **Diagram 1.3** for neap flood and ebb tides respectively. Similarly, **Diagram 1.4** and **Diagram 1.5** illustrate typical spring tides, with a mean spring peak flow of between 1.0 m/s and 0.3 m/s. Tidal currents range from the fastest currents in the west to the slowest currents in the east within the study area at the coast (ABPmer, 2008). A flood dominance is more evident and pronounced during spring tides (Fugro, 2022).

1.5.4.6 Littoral currents are driven by tides, waves, and meteorological events. The littoral currents were modelled from the westerly sector during a one in one year storm event, resulting in the increase of currents on the peak flood tide and decrease on the ebb.

1.5.4.7 A range of freely available metocean data sources (Marine Data Exchange, 2023) were utilised in conjunction with project specific data relating to the Morgan Offshore Wind Project: Generation Assets and Mona Offshore Wind Project (Fugro, 2022), in the calibration and validation of modelling studies used to support the physical processes assessment. Locations of site specific and historic metocean data used to inform the assessment are displayed in Figure 1.3 (Volume 2, Chapter Figures).

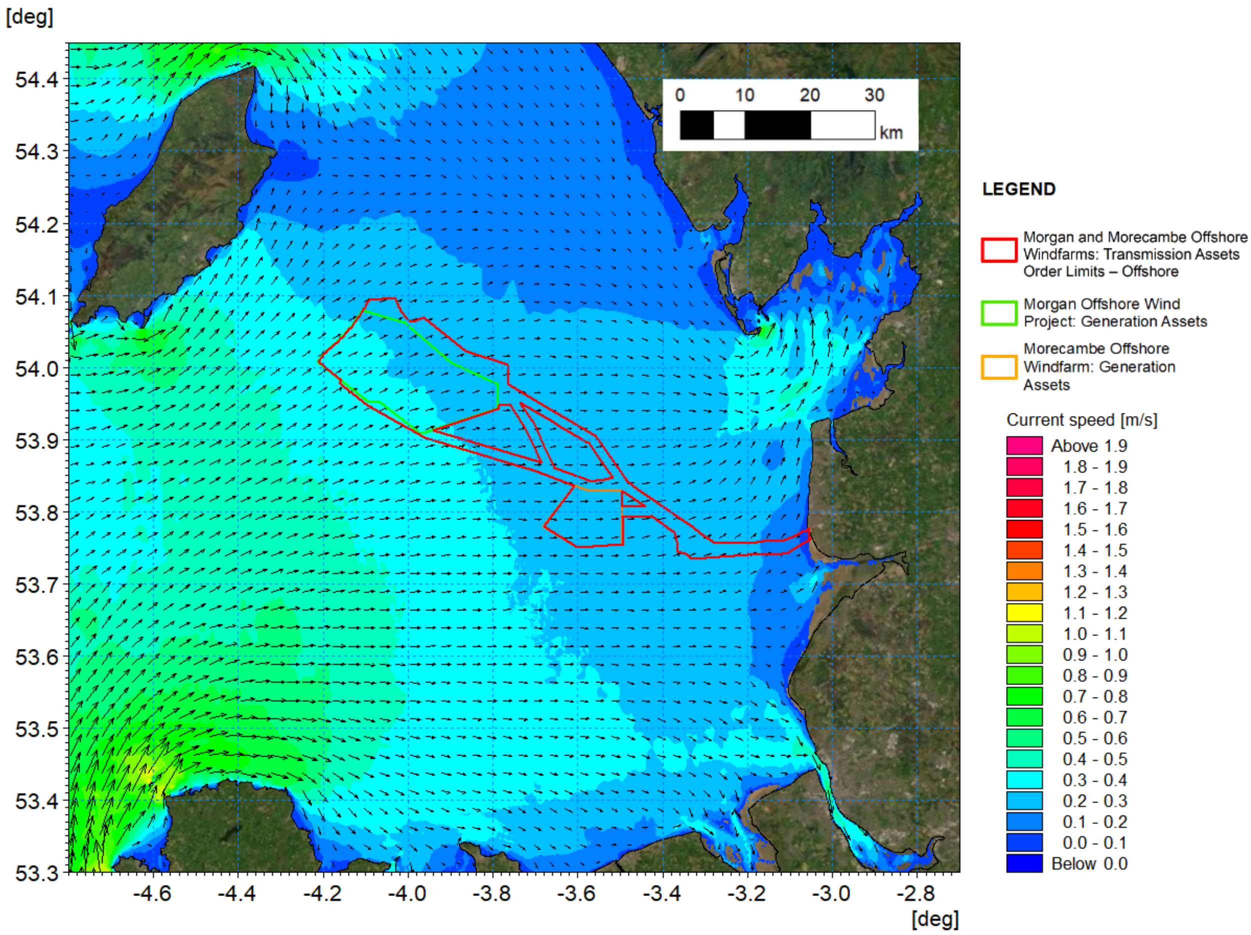

Diagram 1.2: Tidal flow patterns – neap tide flood (not to scale)

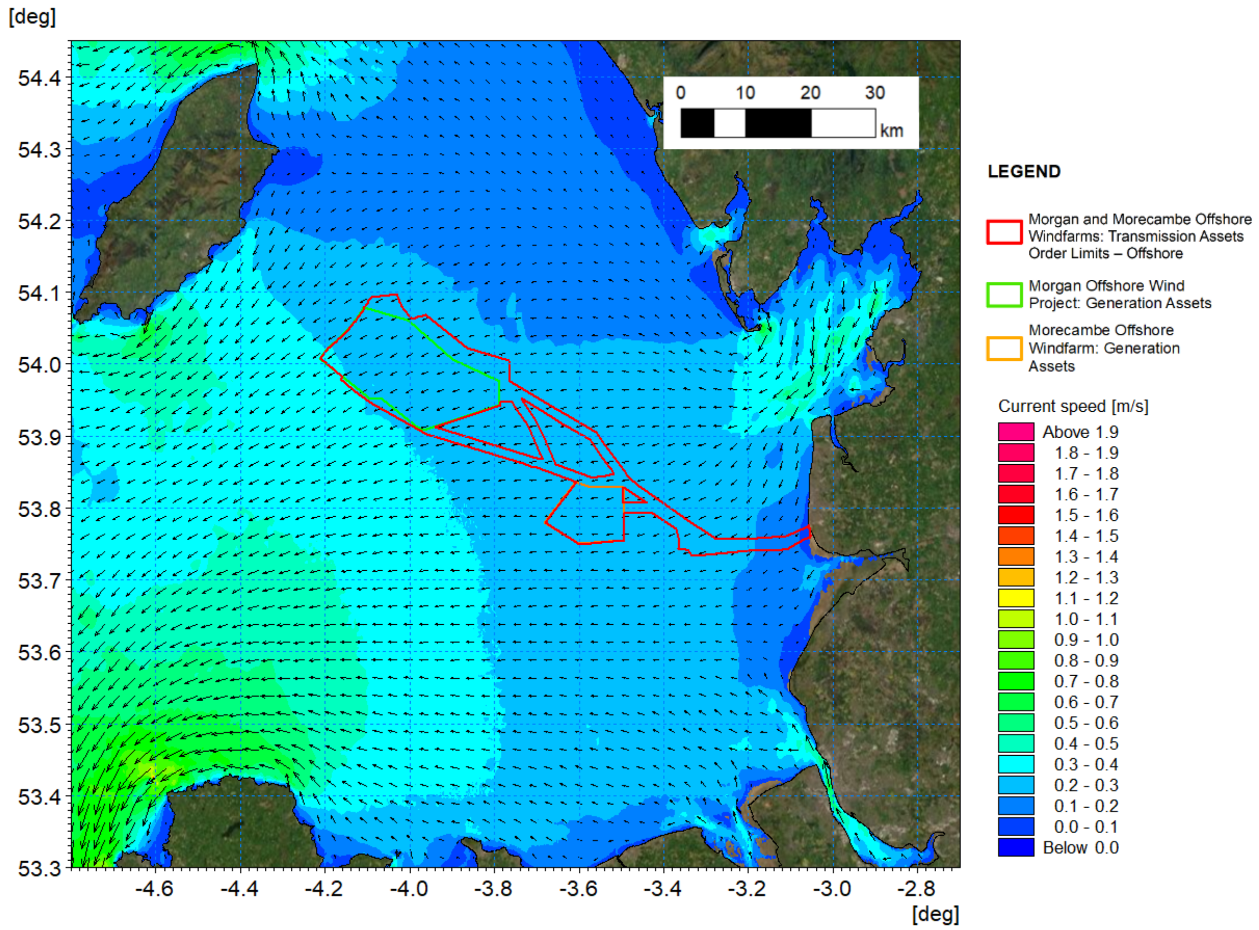

Diagram 1.3: Tidal flow patterns – neap tide ebb (not to scale)

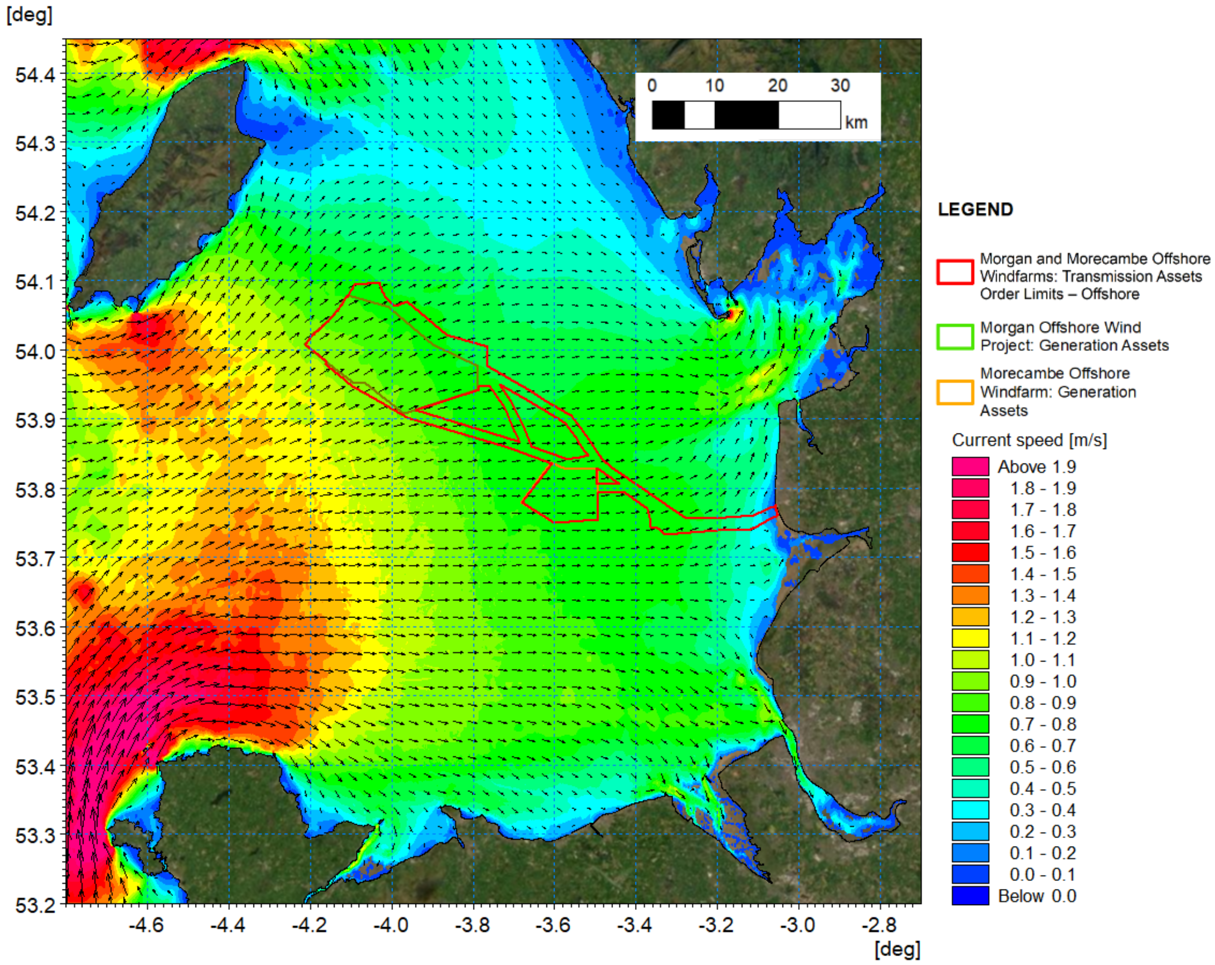

Diagram 1.4: Tidal flow patterns – spring tide flood (not to scale)

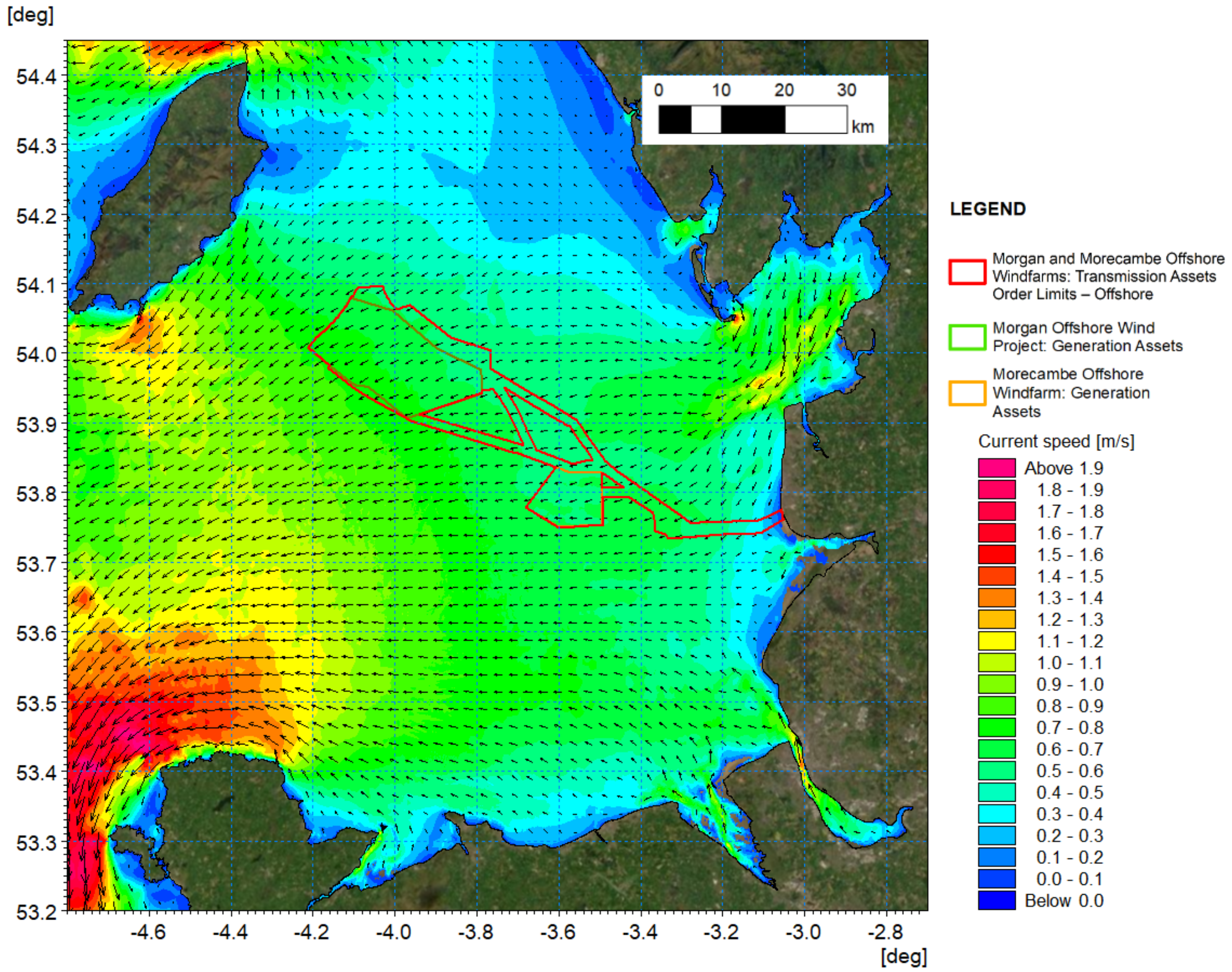

Diagram 1.5: Tidal flow patterns – spring tide ebb (not to scale)

Wave climate

1.5.4.8 Waves in the Irish Sea are highest to the south west of the Isle of Man, with the highest mean annual significant wave height of 1.39 m recorded between the Isle of Man and Anglesey. Significant wave height is reduced closer to the coast, with the lowest significant wave height of 0.73 m recorded to the west of the Dee Estuary (ABPmer, 2008).

1.5.4.9 Mean annual wave height in the study area ranges from 0.5 m near the coast to 1.3 m at the north west extent. As presented in **Diagram 1.6**, over 30% of the waves near the study area arise from the south west with all significant wave heights (>4 m) arriving from the south west or west. Near the coast, over 40% of the waves arise from the west with the significant wave height not typically reaching over 2 m (ABPmer, 2018). The directionality of wind action is much line with that of the waves, with *c.* 40% originating from the west or south west, as presented in **Diagram 1.7** with peak wind speeds in excess of 16 m/s.

1.5.4.10 The wave climate in the Morgan Offshore Wind Project: Generation Assets is described as having dominant short period, south west direction waves.

During the metocean buoy deployment the largest wave height recorded was 8.92 m during Storm Franklin (Fugro, 2022).

1.5.4.11 Metocean buoys were deployed for the Ormonde offshore wind project in 2010, to the east of the study area. Waves in this survey were recorded with a dominant direction from the south west, with the majority of the waves originating from the open sea. Significant wave heights ranged from 0.06 m to 5.95 m, with a maximum wave height of 14.22 m recorded in November 2010 (GEMS, 2011).

1.5.4.12 Metocean buoys were deployed in 2010 to monitor the hydrodynamic conditions within the proposed Round 3 Irish Sea Offshore Wind Farm Development Zone. The locations of which can be seen in Figure 1.3 (Volume 2, Chapter Figures). The campaign recorded significant wave heights of over 6 m in October, November and December, with the maximum wave height recorded at 9.8 m. The most commonly occurring wave direction was from the south west (EMU, 2013).

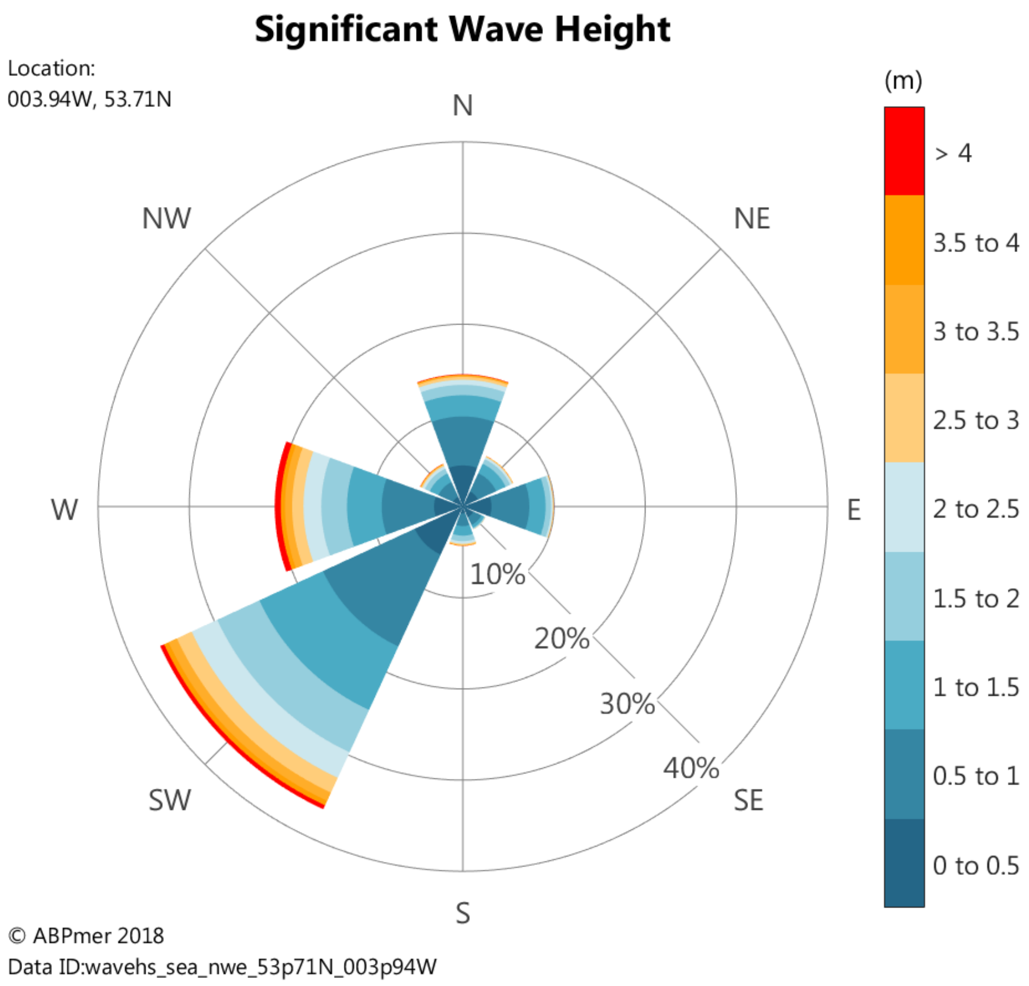

Diagram 1.6: Wave rose for the Morgan and Morecambe Offshore Windfarms: Transmission Assets (ABPmer, 2018) (not to scale)

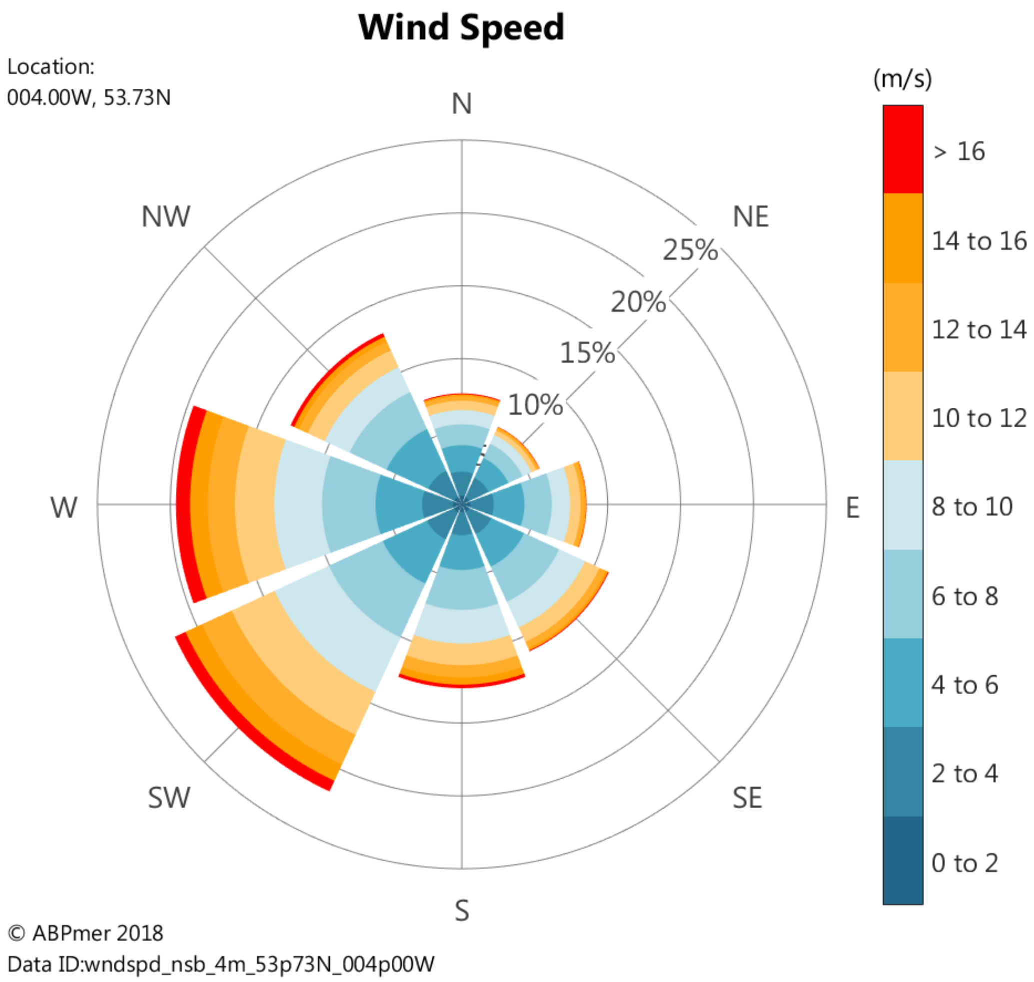

Diagram 1.7: Wind rose for the Morgan and Morecambe Offshore Windfarms: Transmission Assets (ABPmer, 2018) (not to scale)

Seabed sediment and geology

1.5.4.13 In the Irish Sea, there is a high variability in the bedforms ranging from very small ripples (5 cm high) to very large sediment waves (>10 m high). Site specific surveys performed for the Morgan Offshore Wind Project: Generation Assets denote that the study area contains a number of distinct features such as sandwaves, mega-ripples, sediment waveforms and outcrops. Some such features have been described using a multi-beam echo sounder for the Transmission Assets cable route south of the Morgan Offshore Wind Project: Generation Assets as presented in Figure 1.5 (Volume 2, Chapter Figures). These bedforms which are predominately aligned perpendicular to the direction of net sediment transport (e.g., to the east/north east) as shown in Figure 1.4 (Volume 2, Chapter Figures) are highly mobile in nature and exhibit a general eastward migration as characterised by seabed assessments within the study area (ABPmer, 2023).

1.5.4.14 Seabed sediments across the east Irish Sea are comprised of regions of soft mud (clay and silt) rich sediment. Therefore, seabed sediments within the study area are dominated by circalittoral sand, circalittoral sandy mud, circalittoral mud and circalittoral coarse sediment with circalittoral muddy sand near the coast (EMODnet, 2019). EMODnet seabed substrate data along with Gardline site specific substrate data within the study area is displayed in Figure 1.6 (Volume 2, Chapter Figures). However, the north west of the Offshore Order Limits lies within the central gravel belt containing coarse sand and gravel (Mellet, et al., 2015).

1.5.4.15 A geophysical survey of the Transmission Assets offshore export cable corridor performed by Gardline Limited (Gardline Ltd, 2022), using multibeam echo sounder, side scan sonar, magnetometer, sub-bottom profiler, and geotechnical and environmental equipment provides additional information on seabed substrate and morphology. The study highlighted that the route north of the Morgan Offshore Wind Project: Generation Assets, is largely rippled (with orientation north to south) with dominant substrate being clayey sand. South of the Morgan Offshore Wind Project: Generation Assets the seafloor generally consists of clay beneath a thin layer of sand, with environmental sampling showing the composition is generally slightly gravelly clayey sand. Boulders are more common in this section of the cable route. As this section moves east the seafloors isolated dunes begin to shoal and grow in height and number. In the nearshore area of the offshore export cable route, the seabed alternates between featureless clayey sand and rippled clayey sand. Patches of sandy clay and slightly gravelly clayey sand become more common as the seabed shoals towards the beach.

1.5.4.16 Quaternary sediment thickness in the central Irish Sea is <20 m although in short distances this can increase to >100 m due to the presence of glacial valleys. However, in the east and west of the Irish Sea sediment thickness is circa 50 m.

Sediment transport and suspended sediments

1.5.4.17 The Cefas Climatology Report 2016 (Cefas, 2016) provides the spatial distribution of average non-algal Suspended Particulate Matter (SPM) for the majority of the UK continental shelf. Between 1998 and 2005, the greatest plumes were associated with large rivers such as the Thames Estuary, the Wash and Liverpool Bay, which showed mean values of SPM above 30 mg/l. Based on the data provided within this study, the SPM within the study area has been estimated as approximately 2 mg/l offshore to c.40 mg/l inshore over the 1998 to 2015 period, as illustrated in Figure 1.7 (Volume 2, Chapter Figures). Higher levels of SPM are experienced more commonly in the winter months; however, due to the tidal influence, even during summer months the levels remain elevated.

1.5.4.18 The principal mechanisms governing SSC in the water column are tidal currents, with fluctuations observed across the spring-neap cycle and across the different tidal stages (high water, peak ebb, low water, peak flood). It is important to note that SSC can also be temporarily elevated by wave driven currents during storm events. During high-energy storm events, levels of SSC can rise significantly, both near bed and extending into the water column. Following storm events, SSC levels will gradually decrease to baseline levels, regulated by the ambient regional tidal regimes. The seasonal nature and frequency of storm events supports a broadly seasonal pattern for SSC levels.

1.5.4.19 Sediments in the Irish Sea have been reported, on average, to experience mobilisation 35% of the time during a year (Couglan, et al., 2021). Sediments in the east Irish Sea have been reported to experience 5 to 95% sediment mobility with the highest mobility around Morecambe Bay, Solway Firth and around the north coast of Anglesey (Couglan, et al., 2021). The 2012 report commissioned by Celtic Array as part of the Zonal Appraisal and Planning process reported that in the east Irish Sea, sediment suspension and transport are mainly driven by tidal currents. Sediment transport was reported to be of a net north easterly and easterly transport pathway into Liverpool Bay (Celtic Array Ltd, 2014). This is corroborated by the project specific seabed mobility study, (ABPmer, 2023), which demonstrated that with the Morgan Offshore Wind Project: Generation Assets bedforms may move in an east / north east direction by as much as 1 m per year.

1.5.4.20 Metocean buoys were deployed in 2010 to monitor the hydrodynamic conditions within the proposed Round 3 Irish Sea Offshore Wind Farm Development Zone, between the Isle of Man and Anglesey. Mean SSC near the seabed ranged from 4.3 mg/l to 23.6 mg/l offshore. Maximum SSC were recorded at 48 mg/l, whilst mean SSC in the water column ranged from 1.6 mg/l to 55.8 mg/l (EMU, 2013).

1.5.4.21 There are strong circulatory currents in the east Irish Sea where tidal flows interact with headlands and embayments. The greatest sediment transport rates are evident in estuaries and at headlands where finer sand fractions are present and where tidal currents are strongest as shown in **Diagram 1.8 - Diagram 1.11**. This corresponds with lower magnitudes of sediment transport in the offshore environment as within the western extents of the Offshore Order Limits. The littoral currents and dominant flood tide subsequently increase sediment transport during storm conditions. Residual currents are the net flow over a full tidal cycle and drive the sediment transport. Residual currents flow into the east Irish Sea from the north of the Isle of Man and also west around Anglesey as presented in **Diagram 1.8**. This correlates with this region being a sediment sink as can be seen in **Diagram 1.9**.

1.5.4.22 As can be seen from Figure 1.4, bedforms such as sandwaves are aligned perpendicular to the net direction of sediment transport, this being to the east and north east.

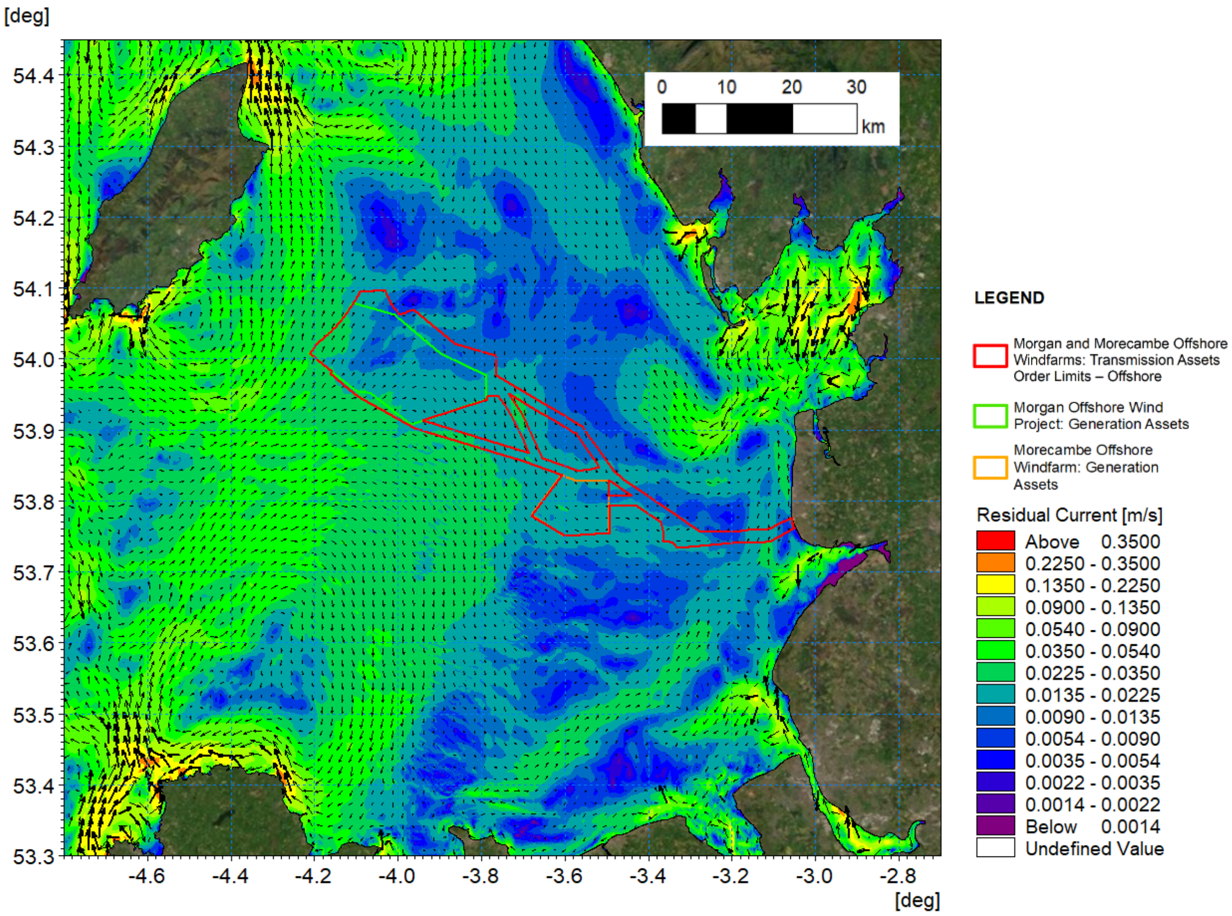

Diagram 1.8: Residual current - spring tide (not to scale)

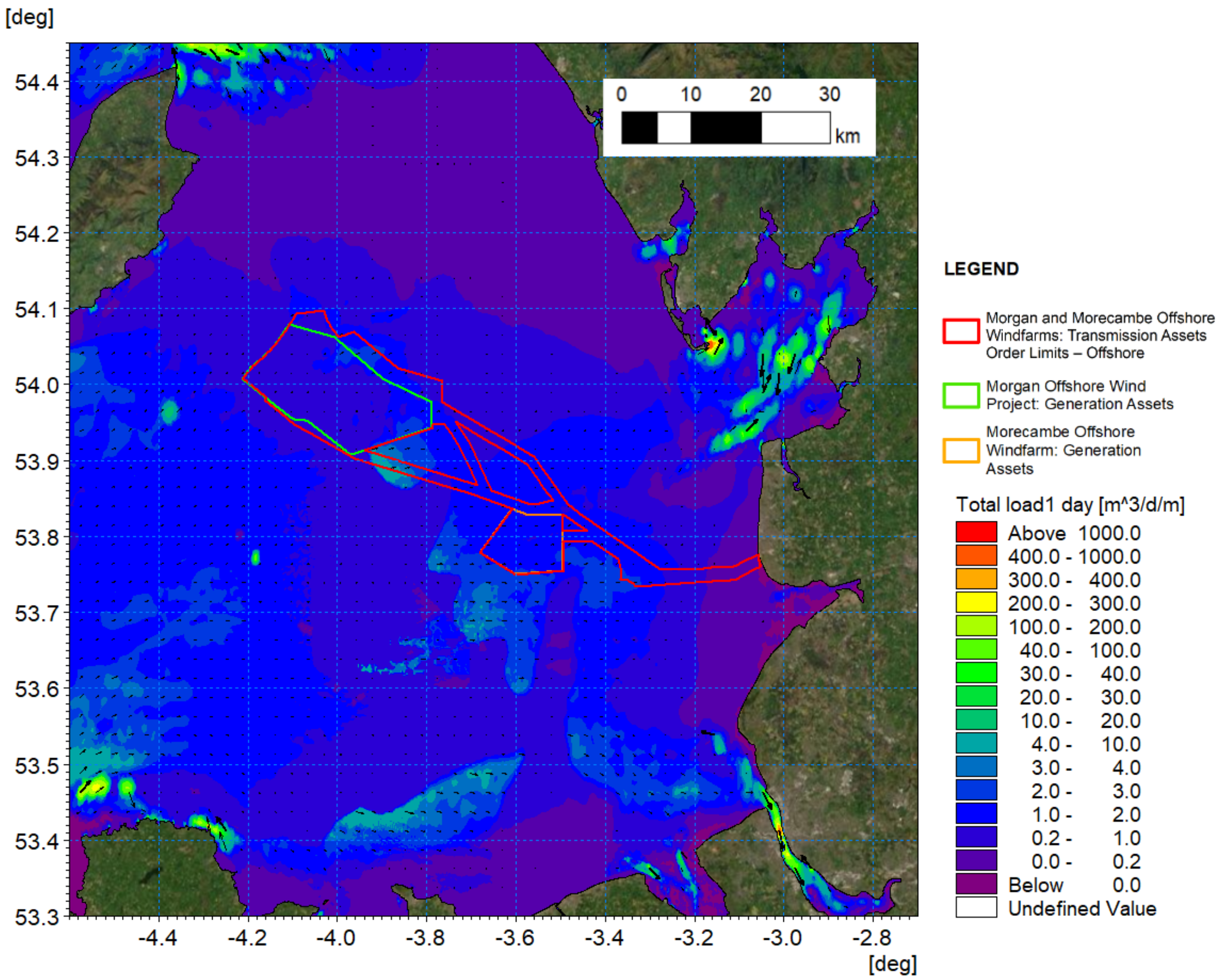

Diagram 1.9: Potential sediment transport over the course of one day (two tide cycles) (not to scale)

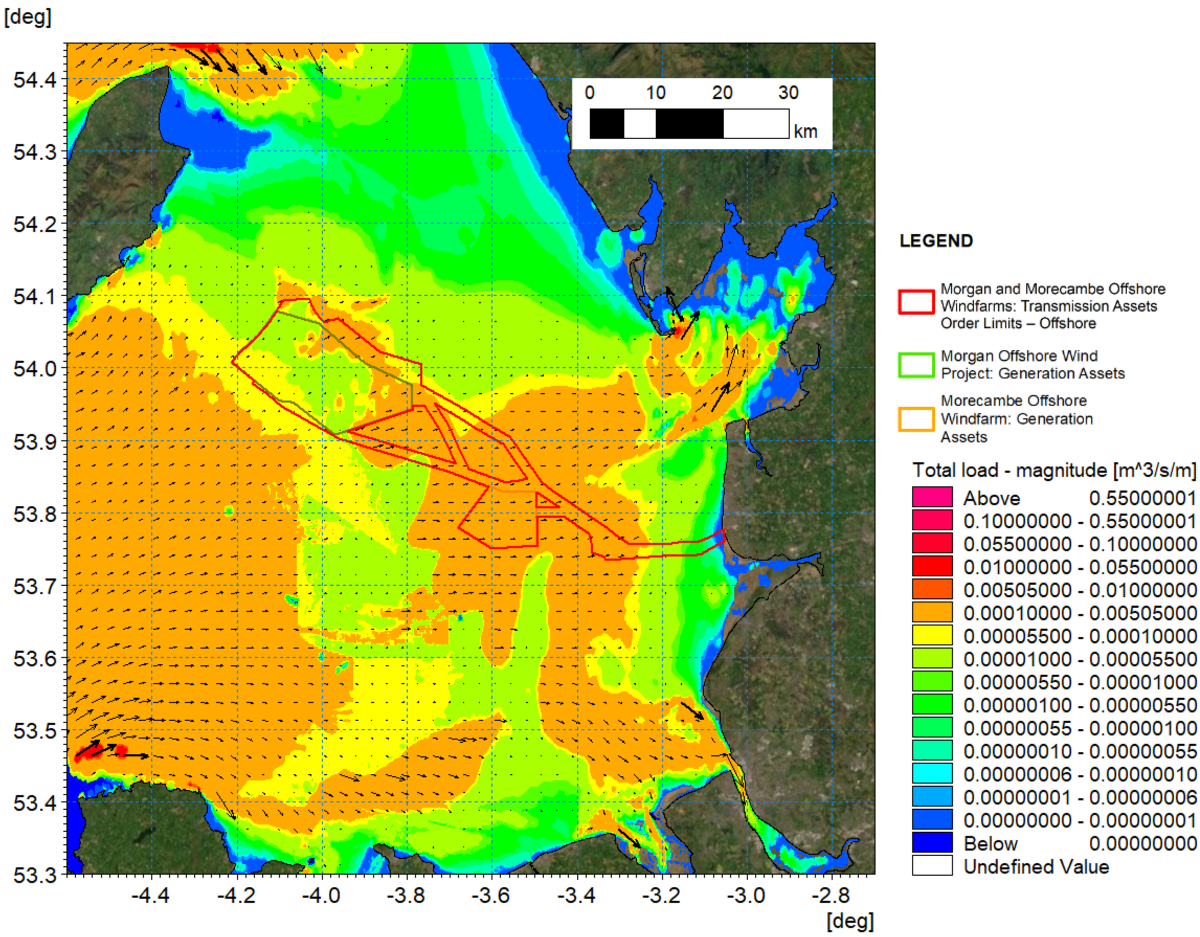

Diagram 1.10: Typical sediment transport – flood tide (not to scale)

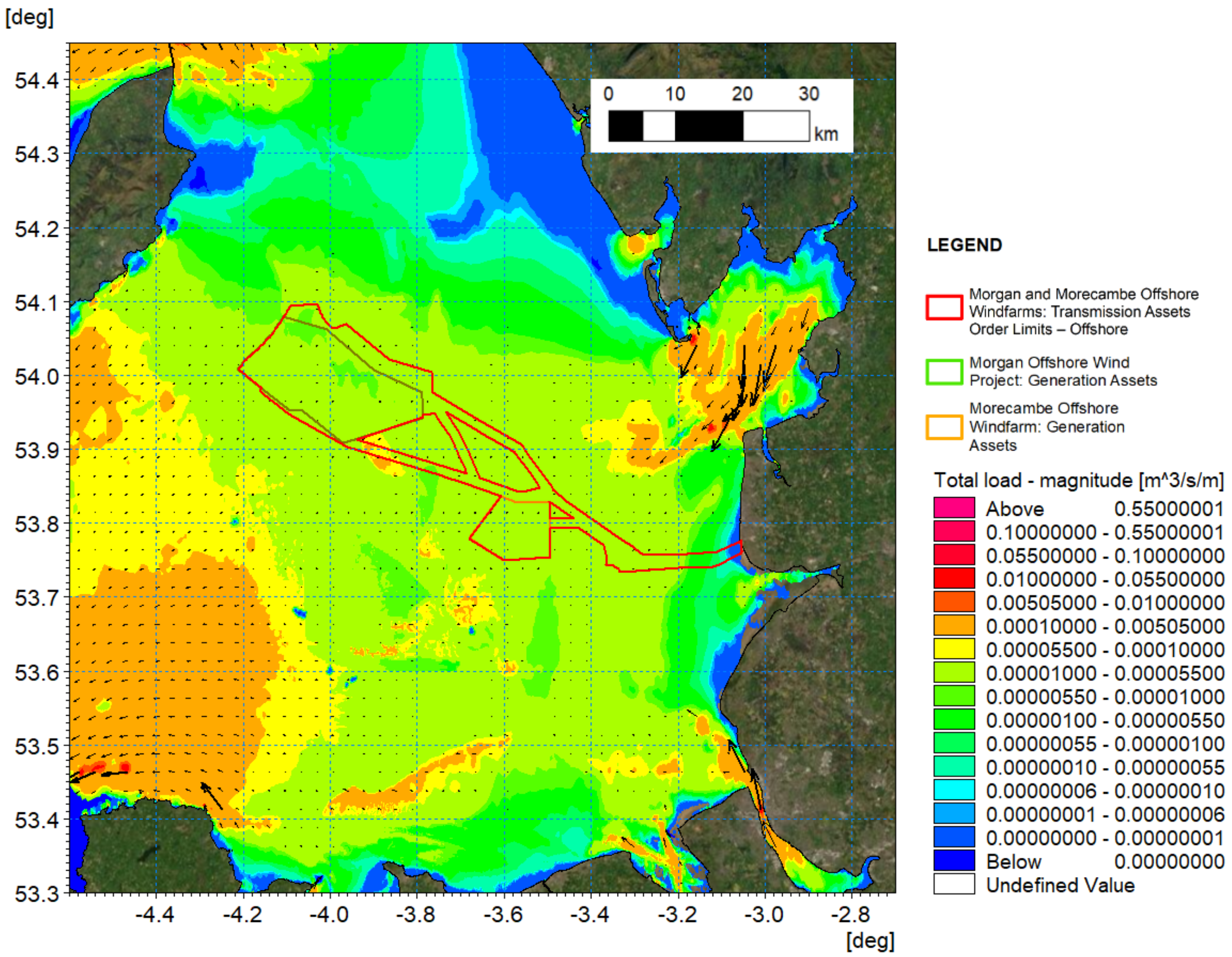

Diagram 1.11: Typical sediment transport – ebb tide (not to scale)

1.5.4.23 Seabed characteristics at landfall were examined over the period of 17 years for which data was available, and the greatest overall difference in beach level over the foreshore of the available measured data is in the order of 1.1 m to 1.5 m, primarily due to the movement of the ridge and runnel features, (ABPmer, 2023). Therefore, with a target trench depth of 3 m, this means that for the anticipated levels of beach drawdown, that cables would not be exposed. Areas of the dune system towards the back of the beach show greater variability over the 17-year period, with some areas changing (typically accreting) by more than 4 m.

1.5.4.24 As noted in the outline cable specification and installation plan (CSIP) (document reference J15), a review of sedimentary processes of the offshore export cable route in the Fylde MCZ relative to the Ribble Estuary was undertaken. Sediment supply along the coast is controlled in part by tidal currents that drive net onshore sediment transport of seabed sediment from sand banks offshore, and by alongshore littoral sediment transport. Sediment transport numerical modelling indicated there is a sediment divide at Squires Gate, (ABPmer, 2023). To the north of this divide, sediment is transported north. To the south, sediment is transported south towards the Ribble Estuary. This would suggest net longshore sediment transport at the landfall is from north to south. However, Jacobs (Halcrow 2013) note the exact location of the divide varies depending on wave climate and there is potential for this divide to move to the north and south. This could change net longshore sediment transport pathways on an annual basis.

1.5.4.25 These studies indicated low sediment transport rates at the landfall site. This is corroborated within the Morgan Offshore Wind Project: Generation Assets modelling study, where littoral and residual currents were examined under a range of conditions. This could change net longshore sediment transport pathways on an annual basis and is further evidenced by coastal migration data (EMODnet, 2019) which indicates sections of seaward migration (accretion), landward migration (erosion) interspersed with stable sections of coastline in the vicinity of landfall. The updated National Coastal Erosion Risk Mapping (NCERM) (Environment Agency, 2024) indicates areas of recession at the landfall site, and it is noted under the Shoreline Management Plan (SMP) that this region (Cell 11B2.1) is assigned managed realignment of natural features. The detailed sediment mobility study undertaken for Morgan Offshore Wind Project: Generation and Transmission Assets (ABPmer, 2023) was used to inform the Outline CSIP (document reference J14) and Outline CBRA (document reference J15). They identify the risks to the offshore export cables such as those associated with sediment mobility, including details of target burial depths and depth of lowering required to provide asset security and ensure cables do not become exposed.

1.5.4.26 Geophysical surveys detail sub-seabed geology and ground conditions, and indicate the sediment type found in the nearshore area and Fylde MCZ are predominantly sand and mud. As detailed in the outline CBRA, the first section presented is the Export Cable Landing Section (KP0 – KP13.25) which extends from the Transition Joint Bays (TJBs) onshore out to a distance of 13.25 km offshore at a depth 14.23 m chart datum (CD). This indicates that geological conditions are suitable for traditional burial techniques to achieve the target burial depths. This is in accordance with commitment CoT54 which identifies that cable burial is the preferred option for cable protection where practicable and also commitment CoT133 that no cable/scour protection shall be ~~permanently~~ deployed in the intertidal area between MLWS and MHWS during the construction and operation and maintenance phases.

1.5.4.27 In the nearshore area the Depth of Closure (DoC) is circa 10 m CD. Offshore of the DoC sediment transport is dominated by tidal currents (i.e. onshore transport of sediment from offshore areas) and inshore of DoC the sediment transport is also influenced by metrological conditions (i.e. wave climate / littoral currents). This drives longshore and cross-shore transport and provides the sediment source for the Ribble Estuary SPA. The nearshore ground conditions indicate that due to the sediment type found in the nearshore area and Fylde MCZ (i.e. predominantly sand and mud), traditional burial techniques are suitable to achieve the target burial depths. It is therefore not anticipated that external cable protection would be required in the nearshore and this is to be confirmed by pre-construction surveys.

1.5.4.28 Seabed characteristics along the offshore cable corridor beyond the nearshore region were shown to have sediment depths greater than the proposed burial depths detailed in the outline CBRA, indicating that traditional burial techniques would also be applicable throughout the

Transmission Assets cable corridor. Variations in seabed levels are predominantly due to the migration of sandwave features of typically 1 to 3 m in height, with long term regional variations in bed levels typically less than 1 m, (ABPmer, 2023).

1.5.5 Future baseline conditions

1.5.5.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that '*an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*' is included within the ES. This section provides an outline of the likely future baseline conditions in the absence of the Transmission Assets.

1.5.5.2 The baseline environment for physical processes is not static and will exhibit a degree of natural change over time. Such changes will occur with or without the Transmission Assets in place due to natural variability. Future baseline conditions would be altered by climate change resulting in sea level rise and increased storminess. This is unlikely to have the effect of significantly altering tidal patterns and sediment transport regimes offshore. The return period of the wave climates would however be altered (e.g. what is defined as a 1 in 50 year event may become a 1 in 20 year event) as deeper water would allow larger waves to develop. Although increased water depth would potentially increase the wave climate, sandbank development is driven by tides and sediment source rather than waves (Kenyon & Cooper, 2005). Therefore, features such as the sandwaves within the Offshore Order Limits would continue to develop regardless of wave climate. There is, however, a notable degree of uncertainty regarding how future climate change will impact prevailing wave climates within the Irish Sea and beyond.

1.5.5.3 In the near-shore or inter-tidal areas increased frequency of storm events may have the potential to alter existing sediment transport regimes however the presence of buried offshore export cables would not influence these changes. Natural variability of beach levels at the landfall are around +/- 1 – 3 m, with a trench depth of 3 m, this means that for the anticipated levels of beach drawdown that cables would not be exposed (ABPmer, 2023). Routine inspection of cables and geophysical surveys in line with the outline Offshore In Principle Monitoring Plan (IPMP) (document reference J20) submitted with the Application, would also have the benefit of identifying any changes in baseline conditions.

1.5.6 Key receptors

1.5.6.1 **Table 1.10** identifies the receptors taken forward into the assessment and agreed with stakeholders through consultation process, as presented in **section 1.3**.

Table 1.10: Key receptors taken forward to assessment

Receptor	Description	Sensitivity/value
Fylde (MCZ)	Fylde MCZ is designated for its extensive subtidal sediment habitats and plant and animal communities, with the site supporting species such as crabs, starfish and crustaceans and bivalve shellfish. The conservation objectives for the MCZ's protected features are that they should be 'maintained in a favourable condition'.	High value (designated feature) Active seabed feature not sensitive to SSC and low sensitivity to deposition due to natural exposure to sediment redistribution. Low sensitivity due to ability to adapt to small changes in tidal flow, wave climate and sediment transport.
West of Copeland (MCZ)	The West of Copeland MCZ is designated for protected features such as, subtidal coarse sediment, subtidal sand and subtidal mixed sediments. These subtidal sediments may provide habitats which support a wide range of associated biological communities. The north section of the MCZ includes Annex 1 sandbank features. The conservation objectives for the subtidal sand feature is to 'maintain in favourable condition' and for the subtidal coarse sediment and subtidal mixed sediments is to 'recover to a favourable condition'.	High value (designated feature) Active seabed feature not sensitive to SSC and low sensitivity to deposition due to natural exposure to sediment redistribution. Low sensitivity due to ability to adapt to small changes in tidal flow, wave climate and sediment transport.
West of Walney (MCZ)	The protected features within the West of Walney MCZ are subtidal sand, subtidal mud and sea-pen and burrowing megafauna communities. The conservation objectives for the MCZ's protected features are that they have 'recovered to a favourable condition'.	High value (designated feature) Active seabed feature not sensitive to SSC and low sensitivity to deposition due to natural exposure to sediment redistribution. Low sensitivity due to ability to adapt to small changes in tidal flow, wave climate and sediment transport.
Shell Flat and Lune Deep (SAC)	The Shell Flat and Lune Deep SAC is made up of two separate areas of ecological importance. Shell Flat is a sandbank comprised of mud and sand which is slightly covered by sea water all the times and provides Annex I habitat. The Lune Deep component of the SAC relates to the deep channel within the area, which hosts Annex I reef habitats.	High value (designated feature) Active seabed feature not sensitive to SSC and low sensitivity to deposition due to natural exposure to sediment redistribution. Low sensitivity due to ability to adapt to small changes in tidal flow, wave climate and sediment transport.
Ribble and Alt Estuaries (SPA)	The Ribble Estuary SSSI, Ribble and Alt Estuaries Ramsar site and Ribble and Alt Estuary SPA, from here on referred to as the "Ribble Estuary designations" are	High value (designated feature) Active seabed feature not sensitive to SSC and low sensitivity to deposition due to natural exposure to sediment redistribution.
Ribble and Alt Estuaries (Ramsar)		

Receptor	Description	Sensitivity/value
Ribble Estuary (SSSI)	characterised by tidal flats and saltmarsh. The mudflats/sandflats have a large invertebrate fauna supporting internationally important populations of wintering waterbirds.	Low sensitivity due to ability to adapt to small changes in tidal flow, wave climate and sediment transport.

1.6 Scope of the assessment

1.6.1.1 The scope of the ES has been developed in consultation with relevant statutory and non-statutory consultees as detailed in **Table 1.5**. The assessment encompasses all stages of the Transmission Assets project including those associated with site preparation, construction activities, operation and maintenance, and decommissioning activities which will cause sediment to be mobilised into the water column giving rise to increased SSC. Additionally, the presence of the infrastructure as described in Volume 1, Chapter 3: Project description of the ES was assessed for potential effects on the inter-related physical processes relating to tidal currents, wave climate and sediment transport.

1.6.1.2 Taking into consideration the scoping and consultation process **Table 1.11** summarises the impacts considered as part of this assessment.

Table 1.11: Impacts considered within this assessment

Activity	Impacts scoped into the assessment
Construction phase	
Site preparation	Increase in suspended sediments and the potential impact to physical features
Cable installation	
Introduction of infrastructure in the marine environment	Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines
	Impacts to sediment transport and sediment pathways at the offshore export cable landfall
Operation and maintenance phase	
Offshore export cable repairs	Increase in suspended sediments and the potential impact to physical features
Presence of infrastructure within in the marine environment	Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines
Decommissioning phase	
Removal of infrastructure	Increase in suspended sediments and the potential impact to physical features
Retention of cable protection	Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines

1.6.1.3 Impacts that are not likely to result in significant effects have been scoped out of the assessment. A summary of the impacts scoped out, together with justification for scoping them out and whether the approach has been agreed with key stakeholders through either scoping or consultation, is presented in **Table 1.12**.

Table 1.12: Impacts scoped out of the assessment

Potential effect	Justification
Changes to bathymetry due to depressions left by jack-up vessels.	The potential for jack-up vessel spud-cans to affect the sediment regime has been scoped out of the assessment. Jack-up footprint depressions would occur in sandy/loose material as the equipment is installed. On removal the depression would be partially infilled by gravity and then, over time, be infilled by the mobile seabed sediments. The extent of temporary depressions, following completion of jack-up operations, would be limited to the immediate area therefore, short term changes to bathymetry would have negligible impacts on tidal currents and sediment transport regimes. Monitoring at the Barrow offshore wind farm showed depressions were almost entirely infilled 12 months after construction (BOWind, 2008). It is noted that cable lay jack-up vessel proposed for the Transmission Assets has a much smaller footprint than that required for turbine installation. Additionally, significantly fewer jack events are required for cable installation; four relating to the Morgan export cables and two relating to Morecambe i.e. one per cable. Although the monitoring study was undertaken during the first year of

Potential effect	Justification
	operation of Barrow Offshore Wind Farm (post construction monitoring initiated July 2006) it included oceanography, seabed morphology (scour etc.) and bathymetry. The wind farm is located in the east Irish Sea near Barrow-in Furness and therefore provides relevant, applicable datasets in compliance with regulatory standards. Given the short timescale of recovery, and the fact that impacts to bathymetry and subsequently physical processes such as waves, tides and sediment transport are negligible, this impact pathway has been scoped out, as agreed through consultation with the MMO and Planning Inspectorate.
Scour of seabed sediments during the operation and maintenance phase.	Interaction between the waves and currents and the Transmission Assets have the potential to cause localised scouring of seabed sediment. Cable protection will be a committed mitigation measure (presented in the measures adopted as part of the project, **section 1.7** and in Volume 1, Annex 5.3: Commitments Register) to prevent scour from occurring. The cable protection measures will be subject to engineering design to ensure they minimise as much as practical the occurrence of scour, to such a degree that it will not impact upon seabed morphology, and therefore any impacts would relate only to residual/secondary scour which is considered in **section 1.10**. The scoping out of primary scour was considered with stakeholders within the consultation process and ultimately agreed upon during the EWG meetings.
Increase in suspended sediments and impacts to physical featuresas a result of UXO clearance	UXO clearance for the Transmission Assets and for other projects in the region can cause increased SSCs and indentations on the seabed. However, these effects would be local, temporary and recoverable and, as such, effects are negligible and impacts on SSC are not considered within the physical processes assessment. In response to requests from Natural England during examination the impacts to physical features due to UXO clearance were scoped in and are considered in **section 1.10** of the updated assessment.

1.7 Measures adopted as part of the Transmission Assets (Commitments)

1.7.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the Transmission Assets' is used to include the following two types of mitigation measures (adapted from the Institute of Environmental Management and Assessment (IEMA), 2016). These measures are set out in Volume 1, Annex 5.3: Commitments register of the ES.

- Embedded mitigation. This includes the following.
  - Primary (inherent) mitigation - measures included as part of the project design. IEMA describes these as '*modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project and do not require additional action to be taken*'. This includes modifications arising through the iterative design process. These measures will be secured through the consent itself through the description of the project and the parameters secured in the Development Consent Order and/or marine licences. For example, a reduction in footprint or height.

  - Tertiary (inexorable) mitigation. IEMA describes these as '*actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects'*. It may be helpful to secure such measures through a Code of Construction Practice or similar.
- Secondary (foreseeable) mitigation. IEMA describes these as '*actions that will require further activity in order to achieve the anticipated outcome'*. These include measures required to reduce the significance of environmental effects (such as lighting limits) and may be secured through an environmental management plan.

1.7.1.2 All of such measures are clearly identified within Volume 1, Annex 5.3: Commitments Register of the ES. The measures relevant to this chapter are summarised in **Table 1.13**.

1.7.1.3 Embedded measures that will form part of the final design (and/or are established legislative requirements/good practice) have been taken into account as part of the initial assessment presented in **section 1.10** (i.e., the initial determination of impact magnitude and significance of effects assumes implementation of these measures). This ensures that the measures to which the Applicants are committed are taken into account in the assessment of effects.

1.7.1.4 Where an assessment identifies likely significant adverse effects, further or secondary mitigation measures will be applied. These are measures that could further prevent, reduce and, where possible, offset these effects. They are defined by IEMA as actions that will require further activity in order to achieve the anticipated outcome and may be imposed as part of the planning consent, or through inclusion in the ES (referred to as secondary mitigation measures in IEMA, 2016). For further or secondary measures both pre-mitigation and residual effects are presented.

Table 1.13: Measures (commitments) adopted as part of the Transmission Assets.

Commitment number	Measure adopted	How the measure will be secured
Embedded measures		
CoT44	The Project Description (Volume 1, Chapter 3 of the Environmental Statement) sets out that the installation of the offshore export cables under Lytham St Annes SSSI and the St Annes Old Links Golf Course will be undertaken by direct pipe trenchless installation technique. The exit pits associated with the direct pipe installation will be at least 100 m seaward of the western boundary of the SSSI.	DCO Schedules 2A & 2B, Requirement 8 (Code of Construction Practice)
CoT45	The Outline Offshore Cable Specification and Installation Plan (CSIP) for the Fylde MCZ includes: details of cable burial depths, cable protection, and cable monitoring. The Outline CSIP also includes an Outline Cable Burial Risk Assessment (CBRA). Detailed CSIP(s) and CBRA(s) will be prepared by the Applicants covering the full extent of their respective offshore export cable corridors. Detailed CSIPs will be developed in accordance with the Outline CSIP and will ensure safe navigation is not compromised including consideration of under keel clearance. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the offshore export cable corridor route without prior written approval from the licencing authority in consultation with the MCA and Trinity House.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition 18(1)(e) (Pre-construction plans and documentation)
CoT47	The Outline Offshore Cable Specification and Installation Plan (CSIP) includes measures to limit the extent of cable protection to 3% of the offshore export cable route within the Fylde (Marine Conservation Zone) MCZ (excluding cable crossings). Within the Fylde MCZ, external cable protection will only be used where deemed to be essential, e.g. for cable crossings or in the instance that adequate burial / reburial is not possible for any section of the route through the Fylde MCZ.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 -

Commitment number	Measure adopted	How the measure will be secured
	The Outline CSIP also includes measures to limit sandwave clearance to up to 5% of the offshore export cable corridor route within the Fylde MCZ. Material arising from sandwave clearance in the Fylde MCZ, which will only be undertaken using Controlled Flow Excavator, will be deposited within the Fylde MCZ. The requirements for cable protection and sandwave clearance will be informed through the undertaking of survey works pre-construction. Detailed CSIP(s) will be developed in accordance with the Outline CSIP.	Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition 18(1)(e) (Pre-construction plans and documentation)
CoT49	Construction Method Statement(s) (CMSs) including Offshore Cable Specification and Installation Plan(s), will be produced and implemented prior to construction. These will contain details of cable installation and methodology.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition 18(1)(e) (Pre-construction plans and documentation)
CoT54	An Outline Offshore Cable Specification and Installation Plan (CSIP) includes for cable burial to be the preferred option for cable protection, where practicable. Detailed CSIP(s) will be developed in accordance with the Outline CSIP.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 -

Commitment number	Measure adopted	How the measure will be secured
		Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition 18(1)(e) (Pre-construction plans and documentation)
CoT64	Detailed Marine Mammal Mitigation Protocols (MMMPs) will be developed and implemented in accordance with the Outline MMMP (document reference J18), to reduce the risk of injury to marine mammals. The Detailed MMMP(s) will include measures to apply in advance of and during UXO clearance. The Detailed MMMP(s) will include for the use of low order techniques only. The detailed MMMP(s) will be approved by Marine Management Organisation, in consultation with Natural England. The detailed MMMP(s) will require the implementation of a mitigation hierarchy with regard to Unexploded Ordnance (UXO) clearance as follows: – Avoid UXO; and – Clear UXO with low order techniques. Low order techniques or avoidance of confirmed UXO are not always possible and are dependent upon the individual circumstances surrounding each UXO. Should high order UXO techniques be required, a separate marine licence will be applied for and will include consideration of secondary mitigation measures such as Noise Abatement Systems (NAS).	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 – Condition 20(1)(b) (Low order unexploded ordnance clearance) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition20(1)(b) (Low order unexploded ordnance clearance).
CoT108	The Outline Offshore Cable Specification and Installation Plan (CSIP) submitted as part of the application for development consent, includes for all external cable protection used within the Fylde MCZ to be designed to be removable on decommissioning. Detailed CSIP(s) will be developed in accordance with the Outline CSIP.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 -

Commitment number	Measure adopted	How the measure will be secured
		Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition18(1)(e) (Pre-construction plans and documentation)
CoT109	The requirement for removal of cable protection within the Fylde MCZ will be agreed with stakeholders and regulators at the time of decommissioning. Removal of cable protection will be in accordance with the Offshore Decommissioning Programme(s).	DCO Schedule 2A Requirement 21 (Offshore decommissioning) and & DCO Schedule 2B Requirement 21 (Offshore decommissioning)
CoT114	All permanent infrastructure located between Mean Low Water Springs (MLWS) and Mean High Water Springs (MHWS) will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within Detailed Cable Burial Risk Assessments (CBRAs). An Outline CBRA has been prepared and submitted with the application for development consent.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 – Condition18(1)(e)(i)(bb) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets),

Commitment number	Measure adopted	How the measure will be secured
		Part 2 - Condition18(1)(e)(i)(bb) (Pre-construction plans and documentation)
CoT115	An Offshore In-Principal Monitoring Plan (OIPMP) has been prepared and submitted as part of the application for development consent. The OIPMP includes for monitoring of the recovery of sediments and benthic communities within representative areas of the Fylde MCZ potentially impacted by sandwave clearance, cable installation and cable protection, at appropriate temporal intervals. Detailed Offshore Monitoring Plans will be produced prior to operation and maintenance phases in accordance with the OIPMP, and will be approved in consultation with statutory advisors and regulators.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(d) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition18(1)(d) (Pre-construction plans and documentation)
CoT133	No cable/scour protection shall be ~~permanently~~ deployed in the intertidal area between MLWS and MHWS during the construction and operation and maintenance phases.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets),

Commitment number	Measure adopted	How the measure will be secured
		Part 2 - Condition 18(1)(e) (Pre-construction plans and documentation).
CoT134	As part of the detailed design process, micro-siting of the offshore export cables within the offshore export cable corridors will be considered where successful burial could pose a challenge or where a higher risk of remedial works such as external cable protection may be required.	DCO Schedule 14 (Marine Licence 1: Morgan Offshore Wind Project Transmission Assets) Part 2 - Condition18(1)(e) (Pre-construction plans and documentation) and DCO Schedule 15 (Marine Licence 2: Morecambe Offshore Wind Farm Transmission Assets), Part 2 - Condition 18(1)(e) (Pre-construction plans and documentation).

1.8 Key parameters for assessment

1.8.1 Maximum design scenario

1.8.1.1 The maximum design scenarios (MDS) identified in **Table 1.14** have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the ES. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g., different infrastructure layout), to that assessed here be taken forward in the final design.

1.8.1.2 The construction phase is anticipated to take up to 30 months for sequential site preparation and construction scenario, or up to 21 months based on concurrent site preparation and construction scenario (further details are provided in Volume 1, Chapter 3: Project description of the ES).

1.8.1.3 The construction scenario laid out within the MDS in **Table 1.14** and assessed within the Assessment of effects in section **1.10** considers activities to be carried out concurrently as per the scenarios presented in Volume 1, Chapter 3: Project Description of the ES as this presents the maximum potential disturbance to physical processes.

1.8.1.4 The MDS assessed for physical processes has taken due regard of the potential range of construction scenarios including sequential construction with a gap of up to four years. The MDS for physical processes was determined to be concurrent construction as the recovery between phases which is associated with sequential construction is deemed to be beneficial for coastal processes. It is noted that the relevant scenario is dependent on both the impact and receptor being assessed, therefore the MDS may not be the same for all disciplines.

1.8.1.5 The physical processes study area is a region comprising a range of active seabed features, such as those designated in the Fylde MCZ, the West of Copeland MCZ and the West of Walney MCZ. Similarly the Shell Flat and Lune Deep SAC is designated for the Shell Flat sandbank which is an active bedform. Given the active nature of these features they are more readily recoverable to lesser impacts which occur at discrete intervals over an extended period of time. For example, with activities which result in increases in SSC and subsequent deposition, the settled material is readily drawn into the underlying sediment transport regimes. Smaller sedimentation depths would not result in notable changes to wave climate or tidal flow as the native material is assimilated. Hence the selection of the concurrent construction scenario as the MDS.

Table 1.14: Maximum design scenario considered for the assessment of impacts

Impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
Increase in suspended sediments due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	**Construction phase** **Site preparation** Sandwave clearance of up to 1,426,800, m³ undertaken concurrently over 21 months during site preparation and construction. . • Morgan offshore export cable: sandwave clearance along 9% of 400 km of offshore export cable length with a width of 60 m. This equates to a total spoil volume of 1,080,000 m³ associated with the cable corridor. • Morecambe offshore export cable: sandwave clearance along 9% of 84 km of offshore export cable length with a width of 48 m. This equates to a total spoil volume of 346,800 m³. • MCZ: sandwave clearance via Controlled Flow Excavator along 5% of the 64 km of Morgan offshore export cables within Fylde MCZ and 5% of the 24 km of Morecambe offshore export cable within Fylde MCZ. This equates to a total spoil volume of 172,800 m³ for the Morgan offshore export cables within the Fylde and a total spoil volume of 97,200 m³ for the Morecambe offshore export cables within the Fylde MCZ. Sandwave clearance within the MCZ represents 3% of the total offshore export cable. • Removal of up to 28 km of disused cables. **Cable installation.** Total spoil volume of up to 2,178,000 m³ for cable installation of 484 km of offshore export cable undertaken concurrently over an 18 month construction period.	**Construction phase** **Site preparation.** • The volume of material to be cleared from individual sandwaves will vary according to the local dimensions of the sandwave (height, length, and shape) and the level to which the sandwave must be reduced. As shown in Figure 1.4 (Volume 2, Chapter Figures), sandwaves are most prevalent within the Morgan Offshore Wind Project: Generation Assets where sandwave heights can be as great as 5 m at the bedforms crest. Given updated analysis of bedforms and morphology within the Transmission Assets Order Limits, sandwave clearance values used within the ES have been significantly reduced from those used in PEIR. • Site clearance activities may be undertaken using a range of techniques, the suction hopper dredger will result in the greatest increase in suspended sediment and largest plume extent as material is released near the water surface during the disposal of material. • Within the Fylde MCZ, the Controlled Flow Excavator will be the only method used for sandwave clearance. • Boulder clearance activities and pre-lay grapnel runs will result in minimal increases in suspended sediment concentrations and have therefore not been considered in the assessment of this impact. • The scenario assessed relates to the largest potential volume of material related to site preparation activities. **Cable Installation.** • Cable routes inevitably include a variety of seabed material and in some areas 3 m depth may not be achieved or may be of a coarser nature which settles in the vicinity of the cable route. The

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Morgan Offshore Wind Project Offshore export cables: Installation via trenching of up to 400 km of cable with a trench width of up to 3 m and a depth of up to 3 m. Total spoil volume of 1,800,000 m^3. Of this, up to 64 km would be within the Fylde MCZ with a total spoil volume of 288,000 m^3. • Morecambe Offshore Windfarm: Installation of up to 84 km of cable with a trench width of up to 3 m and a depth of up to 3 m. Total spoil volume of 378,000 m^3. Of this, up to 24 km would be within the Fylde MCZ with a total spoil volume of 108,000 m^3 **Operation and maintenance phase** Operational life of 35 years Subtidal Export cable repair: • Up to 14 subtidal cable repair events (up to 4 km per event) totalling up to 56 km of subtidal cable repair over lifetime of the Morgan Offshore Wind Project. • Up to 7 subtidal cable repair events (up to 4 km per event) totalling up to 28 km subtidal repair over the lifetime of the Morecambe Offshore Windfarm Subtidal cable reburial: • Up to 7 subtidal cable reburial events (up to 16 km per event) totalling up to 112 km over the lifetime of the Morgan Offshore Wind Project. • Up to 7 subtidal cable reburial events (3.4 km per event) totalling up to 23.8 km over the lifetime of the Morecambe Offshore Windfarm. Intertidal export cable repair:	assessment therefore considers the upper bound in terms of suspended sediment and dispersion potential assuming a trench with "v" shape cross section. • Cables may be buried by ploughing, trenching or jetting with jetting mobilising the greatest volume of material to increase suspended sediment concentrations. • Open-cut trenching represents the MDS for cable installation within the intertidal area. The offshore export cables transitioning onshore will be installed using the direct pipe trenchless technique under the Dunes. The direct pipe installation is a fully cased system which reduces risks associated with frack out of drilling fluids. It is anticipated that the direct pipe will exit on the beach around MHWS with a minimum offset distance of 100 m from boundary of the Lytham St Annes Dunes SSSI (see CoT 44, **Table 1.13**). The excavation of up to six exits pits in the intertidal area would be required to support direct pipe trenchless installation under the Lytham St. Annes dunes SSSI and may require the installation of cofferdams. The MDS for each cofferdam per exit pit/circuit/cable is up to 75 m^2 (15 m x 5 m). As detailed in Volume 1, Chapter 3: Project Description of the ES, only one offshore wind farm project is able to undertake work on the beach at any given time. The offshore export cables will be buried between the direct pipe exit pits and MLWS via open trenching. The trench is likely to be a stepped side trench to maintain stability with a top width of up to 10 m and a depth of approximately 3 m. Up to 300 m of open trenching may be required per cable before transitioning to a marinised (mechanical) trencher. The concurrent construction scenario is included as the MDS as this presents the maximum potential disturbance to physical processes. **Operation and maintenance phase** • The greatest foreseeable number of cable reburial and repair events is considered to be the MDS for sediment dispersion.

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Up to 4 intertidal cable repair events (up to 1 km per event) totalling 4 km over the lifetime of the Morgan Offshore Wind Project. • Up to 4 intertidal cable repair events (up to 2.4 km per event) totalling 9.6 km over the Morecambe Offshore Windfarm Intertidal cable reburial: • Up to 28 intertidal cable reburial events (up 250 m per event) totalling up to 7 km over the lifetime of the Morgan Offshore Wind Project. • Up to 14 intertidal cable reburial events (up to 250 m per event) totalling up to 3.5 km over the Morecambe Offshore Windfarm **Decommissioning phase** • All offshore export cables will be removed and disposed of onshore. • Cable protection will remain *in situ*.	~~Within~~Outside of the Fylde MCZ, deployment of any remedial cable protection is limited to the first ~~2~~ ten years of the O&M phase / extent of the marine licensable activity (whichever is first)~~ and 10 years outside of~~ . Any deployment of cable/scour protection within the Fylde MCZ during the O&M phase will require a marine licence application, as detailed in the Outline Offshore Operations and Maintenance Plan (document reference J19). **Decommissioning phase** • The removal of cables may be undertaken using similar techniques to those employed during installation, therefore the potential increases in SSC and deposition would be in-line with the construction phase. Although specific techniques relating to the removal of cables may be development during the project lifetime, the MDS assumes as a worst case that techniques similar to construction will be employed during the decommissioning phase. • It should be noted that the MDS has assessed that cable protection will remain in situ during the decommissioning phase, however there is a commitment CoT109, as outlined in **Table 1.13,** to remove cable protection within the MCZ in accordance with the Offshore Decommissioning Programme. In this respect the approach used within the assessment is a conservative one.

<table>
<tr><th rowspan="2">Impact</th><th colspan="3">Phase[a]</th><th rowspan="2">Maximum Design Scenario</th><th rowspan="2">Justification</th></tr>
<tr><th>C</th><th>O</th><th>D</th></tr>
<tr><td>Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.</td><td>✓</td><td>✓</td><td>✓</td><td rowspan="2">Construction phase
• During the18 month concurrent construction phase the potential changes to the receptor will be gradual as the presence of infrastructure increases reaching the MDS outlined below in the operation and maintenance phase. The MDS in terms of the presence of infrastructure would be on the completion of construction, during the operation and maintenance phase.
• All permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres.
Site preparation:
• UXO clearance: clearance of up to 25 UXOs (22 for Morgan OWL and 3 for Morecambe OWL) ranging from 25 kg up to 907 kg, with 130 kg being the most likely maximum. Using low order techniques.
• Boulder clearance: pre-lay preparation (boulder and debris clearance) is likely to be required across all export cables with a width of 20 m.
Operation and maintenance phase
Cable protection for the Morgan Offshore Wind Project:
• Cable protection for ground conditions along 10% (40 km) of the length of the cables, with a height of up to 2 m and up to 10 m width. Of this, 1,920 m could occur within the Fylde MCZ with a height of up to 2 m and up to 10 m width.
• Up to 45 cable crossings, each crossing has a height of up to 2.8 m, a width of up to 30 m and a length of up to 150 m. Of these crossings, up to 4 cable crossings could occur within the Fylde MCZ with a height of 2 m, width up to 20 m and a length of up to 50 m.</td><td rowspan="2">Physical processes are comprised of tides, waves and sediment transport and these aspects are integrated (i.e., without the influence of tides and waves there would be no sediment transport) as outlined below.
• The tidal regime is influenced by changes in bathymetry due to the placement of cable protection and the obstruction of tidal flow due to structures within the water column.
• The wave climate is influenced by obstruction within the water column however changes in bathymetry would only cause effects in shallow water.
• The sediment transport regime is affected by obstructions in the sediment transport pathways and also potential changes to the littoral currents which drive this process (i.e. those factors which also affect tide and wave climate).
A holistic approach has therefore been applied to assessing the MDS.
Pre-lay grapnel runs would only be carried out, if required, after sandwave clearance or boulder clearance has been undertaken and would not change the seabed bathymetry or composition and therefore physical processes would remain unaffected by these activities.
The only infrastructure to be installed on/within the seabed/water column relates to the Morgan and Morecambe offshore export cables, associated cable protection and cable crossings. All permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs) as outlined in CoT114 (Table 1.13).
Although cable protection will be designed to be readily removable from seafloor, particularly in shallower waters and within the MCZ as outlined by CoT109, Table 1.13, a worst case scenario for impacts to physical processes and seabed morphology would involve the retention of cable protection in the water column.</td></tr>
<tr><td>Impacts to sediment transport and sediment pathways at the offshore export cable landfall.</td><td>✓</td><td>x</td><td>x</td></tr>
</table>

Impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Cable protection for the Morecambe Offshore Wind Project • Cable protection for ground along 10% (8.4 km) of the length of the cables, with a height of up to 2 m and up to 10 m width. Of this, 720 m could occur within the Fylde MCZ with a height of up to 2 m and up to 10 m width • Up to six cable crossings, each crossing has a height of up to 2.8 m, a width of up to 30 m and a length of up to 150 m. **Decommissioning phase** • Cable protection will remain *in situ* and continue to influence tidal regime.	It should be noted that although the MDS for cable protection height is 2 m and 2.8 m for cable crossings, this will not be the case throughout the cable route particularly in the nearshore. The Outline Offshore Cable Specification and Installation Plan(s) (CSIP) will ensure that where practicable cable protection will be compliant with the MCA navigation guidance which includes that there will be "…No more than a 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the offshore export cable corridor route without prior written approval from the licencing authority in consultation with the MCA and Trinity House." as per CoT45 outlined in **Table 1.13**. Primary scouring of the seabed has not been assessed as part of the MDS as it was scoped out due to the provision of scour protection, as outlined in **Table 1.12**,The impact of secondary scour as a result of cable protection has however been assessed. The concurrent construction scenario is included as the MDS as this presents the maximum potential disturbance to physical processes.

[a] C=construction, O=operation and maintenance, D=decommissioning

1.9 Assessment methodology

1.9.1 Overview

1.9.1.1 The approach to determining the significance of effects is a two-stage process that involves defining the magnitude of the impact and the sensitivity of the receptor. This section describes the criteria applied in this chapter to assign values to the magnitude of impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 1, Chapter 5: Environmental assessment methodology of the ES.

1.9.2 Receptor sensitivity/value

1.9.2.1 The criteria for defining sensitivity in this chapter are outlined in **Table 1.15** below.

Table 1.15: Sensitivity criteria

Sensitivity	Definition
Very High	Coastal feature forms vital part of a wider scale system which is scarce and non-recoverable.
High	Coastal feature forms part of a wider scale system and is non-recoverable.
Medium	Coastal feature has limited potential for recovery.
Low	Coastal features of local scale and recoverable.
Negligible	Coastal feature adaptable to changes in physical processes.

1.9.2.2 The criteria for defining the value of receptors in this chapter are outlined in **Table 1.16** below.

Table 1.16: Value criteria

Value	Definition
High	Receptor is designated and/or of national or international importance for marine geology, oceanography or physical processes. Likely to be rare with minimal potential for substitution. May also be of significant wider-scale, functional or strategic importance.
Medium	Receptor is not designated but is of local to regional importance for marine geology, oceanography or physical processes.
Low	Receptor is not designated but is of local importance for marine geology, oceanography or physical processes.
Negligible	Receptor is not designated and is not deemed of importance for marine geology, oceanography or physical processes.

1.9.3 Magnitude of impact

1.9.3.1 The criteria for defining magnitude in this chapter are outlined in **Table 1.17** below.

Table 1.17: Magnitude of impact criteria

Magnitude of impact		Definition
High	Adverse	Change in physical processes which results in the loss of a coastal feature (e.g. blockage of sediment pathway resulting in loss of spit). Persists for a long-term duration i.e. more than five years and is irreversible.
	Beneficial	Change in physical processes which results in the creation of a coastal feature (e.g., reduction in wave climate giving rise to dune formation). Persists for a long-term duration i.e. more than five years and is irreversible.
Medium	Adverse	Alteration of physical processes which effects the rate at which a coastal feature is maintained (e.g., reduction in accretion rate). Persists for a long-term duration i.e. more than five years.
	Beneficial	Alteration of physical processes which effects the rate at which a coastal feature is developing (e.g., reduction in erosion rate). Persists for a long-term duration i.e. more than five years.
Low	Adverse	Some measurable change in physical processes but does not affect the rate at which a coastal feature is maintained. Persists for a medium-term duration i.e. one to five years.
	Beneficial	Some measurable change in physical processes but does not affect the rate at which a coastal feature is developing. Persists for a medium-term duration i.e. one to five years.
Negligible	Adverse	Imperceptible loss to a coastal feature, or alteration to physical processes of short-term duration i.e. less than one year.
	Beneficial	Imperceptible gain to a coastal feature, or alteration to physical processes of short-term duration i.e. less than one year.
No change		No loss or alteration of characteristics, features or elements; no observable impact in either adverse or beneficial.

1.9.4 Significance of effect

1.9.4.1 The significance of the effect upon physical processes has been determined by considering the sensitivity of the receptor and the magnitude of the impact. The method employed for this assessment is presented in **Table 1.18.** Where a range of significance levels is presented, the final assessment for each effect is based upon expert judgement, with a holistic approach taking in recoverability, mitigating measures and receptor value.

1.9.4.2 In all cases, the evaluation of receptor sensitivity, impact magnitude and significance of effect has been informed by professional judgement and is underpinned by narrative to explain the conclusions reached.

1.9.4.3 For the purpose of this assessment, any effects with a significance level of minor or less are not considered to be significant in terms of the EIA Regulations.

Table 1.18: Assessment matrix

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

1.9.4.4 Where the magnitude of impact is 'no change', no effect would arise.

1.9.4.5 The definitions for significance of effect levels are described as follows.

- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process. These effects are generally, but not exclusively, associated with designated sites or coastal features of international, national or regional importance that are likely to suffer a most damaging impact and loss of integrity. However, a major change in a designated site or coastal feature of local importance may also enter this category.
- Moderate: These beneficial or adverse effects have the potential to be important and may influence the key decision-making process. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse or beneficial effect on a particular designated site or coastal receptor.
- Minor: These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision-making process but are important in enhancing the subsequent design of the project.
- Negligible: No effects or those that are beneath levels of perception, within normal bounds of natural variation or within the margin of forecasting error.

1.9.5 Assumptions and limitations of the assessment

1.9.5.1 The study area has been the focus of study for both academic and government institutions. Additionally, significant data collection campaigns have been undertaken for the Transmission Assets, related Generation Assets projects, and other offshore wind farm developments in the locality. Although some physical processes are complex and inter-related, there is a significant amount of data available. It is therefore considered that the data used in this assessment are robust and sufficient for the purposes of the impact assessment presented.

1.9.5.2 The physical processes assessment was undertaken using an evidence-based conceptual approach using existing modelling studies and assessments. The Offshore Order Limits encompasses the Morgan Offshore Wind Project: Generation Assets. For this associated project, modelling has been undertaken for the Morgan Offshore Wind Project: Generation Assets ES to examine sandwave clearance and cable installation/protection on physical processes and this is therefore directly applicable to the Transmission Assets assessment as these structures and activities are analogous. The methodology and results of said modelling are presented in Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. Similar seabed material, tidal current speed and orientation are present within the Offshore Order Limits and Intertidal Infrastructure Area, therefore further comparisons are appropriate.

1.9.5.3 Models and model data from the Morgan Offshore Wind Project: Generation Assets ES, which extends beyond the study area were made available for the purposes of the assessment. Dispersion modelling was undertaken to determine the spring tidal excursion relating to the Transmission Assets Red Line Boundary defined within the PEIR. Information on the extent of sediment plumes was therefore determined and SSC and subsequent deposition from seabed preparation was inferred.

1.9.5.4 Extensive modelling was also undertaken for the Mona Offshore Wind Project ES located circa 10 km to the south of the Offshore Order Limits. The methodology and results of said modelling are presented in Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. As the numerical modelling undertaken for the Mona Offshore Wind Project ES, considered the impact of cable protection on physical processes in insolation (which was not modelled for the Morgan Offshore Wind Project: Generation Assets), its inclusion within Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES provides essential evidence for the assessment below. The Transmission Assets are located within the same geological formation as the Mona offshore export cable; each having a thin veneer of superficial sediments (<0.5 m) comprising mainly sand, overlaying Holocene sediments containing varying proportions of sand. This therefore provides a further source of information on potential impacts on physical processes due to offshore wind developments in a similar environment.

1.10 Assessment of effects

1.10.1 Introduction

1.10.1.1 The impacts arising from the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are listed in **Table 1.14**, along with the MDS against which each impact has been assessed.

1.10.1.2 A description of the likely effect on receptors caused by each identified impact is given below.

1.10.2 Increase in suspended sediments due to construction, operation and maintenance, and/or decommissioning related activities, and the potential impact to physical features

1.10.2.1 Increased suspended sediment concentrations may arise due to seabed preparation involving sandwave clearance and dredging, the installation and maintenance of Transmission Assets offshore export cables, and associated decommissioning activities. Activities associated with each of these phases are assessed in the following section. The evidence based approach for this section is based of coastal geomorphological sediment modelling undertaken as part of the Morgan Offshore Wind Project: Generation Assets ES and the Mona Offshore Wind Project ES as described in **section 1.9.5**.

Construction phase

Sensitivity of the receptor

1.10.2.2 Fylde MCZ is an active seabed feature, designated for its extensive subtidal sediment habitats and plant and animal communities, with the site supporting species such as crabs, starfish and crustaceans and bivalve shellfish. The conservation objectives for the MCZ's protected features are that they should be 'maintained in a favourable condition'. It is a designated feature and is therefore of high value.

1.10.2.3 The West of Copeland MCZ is an active seabed feature, designated for protected features such as, subtidal coarse sediment, subtidal sand and subtidal mixed sediments. These subtidal sediments may provide habitats which support a wide range of associated biological communities. The conservation objectives for subtidal sand features are that they are 'maintained in favourable condition' and for the subtidal coarse sediment and subtidal mixed sediments is to 'recover to a favourable condition'. It is a designated feature which includes areas of Annex I Sandbanks at the north end of the MCZ and therefore of high value.

1.10.2.4 The West of Walney MCZ is an active seabed feature, designated for the protected features of subtidal sand, subtidal mud and sea-pen and burrowing megafauna communities. The conservation objectives for the MCZ's protected features are that they have 'recovered to a favourable condition'. It is a designated feature and therefore of high value.

1.10.2.5 The Shell Flat and Lune Deep SAC is designated for the Shell Flat sandbank comprised of mud and sand which is slightly covered by sea water all the times which provides Annex I habitat. It is an active bedform and designated feature and therefore of high value. The Lune Deep component of the SAC consists of a deep water channel which hosts Annex I reef habitats, this is also a designated feature and therefore of high value.

1.10.2.6 Ribble and Alt Estuaries SPA, Ramsar and SSSI sites are characterised by tidal flats and saltmarsh. The mudflats have a large invertebrate fauna supporting internationally important populations of wintering waterbirds. These are designated features and therefore of high value.

1.10.2.7 The Fylde, West of Copeland, and West of Walney MCZ's along with the Shell Flat feature of the Shell Flat and Lune Deep SAC and the Ribble Estuary all have active seabed features which are not sensitive to SSC and of negligible vulnerability to deposition due to natural exposure to sediment redistribution and would recover in the short term.

1.10.2.8 Therefore, all receptors are considered to be of **low** sensitivity.

Magnitude of impact

1.10.2.9 The project design includes the provision of site preparation/sandwave clearance activities which have the potential to increase suspended sediment concentrations in the (concurrent) construction phase with associated deposition. The MDS for sandwave clearance for cable installation was along 9% of the 400 km offshore export cable associated with Morgan Offshore Wind Project: Generation Assets and along 9% of the 84 km Morecambe Offshore Windfarm: Generation Assets offshore export cable length. Sandwave clearance parameters for offshore export cables are defined as having a width of 60 m and 48 m, for the Morgan Offshore Wind Project: Generation Assets and the Morecambe Offshore Windfarm: Generation Assets respectively. Within the Fylde MCZ sandwave clearance is required along 5% of the 64 km offshore export cable associated with Morgan Offshore Wind Project: Generation Assets which falls within the designation, and along 5% of the 24 km of Morecambe Offshore Windfarm: Generation Assets.

1.10.2.10 The Outline cable burial risk assessment (CBRA) (document reference J14) confirms that the seabed geology and ground conditions within the Transmission Assets offshore cable corridor is dominated by sandy and clay sediments. These sediments are characterised as loose to dense sand and low to medium strength clay in shallow water depth (up to -14.23 m). Ploughing, jetting and cutting are suitable techniques for loose to dense sand and low to medium strength clay (soft to firm). Additionally, these techniques are suitable for offshore, nearshore, and beach areas. A combination of burial methods is likely to be adopted, with the Outline CSIP (document reference J15) covering all necessary techniques to allow the appropriate method to be selected based on the expected sediment density and strength, ensuring the minimum burial depth is achieved. The information presented within the Outline CBRA shows that ploughing, jetting and cutting are suitable installation techniques for the sandy and clay sediment types found in shallow waters within the Transmission Assets offshore cable corridor and a worst case scenario has been assessed.

1.10.2.11 In practice, plough dredging or the use of a Control Flow Excavator, the later of which will be the only method used for sandwave clearance within the Fylde MCZ, mobilises a much smaller amount of sediment into suspension at the seabed and has reduced sediment plume concentrations and extents compared to other types of dredging activities which may be undertaken. However, the assessment is undertaken applying modelling carried out for the Morgan Offshore Wind Project: Generation Assets ES which simulated the use of a suction hopper dredger with a phasing representative of the scale of the sandwaves; dredging, and then depositing material by side casting within the cable corridor as it progressed along the route, resulting in higher SSC and dispersion plumes compared to plough dredging.

1.10.2.12 Sandwave clearance operations mobilise the greatest volume of material when compared to the range of construction activities. The Morgan Offshore Wind Project: Generation Assets ES modelling undertook a sample of sandwave clearance along the north east corner of the Morgan Offshore Wind Project: Generation Assets and, with relatively homogeneous tidal currents and sediments along much of the offshore cable corridors where sandwaves occur, these simulations may be used to quantify potential impacts for the Transmission Assets. The sediment plume extends circa 5 km in a principally east/west orientation. Suspended sediment concentrations are at their greatest at the dredging site and where they have remobilisation following slack tide and may reach up to 1000 mg/l. However average concentrations are typically one tenth of this value and near background levels at the edge of the plume's extent. Sedimentation following the operation is in the order of 3 to 5 mm across the region where material is redistributed and < 0.1 mm at the extent of the plume.

1.10.2.13 Remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be elongated. However, where this sedimentation occurs, it does so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. The Fylde MCZ and Ribble Estuary designations would experience greater levels of deposition if works were to be undertaken either in close proximity (< 10 km) or within these areas.

1.10.2.14 The installation of cabling related to the Transmission Assets may lead to increased suspended sedimented concentrations and associated deposition. In each case, cables will be installed in a trench with a maximum depth of 3 m, a width of 3 m at the bed and a "v" shape cross-section. In total, cabling comprises of 484 km of offshore export cables.

1.10.2.15 The installation of offshore export cables associated with the Morgan Offshore Wind Project: Generation Assets was modelled as part of the Morgan Offshore Wind Project: Generation Assets ES, the outputs of which can be seen in Volume 2, Annex 1.1: Physical processes associated modelling studies of the ES. As with the sandwave clearance, it is expected that cable installation activities will create a suspended sediment plume extending up to 5 km of the trenching operation. In the direct vicinity of the trenching, SSC was found to be typically 500 mg/l whilst at the extents of the plume SSC levels dropped to 0.5 mg/l which is in the order of background level variation. Sedimentation levels beyond the immediate vicinity of the trench were circa 50 mm and reducing to < 0.5 mm within 2 km. Noting that much of the displaced material would, in reality, be used to backfill the trench. Cabling along routes located to the south of the Morgan Offshore Wind Project: Generation Assets and extending to the Morecambe Offshore Windfarm: Generation Assets where the offshore cables coalesce would not impact on the designated areas. Deposition arising from cable installation and subsequent remobilisation and redistribution on the north routes would be indistinguishable from background levels at the adjacent MCZs.

1.10.2.16 Trenching undertaken from the east edge of the Morecambe Offshore Windfarm: Generation Assets site towards the shore would pass through areas where the tidal currents are of a similar magnitude but are orientated north to south, parallel to the coastline. With the cable corridor passing though Fylde MCZ and the Ribble Estuary designations, these areas would be directly affected at the magnitude described. Redistributed sediment may reach the south edge of the Shell Flat feature of the Shell Flat and Lune Deep SAC under certain conditions. namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be elongated. However, where this sedimentation occurs, it does so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits.

1.10.2.17 As per the construction programme, there remains a possibility that sandwave clearance activities may be undertaken simultaneously with cable installation activities. Given the mobile nature of sediment within the offshore export cable corridor it is likely that sandwave clearance will occur in sections of the cable route just prior to cable trenching in that area, to avoid the newly formed channels from in-filling. Thus, it is likely that plumes from these activities will coalesce, and greater levels of SCC and deposition can be expected within the Fylde MCZ and Ribble Estuary designations as a result.

1.10.2.18 This is the case not only for activities relating to the individual components of the Transmission Assets, i.e., sandwave clearance/cable installation activities relating to Morgan Offshore Wind Project: Transmission Assets, but also sandwave clearance/cable installation activities of the Morgan Offshore Wind Project: Transmission Assets and sandwave clearance/cable installation activities relating to the Morecambe Offshore Windfarm: Transmission Assets. Where this does occur plumes will likely interact resulting in increased cumulative deposition within the Fylde MCZ and Ribble Estuary designations.

1.10.2.19 For cable trenching in the intertidal area, material released may migrate within the sediment cell but it would be insufficient to impact the beach morphology, with deposition of *c.* 5 to 10 mm along the coast and typically far less along the shoreline which is redistributed on successive tides following cable installation. With the intertidal region of the cable corridor passing through the Ribble Estuary designations, it would be directly affected by the open trenching techniques used during cable installation.

1.10.2.20 Despite not being in the MDS in terms of SSC, there is potential that trenchless techniques in the form of direct pipe installation would be utilised within the upper part of the intertidal region. This will depend on the location of exit pits for the transition to trenchless installation under the dunes. The exit pits will be located at least 100 m from the western boundary of the Lytham St. Annes Dunes SSSI (CoT44, Table 1.13). Additionally, the direct pipe installation is a fully cased system which reduces the risks associated with frack out of drilling fluids or the collapse of the drill hole in the case of unsuitable ground conditions. In this scenario up to 300 m of trenching per cable would still be required within the intertidal region dependent on the location of exit pits. The trench is likely to be a stepped side trench to maintain stability with a top width of up to 10 m and a depth of approximately 3 m.

1.10.2.21 The direct pipe exit pits would be located above MLWS and are anticipated to be around MHWS. If they are required within the intertidal zone then works will most likely be undertaken at low tide utilising a coffer dam so that drilling can occur in a dry environment, mitigating suspended sediments. Each cofferdam exit pit is up to 75 m^2 (15 m x 5 m) with only one project installing and utilising cofferdams at a time. Any plume induced is therefore likely to have a similar spatial extent as expected for open-cut trenching in the vicinity; however, it should be noted that the volumes released, and hence SSC, would be much smaller.

1.10.2.22 The impact is predicted to be of local spatial extent and short term duration. The magnitude of impact is therefore **low adverse**.

Significance of the effect

1.10.2.23 Outline Offshore Cable Specification and Installation Plan(s) (CSIP) (document reference J15) submitted with the application, will include for cable burial to be the preferred option for cable protection, where practicable, as stated in CoT54, and outlined in **Table 1.13**. During the offshore export cable trenching, direct impact is expected on the Fylde MCZ and the sandbanks within the site with deposition up to 10 mm along site of trenching. However due to the nature of the site as an active bedform and its natural exposure to sediment redistribution, it is likely that the site would recover quickly. It should also be noted that sandbanks that extend into the site form the edge extent of the Annex I sandbanks from the Shell Flat and Lune Deep SAC, however they are not included in the Annex I designation due to the 0.1° slope cut off. A sandwave recoverability study associated with similar cable trenching activities for the Race Bank Offshore Wind Farm, showed that within two years of offshore export cable trenching operations, sandwaves affected within the Inner Dowsing, Race Bank and North Ridge SAC had mostly recovered to pre-construction levels (Ørsted 2018). As described in Table 1.17, this constitutes a low adverse magnitude i.e., one to five years. As part of CoT45, outlined in **Table 1.13**, the Outline Offshore CSIP (document reference J15) will encompass monitoring of the MCZ recovery through asset integrity surveys. Analysis of inter-array cable installation activities modelled for the Morgan Offshore Wind Project: Generation Assets (with the same 3 m width and depth) showed that sedimentation can be in excess of 50 mm at the trench site and decreasing with distance. This would however be maintained within the sediment cell and kept within the sediment transport system. Again, note that much of this material would be used to backfill the trench during the installation operation.

1.10.2.24 Post construction monitoring undertaken for the Barrow Offshore Wind Farm, also located in the East Irish Sea, examined natural trench infill, one year post construction. The conclusion of the monitoring report with respect to cable trenching presented that within one year of construction, the cable trench had almost completely infilled through natural processes (BoWind, 2008). The magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation, and the sensitivity of the receptors is considered to be **low.** The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.10.2.25 The Ribble Estuary designations will also be directly impacted by offshore export cable trenching, due to overlap with the offshore export cable corridor. However, (as with Fylde MCZ) the nature of the site as an active seabed and its natural exposure to sediment redistribution, means it is likely that the site would recover quickly from any sedimentation. With affected features such as ripples likely recovering in a similar timescale (if not sooner due to smaller scale of features) as presented for the Race Bank Offshore Wind Farm above. Sedimentation associated with offshore export cable installation would be similar to that experienced in the Fylde MCZ, however, would likely be reduced as sediment nearshore is redistributed on successive tides. The magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation, and the sensitivity of the receptors is considered to be **low.** The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.10.2.26 Remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be elongated. However, where this sedimentation occurs, it does so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. However, in all these cases values are expected to fall within the range of natural variation. The magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation, and the sensitivity of the receptors is considered to be **low.** The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

1.10.2.27 Overall, the magnitude of the impact is **low** and the sensitivity of the receptor is **low**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effect

1.10.2.28 No physical processes mitigation is considered necessary because the likely residual effect(s) in the absence of further mitigation (beyond the designed in measures outlined in **section 1.10.5**) is **not significant** in EIA terms.

Operation and maintenance phase

Sensitivity of receptor

1.10.2.29 The Fylde MCZ and the Ribble Estuary are designated features and therefore of high value. They have active seabed features which are not sensitive to SSC and of negligible vulnerability to deposition due to natural exposure to sediment redistribution and would recover in the short term.

1.10.2.30 Therefore, all receptors are considered to be of **low** sensitivity.

Magnitude of impact

1.10.2.31 Operation and maintenance associated with the Transmission Assets may lead to increases in SSC and associated sediment deposition over the lifetime of the projects. The MDS for offshore export cable maintenance is for the subtidal repair of up to 4 km of offshore export cable in up to 14 repair events relating to Morgan Offshore Wind Project: Transmission Assets and seven repair events relating to Morecambe Offshore Windfarm: Transmission Assets. Up to four intertidal repair events for each Offshore Windfarm with each event for Morgan Offshore Wind Project: Transmission Assets being up to 1 km and up to 2.4 km for each event for Morecambe Offshore Windfarm: Transmission Assets may be required. The MDS sets out potential subtidal cable reburial lengths of circa 16 km and 3.4 km in each of up to seven events relating to the Morgan Offshore Wind Project: Transmission Assets and the Morecambe Offshore Windfarm: Transmission Assets respectively. Intertidal cable reburial may also be required, with lengths of up to 250 m per events with up to 28 events associated with Morgan Offshore Wind Project: Transmission Assets and 14 intertidal repair events relating to Morecambe Offshore Windfarm: Transmission Assets.

1.10.2.32 Repairs and reburial would be undertaken using similar methods as those for cable installation activities (i.e. trenching/jetting, with trench width up to 3 m and trench depth up to 3 m), therefore the magnitude of the impacts would be a fraction of those for the construction phase. The sediment plumes and sedimentation footprints would be dependent on which section of the cable is being repaired however the entire length has been considered under the construction phase assessment. If cable repairs are undertaken within a distance of 5 km of the Fylde MCZ or Ribble Estuary designated areas, then the magnitude of impact would be as described for the construction phase in the previous section.

1.10.2.33 The impact is predicted to be of local spatial extent and short term duration. The magnitude of impact is therefore **low adverse.**

Significance of effect

1.10.2.34 The occurrence of repair and reburial activities within the Fylde MCZ and Ribble Estuary designations, through the use of similar techniques to installation (i.e., trenching/jetting) can be considered to have a direct impact to the designated areas. However, the effect can be expected to be of a smaller temporal and spatial scale. An Outline Offshore Cable Specification and Installation Plan(s) (CSIP) (document reference J15) submitted with the application, produced prior to construction of the offshore export cable which will include: "…details of cable burial depths, cable protection, cable monitoring, and a cable layout plan which ensures safe navigation is not compromised…", as per CoT45 outlined in **Table 1.13.** The sensitivity of the receptors is considered to be **low** and the magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation**.** The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effects

1.10.2.1 No physical processes mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in **section 1.7**) is **not significant** in EIA terms.

Decommissioning

Sensitivity of receptor

1.10.2.2 The Fylde MCZ and the Ribble Estuary are designated features and therefore of high value. They have active seabed features which are not sensitive to SSC and of negligible vulnerability to deposition due to natural exposure to sediment redistribution and would recover in the short term.

1.10.2.3 Therefore, all receptors are considered to be of **low** sensitivity.

Magnitude of impact

1.10.2.4 Following decommissioning, increases in suspended sediments and potential impacts on the physical features would be of a similar magnitude to those described for the construction phase but slightly reduced with the reduction in seabed preparation activities. The removal of project cabling would lead to an increase in SSC through similar trenching techniques as implemented during installation. The expected magnitude of impact is therefore assumed at a MDS equal to or less than that of the construction phase.

1.10.2.5 The impact is predicted to be of local spatial extent and short term duration. The magnitude of impact is therefore **low adverse.**

Significance of effect

1.10.2.6 There is potential for increased SSC and deposition within the Fylde MCZ and Ribble Estuary designations, however the magnitude of plume could be expected to fall within background levels. The sensitivity of the receptors is considered to be **low** and the magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation, The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effects

1.10.2.7 No physical processes mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in **section 1.7**) is **not significant** in EIA terms.

1.10.3 Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.

1.10.3.1 Both the seabed preparation activities in the construction phase and the presence of infrastructure in the water column during the operation and maintenance phase may lead to changes to physical processes and thus seabed morphology. The project includes a number of commitments which will specify cable protection requirements (see **Table 1.13**). Most notably commitment CoT47 will include measures to limit the extent of cable protection within the Fylde MCZ, "…Within the Fylde MCZ, external cable protection will only be used where deemed to be essential, e.g. for cable crossings or in the instance that adequate burial / reburial is not possible for any section of the route through the Fylde MCZ…" Whilst the preferred option for cable protection is cable burial, CoT54 as outlined in **Table 1.13**, which will minimise changes to the physical processes, particularly in nearshore, shallow areas.

Construction phase

Sensitivity of the receptor

1.10.3.2 Due to the inter-related nature of physical processes, the sensitivity of receptors are the same for each impact and in the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**.

1.10.3.3 Based on this, all receptors are considered to be of **low** sensitivity**.**

Magnitude of impact

1.10.3.4 Seabed preparation in the form of sandwave clearance for the pre-laying of cable is required along the offshore export cable routes relating to the Transmission Assets. The MDS defines for sandwave clearance of up to 9% of the 484 km of offshore export cabling, with a height of 5 m and width of 60 m and 48 m for the Morgan Offshore Wind Project: Transmission Assets and the Morecambe Offshore Windfarm: Transmission Assets respectively. Totalling a clearance volume of 1,426,800 m^3 (1,080,000 m^3 and 346,800 m^3 for the Morgan Offshore Project: Transmission Assets and the Morecambe Offshore Windfarm: Transmission Assets, respectively).

1.10.3.5 The rate of reformation of sandwaves is dependent on a range of factors including the size, location and alignment of any breach with respect to the sediment transport pathways and available recharge material. It has been shown that the region has active sediment transport systems with net sediment transport rates of *c*. 0.75 m^3/d/m within the Morgan Offshore Wind Project: Generation Assets, this can be increased further during storm events which raise littoral currents and in turn net sediment transport rates. The sandwave features themselves are also mobile, typically moving 1 m in an easterly direction each year (ABPmer, 2023). Therefore, although it is not possible to quantify the reformation rate of sandwave breaches with certainty, given the number of variables and dependencies, in an areas of active sediment transport with rechange material available it is anticipated that in the months following installation infilling would become evident.

1.10.3.6 The physical processes MDS for UXO removal relates to clearance of up to 25 UXOs, 22 within the Morgan Offshore Export Cable Corridor and 3 within Morecambe Offshore Export Cable Corridor. UXO clearance is likely to include a range of UXO sizes with the Net Explosive Quantity (NEQ) ranging between 25 kg to 907 kg with 130 kg being the most likely, noting that the draft DCO does not authorise high order UXO clearance, CoT64.

1.10.3.7 A desk-based review indicates that there are no known UXOs recorded within the overlapping area of the Fylde MCZ and the Offshore Order Limits. The Marine Conservation Zone (MCZ) Screening and Stage 1 Assessment Report details that, based on current information, there is only one known buried UXO within the Offshore Order Limits and this is outside the boundary of the Fylde MCZ. However, a precautionary approach has been adopted to the assessment which assumes that up to four UXOs may require clearance within the MCZ.

1.10.3.8 Data in the public domain was used to determine likely crater size for the most likely (common) maximum UXO size of 130 kg with a diameter of 12.61 m and a depth of circa 3 m (Ordtek, 2018). Further data was also available for larger UXO up to 700 kg (Equinor, 2022). Data relating to the larger UXO indicates that crater sizes for 700 kg ordinance may be up to 5 m in depth (21 m in diameter), although observations of UXO in areas of sandy gravel, similar to those found in the study area, were typically half of this predicted diameter and less than 1.5 m in depth (Ordtek, 2018). Therefore, individual craters generated for clearance for a maximum 907 kg UXO in an area characterised by active sediment transport would not give rise to significant impacts on physical processes. Although craters may initially infill with the most mobile, finest, sediment the baseline sediment processes would continue restoring the sediment transport regime and seabed characteristics.

1.10.3.9 The detailed seabed mobility study undertaken for the Morgan OWF Generation and Transmission Assets (ABPmer, 2023) examined the potential of undertaking cable installation in stages with a pre-dug trench. The study concluded that in offshore areas the trench, which is of a similar depth to the potential UXO craters under high order clearance, would potentially infill within a couple of tidal cycles during spring tides with further acceleration of infill under wave action. In nearshore areas the sediment transport rate is somewhat reduced due to the lower current speed and, in these areas, infill is anticipated in the order of weeks to months. Additionally, a review of the effects of cable installation on subtidal sediments (RPS, 2019), which drew on monitoring reports from over 20 UK offshore wind farms found that sandy sediments recover quickly following cable installation. The review also presented evidence that remnant cable trenches in coarse and mixed sediments were conspicuous for several years after installation. However, these shallow depressions were of limited depth (i.e. tens of centimetres) relative to the surrounding seabed, over a horizontal distance of several metres and therefore did not represent a large shift from the baseline environment. Therefore residual impacts and recovery of the seabed from seabed preparation activities would be anticipated to occur on a similar timescale, albeit on a much smaller spatial extent.

1.10.3.10 Low order deflagration is a new technique which has been successfully applied at the Moray West Offshore Windfarm, where 81 UXO ranging from 14 kg to 879 kg were all cleared using this technique (Ocean Winds, 2024). This example demonstrates the success of low order detonation techniques such as deflagration and demonstrates that it is highly likely the majority, if not all, of the UXO identified could be cleared using low-order methods with resulting crater sizes significantly smaller than those cited above for high order clearance.

1.10.3.11 Any boulders identified as likely to impact installation will need to be moved to the side (side cast), away from the immediate location of the offshore export cable infrastructure. There are two key methods of clearing boulders: boulder plough and boulder grab. Where a high density of boulders is seen, a plough would typically be required to clear the offshore export cable installation corridor. Where medium and low densities of boulders are present, a subsea grab is expected to be employed.

1.10.3.12 The Outline Offshore CSIP also details that geotechnical data indicates that boulders are present in a low density across the majority of the study area but distributed sporadically along the offshore export cable corridor routes. Therefore, the method of boulder clearance is likely to be subsea grab, especially within the Fylde MCZ. The outline Offshore CSIP indicates that this portion of the offshore export cable route is largely featureless with small areas of ridge and runnel in the nearshore area, sporadic ripples throughout the MCZ, and mega-ripples along the western edge of the MCZ.

1.10.3.13 The required boulder clearance width is 20 m centred on each cable and boulders would be relocated circa 10 m either side from the centreline of each cable. Due to this limited distance, boulders would, inevitably, be relocated to areas of similar habitat, and seabed characteristics would remain unchanged. Also, due to the low density and sporadic nature of the boulders coupled with the limited relocation distance, linear structures would not be formed to potentially interfere with baseline sediment transport regimes.

1.10.3.14 The impact due to seabed preparation activities involving sandwave clearance along the offshore export cable routes, low order UXO clearance and the relocation of boulders, is considered to be of local spatial extent, short term duration, intermittent and of high reversibility. The impact will directly affect the Fylde MCZ and Ribble Estuary designations, however given that dredged material would be deposited in the direct vicinity of clearance operations and remain within the sediment cell, the magnitude of impact due to seabed preparation activity is considered to **low adverse**.

Significance of effect

1.10.3.15 There is potential for localised changes to seabed morphology within the Fylde MCZ and Ribble Estuary designations, however given the recoverability of the highly mobile sandwaves within the study area, and ripples within the MCZ specifically, effects are expected to be of short term duration. The sensitivity of the receptors is considered to be **low** and the magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation, The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effects

1.10.3.16 No physical processes mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in **section 1.7**) is **not significant** in EIA terms.

Operation and maintenance phase

1.10.3.17 Cable protection will be installed during laying of the cables during the Construction phase however if remedial burial continuously fails, cable protection may be installed as necessary in the operation and maintenance phase. This section discusses any long term impact associated with the placement of cable protection during construction (i.e. any impacts that arise during the operation of the Proposed Development).

Sensitivity of the receptor

1.10.3.18 In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2 to 1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**.

1.10.3.19 Based on this, all receptors are considered to be of **low.**

Magnitude of impact

1.10.3.20 For the Morgan Offshore Wind Project: Transmission Assets, it is anticipated that cable protection along up to 40 km of the offshore export cable may be required, with a height of up to 2 m and up to 10 m in width. Up to 45 cable crossings may be necessary, each crossing with a height of up to 2.8 m, a width of up to 30 m and a length of up to 150 m. Similarly, for the Morecambe Offshore Windfarm: Transmission Assets, up to 8.4 km of the offshore export cables may require protection, with a height of up to 2 m and up to 10 m width. With up to six cable crossings, each crossing with a height of up to 2.8 m, a width of up to 30 m and a length of up to 150 m. However, it should be noted the nearest cable crossing to shore is *c*. 20km from the coastline, due to the selection of landfall location and therefore is not expected to impact shorelines.

1.10.3.21 Although cable protection was included in the Morgan Offshore Wind Project: Generation Assets ES modelling, its impact on physical processes is not readily isolated from the infrastructure as a whole. However, as part of the Mona Offshore Wind Project ES modelling, it was provided along sections of the offshore export cable as presented in Volume 2, Annex 1.1 Physical processes associated modelling studies of the ES. Therefore in lieu of modelling relating to cable protection specific to the Morgan Offshore Wind Project: Generation Assets, the basis of the assessment of cable protection within this ES utilises the modelled results from the Mona Offshore Wind Project, as included in Volume 2, Annex 1.1 Physical processes associated modelling studies of the ES.

1.10.3.22 In the case of wave climate where the cable protection height was less than circa 15% of the water depth there was no change in wave climate; whilst in shallower water the change was 0.5 to 1% of background levels at the site of cable protection, reducing rapidly with distance and indistinguishable from background levels within 1 km of the site.

1.10.3.23 For tidal currents, where cables were perpendicular to tidal currents and continuous length of cable protection was provided there was a highly localised increase in current speed of circa 1% as flow is accelerated over and around the structure due to the depth reduction. The area influenced extended circa 500 m from the structure however the influence diminished rapidly within this zone.

1.10.3.24 Impacts to the sediment transport regime would be highly dependent on the length and orientation of cable protection. Baseline sediment transport, driven by residual tidal currents, runs in an easterly direction offshore and therefore largely parallel to the cable routes. Sediment transport in the nearshore environment runs parallel to the coast; however, cable protection would be perpendicular to these pathways.

1.10.3.25 Localised changes in wave climate, tidal currents and the sediment transport regime may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. The magnitude of the impact of cable protection on sediment transport pathways would be highly dependent on the length and orientation of the infrastructure. Baseline sediment transport, driven by residual tidal currents, runs in an easterly direction offshore and therefore largely parallel to the cable routes.

1.10.3.26 The use of cable protection will be further evaluated and considered post-consent in the detailed CSIP(s), following further post-consent / pre-construction surveys. This will identify where cable protection is required ensuring that cable protection is only used if and where necessary, with cable protection measures tailored to the specific location. Noting that a commitment (CoT134) has also been made which states that "*As part of the detailed design process, micro-siting of the offshore export cables within the offshore export cable corridors will be considered where successful burial could pose a challenge or where a higher risk of remedial works such as external cable protection may be required*.". Similarly, the Applicants have also committed to no rock dumping within the Fylde MCZ as a condition of the draft DCO.

1.10.3.27 The Outline CBRA details sub-seabed geology and ground conditions and depth of lowering (burial depth) for cable burial along the full length of the cable corridor. The nearshore section extends onshore out to a distance of 13.25 km offshore at a depth 14.23m chart datum (CD) and incorporates DoC which is circa 10 m CD. Within the DoC the sediment transport is more predominantly influenced by metrological conditions (i.e. wave climate / littoral currents) rather than tidal flow. These littoral currents drive longshore and cross-shore transport and provides the sediment source for the Ribble Estuary SPA.

1.10.3.28 The information from the Outline CBRA indicates, from Lowest Astronomical Tide (LAT) to DoC, geological conditions are suitable for trenching to required depth due to the sediment type found in the nearshore area and Fylde MCZ (i.e. predominantly sand and mud). It is therefore not anticipated that external cable protection would be required in the nearshore and this is to be confirmed by pre-construction surveys. However, in the unlikely event that burial to the target depth is not achievable, commitment CoT45 states that cable protection will be tailored to the specific location and installed to limit change in water depth to no more than 5% (referenced to Chart Datum).

1.10.3.29 Whilst the basis of this limitation, which has been standard in DCOs for many years, is to maintain sufficient under-keel clearance of vessels to minimise the risk of vessel fouling, its applicability to minimising the potential for effects on physical processes and other environmental receptors is valid. In practical terms the 5% limitation means that in 10 m water depth, cable protection, if required, cannot exceed 0.5 m and in 5 m water depth, this is reduced to 0.25 m. At water depths of less than 5 m, the potential for any cable protection is essentially none. Additionally, the Outline CSIP states that, should cable protection be required in shallow water, protection will be sufficiently low profile and /tapered to cause minimal changes to wave, tide and sediment transport. This mitigation is specifically designed for physical processes to ensure baseline sediment transport regimes are unhindered.

1.10.3.30 Thus, the detailed design (either by location, installation methodology or type of cable protection) will ensure there are no significant effects to the nearshore as result of any cable protection, in accordance with NPS EN-1 paragraph 5.6.17 and implemented with approval by the MMO in consultation with relevant stakeholders.

1.10.3.31 Given that any impact is limited to the immediate vicinity of the site of cable protection, it is not expected to affect adjacent shorelines such as Blackpool Beach which is located > 3 km from the landfall location or Lytham St Annes beach and promenade to the south of the landfall. Additionally, any cable protection in shallow water would entail the use of tapered cable protection such as mattresses, which are specifically designed to allow sediment transport to continue unhindered and sediment sources and sediment transport into the Ribble Estuary would not be impacted by the presence of this infrastructure.

1.10.3.32 Given the small scale of cable protection and crossings to be implemented and further mitigating measures such as tapered profiles and compliance with the limitation on the height with regards to water depth (CoT45, as outlined in **Table 1.13**), it is not expected that impacts from cable protection would be sufficient to disrupt offshore bank morphological processes, experience significant secondary scour or destabilise coastal features, the magnitude of impact is therefore considered to be **low adverse** for the Transmission Assets.

Significance of effect

1.10.3.33 To minimise the potential impact from the cables and removal of cables there is a commitment to bury cables where possible as per CoT54 outlined in **Table 1.13**. Where burial cannot be achieved to the required depth cable, protection may be required. A CBRA (document reference J14) and outline CSIP (document reference J15), provides further parameters as per CoT45 outlined in **Table 1.13**. The detail of design and construction will be outlined within the CSIP (document reference J15) and would also determine the likely extent of any potential scour and would aim to mitigate this through site specific detailed design of scour protection measures. It is therefore likely that any secondary scour effects associated with cable protection would be confined to within a few meters of the direct footprint of that cable protection material.

1.10.3.34 It is anticipated that cable protection may be required, however, this would only be necessary where a suitable burial depth may not be achieved due to ground conditions or the presence of existing infrastructure, (i.e. where cable crossings are required as outlined in Volume 1, Annex 3.1: Offshore Crossing Schedule of the ES (document reference F1.3.1). If, and where, cable protection is required in shallow subtidal conditions, the measures used will be of sufficiently low profile to cause minimal interruption to sediment transport. Descriptions of the possible types of cable protection to be utilised can be found in Volume 1, Chapter 3: Project description of the ES with the detail of design be outlined within the CSIP (document reference J15) to ensure that the most suitable protection is applied in line with the project commitments, as per CoT45 outlined in **Table 1.13**. It is noted that commitment CoT47, **Table 1.13**, aims to limit the extent of cable protection in the Fylde MCZ, "…Within the Fylde MCZ, external cable protection will only be used where deemed to be essential, e.g. for cable crossings or in the instance that adequate burial / reburial is not possible for any section of the route through the Fylde MCZ…". Where practicable the requirements will be compliant with the MCA navigation guidance which includes that there will be "…No more than a 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the offshore export cable corridor route without prior written approval from the licencing authority in consultation with the MCA and Trinity House." (MCA, 2021), as per CoT45 outlined in **Table 1.13**.

1.10.3.35 There is potential for localised changes to seabed morphology within the Fylde MCZ and Ribble Estuary designations. The sensitivity of the receptors is considered to be **low** and the magnitude of the impact is deemed to be **low** due to limited and temporary nature of sedimentation. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effects

1.10.3.36 No physical processes mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in **section 1.7**) is **not significant** in EIA terms.

Decommissioning

Sensitivity of receptor

1.10.3.37 In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**.

1.10.3.38 Based on this, all receptors are considered to be of **low** sensitivity.

Magnitude of impact

1.10.3.39 Following decommissioning, changes to physical processes and seabed morphology would be of a similar magnitude to those in the operation and maintenance phase with cable protection within the context of the MDS.

1.10.3.40 Localised changes in physical processes and thus seabed morphology may potentially persist within the Fylde MCZ and Ribble Estuary designated areas if cable protection is retained within these areas.

1.10.3.41 The impact is predicted to be of local spatial extent and long term duration as it relates to permanent infrastructure. The magnitude of impact is therefore **low adverse**.

Significance of effect

1.10.3.42 It should be noted that although a worst case scenario relates to cable protection remaining within the water column, it will be designed to be readily removable within shallow water/within the MCZ and has the potential to be removed from the seafloor during the decommissioning phase as outlined by CoT109, **Table 1.13**. Impacts may potentially persist within the Fylde MCZ and Ribble Estuary designations, however in line with navigational regulations as outlined by CoT45, **Table 1.13,** "…No more than a 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the offshore export cable corridor route without prior written approval from the the licencing authority in consultation with the MCA and Trinity House.". Likewise, As per, CoT114, **Table 1.13**, all permanent infrastructure between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within Detailed Cable Burial Risk Assessments (CBRAs).

1.10.3.43 Overall, the sensitivity of the Fylde MCZ and Ribble Estuary receptors is considered to be **low** and the magnitude of the impact is deemed to be **low**. Considering both a low magnitude of impact combined with a low sensitivity of the receptor coupled with the limited spatial extent of the impact the effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effects

1.10.3.44 No physical processes mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in **section 1.7**) is **not significant** in EIA terms.

1.10.4 Impacts to sediment transport and sediment pathways at the offshore export cable landfall

1.10.4.1 Volume 1, Chapter 3: Project description of the ES, outlines that the offshore export cable may be installed using open trenching and/ or direct pipe trenchless techniques. No foreign material will be placed above the surface (winter beach levels), which could potentially interfere with sediment transport pathways and no cable/scour protection shall be ~~permanently~~ deployed in the intertidal area between MLWS and MHWS during the construction and operation and maintenance phases (CoT133), therefore only the construction phase may be affected.

Construction phase

Sensitivity of the receptor

1.10.4.2 In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**.

1.10.4.3 Based on this, all receptors are considered to be of **low** sensitivity.

Magnitude of impact

1.10.4.4 At landfall, to ensure no exposure of cabling occurs in the event of open-cut trenching, commitment CoT114 states that all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 m, subject to further pre-construction surveys to be reported within Detailed CBRAs.. Geophysical surveys indicate the sediment type at landfall is predominantly sand and therefore suitable for traditional burial techniques to achieve the target burial depths. Given natural beach variability falls within a range of 1 m to 3 m, i.e. a maximum of ± 1.5 m, it can be expected that trenching to this depth will avoid cable exposure (ABPmer, 2023).

1.10.4.5 Trenching may be undertaken using a range of options including marinised trenching part of the length within the intertidal area. Marinised trenching is a method of trenching which will be undertaken in the wet (i.e. rather than in the dry when the tide is out) which includes machine-instigated initiation of backfill of the trench to support natural backfill. Trenches will therefore be backfilled to beach level and there will be no interruption in sediment transport pathways at the landfall following construction. Moreover, a further commitment has been made which states that “no cable/scour protection shall be ~~permanently~~ deployed in the intertidal area between MLWS and MHWS during the construction and operation and maintenance phases” (CoT133).

1.10.4.6 The excavation of up to six exits pits up to 15 m by 5 m (located at least 100 m from the western boundary of the Lytham St. Annes Dunes SSSI (CoT44; **Table 1.13**)) would be required to support direct pipe trenchless installation under the Lytham St. Annes dunes. Noting that only one project can carry out cable installation at landfall at any given time; the maximum number of exit pits would be up to four associated with Morgan Offshore Export Cables. In the event that the transition to direct pipe trenchless techniques installation occurs within the inter-tidal region, a cofferdam may be required to ensure a dry working environment for exit pits. In this event the cofferdam will act as a physical obstacle to sediment transport within the intertidal region, however this impact would be of a temporary nature with the cofferdam removed post construction, i.e. only whilst the cable installation is undertaken. Thus, the temporary obstacle posed by the cofferdam is outweighed by the amount of material that may otherwise be released into the intertidal area.

1.10.4.7 The use of cofferdams will enable direct backfilling of excavated material into the pit following cable installation, reducing the risk of sediment dispersion and eliminating the need for separate off-site or intertidal storage options. The storage of material excavated from the landfall exit pits and open cut trenching is only required for the short durations that the excavations are open, with the excavated material stored next to the exit pits and trenches. Once the cable ducts are installed, the exit pits will be backfilled with the excavated material; first with the subsoil, followed by the upper layers of sediment and land reinstatement back in its previous use, thereby maintaining existing shoreline characteristics and sediment transport processes.

1.10.4.8 It can therefore be concluded that the sediment sources and sediment transport into the Ribble Estuary would not be impacted. Blackpool beach, to the north, and Lytham St Annes beach and promenade, to the south, will also be unaffected.

1.10.4.9 The impact is predicted to be of local spatial extent and short term duration. The magnitude of impact is therefore **negligible adverse**.

Significance of the effect

1.10.4.10 It is not anticipated that cable protection would be required at landfall and sufficient depth of burial may be achieved. Under commitment CoT54, (**Table 1.13)** included within the outline CSIP (document reference J15), cables will be buried where practicable along the length of the cable corridor. Additionally, as outlined by CoT114, **Table 1.13**, all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs). In the unlikely event of cable protection being required in the nearshore the outline CSIP states that, should cable protection be required in shallow water, protection will be sufficiently low profile/tapped to cause minimal changes to wave, tide and sediment transport. Heights of cable protection in the nearshore will be compliant with the MCA navigation guidance which states that there will be "…No more than a 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the offshore export cable corridor route without prior written approval from the the licencing authority in consultation with the MCA and Trinity House." (MCA, 2021), as per CoT45 outlined in **Table 1.13**. Furthermore, an additional commitment, CoT133, has been made during the course of the examination that no cable/scour protection shall be permanently deployed in the intertidal area between MLWS and MHWS (**Table 1.13).**

1.10.4.11

1.10.4.12 The significance of effect within the Ribble Estuary designations will be dependent on detailed design. Overall, the magnitude of the impact is deemed to be **negligible,** and the sensitivity of the Fylde MCZ and Ribble Estuary receptors is considered to be **low**. Considering both a negligible magnitude of impact combined with a low sensitivity of the receptor, coupled with adaptability of the active seabed features to small scale changes in sediment transport, the effect will therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Further (secondary) mitigation and residual effects

1.10.4.13 No physical processes mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in **section 1.7**) is **not significant** in EIA terms.

1.10.5 Future monitoring

1.10.5.1 The assessment of impacts on physical processes as a result of the construction, operation and maintenance, and decommissioning phases of the Transmission Assets are predicted to be not significant in EIA terms. Based on the predicted impacts, it is concluded that no specific further monitoring to test the predictions made within the impact assessment is required.

1.10.5.2 As per the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the ES, geophysical surveys will however be undertaken as part of operation and maintenance activities. Further detail on these activities is described within the Outline Offshore Operations and Maintenance Plan (document reference J19).

1.10.5.3 The Applicants have committed to monitoring to observe the effect of sediment transport and sediment transport pathways on cable burial and ensure that cables remain buried and adequately protected, as detailed in the Offshore IPMP. This would therefore encompass areas where sandwave clearance has been undertaken and morphological changes may occur, CoT115. It is also noted that commitment CoT133 states that no cable/scour protection shall be ~~permanently~~ deployed in the intertidal area between MLWS and MHWS during the construction and operation and maintenance phases therefore, there will be no influence on coastal processes in the intertidal area and no need for monitoring at this specific location.

1.10.5.4 Physical processes monitoring will also be considered in the Outline Offshore IPMP (document reference J20) and submitted with the application, and will consider whether existing asset integrity surveys can have scope added to cover physical processes monitoring. If secondary scour is identified, remedial works may be undertaken to both mitigate environmental impacts and to provide asset security.

1.10.5.5 Likewise, the Outline Offshore CSIP (document reference J15) as per CoT45 outlined in **Table 1.13,** will include for routine inspections of offshore export cables to ensure the cables are buried to an adequate depth and not exposed.

1.11 Cumulative effect assessment methodology

1.11.1 Introduction

1.11.1.1 The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Transmission Assets together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 1, Annex 5.5: Cumulative screening matrix and location plan of the ES). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways, and the spatial/temporal scales involved.

1.11.1.2 The cumulative assessment has been undertaken as follows.

- Scenario 1: Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets only.
- Scenario 2: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets only.
- Scenario 3: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Windfarm: Generation Assets.
- Scenario 4: Scenario 3 together with Tier 1, Tier 2 and Tier 3 projects, plans and activities, defined as follows.
  - Scenario 4a: Scenario 3 and Tier 1 projects, plans and activities which are:
    - under construction;
    - permitted application;
    - submitted application; or
    - those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact.
  - Scenario 4b: Scenario 4a and Tier 2 projects, plans and activities which a:
    - scoping report has been submitted in the public domain.
  - Scenario 4c: Scenario 4b and Tier 3 projects, plans and activities which are:
    - where a scoping report has not been submitted but some information is in the public domain;
    - identified in the relevant Development Plan; or
    - identified in other plans and programmes.

1.11.1.3 This assessment is followed by all other relevant projects, identified by tier.

1.11.1.4 This tiered approach is adopted to provide a clear assessment of the Transmission Assets alongside other projects, plans and activities.

1.11.1.5 The specific projects, plans and activities scoped into the CEA, are outlined in **Table 1.19**, and illustrated in Figure 1.8 (Volume 2, Chapter Figures).

1.11.1.6 Note that the significance of cumulative effects is determined by combining the magnitude of the impact of the Transmission Assets with the magnitude of the impact of the relevant projects scoped into the CEA. Thus, the significance determined from the matrix based approach considers the total magnitude and sensitivity of the receptor for projects rather than the accumulation of separate significance of impacts of each individual project/operation.

Table 1.19: List of other projects, plans and activities considered within the CEA

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Morecambe Offshore Windfarm: Generation Assets	Submitted	0 km	480 MW Offshore wind farm (generating assets)	2026 to 2029	2029 to 2064	Yes
Morgan Offshore Wind Project: Generation Assets	Submitted	0 km	1.5GW Offshore wind farm (generating assets)	2026 to 2030	2030 to 2065	Yes
Tier 1-						
Isle of Man to UK Interconnector Cable – Maintenance and Repair	Operational	0 km	Cable repair or maintenance to lay a new section of cable and or cable protection in the form of rock or concrete mattresses	N/A	9 August 2018 to 8 August 2033	Yes
Isle of Man Interconnector Cable – Cable Protection Remedial Works	Operational	0.00 km	Replacement of concrete mattresses used for cable protection with rock filled filter units	N/A	1 July 2014 to 1 July 2065	Yes
Millom West	Decommissioning	0.49 km	Decommissioning of the Millom West offshore platform.	N/A	Operational to 2024 Decommissioning 2024 to 2030	Yes

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
RNLI North Division – Regional Licence for Low Impact Maintenance Works	Operational	1.40 km	Maintenance activities including minor beach reprofiling at Lytham St. Annes	N/A	29 September 2017 to 29 September 2027	Yes
Walney extension 3, Operation and Maintenance (O&M) Marine Licence Application	Operational	5.71 km	Maintenance activities including cable repair/replacement and cable scour remediation work	N/A	28 November 2014 to 28 November 2039	Yes
Walney extension 4, Operation and Maintenance (O&M) Marine Licence Application	Operational	6.05 km	Maintenance activities including cable repair/replacement and cable scour remediation work	N/A	28 November 2014 to 28 November 2039	Yes
West of Duddon Sands Offshore Wind Farm O&M Marine Licence	Operational	6.47 km	Maintenance activities including major component replacement	N/A	27 September 2016 to 9 November 2037	Yes
Mona Offshore Wind Project	Submitted	9.73 km	1.5 GW Offshore wind farm (generating and transmission assets)	2026 to 2030	2030 to 2065	Yes
Walney 1&2 Offshore Wind	Operational	10.17 km	Maintenance activities including major component replacement	N/A	27 September 2016 to 1 March 2032	Yes

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Farms O&M Marine Licence						
Walney 2 Offshore Wind Farm, Composite Operation and Maintenance (O&M) Marine Licence Application	Operational	10.17 km	Maintenance activities including export cables repair/replacement and cable scour protection remediation work	N/A	1 January 2018 to 1 January 2038	Yes
Walney Offshore Wind Farm Operational Marine Licence – Inter Array Cable Repair	Operational	11.4 km	Emergency inter array cable repairs for up to 10 cables over the operational life time of the Walney Offshore Wind Farm (1 & 2)	N/A	11 January 2018 to 1 March 2032	Yes
Walney Offshore Wind Farm Operational Marine Licence – Phase 2 Export Cable	Operational	11.91 km	Emergency export cable repair; recovery, repair and replacement of up to four breakages	N/A	24 April 2014 to 24 April 2037	Yes
Walney Offshore Wind Farm, Composite Operation and Maintenance (O&M) Marine	Operational	15.32 km	Maintenance activities including export cables repair/replacement and cable scour protection remediation work	N/A	6 July 2017 to 31 July 2037	Yes

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Licence Application						
Walney Offshore Wind Farm Operational Marine Licence – Phase 1 Export Cable	Operational	15.32 km	Emergency export cable repair; recovery, repair and replacement of up to four breakages	N/A	24 April 2014 to 24 April 2037	Yes
Barrow Offshore Wind Farm O&M Marine Licence	Operational	18.03 km	Maintenance activities including major component replacement	N/A	27 September 2016 to 1 July 2026	Yes
Douglas Harbour Dredging Disposal	Operational	22.74 km	Douglas outer harbour, basin and fairway are plough dredged annually, normally in January/February. The inner harbour/marina is also dredged annually, and silt is deposited at a licensed site off Douglas Head.	N/A	N/A	Yes
Tier 2-						
Liverpool Bay Area 457 - Westminster Gravels Aggregate Extraction Licence	Pre-application Scoping submitted	1.43 km	Westminster Gravels are renewing their aggregate extraction licence in Area 457 in Liverpool Bay. Environmental Statement is planned to be submitted in 2024.	N/A	2025-2040	Yes
Mooir Vannin wind farm lease area	Pre-application Scoping submitted	2.59 km	Agreement for lease to develop a 700 MW (annual output ~3000 GWh) offshore wind farm	Unknown	Unknown	No

Project/Plan	Status	Distance from the Transmission Assets (nearest point, km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Transmission Assets
Eni Hynet – Carbon Capture Project	Pre-application Scoping submitted	5.72 km	CCS project in the east Irish Sea. Works will include installation of a new cable, a new Douglas CCS platform and work on the existing Hamilton, Hamilton North and Lennox wellhead platforms.	Unknown	Unknown	No
Tier 3-						
Moor Vannin UK Transmission Assets	Pre- scoping	0 km	Transmission assets consisting of subsea electrical cable that will transport electricity from the Mooir Vannin Offshore Array to an onshore substation in Penwortham, England before connecting to a national grid substation.	Unknown	Unknown	Yes
Isle of Man to UK Interconnector Cable 2	Pre- scoping	N/A	A new 70 MW to 100 MW HVAC interconnector to be deployed by 2030 between Pulrose substation and north west England Distribution network.	2024-2030	2030 onwards	Yes

1.11.2 Scope of cumulative effects assessment

1.11.2.1 The impacts identified in **Table 1.20** have been selected as those having the potential to result in the greatest cumulative effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been based on the Project Design Envelope set out in Volume 1, Chapter 3: Project Description, of the ES as well as the publicly available information on other projects and plans.

Table 1.20 Scope of assessment of cumulative effects

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
Increase in suspended sediments due to construction, operation and maintenance, and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	MDS as described for the Transmission Assets **Table 1.20** assessed cumulatively with the following other projects/plans: • Construction, operation and maintenance and decommissioning of Morecambe Offshore Windfarm: Generation Assets. • Construction operation and maintenance and decommissioning of Morgan Offshore Wind Project: Generation Assets. **Tier 1** **Construction Phase.** • Maintenance of Walney Extension 4 Offshore Wind Farm. • Maintenance of Walney Extension 3 Offshore Wind Farm. • Maintenance of Walney 2 Offshore Wind Farm. • Maintenance of Walney 1 Offshore Wind Farm. • Maintenance of Walney export and inter array cables. • Maintenance of West of Duddon Sands Offshore Wind Farm. • Maintenance of Barrow Offshore Wind Farm. • Maintenance/repair of Isle of Man to UK interconnector and replacement of concrete mattresses used for cable protection with rock filled filter units. • RNLI maintenance activities including beach reprofiling at Lytham St. Annes. • Ribble Estuary dredging and dump at sea. • Construction of the Mona Offshore Wind Project.	Outcome of the CEA will be greatest when the greatest number of other schemes are considered in combination. Including schemes and developments within the CEA physical processes study area to capture the potential overlap of impacts during the construction, operation and maintenance and decommissioning phases. Activities from schemes that potentially increase suspended sediment concentrations during the temporal overlap with the Transmission Assets phases have been included as these may create a cumulative impact on physical features/receptors.

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• Disposal of Douglas Harbour Dredging material at Douglas Head Disposal Site. **Operation and Maintenance Phase.** • Maintenance of Walney Extension 4 Offshore Wind Farm. • Maintenance of Walney Extension 3 Offshore Wind Farm. • Maintenance of Walney 2 Offshore Wind Farm. • Maintenance of Walney 1 Offshore Wind Farm. • Maintenance of Walney export and inter array cables. • Maintenance of West of Duddon Sands Offshore Wind Farm. • Maintenance/repair of Isle of Man to UK interconnector and replacement of concrete mattresses used for cable protection with rock filled filter units. • Ribble Estuary dredging and dump at sea. • Operation and maintenance of the Mona Offshore Wind Project. **Decommissioning Phase.** • Mona Offshore Wind Project decommissioning structures. **Tier 2** **Construction Phase.** • Tier 1 Projects. • Proposed development of the Mooir Vannin Offshore Wind Farm. • Proposed development of the Eni Hynet – Carbon Capture Project. • Operation of the Westminster Gravels Aggregate Extraction site – Liverpool Bay Area 457.	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				Operation and Maintenance Phase. • Tier 1 Projects. • Proposed development of the Mooir Vannin Offshore Wind Farm. • Proposed development of the Eni Hynet – Carbon Capture Project. • Operation of the Westminster Gravels Aggregate Extraction site – Liverpool Bay Area 457. **Decommissioning Phase.** • Tier 1 Projects. • Proposed development of the Mooir Vannin Offshore Wind Farm. • Proposed development of the Eni Hynet – Carbon Capture Project **Tier 3** **Construction Phase.** • Tier 2 Projects. • Construction of the Isle of Man to UK Interconnector Cable 2. **Operation and Maintenance Phase.** • Tier 2 Projects. • Operation and Maintenance of the Isle of Man to UK Interconnector Cable 2.	
Impacts to physical processes, seabed morphology and the associated potential	✓	✓	✓	• Construction, operation and maintenance and decommissioning of Morecambe Offshore Windfarm: Generation Assets.	

Cumulative effect	Phase[a] C	O	D	Project(s) considered	Justification
impacts to physical features and adjacent shorelines				• Construction, operation and maintenance and decommissioning of Morgan Offshore Wind Project: Generation Assets. **Tier 1** **Construction Phase.** • Maintenance of Walney Extension 4 Offshore Wind Farm. • Maintenance of Walney Extension 3 Offshore Wind Farm. • Maintenance of Walney 2 Offshore Wind Farm. • Maintenance of Walney 1 Offshore Wind Farm. • Maintenance of Walney export and inter array cables. • Maintenance/repair of Isle of Man to UK interconnector and replacement of concrete mattresses used for cable protection with rock filled filter units. • RNLI maintenance activities including beach reprofiling at Lytham St. Annes. • Construction of the Mona Offshore Wind Project. • Decommissioning of Millom West offshore platform. **Operation and Maintenance Phase.** • Maintenance of Walney Extension 4 Offshore Wind Farm. • Maintenance of Walney Extension 3 Offshore Wind Farm. • Maintenance of Walney 2 Offshore Wind Farm. • Maintenance of Walney 1 Offshore Wind Farm. • Maintenance of Walney export and inter array cables. • Maintenance/repair of Isle of Man to UK interconnector and replacement of concrete mattresses used for cable protection with rock filled filter units.	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• Operation and maintenance of the Mona Offshore Wind Project. **Decommissioning Phase.** • Isle of Man to UK interconnector replacement of concrete mattresses used for cable protection with rock filled filter units. • Mona Offshore Wind Project residual structures. **Tier 2** **Construction Phase.** • Tier 1 Projects. • Proposed development of the Mooir Vannin Offshore Wind Farm. • Proposed development of the Eni Hynet – Carbon Capture Project **Operation and Maintenance Phase.** • Tier 1 Projects. • Proposed development of the Mooir Vannin Offshore Wind Farm. • Proposed development of the Eni Hynet – Carbon Capture Project **Decommissioning Phase.** • Tier 1 Projects. • Proposed development of the Mooir Vannin Offshore Wind Farm. • Proposed development of the Eni Hynet – Carbon Capture Project **Tier 3**	

Cumulative effect	Phase[a]			Project(s) considered	Justification
	C	O	D		
				• No Tier 3 projects associated with this impact	

[a] C=construction, O=operation and maintenance, D=decommissioning

1.12 Cumulative effects assessment

1.12.1 Introduction

1.12.1.1 A description of the significance of cumulative effects upon physical processes receptors arising from each identified impact is given below.

1.12.1.2 The CEA is presented in a series of tables (one for each potential cumulative impact) and considers the following.

- Scenario 1: Transmission Assets together with Morecambe Offshore Windfarm: Generation Assets.
- Scenario 2: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets.
- Scenario 3: Transmission Assets together with Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Windfarm: Generation Assets.
- Scenario 4a to 4c: Transmission Assets together with the Generation Assets (Scenario 3) and other relevant projects and plans.

1.12.2 Increase in suspended sediments due to construction, operation and maintenance, and/or decommissioning related activities, and the potential impact to physical features

1.12.2.1 Increased suspended sediment concentrations may arise due to seabed preparation involving sandwave clearance and the installation and/or maintenance of cables and associated decommissioning activities. Should the other projects cited take place concurrently with the Transmission Assets and Generation Assets (construction, operation and maintenance, or decommissioning phase), there is potential for cumulative increased turbidity levels. The CEA for impacts to suspended sediments and the Transmission Assets with respect to the scenarios outlined in **Section 1.12.1**, in **Table 1.21** and **Table 1.22** overleaf.

Table 1.21 Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features – Scenario 1 – 3.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
Construction			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of Impact	The magnitude of the increase in suspended sediment concentrations arising from seabed preparation involving sandwave clearance, and the installation of the offshore export cables has been assessed as low for the Transmission Assets alone, as described in **section 1.10**. Remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be extended. However, where this sedimentation occurs, it does so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. With the cable corridor passing though Fylde MCZ and the Ribble Estuary designations, these areas would be directly affected with sedimentation levels beyond the immediate vicinity of the trench circa 10 mm and reducing to <1 mm within 2 km. Noting that much of the displaced	The magnitude of the increase in suspended sediment concentrations arising from seabed preparation involving sandwave clearance and the installation of the offshore export cables has been assessed as low for the Transmission Assets alone, as described in **section 1.10**. Remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be extended. However, where this sedimentation occurs, it does so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. With the cable corridor passing though Fylde MCZ and the Ribble Estuary designations, these areas would be directly affected with sedimentation levels beyond the immediate vicinity of the trench circa 10 mm and reducing to < 1 mm within 2 km. Noting that much of the displaced	The magnitude of the cumulative effect to suspended sediments and subsequent deposition from the Transmission Assets and both sets of Generation Assets will be a combination of scenario 1 and 2 in a spatial sense. However, in terms of impacts due to overlapping SSC and deposition the magnitude of impact will be no greater than the scenario 1 or 2. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents, no increased cumulative effect between the two projects are predicted to occur. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	material would, in reality, be used to backfill the trench. During the construction phase of the Transmission Assets there is the potential for cumulative impacts with the Morecambe Offshore Windfarm: Generation Assets, which is located within the Offshore Order Limits. This involves the potential for sediment plume and deposition overlap during construction activities. The MDS for Morecambe Offshore Windfarm: Generation Assets includes seabed preparation for 35 conical gravity bases, two conical gravity base OSPs up to 8 km of sandwave clearance, foundation installation of 30 monopile wind turbine structures, two monopile OSPs and 80 km of cable trenching. In terms of sedimentation, 'light' deposition is anticipated to deposit on a small proportion of the Fylde MCZ, Shell Flat and Lune Deep SAC and Annex I sandbanks. It is noted that given the relationship of these projects, site preparation and installation of infrastructure would be phased, and SSC increases would not occur concurrently. However, should multiple operations be undertaken plumes would be advected on the tide and not towards one another and these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. In both cases the majority of sedimentation would	material would, in reality, naturally backfill the trench. During the construction phase of the Transmission Assets there is the potential for cumulative impacts with the Morgan Offshore Wind Project: Generation Assets which is programmed on a similar timeframe. The Morgan Offshore Wind Project: Generation Assets is located within the Offshore Order Limits. Construction activities for the MDS for SSC include site preparation with sandwave clearance along 286 km inter-array and interconnector cables, installation of up to 45 three-legged jacket piles, 23 conical gravity base foundations, a six-legged OSP with three piles per leg and trenching for 450 km of inter-array and interconnector cables. Sedimentation is typically < 50 mm beyond the immediate vicinity of the installation and less than one tenth of this value in the wider domain and is generally limited to the Morgan Offshore Wind Project: Generation Assets. The SSC plumes may extend to the two neighbouring designated sites namely, West of Walney MCZ and the West of Copeland MCZ on the flood tide however sediment concentrations are dispersed to well below background levels at these locations and sedimentation levels are de minimis. It is noted that given the relationship of these projects site preparation and installation of	Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	occur within close proximity to each installation; however, given the active sediment transport regime deposited material would be redistributed across the vicinity. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	infrastructure would be phased and SSC increases would not occur concurrently. However, should multiple operations be undertaken plumes would be advected on the tide and not towards one another and these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. In both cases the majority of sedimentation would occur within close proximity to each installation; however, given the active sediment transport regime deposited material would be redistributed across the vicinity. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	
Significance of effect	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	The significance of the cumulative effect of the Transmission Assets in combination with the Generation Assets for the construction phase, is not considered to be different to the cumulative effect of the Transmission Assets and either the Morgan Offshore Wind Project: Generation Assets or the Morecambe Offshore Windfarm: Generation Assets alone. This being due to the fact the Morgan Offshore

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
			Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents, no increased cumulative effect between the two projects is predicted to occur. Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Operations and maintenance			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
	The magnitude of the increase in suspended sediment concentrations arising from maintenance activities during the operation and maintenance phase, has been assessed as low for the Transmission Assets alone, as described in **section 1.10**. If cable repairs are undertaken within a distance of 5 km of the Fylde MCZ or Ribble Estuary designated areas, then the magnitude of impact would be as described for the construction phase in the	The magnitude of the increase in suspended sediment concentrations arising from maintenance activities during operation and maintenance phase, has been assessed as low for the Transmission Assets alone, as described in **section 1.10**. If cables repairs are undertaken within a distance 5 km of the Fylde MCZ or Ribble Estuary designated areas, then the magnitude of impact would be as described for the construction phase in the previous	The magnitude of the cumulative effect to suspended sediments and subsequent deposition from the Transmission Assets and both sets of Generation Assets will be a combination of scenario 1 and 2 in a spatial sense. However, in terms of impacts due to overlapping SSC and deposition the magnitude of impact will be no greater than the scenario 1 or 2. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	previous section for each event but the length of burial would be significantly less and therefore more localised impacts. Additionally, remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be exaggerated. However, this would be highly dependent on where cable repair and reburial takes place. Where this sedimentation may occur, it will do so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. The Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets are on the same projected timeline and will therefore both be in the operation and maintenance phase. Potential cumulative impacts may relate to reburial of up to 300 m of inter-array cables at Morecambe Offshore Windfarm: Generation Assets per year. However, maintenance activities are both intermittent and a smaller scale than that of the construction phase and therefore any potential cumulative impacts are less likely to occur and be on a smaller scale. If maintenance works to the Transmission Assets and the Morecambe Offshore	section for each event but the length of burial would be significantly less and therefore more localised impacts. Additionally, remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be extended. However, this would be highly dependent on where cable repair and reburial takes place. Where this sedimentation may occur, it will do so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. The Transmission Assets and the Morgan Offshore Wind Project: Generation Assets are on the same projected timeline and will therefore both be in the operation and maintenance phase concurrently. Potential cumulative impacts may relate to cable repair and reburial activities for inter-array and interconnector cables. The MDS for repair and reburial of inter-array cables is for up to 8 km in one event every five years and 20 km in one event every five years. Similarly, for the interconnector the MDS states three repair events of 19.63 km in 10 years and one reburial event of up to 3 km every five years. Therefore, the magnitude of the maintenance	located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents, no increased cumulative effect between the two projects are predicted to occur. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	Windfarm: Generation Assets occur simultaneously, it is likely that suspended sediment plumes from offshore export cable and inter array cable repair or reburial could interact. However, these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	activities are both intermittent and a smaller scale than that of the construction phase and therefore any potential cumulative impacts are less likely to occur and be on a smaller scale. If maintenance works to Transmission Assets and the Morgan Offshore Wind Project: Generation Assets occur simultaneously, it is likely that suspended sediment plumes from cable repair or reburial could interact. However, these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	
Significance of effect	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	The significance of the cumulative effect of the Transmission Assets in combination with the Generation Assets for the operation and maintenance phase, is not considered to be different to the cumulative effect of the Transmission Assets and either the Morgan Offshore Wind Project: Generation Assets or the Morecambe Offshore Windfarm: Generation Assets alone, stated above. This

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
			being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents, no increased cumulative effect between the two projects is predicted to occur. Overall, the sensitivity of the receptor is low, and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Decommissioning			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	The magnitude of the increase in suspended sediment concentrations arising from decommissioning activities for the Transmission Assets has been described in **section 1.10** as having at worst case, an impact equal to the construction phase. The primary source of SSC increase would be through the removal of cabling via similar trenching techniques as implemented during	The magnitude of the increase in suspended sediment concentrations arising from decommissioning activities for the Transmission Assets has been described in **section 1.10** as having at a worst case an impact equal to the construction phase. The primary source of SSC increase would be through the removal of cabling through similar trenching techniques as implemented during	The magnitude of the cumulative effect to suspended sediments and subsequent deposition from the Transmission Assets and both sets of Generation Assets will be a combination of scenario 1 and 2 in a spatial sense. However, in terms of impacts due to overlapping SSC and deposition the magnitude of impact will be no greater than the scenario 1 or 2. This being due to the fact the Morgan

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	installation. As with the construction phase this impact would directly impact upon the Fylde MCZ and Ribble Estuary designations, whilst indirectly affecting the West of Copeland MCZ, West of Walney MCZ and the Shell Flat and Lune Deep SAC. Decommissioning of the Morecambe Offshore Windfarm: Generation Assets will most likely occur on the same projected timeline as the Transmission Assets, with cumulative impacts of the same magnitude described for the construction phase to be expected. Decommissioning activities will include the removal of 30 monopile wind turbine foundations and two monopile OSP foundations. It is noted that given the relationship of these projects, the removal of infrastructure would be phased, and SSC increases would not occur concurrently. However, should multiple operations be undertaken plumes would be advected on the tide and not towards one another and these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. In both cases the majority of sedimentation would occur within close proximity to each removal location; however, given the active sediment transport regime deposited material would be redistributed across the vicinity.	installation. As with the construction phase this impact would directly impact upon the Fylde MCZ and Ribble Estuary designations, whilst indirectly affecting the West of Copeland MCZ, West of Walney MCZ and the Shell Flat and Lune Deep SAC. Decommissioning of the Morgan Offshore Wind Project: Generation Assets will most likely occur on the same projected timeline as the Transmission Assets, with cumulative impacts of the same magnitude described for the construction phase to be expected. Decommissioning activities will include the removal of 45 three-legged jacket piles, 23 conical gravity base foundations, a six-legged OSP with three piles per leg, and 450 km of inter-array and offshore export cabling. Sedimentation will be typically <50 mm beyond the immediate vicinity of the removal locations and less than one tenth of this value in the wider domain and is generally limited to the Morgan Offshore Wind Project: Generation Assets. The SSC plumes may extend to the two neighbouring designated sites namely, West of Walney MCZ and the West of Copeland MCZ on the flood tide however sediment concentrations are dispersed to well below background levels at these locations and sedimentation levels are de minimis. It is noted that given the relationship of these projects, the removal of infrastructure would be	Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents, no increased cumulative effect between the two projects are predicted to occur. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. The magnitude of impact is therefore, considered to be low adverse.

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	phased, and SSC increases would not occur concurrently. However, should multiple operations be undertaken plumes would be advected on the tide and not towards one another and these activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. In both cases the majority of sedimentation would occur within close proximity to each removal location; however, given the active sediment transport regime deposited material would be redistributed across the vicinity. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	The significance of the cumulative effect of the Transmission Assets in combination with the Generation Assets for the decommissioning phase, is not considered to be different to the cumulative effect of the Transmission Assets and either the Morgan Offshore Wind Project: Generation Assets or the Morecambe Offshore Windfarm: Generation Assets alone, stated above. This being due to the fact the Morgan

	Scenario 1: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
			Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents, no increased cumulative effect between the two projects is predicted to occur. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		

Table 1.22 Increase in suspended sediments due to construction, operations and maintenance and/or decommissioning related activities, and the potential impact to physical features – Scenario 4a – 4c

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	The magnitude of the increase in suspended sediment concentrations arising from seabed preparation involving sandwave clearance and the installation of the Transmission Assets and Generation Assets (Scenario 3) has been assessed as low. Remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and Shell Flat feature of the Shell Flat and Lune Deep SAC in depths indistinguishable from background levels. With the cable corridor passing though Fylde MCZ and the Ribble Estuary designations, these areas would be directly affected with sedimentation levels beyond the immediate vicinity of the trench circa 10 mm and reducing to < 1 mm within 2 km. Noting that much of the displaced material would, in reality, naturally backfill the trench. The construction phase of the Transmission Assets and Generation Assets coincides with the maintenance phases of the Barrow Offshore Wind Farm, Walney 1, Walney 2, Walney Extension 3 and Walney Extension 4 Offshore Wind Farm and associated export and inter array cables, and West of Duddon	The construction phase of the Transmission Assets and Generation Assets, along with Tier 1 projects (Scenario 4a) considers the addition of the following for Scenario 4b: • Tier 2 Proposed development of the Mooir Vannin Offshore Wind Farm. • Tier 2 Proposed development of the Eni Hynet – Carbon Capture Project. • Tier 2 Operation of the Westminster Gravels Aggregate Extraction site – Liverpool Bay Area 457. • The magnitude of the increase in suspended sediment concentrations arising from Scenario 4a has been assessed as low. There is also potential for cumulative impacts with the proposed development of the Mooir Vannin Offshore Wind Farm installation although as a Tier 2 project there is limited data available. Typical construction activities such as site preparation and cable trenching may result in increased suspended sediment concentration. However, given the alignment of	The construction phase of the Transmission Assets and Generation Assets, along with Tier 1 and Tier 2 (Scenario 4b) with Tier 3 projects considers the following: • Tier 3 Construction of the Isle of Man to UK Interconnector Cable 2. • The magnitude of the increase in suspended sediment concentrations arising from Scenario 4b has been assessed as low. The construction of a second interconnector cable between the Isle of Man and the UK may occur during the construction phase of the Transmission Assets as it is due to be operational in 2030. Interconnector cable installation activities would likely be of similar magnitude and extent as those associated with the Transmission Assets cable installation operations. Dependent on the detailed design and cable routing associated with the interconnector cable, a cumulative impact may arise with the Transmission Assets and Generation Assets with respect to the West of Copeland MCZ and the West of Walney MCZ

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Sands Offshore Wind Farm. In each case these activities are associated with repair and reburial of cables and would be characterised by short term intermittent mobilisation of sediment along relatively short sections of cables. The Walney sites and West of Duddon Sands are located within the West of Walney MCZ and would therefore directly affect this MCZ. Similarly, with prevalent tidal currents in an east – west orientation elevated SSC arising from reburial operations at Barrow may reach the West of Walney MCZ on ebb tides. However, with the east-west orientation the cable maintenance operations are unlikely to affect Shell Flat and Lune Deep SAC and Fylde MCZ. Should cable trenching operations, particularly on the northside of the Transmission Assets, or foundation installation activities within the Morgan Offshore Wind Project: Generation Assets, coincide with these maintenance activities there is the potential for cumulative impacts. It is noted that sediment plumes would be carried in concert with the tide, and not towards one another, therefore the cumulative impacts would relate to potential sedimentation. It has been shown that sedimentation principally occurs at the site of operations, therefore, given the limited nature of the maintenance activities and the distance between the sites this would be constrained. In terms of the West of Walney MCZ, the contribution of sedimentation from the Transmission Assets and Morgan Offshore	the site and the north east to south west orientation of the tidal flow at this location, sediment plumes and subsequent sedimentation would have limited overlap. There is potential for overlap with the proposed development of the Eni Hynet – Carbon Capture Project during the construction phase, although also as a Tier 2 project there is limited data available. Various activities may be undertaken and suspended sediments may arise from Eni Hynet – Carbon Capture Project during both cable installation, platform installation and wellhead drilling. However, given the distance between the development and the Transmission Assets/Generation Assets, and the fact it is located directly to the south, it is not expected that a cumulative increase in SSC or deposition will occur. With suspended sediments instead moving east – west in parallel with those of the Transmission Assets/Generation Assets. There also remains the potential for the construction phase of the proposed development to overlap with the operation of the Westminster Gravels Aggregate Extraction Area 457. Both the installation of cables associated with the Transmission Assets and the processes of aggregate extraction will increase suspended sediment concentrations and thus if carried out simultaneously have the ability to create a cumulative impact; although the contribution from extraction activities will depend largely on the volume and method used to remove material. Given the nature of	designated receptors. As a Tier 3 project there is very limited information available in this respect, however it is anticipated that this impact would be temporary in nature and of limited scale. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Wind Project: Generation Assets is at depths indistinguishable from background levels therefore having minimal cumulative impact. The construction phase of the Transmission Assets and Generation Assets also coincides with the maintenance and repair of cables and cable protection of the Isle of Man to UK Interconnector Cable. Additionally, maintenance works may involve the replacement of concrete mattressing cable protection with rock filled filter units. The route of the interconnector cable runs adjacent to the Morgan Offshore Wind Project: Generation Assets and directly through the Offshore Order Limits, aligning with the north offshore export cable corridor. Thus, it is likely that if activities overlap that suspended sediment plumes could interact, as they may originate from a similar source, and have the potential to impact the Walney MCZ and West of Copeland MCZ, under certain conditions. Namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be extended. However, where this sedimentation occurs, it does so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. As with other maintenance activities these would be intermittent and limited in nature and given the Transmission Assets sedimentation is near background levels at the Walney MCZ and West of Copeland MCZ, those from cable maintenance operations are likely to be of a	the activity generally spill levels are kept to a minimum c. 3% to provide cost efficient extraction. Additionally, the potential for cumulative impact with the Transmission Assets is further limited by the orientation of tidal currents within the East Irish Sea which run east to west, thus sediments would move in parallel and not towards each other. No cumulative effect is expected to affect relevant receptors. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	lesser magnitude with limited potential for cumulative impacts at these sites. The Isle of Man to UK Interconnector does however also lie within and in close proximity to Shell Flat and Lune Deep SAC and Fylde MCZ and here there is greater potential for cumulative impacts at these sites. The magnitude of these impacts would vary greatly depending on the location and scale of reburial operations and also the timing of the work relative to the Transmission Assets and Generation Assets. Repair and reburial operations for the Isle of Man to UK Interconnector will likely be undertaken using similar techniques to those outlined for the cable installation related to the Transmission Assets. It can therefore be expected a cumulative effect will arise within the respective receptors with the Isle of Man to UK Interconnector if the repair/reburial events take place within 5 km of the Shell Flat and Lune Deep SAC and Fylde MCZ. It is possible that a small cumulative effect may also arise under certain conditions (namely flood tides together with winds from the south west) within the edge of the West of Walney MCZ, which is located *c*. 6 km from the Transmission Assets and Isle of Man to UK Interconnector. The RNLI are licensed to carry out maintenance activities including minor beach reprofiling at Lytham St. Annes, in a time period coinciding with the Transmission Assets construction phase. Given the close proximity to the Transmission Assets there may be		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	potential for cumulative impacts, however due to the diminutive nature of works at Lytham St. Annes which is concentrated in the intertidal zone the cumulative effect is expected to be indiscernible from that caused of the Transmission Assets project alone. Given the intertidal location of these works, they will share no cumulative effect with the Generation Assets which are situated too great a distance offshore. The construction phase of the Transmission Assets aligns with those of the Morgan Offshore Wind Project: Generation Assets and the Morecambe Offshore Windfarm: Generation Assets. Cumulative impacts are likely to arise between the Generation assets and the Transmission Assets in the unlikely event that seabed preparation, cable installation or foundation installation activities and undertaken simultaneously. Should multiple operations be undertaken in concert, plumes would however, be advected on the tide and not towards one another. These activities would be of limited spatial extent and frequency and plume interactions likely of a low magnitude and short duration. In both cases the majority of sedimentation would occur within close proximity to each installation however, given the active sediment transport regime deposited material would be redistributed across the vicinity. This cumulative plume may indirectly affect the West of Walney and West of Copeland MCZs with plumes reaching the sites, however,		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	sediment concentrations are dispersed to well below background variations at these locations and sedimentation levels are negligible. The cumulative effect is expected to directly impact on the Fylde MCZ and indirectly impact the Annex I sandbanks within the Shell Flat and Lune Deep SAC, however this would again be characterised by light deposition of a negligible magnitude. Likewise, the construction phase of the Transmission Assets and the Generation Assets overlaps with the construction phase of the Mona Offshore Wind Project. However, the Mona Offshore Wind Project is located >10 km to the south of Morgan Offshore Wind Project: Generation Assets and Transmission Assets, where tidal flows are at an east to west orientation and therefore cumulative impact on SSC, particularly with respect to the receptors, would not occur. Finally, the disposal site associated with the dredging operations at Douglas Harbour is located at the north west extent of the CEA physical processes study area. Due to distance (22.74 km) and the orientation of tidal currents it would not exhibit a cumulative effect with the Transmission Assets or the Morgan Offshore Wind Project: Generation Assets with respect to the West of Copeland MCZ and the West of Walney MCZ designated receptors. With suspended sediment plumes running in parallel instead of coalescing.		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.		
Significance of effect	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Operations and maintenance			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	The magnitude of the increase in suspended sediment concentrations arising from maintenance activities during operation and maintenance phase, has been assessed as low for the Transmission Assets and Generation Assets (Scenario 3). If cables repairs are undertaken within a distance 5 km of the Fylde MCZ or Ribble Estuary designated areas, then the magnitude of impact would be	The operation and maintenance phase of the Transmission Assets and Generation Assets, along with Tier 1 projects (Scenario 4a) considers the addition of the following for Scenario 4b: • Tier 2 Proposed development of the Mooir Vannin Offshore Wind Farm.	The operation and maintenance phase of the Transmission Assets and Generation Assets, along with Tier 1 and Tier 2 projects (Scenario 4b) with Tier 3 projects considers the following: • Tier 3 Construction of the Isle of Man to UK Interconnector Cable 2. • The magnitude of the increase in suspended sediment concentrations

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	as described for the construction phase in the previous section. Additionally, remobilised and redistributed material may reach the south edges of West of Copeland MCZ, West of Walney MCZ and the Shell Flat feature of the Shell Flat and Lune Deep SAC during certain conditions, namely flood tides coupled with winds from the southwest/ west, during which the sediment plume can be extended. However, this would be highly dependent on where cable repair and reburial takes place. Where this sedimentation may occur, it will do so in depths indistinguishable from background levels due to the receptors being situated *c*. 6 km from the Transmission Assets Order Limits. The operation and maintenance phase, of the Morgan Offshore Wind Project: Transmission Assets coincides with the maintenance phases of the Walney 1, Walney 2, Walney Extension 3 and Walney Extension 4 Offshore Wind Farm and associated export and inter array cables and also the West of Duddon Sands Offshore Wind Farm. The magnitude of these impacts is the same as those described for the construction phase however the potential for cumulative impacts is greatly reduced due the limited and intermittent nature of the activities relating to the Transmission Assets maintenance and cable reburial and Generation Assets cable repair. During this period there will be continued maintenance of the Isle of Man to UK Interconnector which was described in the	• Tier 2 Proposed development of the Eni Hynet – Carbon Capture Project. • Tier 2 Operation of the Westminster Gravels Aggregate Extraction site – Liverpool Bay Area 457. • The magnitude of the increase in suspended sediment concentrations arising from Scenario 4a has been assessed as low. The cumulative effects assessment also considers the proposed development of the Mooir Vannin Offshore Wind Farm. Maintenance activities are both intermittent and a smaller scale than that of the construction phase and therefore any potential cumulative impacts are less likely to occur and be on a smaller scale. There is potential for overlap with the proposed development of the Eni Hynet – Carbon Capture Project during the operation and maintenance phase although as a Tier 2 there is limited data available on the project. Suspended sediments may arise from Eni Hynet – Carbon Capture Project due to associated maintenance works. However, given the distance between the development and the Transmission Assets/Generation Assets, and the fact it is located directly to the south, it is not expected that a cumulative increase in SSC or deposition will occur. With suspended sediments instead moving east –	arising from Scenario 4b has been assessed as low. . . The operation and maintenance phase of the Transmission Assets and Generation Assets overlaps with the operation and maintenance phase of the Isle of Man to UK interconnector 2. The magnitude of impact associated with operation and maintenance activities associated with the Isle of Man to UK Interconnector Cable 2, can be expected to be similar to those of reburial/repair activities associated with the Transmission Assets. Therefore, dependent on the detailed design and cable routing associated with the interconnector cable, a cumulative impact may arise with the Transmission Assets and Generation Assets with respect to the West of Copeland MCZ and the West of Walney MCZ designated receptors. As a Tier 3 project there is very limited information available in this respect, however it is anticipated that this impact would be temporary in nature and of limited scale. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	previous section on construction. As with the Offshore Wind Farm maintenance, the potential magnitude of the cumulative impacts is the same however, the likelihood of occurrence if greatly reduced. Both the Transmission Assets, Generation Assets and the Mona Offshore Wind Project are on the same construction schedule and therefore the sites would be in the operation and maintenance phase at the same time. Potential cumulative impacts may relate to cable repair and reburial at either site. However, maintenance activities are both intermittent and a smaller scale than that of the construction phase and therefore any potential cumulative impacts are less likely to occur and be on a smaller scale. The location of the Mona Offshore Wind Project to the south of the Transmission Assets and Generation Assets means that no cumulative effects occur for the designated areas considered within the assessment. As described for the construction phase, a small cumulative change in SSC and deposition is expected between the Transmission Assets and the Morgan Offshore Wind Project: Generation Assets/Morecambe Offshore Windfarm: Generation Assets during the maintenance phase if maintenance activities are undertaken concurrently. However, as for the construction phase this would fall within natural variation in	west in parallel with those of the Transmission Assets/Generation Assets. There also remains the potential for the operation and maintenance phase of the proposed development to overlap with the operation of the Westminster Gravels Aggregate Extraction Area 457. Both the maintenance activities associated with the Transmission Assets and the processes of aggregate extraction will increase suspended sediment concentrations and thus if carried out simultaneously have the ability to create a cumulative impact; although the contribution from extraction activities will depend largely on the volume and method used to remove material. Given the nature of the activity generally spill levels are kept to a minimum c. 3% to provide cost efficient extraction. Additionally, the potential for cumulative impact with the Transmission Assets is further limited by the orientation of tidal currents within the East Irish Sea which run east to west, thus sediments would move in parallel and not towards one another. No cumulative effect is expected to affect relevant receptors. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and	indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	background levels of sedimentation and is not significant. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	
Significance of effect	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Decommissioning			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	The magnitude of the increase in suspended sediment concentrations arising from the removal of Transmission Assets and Generation Assets (Scenario 3), has been assessed as low. As for the construction phase, remobilised and redistributed material	The decommissioning phase of the Transmission Assets and Generation Assets, along with Tier 1 projects (Scenario 4a) considers the addition of the following for Scenario 4b:	The construction phase of the Transmission Assets and Generation Assets, along with Tier 1 and Tier 2 projects (Scenario 4b) with Tier 3 projects considers the following: • Tier 3 Construction of the Isle of Man to UK Interconnector Cable 2.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	may reach the south edges of West of Copeland MCZ, West of Walney MCZ and Shell Flat feature of the Shell Flat and Lune Deep SAC in depths indistinguishable from background levels. With the Fylde MCZ and Ribble Estuary designations affected directly. The decommissioning phase of the Transmission Assets and the Generation Assets overlaps with the decommissioning phase of the Mona Offshore Wind Project. However, the Mona Offshore Wind Project is located >10 km to the south of Morgan Offshore Wind Project: Generation Assets and Transmission Assets, where tidal flows are at an east to west orientation and therefore cumulative impact on SSC, particularly with respect to the receptors, would not occur. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	• Tier 2 Proposed development of the Mooir Vannin Offshore Wind Farm. • Tier 2 Proposed development of the Eni Hynet – Carbon Capture Project. • The magnitude of the increase in suspended sediment concentrations arising from Scenario 4a has been assessed as low. There is potential for a cumulative effect to occur during the decommissioning of the Mooir Vannin Offshore Wind Farm, however, given the alignment of the site and the north east to south west orientation of the tidal flow at this location, sediment plumes and subsequent sedimentation would have limited overlap and be limited to the West of Copeland MCZ. There is potential for overlap with the proposed development of the Eni Hynet – Carbon Capture Project during the operation and maintenance phase although as a Tier 2 project there is limited data available. Suspended sediments may arise from Eni Hynet – Carbon Capture Project due to associated decommissioning works. However, given the distance between the development and the Transmission Assets/Generation Assets, and the fact it is located directly to the south, it is not expected that a cumulative increase in SSC or deposition will occur. With suspended sediments instead moving east – west in parallel with those of the Transmission Assets/Generation Assets. This is further mitigated by the fact decommissioning	• The magnitude of the increase in suspended sediment concentrations arising from Scenario 4b has been assessed as low. The decommissioning phase of the Transmission Assets and Generation Assets overlaps with the operation and maintenance phase of the Isle of Man to UK interconnector 2. The magnitude of impact associated with operation and maintenance activities associated with the Isle of Man to UK Interconnector Cable 2, can be expected to be similar to those of reburial/repair activities associated with the Transmission Assets. Therefore, dependent on the detailed design and cable routing associated with the interconnector cable, a cumulative impact may arise with the Transmission Assets and Generation Assets with respect to the West of Copeland MCZ and the West of Walney MCZ designated receptors. As a Tier 3 project there is very limited information available in this respect, however it is anticipated that this impact would be temporary in nature and of limited scale.. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
		activities of the Eni – Hynet Carbon Capture Project are likely to be very limited. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.	Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.
Significance of effect	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		

1.12.3 Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines

1.12.3.1 Changes to physical processes and seabed morphology may arise due to the presence of offshore export cabling on the seabed. Should the other projects cited take place concurrently with the Transmission Assets and Generation Assets (construction, operation and maintenance, or decommissioning phase), there is potential for cumulative changes to physical processes and seabed morphology. The CEA for impacts to physical processes and seabed morphology due to the Transmission Assets, with respect to the scenarios outlined in **Section 1.12.1**, in **Table 1.23** and **Table 1.24**.

Table 1.23: Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines – Scenario 1–- 3.

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
Construction			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full **in section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	During the construction phase there will be gradual changes to physical processes and seabed morphology for Transmission Assets and Morecambe Offshore Windfarm: Generation Assets. With changes occurring from the baseline environment (no presence of infrastructure) to the operation and maintenance phase (MDS). For the Transmission Assets alone, localised changes in physical processes and seabed morphology may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. The detailed design and commitments to avoid, reduce and mitigate impacts (as per **Table 1.13**) would minimise these impacts in shallow water. Particularly through CoT114, **Table 1.13**, which outlines all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments	During the construction phase there will be gradual changes to physical processes and seabed morphology for Transmission Assets and Morgan Offshore Wind Project: Generation Assets. With changes occurring from the baseline environment (no presence of infrastructure) to the operation and maintenance phase (MDS. For the Transmission Assets alone, localised changes in physical processes and seabed morphology may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. The detailed design and commitments to avoid, reduce and mitigate impacts (as per **Table 1.13**) would minimise these impacts in shallow water. Particularly through CoT114, **Table 1.13**, which outlines all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs). Given the impact is limited to within	The magnitude of the cumulative effect to physical processes and seabed morphology from the Transmission Assets and both sets of Generation Assets will be a combination of scenario 1 and 2 in a spatial sense. However, in terms of impacts due to overlapping changes in physical processes and morphology the magnitude of impact will be no greater than the scenario 1 or 2. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents and wave climate, no increased cumulative effect between the two projects are predicted to occur. The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	(CBRAs). Given the impact is limited to within 1 km and 500 m for wave climate and tidal currents respectively, it is not expected to affect adjacent shorelines such as Blackpool Beach which is located > 3 km from the landfall location and Lytham St Annes beach and promenade located to the south of the landfall. Any shoreline that may be affected would be highly recoverable due to the minor change in physical processes. The Morecambe Offshore Windfarm: Generation Assets MDS comprises of 35 turbines and two OSPs, 65 m in diameter with conical gravity base suction foundations, each with scour protection extending 15 m from foundations. Changes are expected in close proximity to these structures with said changes decreasing rapidly with distance from the infrastructure, and therefore will not impact on adjacent shorelines. There is partial overlap in changes to wave climate with the Fylde MCZ, Shell Flat and Lune Deep SAC and Annex I sandbanks but the impact to physical processes will be indistinguishable from natural variability given the closest designation is located *c*. 8 km to the east/north east. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is	1 km and 500 m for wave climate and tidal currents respectively, it is not expected to affect adjacent shorelines such as Blackpool Beach which is located > 3 km from the landfall location and Lytham St Annes beach and promenade located to the south of the landfall. Any shoreline that may be affected would be highly recoverable due to the minor change in physical processes. The Morgan Offshore Wind Project: Generation Assets MDS comprises of 68 turbines that will be installed throughout the construction phase of the Transmission Assets. Changes are expected in close proximity to these structures with said changes decreasing rapidly with distance from the infrastructure, and therefore will not impact on adjacent shorelines, the nearest of which is > 20 km from the Morgan Offshore Wind Project: Generation Assets. Under certain storm conditions changes in physical processes namely wave climate may extend to the edge of West of Walney MCZ and the West of Copeland MCZ however even under 1 in 20 storm conditions this represents less than 0.1% of the wave height and would be indistinguishable from natural variations. The Morgan Offshore Wind Project: Generation Assets MDS also contains an OSP with rectangular gravity base foundation which may affect waves and tides up to 200 m by *c*. 2 –	Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse.

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	predicted that the impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the Shell Flat and Lune Deep SAC. The magnitude of impact is therefore low adverse.	4%, at which point changes would rapidly decline. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that the impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ and the West of Copeland MCZ. The magnitude of impact is therefore low adverse.	
Significance of effect	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	The significance of the cumulative effect of the Transmission Assets in combination with the Generation Assets for the construction phase, is not considered to be different to the cumulative effect of the Transmission Assets and either the Morgan Offshore Wind Project: Generation Assets or the Morecambe Offshore Windfarm: Generation Assets alone, stated above. The two generation assets are separated by a distance of 16.76 km and owing to the principal orientation of the tidal currents and wave climate, no increased cumulative effect between the two projects are predicted to occur. Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Operations and maintenance			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	The presence of Transmission Assets infrastructure may lead to changes in physical processes and seabed morphology during the operation and maintenance phase of the Transmission Assets. The magnitude of changes in physical processes has been assessed as low for the Transmission Assets alone as described in **section 1.10**. Localised changes in physical processes and seabed morphology may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. The detailed design and commitments to avoid, reduce and mitigate impacts (as per **Table 1.13**) would minimise these impacts in shallow water. Particularly through CoT114, **Table 1.13**, which outlines all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs). Given the impact is limited to	The presence of Transmission Assets infrastructure may lead to changes in physical processes and seabed morphology during the operation and maintenance phase. The magnitude of changes to physical processes has been assessed as low adverse for the Transmission Assets alone as described in **section 1.10**. Localised changes in physical processes and seabed morphology may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. The detailed design and commitments to avoid, reduce and mitigate impacts (as per **Table 1.13**) would minimise these impacts in shallow water. Particularly through CoT114, **Table 1.13**, which outlines all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs). Given the impact is limited to within 1 km and 500 m for wave climate and tidal currents respectively, it is not	The magnitude of the cumulative effect to physical processes and seabed morphology from the Transmission Assets and both sets of Generation Assets will be a combination of scenario 1 and 2 in a spatial sense. However, in terms of impacts due to overlapping changes in physical processes and morphology the magnitude of impact will be no greater than the scenario 1 or 2. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents and wave climate, no increased cumulative effect between the two projects are predicted to occur. The cumulative effect is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ,

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	within 1 km and 500 m for wave climate and tidal currents respectively, it is not expected to affect adjacent shorelines such as Blackpool Beach which is located >3 km from the landfall location and Lytham St Annes beach and promenade located to the south of the landfall. Any shoreline that may be affected would be highly recoverable due to the minor change in physical processes. The Morecambe Offshore Windfarm: Generation Assets MDS comprises of 35 turbines and two OSPs, 65 m in diameter with conical gravity base suction foundations, each with scour protection extending 15 m from foundations. Changes are expected in close proximity to these structures with said changes decreasing rapidly with distance from the infrastructure, and therefore will not impact on adjacent shorelines. There is partial overlap in changes to the wave climate with the Fylde MCZ, Shell Flat and Lune Deep SAC and Annex I sandbanks but the impact to physical processes will be indistinguishable from natural variability given the closest designation is located *c*. 8 km to the east/north east. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that the impact may directly affect	expected to affect adjacent shorelines such as Blackpool Beach which is located >3 km from the landfall location and Lytham St Annes beach and promenade located to the south of the landfall. The Morgan Offshore Wind Project: Generation Assets MDS comprises of 68 turbines that will be in operation during the operation and maintenance phase of the Transmission Assets. Changes are expected in close proximity to these structures with said changes decreasing rapidly with distance from the infrastructure, and therefore will not impact on adjacent shorelines, the nearest of which is >20 km from the Morgan Offshore Wind Project: Generation Assets. Under certain storm conditions changes in physical processes namely wave climate may extend to the edge of West of Walney MCZ and the West of Copeland MCZ however even under 1 in 20 storm conditions this represents less than 0.1% of the wave height and would be indistinguishable from natural variations. The Morgan Offshore Wind Project: Generation Assets MDS also contains an OSP with rectangular gravity base foundation which may affect waves and tides up to 200 m by *c*. 2% to 4%, at which point changes would rapidly decline. The impact is therefore predicted to be of local spatial extent and long term duration	West of Copeland MCZ, and Shell Flat and Lune Deep SAC. The magnitude of impact is therefore, considered to be low adverse

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
	the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the Shell Flat and Lune Deep SAC. The magnitude of impact is therefore low adverse.	continuous and high reversibility. It is predicted that the impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ and the West of Copeland MCZ. The magnitude of impact is therefore low adverse	
Significance of effect	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low in line with the Transmission Assets alone. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low in line with the Transmission Assets alone. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	The significance of the cumulative effect of the Transmission Assets in combination with the Generation Assets for the operation and maintenance phase, is not considered to be different to the cumulative effect of the Transmission Assets and either the Morgan Offshore Wind Project: Generation Assets or the Morecambe Offshore Windfarm: Generation Assets alone, stated above. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents and wave climate, no increased cumulative effect between the two projects are predicted to occur. Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Decommissioning			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	The decommissioning phase of the Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets coincide. Following decommissioning, changes to physical processes and seabed morphology would be of the same magnitude as the operation and maintenance phase for the Transmission Assets alone, as no structures relating to the Morecambe Offshore Windfarm: Generation Assets would remain in the water column. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that the impact may directly affect the Fylde MCZ and Ribble Estuary designations. The magnitude of impact is therefore low adverse.	The decommissioning phase of the Transmission Assets and the Morgan Offshore Wind Project: Generation Assets coincide. Following decommissioning, changes to physical processes and seabed morphology would be of the same magnitude as the operation and maintenance phase, for the Transmission Assets alone, as no structures relating to the Morgan Offshore Wind Project: Generation Assets would remain in the water column. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that the impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ and the West of Copeland MCZ. The magnitude of impact is therefore low adverse.	The magnitude of the cumulative effect to physical processes and seabed morphology from the Transmission Assets and both sets of Generation Assets will be a combination of scenario 1 and 2 in a spatial sense. However, in terms of impacts due to overlapping changes in physical processes and morphology the magnitude of impact will be no greater than the scenario 1 or 2. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents and wave climate, no increased cumulative effect between the two projects are predicted to occur. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that the impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ

	Scenario 1 Transmission Assets + Morecambe Offshore Windfarm: Generation Assets	Scenario 2: Transmission Assets + Morgan Offshore Wind Project: Generation Assets	Scenario 3: Transmission Assets + Morecambe Offshore Windfarm: Generation Assets and Morgan Offshore Wind Project: Generation Assets
			and the West of Copeland MCZ. The magnitude of impact is therefore low adverse
Significance of effect	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	The significance of the cumulative effect of the Transmission Assets in combination with the Generation Assets for the decommissioning phase, is not considered to be different to the cumulative effect of the Transmission Assets and either the Morgan Offshore Wind Project: Generation Assets or the Morecambe Offshore Windfarm: Generation Assets alone, stated above. This being due to the fact the Morgan Offshore Wind Project: Generation Assets are located 16.76 km to the north-west of the Morecambe Offshore Windfarm: Generation Assets and owing to the principal east - west orientation of the tidal currents and wave climate, no increased cumulative effect between the two projects are predicted to occur. Overall, the sensitivity of the receptor is low and the magnitude of the cumulative impact is low. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		

Table 1.24: Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines – Scenario 4a – 4c.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Construction			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	During the construction phases of the Transmission Assets and Generation Assets (Scenario 3) there will be gradual changes to physical processes and seabed morphology. With changes occurring from the baseline environment (no presence of infrastructure) to the operation and maintenance phase (MDS). The introduction of Transmission Assets and Generation Assets may lead to changes in physical processes and seabed morphology during the construction phase and the magnitude of changes has been assessed as low adverse. The change for the Transmission Assets has been assessed as being localised, potentially within 1 km and 500 m for wave climate and tidal currents respectively and limited in nature. These changes in physical processes may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. Changes to Physical Processes as a result of the Generation Assets infrastructure have a greater influence spatially, however the magnitude of change to tidal currents and wave climate decreases rapidly with distance from the structures.	The construction phase of the Transmission Assets and Generation Assets, along with Tier 1 projects (Scenario 4a) considers the addition of the following for Scenario 4b: • Tier 2 Proposed development of the Mooir Vannin Offshore Wind Farm. • Tier 2 Proposed development of the Eni Hynet – Carbon Capture Project. • The magnitude of the increase in suspended sediment concentrations arising from Scenario 4a has been assessed as low. The proposed development of the Mooir Vannin Offshore Wind Farm is located 2.59 km from the Transmission Assets Order Limits, in deeper water and therefore there is no potential for cumulative impacts. There is the potential for the alteration in the wave field from the Morgan Offshore Wind Project: Generation Assets to extend to the Mooir Vannin Offshore Wind Farm and vice versa. However, it should	No Tier 3 projects associated with this impact.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	Maintenance activities relating to the Walney 1, Walney 2, Walney Extension 3 and Walney Extension 4 and Walney export cables may occur during the Transmission Assets and Generation Assets construction phase. These activities may include maintenance or upgrading cable protection, therefore placement of material on the seabed which may affect physical processes. These impacts would be very localised in nature and, given these sites are more than 5 km from the Offshore Order Limits there would be no cumulative impacts. However cumulative changes in wave climate may arise with the Morgan Offshore Wind Project: Generation Assets Under certain storm conditions changes in physical processes namely wave climate may extend to the edge of Walney Extension 3 and Walney Extension 4, however even under 1 in 20 storm conditions this represents less than 0.1% of the wave height and would be indistinguishable from natural variations. This meaning that though a cumulative effect may arise within the West of Copeland and West of Walney MCZs, the magnitude would be significantly different that the impact of the Walney Extensions in isolation. The proposed Mona Offshore Wind Project is located 9.73 km to the south of the Offshore Order Limits there would be no cumulative impact from the Transmission Assets. The MDS relating to physical processes for proposed development of the Mona Offshore Wind Project comprises of 68 turbines, modelling	be recognised that the changes in wave climate from each project arise from the same incident wave field and would not converge (i.e. waves approaching from the southwest would give rise to changes in wave fields to the northeast of both sites). During construction phase there may be overlap with the proposed development of the Eni Hynet – Carbon Capture Project. However, given the distance of separation of the development from the Transmission Assets and Generation Assets, no cumulative effect is expected to arise. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. Any shoreline that may be affected would be highly recoverable due to the minor change in seabed morphology and physical processes. The magnitude of impact is therefore low adverse.	

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	carried out for Mona Offshore Wind Project concluded that storms approaching from the south are limited in magnitude due to restricted fetch length therefore the changes in wave field do not extent to Transmission Assets. No cumulative changes in relation to tidal currents or the sediment transport regime are expected between the developments. The construction phase of the Mona Offshore Wind Project and the Transmission Assets overlaps with those of the Morgan Offshore Wind Project: Generation Assets, and the Morecambe Offshore Windfarm: Generation Assets. Modelling undertaken for the Mona Offshore Wind Project demonstrated no cumulative effect in physical processes is anticipated with the Morecambe Offshore Windfarm: Generation Assets. For wave climate this is due to the presence of Anglesey and limited fetch lengths to the east, and in the case of tidal currents and sediment transport, the distances separating projects are too great for a cumulative effect to arise. Storms arising in the north may result in changes in wave climate in the Morgan Offshore Wind Project: Generation Assets that may extend to the boundary of the Mona Offshore Wind Project. However, they would do so at a c. 0.2% reduction in wave height which falls in the realm of natural variability and is therefore insignificant. Again, the distance separating the Morgan Offshore Wind Project: Generation Assets from the Mona Offshore Wind Project are too great for cumulative changes in relation to tidal currents		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	or the sediment transport regime. Cumulative changes may arise between the Generation Assets and the Transmission Assets, however given the rapid reduction in changes to wave height, tidal currents and sediment transport rates with distance from infrastructure, no significant changes to the physical processes are expected within any designated receptors. The RNLI beach reprofiling at Lytham St. Annes will take place during the construction phase. The nature of the works will have minimal impact on physical processes due to the diminutive scale. The assessment for the Transmission Assets demonstrates that changes in wave climate and tidal currents are limited to a maximum distance of 1 km and 500 m respectively, from the installation of cable protection when this occurs in shallow water. Lytham St. Annes is located 1.4 km from the Transmission Assets therefore there is no pathway for cumulative impacts. Given the intertidal location of these works, they will share no cumulative effect with the Generation Assets which are situated too great a distance offshore. The construction phase of Transmission Assets also overlaps with the decommissioning phase of the Millom West offshore platform. When this platform is removed from the water column there a potential for cumulative effects with infrastructure associated with the Transmission Assets. Given the Millom West offshore platform utilised suction bucket foundations of a similar scale to those suction bucket		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	foundations assessed for the Morgan Offshore Wind Project: Generation Assets, a similar spatial impact and magnitude is expected. This change will take the form of a restoration of natural physical processes. This effect of the decommissioning of the Millom West platform may have effects to physical processes up to 500 m from the structure's original location. The presence of cable protection associated with the Transmission Assets may alter physical processes in the lee of the structure up to a distance of c. 1 km. Given the projects are situated c. 0.49 km from each other it is possible that a cumulative change in physical processes may arise, however this cumulative change would be minor and highly localised. The presence of infrastructure associated with the Morgan Offshore Wind Project: Generation Assets may alter the wave climate in an overlapping area with the Millom West offshore platform when storm waves approach from the west/southwest, however given the scale of effect associated with the removal of the Millom West offshore platform alone, the cumulative change would be highly localised and of low order. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. Any shoreline that may		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	be affected would be highly recoverable due to the minor change in seabed morphology and physical processes. The magnitude of impact is therefore low adverse.		
Significance of effect	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	No Tier 3 projects associated with this impact.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Operations and maintenance			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	During the construction phases of the Transmission Assets and Generation Assets there will be gradual changes to physical processes and seabed morphology. With changes occurring from the baseline environment (no presence of infrastructure) to the operation and maintenance phase (MDS). The introduction of Transmission Assets and Generation Assets (Scenario 3) may lead to changes in physical processes and seabed morphology during the construction phase and the magnitude of changes has been assessed as low adverse. The change has been	The operation and maintenance phase of the Transmission Assets and Generation Assets, along with Tier 1 projects (Scenario 4a) considers the addition of the following for Scenario 4b: • Tier 2 Proposed development of the Mooir Vannin Offshore Wind Farm. • Tier 2 Proposed development of the Eni Hynet – Carbon Capture Project. • The magnitude of the increase in suspended sediment concentrations arising	No Tier 3 projects associated with this impact.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	assessed as being localised, potentially within 1 km and 500 m for wave climate and tidal currents respectively and limited in nature. These changes in physical processes may potentially be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is installed within these areas. Changes to Physical Processes as a result of the Generation Assets infrastructure have a greater influence spatially, however the magnitude of change to tidal currents and wave climate decreases rapidly with distance from the structures. Maintenance activities relating to the Walney 1, Walney 2, Walney Extension 3 and Walney Extension 4 and Walney export cables may occur during the Transmission Assets and Generation Assets operation and maintenance phase. These activities may include maintenance or upgrading cable protection, therefore placement of material on the seabed which may affect physical processes. These impacts would be very localised in nature and, given these sites are more than 5 km from the Offshore Order Limits there would be no cumulative impacts. However cumulative changes in wave climate may arise with the Morgan Offshore Wind Project: Generation Assets under certain storm conditions changes in physical processes namely wave climate may extend to the edge of Walney Extension 3 and Walney Extension 4, however even under 1 in 20 storm conditions this represents less than 0.1% of the wave height and would be	from Scenario 4a has been assessed as low. The proposed development of the Mooir Vannin Offshore Wind Farm is located 2.59 km from the Transmission Assets Order Limits, in deeper water and therefore there is no potential for cumulative impacts. There is the potential for the alteration in the wave field from the Morgan Offshore Wind Project: Generation Assets to extend to the Mooir Vannin Offshore Wind Farm and vice versa. However, it should be recognised that the changes in wave climate from each project arise from the same incident wave field and would not converge (i.e. waves approaching from the southwest would give rise to changes in wave fields to the northeast of both sites). During operation and maintenance phase there may be overlap with the proposed development of the Eni Hynet – Carbon Capture Project. However, given the distance of separation of the development from the Transmission Assets and Generation Assets, no cumulative effect is expected to arise. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations	

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	indistinguishable from natural variations. This meaning that though a cumulative effect may arise within the West of Copeland and West of Walney MCZs, the magnitude would be significantly different that the impact of the Walney Extensions in isolation. The Isle of Man to UK Interconnector maintenance activities also includes replacement of concrete mattresses with rock filled filter units and given the proximality of the cable route to the Transmission Assets there is a potential for cumulative impacts within the Transmission Assets Order Limits. The magnitude of these would be highly dependent on both the water depth and proximity to the Transmission Assets. As with the project alone, if cable protection is placed within a distance of circa 1 km of a designated area in shallow water it may influence physical processes in the form of wave climate however cables located within the Fylde MCZ from the two projects are located at a greater distance and no cumulative impacts are anticipated on any designated areas. A cumulative impact is likely to arise between the Isle of Man to UK interconnector and the Morgan Offshore Wind Project: Generation Assets however where this cumulative impact arises it will not impact upon any relevant designated receptors. There is however the potential for a cumulative impact with the Morecambe Offshore Windfarm: Generation Assets to arise within the Fylde MCZ and Shell Flat component of the Shell Flat and Lune Deep SAC. Where this does arise	whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. Any shoreline that may be affected would be highly recoverable due to the minor change in seabed morphology and physical processes. The magnitude of impact is therefore low adverse.	

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	however the impact to physical processes will be indistinguishable from that of the Isle of Man to UK Interconnector Cable in isolation given the Morecambe Offshore is located *c*. 8 km to the west/south west. The proposed Mona Offshore Wind Project is located 9.73 km to the south of the Offshore Order Limits therefore there would be no cumulative impact from the Transmission Assets. The MDS relating to physical processes for proposed development of the Mona Offshore Wind Project comprises of 68 turbines, modelling carried out for Mona Offshore Wind Project concluded that storms approaching from the south are limited in magnitude due to restricted fetch length therefore the changes in wave field do not extent to Transmission Assets. No cumulative changes in relation to tidal currents or the sediment transport regime are expected between the developments. The operation and maintenance phase of the Mona Offshore Wind Project and the Transmission Assets overlaps with those of the Morgan Offshore Wind Project: Generation Assets, and the Morecambe Offshore Windfarm: Generation Assets. Modelling undertaken for the Mona Offshore Wind Project demonstrated no cumulative effect in physical processes is anticipated with the Morecambe Offshore Windfarm: Generation Assets. For wave climate this is due to the presence of Anglesey and limited fetch lengths to the east, and in the case of tidal currents and sediment		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	transport, the distances separating projects are too great for a cumulative effect to arise. Storms arising in the north may result in changes in wave climate in the Morgan Offshore Wind Project: Generation Assets that may extend to the boundary of the Mona Offshore Wind Project. However, they would do so at a c. 0.2% reduction in wave height which falls in the realm of natural variability and is therefore insignificant. Again, the distance separating the Morgan Offshore Wind Project: Generation Assets from the Mona Offshore Wind Project are too great for cumulative changes in relation to tidal currents or the sediment transport regime. Cumulative changes may arise between the Generation Assets and the Transmission Assets, however given the rapid reduction in changes to wave height, tidal currents and sediment transport rates with distance from infrastructure, no significant changes to the physical processes are expected within any designated receptors. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations whilst indirectly affecting the West of Walney MCZ, West of Copeland MCZ, and Shell Flat and Lune Deep SAC. Any shoreline that may be affected would be highly recoverable due to the minor change in seabed morphology and physical processes. The magnitude of impact is therefore low adverse.		

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Significance of effect	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	No Tier 3 projects associated with this impact.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		
Decommissioning			
Sensitivity of receptor	In the interests of brevity the assessment of receptor sensitivity is presented in full in **section 1.10.1 paragraph 1.10.2.2** to **1.10.2.7**. The criteria for this assessment is presented in **section 1.9.2**. Based on this, all receptors are considered to be of low sensitivity.		
Magnitude of impact	Localised changes in physical processes and seabed morphology may potentially continue to be experienced within the Fylde MCZ and Ribble Estuary designated areas if cable protection is retained within 1 km of these areas. This would be mitigated by the use of low profiled tapered cable protection when it is required in shallow areas. Particularly through CoT114, **Table 1.13**, which outlines all permanent infrastructure located between MLWS and MHWS will be buried to a target depth of 3 metres, subject to further pre-construction surveys to be reported within the Detailed Cable Burial Risk Assessments (CBRAs). Similarly, any additional cable protection provided within or at close proximity to designated area due to the Isle of Man Interconnector may continue to influence	The decommissioning phase of the Transmission Assets and Generation Assets, along with Tier 1 projects (Scenario 4a) considers the addition of the following for Scenario 4b: • Tier 2 Proposed development of the Mooir Vannin Offshore Wind Farm. • Tier 2 Proposed development of the Eni Hynet – Carbon Capture Project. • The magnitude of the increase in suspended sediment concentrations arising from Scenario 4a has been assessed as low. The proposed development of the Mooir Vannin Offshore Wind Farm located is located 2.59 km	No Tier 3 projects associated with this impact.

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
	physical processes. However due to spacing distance of separation they have no cumulative impact on designated areas or adjacent shorelines. The MDS the Generation Assets sets out the removal of all foundation above the seafloor. The decommissioning phase of the Transmission Assets and the Mona Offshore Wind Project coincide. Following decommissioning, changes to wave regime would be of lesser magnitude than the operation and maintenance phase, as no structures would remain in the water column to influence physical processes at both sites, with only the scour and cable protection retained within the context of the MDS. The same can be expected for both the Morgan Offshore Wind Project: Generation Assets and the Morecambe Offshore Windfarm: Generation Assets. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations The magnitude is therefore low adverse in line with the Transmission Assets alone. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations The magnitude is therefore low adverse in line with the Transmission Assets alone.	from the Transmission Assets, in deeper water and therefore there is no potential for cumulative impacts with the Transmission Assets. As no structures relating to the Morgan Offshore Wind Project: Generation Assets will remain in the water column the cumulative impact seen for the operation and maintenance phases will cease to exist. During decommissioning phase there may be overlap with the proposed development of the Eni Hynet – Carbon Capture Project. However, given the distance of separation of the development from the Transmission, no cumulative effect is expected to arise. As no structures relating to Generation Assets will remain in the water column no cumulative change will arise with the Eni Hynet – Carbon Capture Project. The impact is therefore predicted to be of local spatial extent and long term duration continuous and high reversibility. It is predicted that a cumulative impact may directly affect the Fylde MCZ and Ribble Estuary designations The magnitude is therefore low adverse in line with the Transmission Assets alone.	

	Scenario 4a Scenario 3 (Transmission Assets and Generation Assets) + Tier 1	Scenario 4b: Scenario 4a + Tier 2	Scenario 4c: Scenario 4b + Tier 3
Significance of effect	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse, in line with the Transmission Assets alone. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the sensitivity of the receptors are low, and the magnitude of the cumulative impact is low adverse, in line with the Transmission Assets alone. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	No Tier 3 projects associated with this impact.
Further mitigation and residual significance	No effects which are significant in EIA terms have been identified therefore no further mitigation measures are proposed.		

1.13 Transboundary effects

1.13.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to physical processes from the Transmission Assets upon the interests of other states (see Volume 1, Annex 5.4: Transboundary screening of the ES).

1.13.1.2 The offshore components of the Transmission Assets and the study area are located within UK and Isle of Man territorial waters which have been considered as part of the baseline assessment and are therefore not assessed as transboundary receptors. Any impacts on physical processes (i.e., potential changes to the wave regime, tidal regime and sediment transport due to the presence of infrastructure, and potential changes in suspended sediment concentrations due to construction, operation and maintenance, and decommissioning activities) are likely to be confined to within a distance of one spring tidal excursion from the offshore elements of the Transmission Assets which defines the study area. The study area extends approximately 10 km from the Offshore Order Limits, therefore, no transboundary impacts with regards to physical processes are anticipated and no significant effects would arise.

1.14 Inter-related effects

1.14.1.1 Inter-relationships are the impacts and associated effects of different aspects of the Transmission Assets on the same receptor. These are as follows.

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Transmission Assets (construction, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor group than if just one phase were assessed in isolation.
- Receptor led effects: Assessment of the scope for all relevant effects across multiple topics to interact, spatially and temporally, to create inter-related effects on a receptor.

1.14.1.2 A description of the likely interactive effects arising from the Transmission Assets on physical processes is provided in Volume 4, Chapter 3: Inter-relationships of the ES. There is no change in the significance of effects resulting from the inter-related assessment for physical processes.

1.15 Summary of impacts, mitigation measures and monitoring

1.15.1.1 Information on physical processes within the study area was collected during detailed desktop review of existing studies and datasets and supported by site specific surveys and numerical modelling studies for related projects.

1.15.1.2 **Table 1.25** presents a summary of the impacts, measures adopted as part of the Transmission Assets and residual effects in respect of physical processes. The impacts assessed include:

- increased SSC due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features;
- impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines; and
- impacts to sediment transport and sediment pathways at the offshore export cable landfall.

1.15.1.3 Overall, it is concluded that there will be no significant effects arising from the Transmission Assets during the construction, operation and maintenance, or decommissioning phases.

1.15.1.4 **Table 1.26** presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include:

- increased SSC due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features; and
- impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.

1.15.1.5 Overall, it is concluded that there will be no significant cumulative effects from the Transmission Assets alongside other projects/plans.

1.15.1.6 No significant potential transboundary impacts have been identified in regard to effects of the Transmission Assets.

1.15.1.7 No further mitigation is proposed following the assessment of the Transmission Assets in isolation and in a cumulative capacity, as no significant effects are expected to arise, with those mitigation measures adopted as part of the Transmission Assets appropriately attenuating risk to receptors.

Table 1.25: Summary of environmental effects, mitigation and monitoring

Description of impact	Phase[a]			Commitment number ~~(Table 1.13)~~(Table 1.13)	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant residual effect	Proposed monitoring
	C	O	D							
Increase in suspended sediments due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	CoT47	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None
Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.	✓	✓	✓	CoT45 CoT47 CoT54 CoT109 CoT64 CoT133 CoT134	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None
Impacts to sediment transport and sediment pathways at the offshore export cable landfall.	✓	×	×	CoT45 CoT57 CoT54 CoT133 CoT134	C: Negligible O: N/A D: N/A	C: Low O: Low D: Low	C: Negligible O: N/A D: N/A	None proposed beyond existing commitments	C: Negligible O: N/A D: N/A	None

[a] C=construction, O=operation and maintenance, D=decommissioning

Table 1.26: Summary of cumulative environmental effects, mitigation and monitoring

Description of effect	Phase[a]			Commitment number ~~(Table 1.13)~~(Table 1.13)	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant Residual effect	Proposed monitoring
	C	O	D							
Tier 1										
Increase in suspended sediments due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	CoT47	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None
Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.	✓	✓	✓	CoT45 CoT47 CoT54 CoT109 CoT114 CoT64 CoT133 CoT134	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None
Impacts to sediment transport and sediment pathways at	✓	×	×	CoT45 CoT57	C: Negligible O: N/A	C: Low O: Low	C: Negligible O: N/A	None proposed beyond existing commitments	C: Negligible O: N/A	None

Description of effect	Phase[a]			Commitment number ~~(Table 1.13)~~(Table 1.13)	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant Residual effect	Proposed monitoring
	C	O	D							
the offshore export cable landfall.				CoT54 CoT114 CoT133 CoT134	D: N/A	D: Low	D: N/A		D: N/A	
Tier 2										
Increase in suspended sediments due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	CoT47	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None
Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.	✓	✓	✓	CoT45 CoT47 CoT54 CoT109 CoT114 CoT64 CoT133 CoT134	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None

Description of effect	Phase[a]			Commitment number ~~(Table 1.13)~~(Table 1.13)	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant Residual effect	Proposed monitoring
	C	O	D							
Impacts to sediment transport and sediment pathways at the offshore export cable landfall.	✓	×	×	CoT45 CoT57 CoT54 CoT114 CoT133 CoT134	C: Negligible O: N/A D: N/A	C: Low O: Low D: Low	C: Negligible O: N/A D: N/A	None proposed beyond existing commitments	C: Negligible O: N/A D: N/A	None
Tier 3										
Increase in suspended sediments due to construction, operation and maintenance and/or decommissioning related activities, and the potential impact to physical features.	✓	✓	✓	CoT47	C: Low O: Low D: Low	C: Low O: Low D: Low	C: Negligible O: Negligible D: Negligible	None proposed beyond existing commitments	C: Negligible O: Negligible D: Negligible	None
Impacts to physical processes, seabed morphology and the associated potential impacts to physical features and adjacent shorelines.	✓	✓	✓	CoT45 CoT47 CoT54 CoT109 CoT114 CoT64	C: N/A O: N/A D: N/A	C: Low O: Low D: Low	C: N/A O: N/A D: N/A	None proposed beyond existing commitments	C: N/A O: N/A D: N/A	None

Description of effect	Phase[a]			Commitment number ~~(Table 1.13)~~(Table 1.13)	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant Residual effect	Proposed monitoring
	C	O	D							
				CoT133 CoT134						
Impacts to sediment transport and sediment pathways at the offshore export cable landfall.	✓	×	×	CoT45 CoT57 CoT54 CoT114 CoT133 CoT134	C: Negligible O: N/A D: N/A	C: Low O: Low D: Low	C: Negligible O: N/A D: N/A	None proposed beyond existing commitments	C: Negligible O: N/A D: N/A	None

[a] C=construction, O=operation and maintenance, D=decommissioning

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