The Great Grid Upgrade

Sea Link

Preliminary Environmental Information Report

Volume: 1

Part 5 Project Wide Effects

Chapter 4 Marine Conservation Zone Assessment

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Contents

Table of Images

Table of Tables

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5.4 Marine Conservation Zone Assessment

5.4.1 Introduction

5.4.1.1 The Sea Link Project (hereafter referred to as the 'Proposed Project') is a proposal by National Grid Electricity Transmission plc (hereafter referred to as National Grid) to reinforce the transmission network in the South East and East Anglia to accommodate additional power flows generated from renewable and low carbon generation in additional to new interconnection with mainland Europe.

5.4.1.2 This chapter of the Preliminary Environmental Information Report (PEIR) presents the Marine Conservation Zone (MCZ) Assessment for the Proposed Project (as described in **Volume 1, Part 1, Chapter 4, Description of the Proposed Project**).

5.4.1.3 This chapter outlines the legislative requirement for an MCZ Assessment, the potential impacts associated with the Proposed Project, as well the Screening and Stage 1 of the MCZ Assessment.

5.4.1.4 The draft Order Limits, which illustrate the boundary of the Proposed Project, are illustrated on **Figure 1.1.1 Draft Order Limits** and the Offshore Scheme Boundary is illustrated on **Figure 1.1.4 Offshore Scheme Boundary**.

5.4.1.5 This chapter should be read in conjunction with:

- **Volume 1, Part 1, Chapter 3, Main Alternatives Considered**;
- **Volume 1, Part 1, Chapter 4, Description of the Proposed Project**;
- **Volume 1, Part 4, Chapter 2, Physical Environment**;
- **Volume 1, Part 4, Chapter 3, Benthic Ecology**;
- **Volume 1, Part 4, Chapter 4, Fish and Shellfish**;
- **Volume 1, Part 4, Chapter 5, Marine Mammals**; and
- **Volume 1, Part 5, Chapter 3, Habitat Regulations Screening Report**.

5.4.1.6 This chapter is supported by the following figures:

- **Volume 3, Figure 5.4.1 MCZs within 30 km of the Offshore Scheme including sites beyond where indirect effects may occur.**

5.4.1.7 This chapter is supported by the following appendices:

- **Volume 2, Appendix 1.4.A, Outline Code of Construction Practice (CoCP)**;
- **Volume 2, Appendix 1.4.F, Schedule of Environmental Commitments and Mitigation Measures**;
- **Volume 2, Appendix 4.3.A, Benthic Characterisation Report**; and
- **Volume 2, Appendix 4.8.B, Electromagnetic Deviation Study**.

Report Scope

5.4.1.8 Specific consideration of the potential for impact on MCZs is required for any marine licence application in English waters. The need for the consideration of MCZs is set out Section 126 of the Marine and Coastal Access Act 2009 (MCAA) (Ref 4.1).

5.4.1.9 The purpose of this report is to inform the MCZ assessment process in determining whether the Offshore Scheme is capable of affecting (other than insignificantly):

- Protected features of an MCZ; and/or
- Any ecological or geomorphological process on which the conservation of any protected features of an MCZ is (wholly or in part) dependant.

5.4.1.10 This MCZ assessment provides a description of the Offshore Scheme (section 5.4.3.6), identifies the potential impacts that could arise from the planned activities (section 5.4.6) and identifies the MCZ sites that could be affected (section 0).

5.4.1.11 The assessment process for MCZs considered during the licensing process is outlined by the Marine Management Organisation (MMO) in the guidance document 'Marine conservation zones and marine licensing' (Ref 4.2).

5.4.2 Proposed Project Description

Overview of Proposed Project

5.4.2.1 Detail regarding the Proposed Project is presented in **Volume 1, Part 1, Chapter 4, Description of the Proposed Project.** The Offshore Scheme boundary is illustrated on **Figure 1.1.4**.

5.4.2.2 A Scoping Report (Ref 4.3) for the Proposed Project was issued to the Planning Inspectorate (PINS) on 24 October 2022 and a Scoping Opinion (Ref 4.4) was adopted by PINS on behalf of the Secretary of State on 1 December 2022. The Scoping Opinion takes account of responses from consultees, including the MMO.

Consideration of Alternatives

5.4.2.3 Alternatives have been considered at each stage of the Proposed Project's development, with environmental, engineering, and economic considerations influencing the optioneering and design evolution process. Considerations included a detailed routeing and siting study. For more detail regarding the alternatives considered, see **Volume 1, Part 1, Chapter 3, Main Alternatives considered**.

5.4.3 Legislative Framework

5.4.3.1 During the Development Consent Order (DCO) process, the MMO acts as a statutory consultee during the pre-application stage, interested party during the examination stage and licensing and consenting body. If a development consent order (DCO) is granted, this may include provision deeming a marine licence to have been issued under Part 4 of the MCAA (2009). The MMO is responsible for enforcing, post-consent monitoring, varying, suspending, and revoking any deemed marine licence(s) as part of the DCO.

5.4.3.2 MCZs are designated under the MCAA (Ref 4.1) to protect a range of important marine habitats, species and geological formations in English and UK offshore waters. In conjunction with other existing international and national designations, these sites contribute to an ecologically coherent network of MPAs in the North East Atlantic.

5.4.3.3 MCZs have been identified through the MCZ Project. The MCZ Project was set up in 2008 and led by the JNCC and NE. The purpose of the MCZ Project was to identify and recommend MCZs to Government for designation - to date a total of 91 sites have been designated.

5.4.3.4 Under Section 126 of the MCAA (Ref 4.1), public authorities have a duty to consider MCZs during marine licence decision making (**Volume 1, Part 1, Chapter 2 Regulatory and Planning Policy Context**). To meet the requirements of Section 126, the MMO has implemented an MCZ assessment process which will be integrated into the marine licence decision making procedures. The process comprises three main stages, i) screening, ii) Stage 1 Assessment, and iii) Stage 2.

5.4.3.5 Section 126 of the MCAA (Ref 4.1) places specific duties on the public authorities relating to MCZs and marine licence decision making. Section 126 applies where:

- a public authority has the function of determining an application (whenever made) for authorisation of the doing of an act; and
- the act is capable of affecting (other than insignificantly):
  - the protected features of an MCZ;
  - any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or part) dependent.

5.4.3.6 To ensure the public authorities remain compliant with MCAA (Ref 4.1) obligations, the MCZ assessment process has been integrated into the existing marine licence decision making process. Hence, there is a requirement for specific information relating to potential project interactions with MCZs within waters licenced by MMO (i.e., English waters).

5.4.4 Assessment Methodology

5.4.4.1 Guidance published by the MMO (Ref 4.2) describes how MCZ Assessments could be undertaken during the process of marine licence decision making. These MMO guidelines recommend a staged approach to assessment, involving three sequential stages: screening, stage 1 assessment, and stage 2 assessment. Full details of these stages have been provided below and presented in Image 5.4-1.

- **Screening** – Determine whether the licensable activity is taking place within of near an area being put forward or already designated as an MCZ and whether the activity is capable of affecting (other than insignificantly) either (i) the protected features on an MCZ; or (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant. If the answer is yes, then proceed to Stage 1.
- **Stage 1 Assessment** – Is the authority satisfied that there is no significant risk of the activity hindering the conservation objectives stated for the MCZ and can the authority exercise its functions to further the conservation objectives of the site. If the answer is no to either of these questions, then the authority must consider whether there are other means of proceeding with the act which would create a

substantially lower risk of hindering the achieving objectives. If the answer is still no, then proceed to Stage 2.

- **Stage 2 Assessment** – This stage looks at whether the benefit to the public of proceeding with the act clearly outweighs the risk of damage to the environment and seeks to satisfy the authority that the applicant can make arrangements to undertake measures of equivalent environmental benefit to the damage which the act will or is likely to have of the MCZ.

5.4.4.2 To determine whether section 126 applies, it is necessary to consider the geographical proximity of the Offshore Scheme to the MCZ, and the potential for proposed activities to affect the protected features of an MCZ or the ecological/geomorphological processes upon which protected features are reliant.

5.4.4.3 A risk-based approach is recommended by the MMO when determining the proximity of an activity to an MCZ. The application of appropriate buffer zones to the protected features of an MCZ under consideration, as well as consideration of the potential risk of impacts from activities at greater distances from the MCZ is necessary.

5.4.4.4 If the screening stage determines that section 126 does apply, it is necessary for the MMO to assess which elements of section 126 should apply to a marine licence application.

5.4.5 Basis of Assessment

5.4.5.1 This section sets out the assumptions that have been made in respect of design flexibility maintained within the Proposed Project and the consideration that has been given to alternative scenarios and the sensitivity of the preliminary assessment to changes in the construction commencement year.

5.4.5.2 Details of the available flexibility and assessment scenarios are presented in **Volume 1, Part 1, Chapter 4 Proposed Project Description** and **Part 1, Chapter 5 PEIR Approach and Methodology**.

Flexibility Assumptions

5.4.5.3 The main preliminary assessments have been undertaken based on the description of the Proposed Project provided in **Volume 1, Part 1 Chapter 4 Description of the Proposed Project**. To take account of the flexibility allowed in the Proposed Project, consideration has been given to the potential for preliminary effects to be of greater or different significance should any of the permanent or temporary infrastructure elements be moved within the Limits of Deviation (LoD) or draft order Limits.

5.4.5.4 The assumptions made regarding the use of flexibility for the main assessment, and any alternatives assumptions are set out in Table 4.5.1 below.

Table 4.5.1. Flexibility assumptions

Element of flexibility	Proposed Project assumption for initial preliminary assessment	Flexibility assumption considered
Lateral LoD marine HVDC cable	The extent of the draft Order Limits for the Proposed	The worst-case scenario assessed for the Offshore

Element of flexibility	Proposed Project assumption for initial preliminary assessment	Flexibility assumption considered
	Project (Offshore Scheme Boundary).	Scheme is one bundled HVDC (x2) and one fibre optic cable in once trench. This bundled scenario maybe placed anywhere within the Offshore Scheme Boundary.

Coordination Including Co-Location

5.4.5.1 The Proposed Project includes an option for co-location with National Grid Ventures proposed Nautilus and LionLink interconnector projects as explained in **Volume 1, Part 1, Chapter 5 PEIR Approach and Methodology.**

5.4.5.2 Table 4.5.2 details where the option of co-location is relevant to the preliminary benthic assessment.

Table 4.5.2. Consideration of co-location

Element of coordination	How it has been considered within the preliminary assessment
Suffolk landfall	**Sea Link Only** Four ducts (one per cable and one spare). **Sea Link (with co-location)** Up to ten ducts.

Sensitivity Test

5.4.5.1 It is likely that under the terms of the draft DCO, construction could commence in any year up to five years from the granting of the DCO which is assumed to be 2026. Consideration has been given to whether the preliminary effects reported would be any different if the works were to commence in any year up to year five.

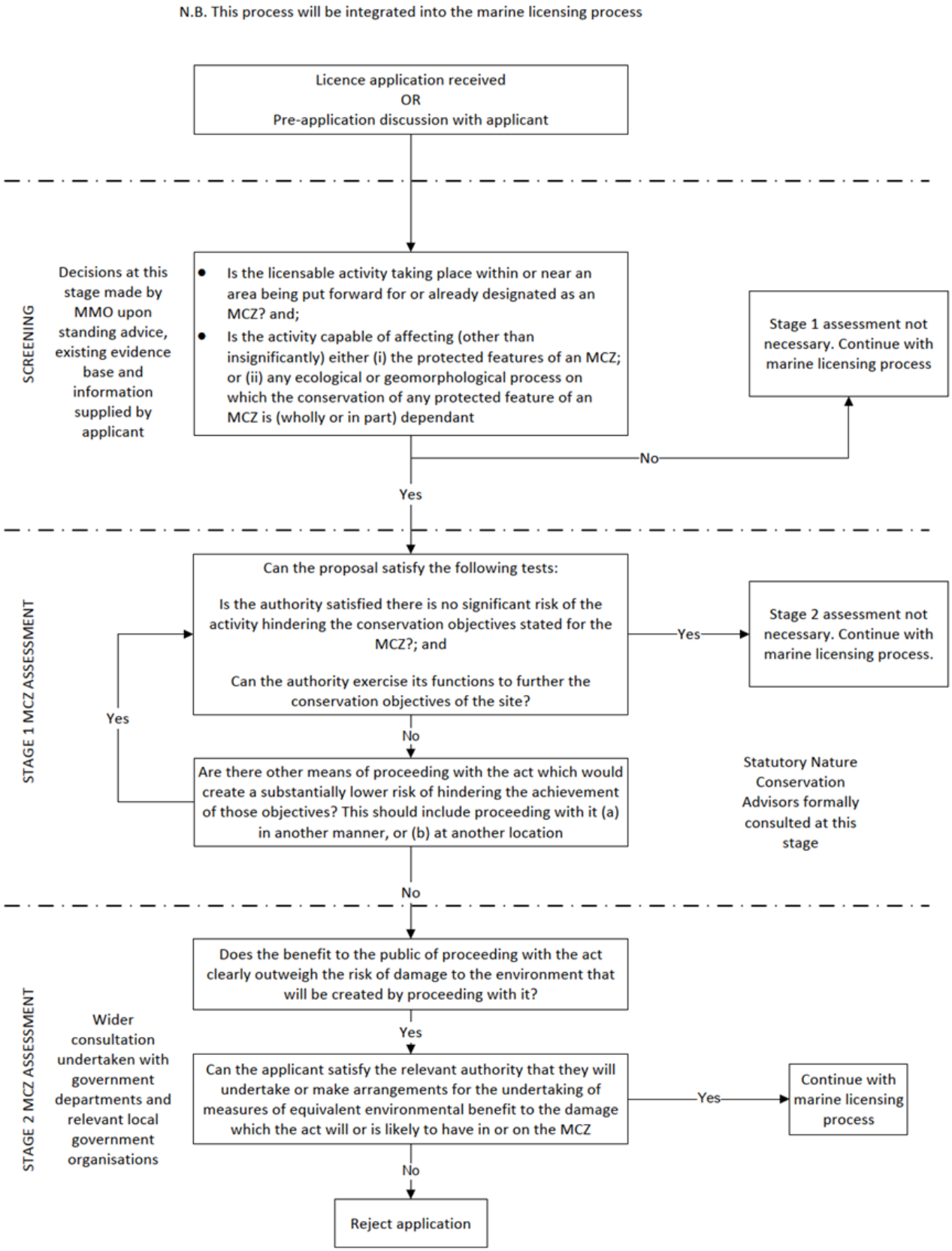

Image 5.4-1 Summary of the MCZ assessment process used by the MMO in marine licence decision making (Ref 4.2)

5.4.6 Potential Impacts, Effect and Zones of Influence (ZoI)

5.4.6.1 The OSPAR Intersessional Correspondence Group on Cumulative Effects pressure list and the Marine Life Information Network (MarLIN) marine evidence-based sensitivity assessments (MarESA) have been used to describe the potential impacts expected from the Offshore Scheme. These pressures align with the risk recommendations and sensitivities outlined within Natural England's Advice on Operations specifically for 'Power cable: laying, burial and protection' and 'Power cable: operation and maintenance' (for see https://designatedsites.naturalengland.org.uk/SiteSearch.aspx).

5.4.6.2 The protected features of identified MCZs fall into one of three categories: 'subtidal benthic habitats and species', 'migratory fish', or 'marine mammals'. The impact pathways and associated ZoIs (the extent of the potential impact from the activity) considered within this assessment are those that specifically relate to these receptors. A summary of impact pathways and associated ZoIs are summarised in Table 4.5.3.

5.4.6.3 Control and management measures for the Proposed Projects have been identified within **Appendix 1.4.A Outline Code of Construction Practice**.

Temporary Physical Disturbance to Subtidal Benthic Habitats and Species

5.4.6.4 Construction activities associated with route preparation and cable installation can lead to direct physical disturbance of substrate which may lead to disturbance and/or loss of benthic habitats and species within the footprint and immediate vicinity of the works. Sensitivity to physical disturbance varies between receptor; for mobile receptors displacement, physiological/morphological damage may occur whilst for habitats and sedentary or less mobile receptors, the likely impacts are physiological/morphological damage and mortality.

5.4.6.5 The Proposed Project will use a trenchless solution between the onshore and offshore elements at both landfalls (**Volume 1, Part 1, Chapter 4, Description of the Proposed Project**). Therefore, any impacts to intertidal habitats and species will be avoided and these areas are not considered further in the assessment.

5.4.6.6 A number of pre-installation and cable installation activities will temporarily disturb seabed habitats. These activities include:

- boulder plough or grab (swathe of 30 to 40 m, length to be confirmed after final RPL);
- pre-lay grapnel run (swathe of 1 to 3 m, length of ~116.7 km);
- sandwave lowering (sidecasting/CFE) (swathe of 30 to 40 m, length of ~7.3 km);
- sandwave lowering (pre-sweeping) (swathe of 20 to 25 m, length of ~25 km);
- sea trails (not currently envisaged) (swathe of 20 to 40 m, length of 1 km minimum); and
- cable trenching – may include various methods depending on seabed conditions (e.g. ploughing, jet trenching, and/or mechanical trenching) (swathe ranges from 5m to 20m, length of cable route – up to 130 km).

Permanent Loss of Subtidal Benthic Habitats and Species

5.4.6.7 Cable protection is required where, third-party assets cross the route, burial can't be achieved, and at exit points at landfall to mitigate the effects of mobile sediments. This would lead to disturbance and/or loss of benthic habitats and species. This would also introduce artificial hard substrata which could have the capacity to function as an artificial rocky reef allowing species dependant on hard substrates to colonise areas that might have previously been unsuitable.

5.4.6.8 Options for external cable protection include:

- rock placement (planned berms) (13.2 km planned post lay rock berm, 10 m wide – area of 0.13 km^2);
- concrete mattresses (80 mattresses, over 480 m in length – area of 0.0014 km^2);
- rock/gravel/sand/grout bags (to be confirmed); and
- protection sleeves/cast-iron shells.

Temporary Increase in Suspended Sediment Concentrations (SSC)

5.4.6.9 Construction activities have the potential to increase SSC creating a plume within the water column. This in turn can lead to increased deposition as suspended sediments settle out of the water column. Increased SSC can lead to elevated turbidity levels which may reduce the feeding efficiency and subsequent growth rates of filter feeders if clogging of feeding structures occurs. Any contaminants, such as heavy metals and toxins, within the sediments, can also be released into the water column and may alter marine water quality with subsequent indirect effects on benthic species.

5.4.6.10 Increased deposition can smother the seabed potentially resulting in changes to seabed geomorphology, sediment structure and habitats. This would have an impact on species that currently rely on these habitats for food and refuge, leading to potential indirect effects on survival, growth, reproduction, and displacement of individuals.

Introduction and spread of Invasive Non-Native Species (INNS)

5.4.6.11 The use of cables is expected to require protection at some locations, which will introduce hard substrates in the form of rock protection or mattresses, to habitats dominated by sediments ranging from mud to sand and gravel. This could provide additional habitat for any existing epifaunal INNS populations allowing for localised spreading.

Underwater Noise

5.4.6.12 Vessel activity and cable installation activities could generate underwater sound which has the potential to directly affect marine species. Underwater sound has a range of potential effects depending on the type of sound and proximity to the sound source. The range of potential effects include lethal effect and physical injury, auditory injury, behavioural responses, and masking.

5.4.6.13 Several activities during the construction phase will generate underwater sound, including:

- pre-installation geophysical surveys comprising Multi-Beam Echo Sounder (MBES), Side-Scan Sonar (SSS), and/or Sub-Bottom Profiler (SBP);
- Acoustic positioning;
- cable trenching – may include various methods depending on seabed conditions (e.g. ploughing, jet trenching, and/or mechanical trenching);
- cable protection placement (e.g. rock placement, concrete mattresses, bags, protection sleeves); and
- vessel movements including vessels operating with dynamic positioning (DP).

5.4.6.14 There is potential for unexploded ordnance (UXO) detonation to be required prior to the cable installation programme. This activity will be subject to a separate marine licence application and assessment and so has not been considered further in this assessment.

Effects of Electromagnetic Field (EMF) Emissions

5.4.6.15 Electromagnetic fields may have potential to disrupt sensory mechanisms in magnetosensitive and electrosensitive marine species. EMF emissions from the cables have the potential to disturb foraging behaviour and inhibit migratory success through displacement of migratory fish, and cetaceans. The worst-case scenario for the Offshore Scheme is two HVDC cables and one fibre optic cable bundled as one in one trench buried to a depth of 1.5 m, with field intensities between 53 and 126 µT at the seabed surface.

Thermal Emissions

5.4.6.16 Operation of buried subsea HVDC cables generates heat due to resistance in the conductor components and have been shown to generate and dissipate heat when active. Such heat has the potential to cause sediment dwelling and demersal mobile organisms to move away from the affected area. Increased heat may also alter physico-chemical conditions and bacterial activity (with shifts in bacterial community composition and changes in nitrogen cycling) in surrounding sediments, contributing to altered faunal composition and localised ecological shifts. The rate of heat loss, and magnitude of environmental heating, is dependent on several factors; most notably the amount of power passing through the cables; the design of the cables; and the thermal properties of the surrounding substrates which in turn is influenced by sediment grain size. Where cables are buried thermal effects at the sediment surface are significantly reduced.

Vessel Collision Risk

5.4.6.17 Installation, maintenance, and decommissioning activities will involve the deployment of several vessels. Therefore, there is an inherent risk of collision between vessels and marine mammals associated with the Proposed Project. Direct strikes from vessels, including sharp objects such as propellers, have the potential to cause lethal injury to marine mammals.

Airborne Sounds and Visual Disturbance:

5.4.6.18 Disturbance to seals may occur through the movement of, and production of airborne sound by vessels. Sounds produced from shipping traffic have been associated with “flushing” of seals at haul-out sites (Ref 4.5). Given the slow speeds at which the installation vessels are known to operate during cable installation, it is unlikely that high airborne sound levels will be produced. Moreover, as these vessels are continuously moving any impacts will be transient, intermittent, and short-term.

Table 4.5.3. Summary of potential impact pathways and associated Zones of Influence (ZoI)

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
Construction, maintenance, and decommissioning	Temporary physical disturbance to subtidal benthic habitats and species	Subtidal benthic habitats and species	Proposed Project activities will result in short term physical disturbance to, and temporary loss of, seabed habitats and in some instances physical damage of less mobile receptors. Sensitivity to the impact of habitat disturbance varies between habitats and species, depending on the stability of the habitat and its resilience to disturbance, and the vulnerability of individual species to mechanical disturbance. Mobile species and life stages are considered to have greater capacity to accommodate such changes through movement to undisturbed areas while sessile or less mobile species/life stages are considered less tolerant of such disturbance which may also result in physical damage in some instances. Temporary disturbance will occur along the entire Offshore Scheme (up to 130 km in length). Boulder plough or grabs would result in the widest disturbance swathe, of up to 40 m for the bundled cable trench.	15 m width, widening to 40 m when boulder plough and pre-sweep is required through sand waves
		Marine mammals	There may also be an indirect impact on marine mammals due to impacts on their prey. However, marine mammals undertake very wide-ranging foraging trips, and it therefore, acknowledged that the ZoI represents a very limited portion of their foraging area.	
		Migratory fish	Migratory fish are not considered to have functional associations with seabed habitats due to their life history strategies and transient presence within the Offshore	NA

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
			Scheme. Therefore, this receptor group has not been considered further for this impact pathway.	
Construction and maintenance	Permanent loss of subtidal benthic habitats and species	Subtidal benthic habitats and species	The total footprint of permanent habitat loss as a result of placement of cable protection, including rock berms and concrete mattresses is approximately 0.13 km^2, which equates to approximately 2.3 % of the Offshore Scheme. This would lead to loss of benthic habitats and species, as well as impacts to spawning grounds for demersal spawners, particularly herring and sandeel.	Highly localised (~/<10m) from any rock placement
		Marine mammals	There may also be an indirect impact on marine mammals due to impacts on their prey. However, marine mammals undertake very wide-ranging foraging trips, and it therefore, acknowledged that the ZoI represents a very limited portion of their foraging area.	
		Migratory fish	Migratory fish are not considered to have functional associations with seabed habitats due to their life history strategies and transient presence within the Offshore Scheme. Therefore, this receptor group has not been considered further for this impact pathway.	NA
Construction, maintenance, and decommissioning	Temporary increase in suspended sediment	Subtidal benthic habitats and species	There are several potential effects to benthic receptors, associated with increased SSC and sediment deposition including:	< 5km[1]

[1] Awaiting further sediment dispersion calculations. These will be undertaken as part of work for the Environmental Statement (ES) to estimate the extent of sediment dispersion as a result of trenching activities.

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
	concentrations (SSC)	Migratory fish	- Reduced photosynthesis due to increased turbidity, resulting in reduced primary production in marine seaweed and algae; - Smothering of species and clogging of respiratory and feeding apparatus; - mortality of eggs and larvae associated with the benthos, leading to implications on spawning success and recruitment (Ref 4.6); - Indirect effects of the release of contaminants, such as heavy metals and hydrocarbons, during sediment mobilisation, on species; and - Potential barrier to the movement and migration of fish from increased SSC. The largest sediment plumes, and highest levels of SSC, will be associated with disturbance of sediments with a high proportion of fine particulate material. Dispersion processes will act to dilute the small proportion of fine and very fine sediment carried in suspension (**Volume 1, Part 4, Chapter 2 Physical Environment**), after which point concentration of particulate matter would be negligible and the deposition thickness on the seabed, where the sediment will settle, will be negligible and highly localised.	
		Marine mammals	There may also be an indirect impact on marine mammals due to impacts on their prey. However, marine mammals undertake very wide-ranging foraging trips, and the ZoI represents a very limited portion of their potential foraging area.	

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
Construction and maintenance	Introduction and spread of invasive non-native species (INNS)	Subtidal benthic habitats and species	Rock placement and concrete mattresses are proposed for a number of locations along the Offshore Scheme to protect the cable at intersections with other cables or pipeline infrastructure and in areas where burial cannot be achieved. These locations are anticipated to consist of an area of 0.13 km^2. Some studies have demonstrated the ability for artificial hard structures to function as artificial rocky reef, which are known to be preferred habitat for many INNS acting as 'ecological stepping stones' (Ref 4.7). This could facilitate the colonisation and spread of INNS in areas of the benthos which may have previously been unsuitable. However, there remain uncertainties surrounding this theory (Ref 4.8) and the function of artificial structures as 'stepping stones' remains unclear. To ensure, that the potential impact of INNS introduction is reduced, all rock and concrete mattresses used for cable protection will be cleaned so do not provide a vector for INNS directly. Furthermore, although there are concerns around introduced substrata providing habitat for INNS, particularly given the substantial growth of marine infrastructure in the North Sea, to date, no spread of INNS caused by submarine cabling has been documented (Ref 4.9). Therefore, the overall magnitude of the impact is expected to be small, and so the introduction of INNS is not considered further as a potential impact pathway.	NA
	Underwater noise	Subtidal benthic habitats		

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
Construction, maintenance and decommissioning		and species Migratory fish	Sensitivity to the impact of underwater noise on benthic ecology, depends on the sensitivity of the species associated with the habitats. Few formal studies have been conducted on the impacts of underwater sound on marine invertebrates, although invertebrates are believed to be sensitive to particle motion rather than to sound pressure (Ref 4.10). At present there are no published sensitivity thresholds for invertebrates. Some lab-based studies have demonstrated some behavioural changes of certain species in response to pile driving (Ref 4.11; Ref 4.12), although, repeated exposure resulted in the habituation or tolerance to underwater noise (Ref 4.13). Field based studies revealed no evidence of increased mortality in bivalves or lobsters, or of reduced catch-rates for plankton or reef associated invertebrates when exposed to acute underwater noise (Ref 4.12). These studies found responses in invertebrates ranged depending on species, with little evidence of increased mortality or ecosystem impacts. The Proposed Project activity with the highest sound source is expected to be sub bottom profiling (SBP). This activity operates at frequencies of 0.5-12 kHz, within the hearing range of some fish species. However, there is an understanding that these more mobile species are able to move away from a sound source before the effects are realised. The noise levels associated with the Proposed Project activities will be operating at frequencies that are not	Highly localised (< 10 m)

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
			expected to have an impact ecology. Thus, the ZoI of underwater noise is expected to be anticipated to be localised.	
		Marine mammals	The Project activity with the highest sound source is expected to be SBP. This activity operates at frequencies of 0.5-12 kHz within the hearing range of harbour porpoise, harbour seal, and grey seal. For SBP activities, the distance from the sound source at which disturbance can occur, referred to as the Effective Deterrent Range (EDR) is understood to be 5 km (Ref 4.14).	5 km
Operation	Effects of electromagnetic field (EMF) emissions	Subtidal benthic habitats and species	Sensitivity to the EMF emissions depends on the sensitivity of the species associated with benthic habitats. There is very little information about the sensitivity of benthic species to EMF but there have been a small number of investigations in laboratory experiments. There is evidence from studies that some benthic invertebrates are able to detect EMF (Ref 4.15). However, in a laboratory study there was found to be no evidence of avoidance or attraction behaviours at an EMF of 1000 µT (Ref 4.16) a much higher intensity than will be emitted by the Offshore Scheme. Moreover, in an experiment with American lobsters, only subtle behavioural responses to HVDC EMF were observed (Ref 4.17). There were notable changes in movement and distribution within an enclosed space, but the EMF did not represent a barrier to lobster movements, and no significant impact was observed overall. EMF emissions from the cables also have the potential to disturb foraging behaviour and inhibit migratory success through displacement of migratory fish.	Highly localised (8 m)
		Migratory fish		
		Marine mammals		

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
			Moreover, there is potential for any marine mammals that forage on the seafloor to be exposed to these emissions. The species likely to occur near the Offshore Scheme are harbour porpoise, harbour seal, and grey seal. All three forage for sandeel, whilst harbour and grey seal in the area typically also forage for flatfish, gadoids, and other benthic species (Ref 4.18; Ref 4.19). Modelling of sandeel distribution in the North Sea has indicated that no important sandeel areas overlap with the Offshore Scheme (Ref 4.20). Furthermore, given the wide-ranging nature of each of these species, it is likely that they will be capable of avoiding any EMF effects, and can easily forage in other areas. In a worst-case scenario, the HVDC cables will be bundled, which are known to emit significantly lower magnetic fields due to cancellation of the magnetic fields between poles. Modelling of the predicted EMF emissions for the Offshore Scheme (**Volume 2, Part 4, Appendix 4.8.B, Electromagnetic Deviation Study**) shows that the geometric field for a bundled cable design buried at 1 m, indicates field intensities between 53 and 126 µT at the seabed surface, and that the geometric field was reduced to background levels within around 8 m from the cable, having only a very localised effect.	
Operation	Thermal emissions	Subtidal benthic habitats and species	Subsea HVDC power cables have been shown to generate and dissipate heat when active, reaching cable surface temperatures of up to 70°C. Such heat has the potential to cause sediment dwelling and demersal mobile organisms to move away from the affected area.	Highly localised (< 10 m)

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
			Sensitivity to the thermal emissions depends on the sensitivity of the species associated with benthic habitats, as well as the sediment particle size composition (Ref 4.11), with coarser sediments with higher permeability transferring heat further but with a lower increase in temperature. Increased sediment temperature has the potential to affect infaunal species and assemblages directly. Whilst the sediment surrounding the cable may be heated, there is negligible capability to heat the overlying water column as seawater at the seabed surface will have a cooling effect and will dissipate any temperature increases further reducing any effects on epibenthic communities. Increased heat may also alter physico-chemical conditions and bacterial activity (with shifts in bacterial community composition and changes in nitrogen cycling) in surrounding sediments, contributing to altered faunal composition and localised ecological shifts (Ref 4.21; Ref 4.22). The construction approach for the Offshore Scheme is two HVDC cables and one fibre optic cable bundled as one in one trench buried to a target depth of 1.5 m. Heat dissipation modelling undertaken in previous projects (Ref 4.23) indicates that, for bundled cables buried at a depth of 1.5 m, within 50 cm of the seabed surface the increase in sediment temperature was limited to 3°C.	
Construction, maintenance, and decommissioning	Vessel collision risk	Marine mammals	Marine mammals have been reported as involved in vessel strikes in the North Sea and wider Atlantic (Ref 5.24). Vessel strikes can result in physical impairment or even mortality,	Highly localised to the vessel

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
			which may reduce foraging abilities and fitness at an individual level (Ref 5.25) and a population level. Vessel speed and draft depth are thought to be the biggest factors concerning collision risk and severity, with higher vessel speeds producing greater impact force and larger drafts being associated with increased mortality (Ref 5.26). The vessels supporting Proposed Project activities typically operate at low speeds of 4 to 6 knots and transit at slightly greater speeds of 10 to 14 knots. At these speeds, it is unlikely that vessels pose a significant risk to marine mammals. Marine mammals are also highly manoeuvrable, and studies have observed avoidance behaviours (Ref 4.27; Ref 4.28; Ref 4.29). Some studies have also correlated avoidance behaviour with sustained or increased vessel traffic (Ref 4.30; Ref 4.31). Therefore, it is likely individuals are habituated to vessel presence in the Greater Thames Estuary and Southern North Sea, which are subject to high levels of vessel traffic (Ref 4.32). As Proposed Project vessels are continuously moving along the Offshore Scheme, the ZoI is expected to be highly localised to the vessel, and any impacts will be transient, intermittent, and short-term.	
Construction, maintenance, and decommissioning	Airborne sounds and visual disturbance	Marine mammals	Sounds produced from shipping traffic have been associated with “flushing” of seals at haul-out sites (Ref 4.5). The Thames is a highly trafficked area and although not home to major haul-out sites, hauling out still occurs regularly around the estuary, likely indicating a degree of habituation to airborne vessel noise and visual disturbance.	Highly localised to the vessel

Proposed Project phase	Potential impact pathway	Receptor	Rationale	ZoI
			Studies have indicated a reluctance to fleeing during the breeding season (Ref 4.33; Ref 4.34), and site fidelity, with individuals returning to the same sites despite repeated disturbance (Ref 4.33). A spatial analysis indicated a high co-occurrence of seals and shipping vessels within 50 km of the coastline near haul-out sites, with no evidence of related population declines (Ref 4.35). Airborne sound produced is likely to be limited to Proposed Project vessels. Given the slow speeds at which the installation vessels are known to operate during construction, maintenance, and decommissioning it is unlikely that high airborne sound levels will be produced. Moreover, as these vessels are continuously moving, the ZoI is expected to be highly localised to the vessel, and any impacts will be transient, intermittent, and short-term.	

5.4.7 Screening

5.4.7.1 The assessment approach applied during the MCZ screening is based on MMO guidance document (Ref 4.2) and presented in Image 5.4.2.

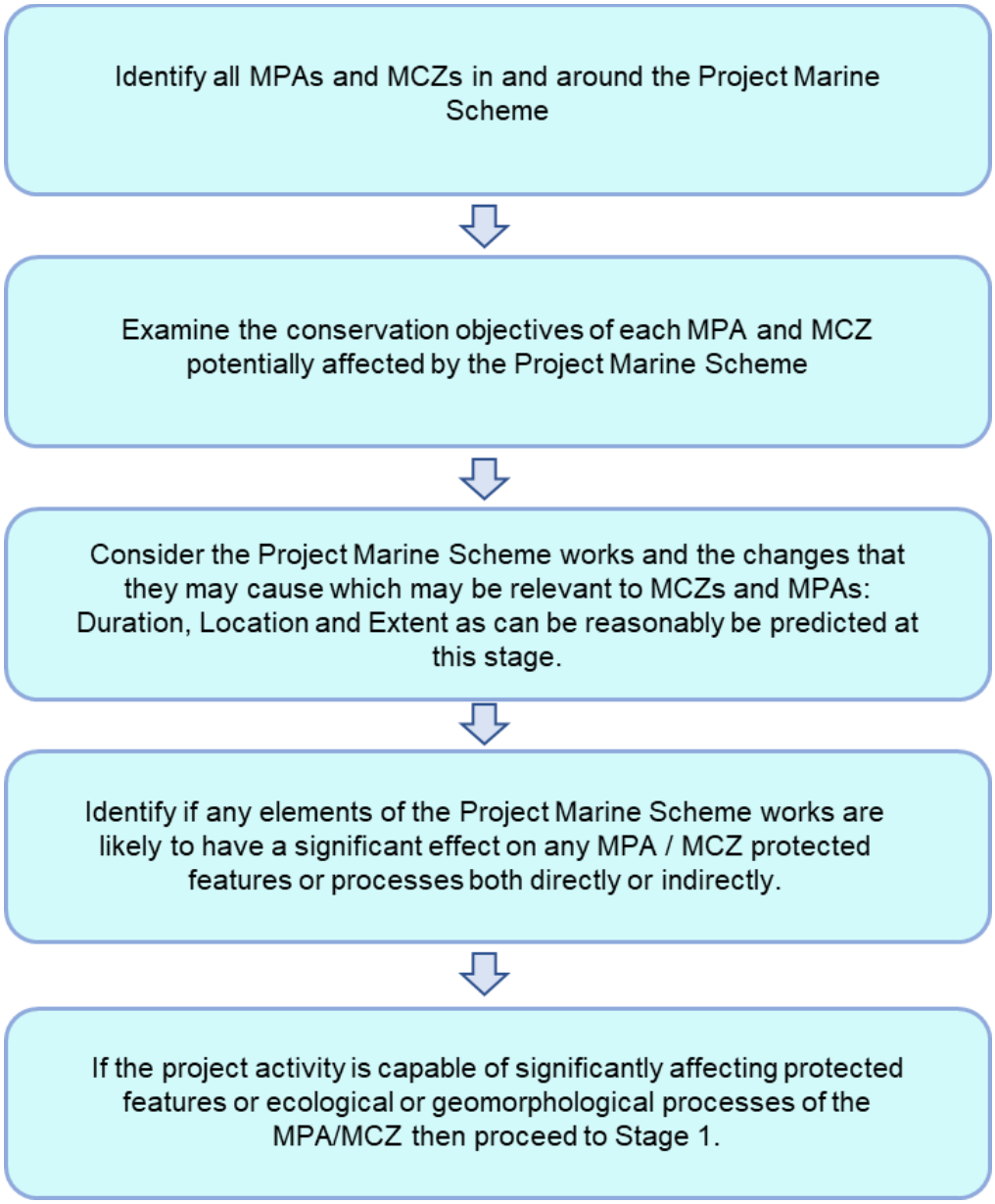

Image 5.4.2 Marine Conservation Zone (MCZ) screening process

5.4.7.2 In line with the precautionary approach encouraged by the MMO, the screening process has considered a Study Area in which any MCZ within 30 km of the Offshore Scheme to ensure that all ZoIs are represented (**Figure 5.4.1 MCZs within 30 km of the Offshore Scheme including sites beyond where indirect effects may occur**). This is considered a sufficiently precautionary buffer around the Proposed Project that exceeds the maximum ZoI of Proposed Project related activities that are likely to impact MCZ protected features in this instance, particularly since the majority of MCZ features are benthic habitats and species.

5.4.7.3 However, given that migratory fish species are known to migrate over large distances, consideration has also been given to indirect effects on the Medway Estuary MCZ,

which has smelt as a protected feature, which is beyond the 30 km screening distance (**Figure 5.4.1 MCZs within 30 km of the Offshore Scheme including sites beyond where indirect effects may occur**).

Goodwin Sands MCZ

5.4.7.4 Goodwin Sands is an MCZ that covers 277 km^2 and consists of a dynamic area of sand and coarse sediments off the coastline of Kent, including the English Channel outburst flood feature. The site is designated for areas of subtidal sand and coarse sediment (Table 4.5.4) that are managed to maintain their favourable condition. The site is also designated for, and is managed to recover to favourable condition, several specific habitat types: Ross worm (*Sabellaria spinulosa*) reefs, blue mussel beds, and moderate energy circalittoral rock, which is animal-dominated rock found on deeper or shaded vertical rock faces. This rocky habitat supports a range of species including bryozoans, anemones, pink sea fans, cup corals, soft corals, sponges, sea squirts and red algae, as well as commercially important shellfish and fish (Ref 4.36).

5.4.7.5 This MCZ is within the Offshore Scheme, falling within the ZoI of the following impact pathways (Table 4.5.3):

- Temporary physical disturbance to subtidal benthic habitats and species;
- Permanent loss of subtidal benthic habitats and species;
- Temporary increase in SSC;
- Underwater noise;
- Effects of EMF emissions; and
- Thermal emissions.

5.4.7.6 Due to the potential for a number of impact pathways to have an effect on the Goodwin Sands MCZ, this site has been **screened in for Stage 1 assessment** (Table 4.5.4).

Thanet Coast MCZ

5.4.7.7 Thanet Coast MCZ includes an area of subtidal chalk that extends seawards from the chalk reefs and cliffs and covers an area of 64 km^2. The chalk seabed within the area is the longest continuous stretch of coastal chalk in the UK. The site is designated for a range of protected features (Table 4.5.4) that currently have a conservation objective to maintain in favourable condition. These features include a range of subtidal benthic habitats such as *Sabellaria spinulosa* reefs and blue mussel beds. The conservation objective for the *Sabellaria spinulosa* reefs is to recover to favourable condition. Living reefs such as this play an important role within the ecosystem as they stabilise mobile sediment, provide habitat niches, and can protect coastlines by reducing the energy of incoming waves, and improving water quality through water filtration processes. The MCZ protects two species of stalked jellyfish that are typically attached to red seaweeds or seagrasses (Ref 4.37).

5.4.7.8 This MCZ is within 1 km of the Offshore Scheme, falling within the ZoI of the following impact pathway (Table 4.5.3):

- Temporary increase in SSC.

5.4.7.9 Due to the potential for a temporary increase in SSC to have an effect on the Thanet Coast MCZ, this site has been **screened in for Stage 1 assessment** (Table 4.5.4).

Kentish Knock East MCZ

5.4.7.10 Kentish Knock East MCZ covers 96 km^2 and is designated for a range of subtidal sediment types (Table 4.5.4). Fine sand is managed to maintain in favourable condition, and coarse and mixed sediments are managed with the aim to recover to favourable condition. The varied nature of the seabed means it supports a wide range of species, both on and in the sediment. Within the sandy areas, burrowing molluscs, such as razor clams, live within the sediment while small shrimplike creatures scavenge within the sand grains. This habitat is also important for a range of fish species, including commercially important flatfish such as sole and plaice. The coarser sediments within the site also support a wide range of species. Again, some live within the sediment, such as anemones and clams, and others live on the surface, such as starfish and sea urchins (Ref 4.38)

5.4.7.11 This MCZ is a distance of 1 km from the Offshore Scheme, falling within the ZoI of the following impact pathway (Table 4.5.3):

- Temporary increase in SSC.

5.4.7.12 Due to the potential for a temporary increase in SSC to have an effect on the Kentish Knock East MCZ, this site has been **screened in for Stage 1 assessment** (Table 4.5.4).

Orford Inshore MCZ

5.4.7.13 Orford Inshore MCZ covers an area of 72 km^2 and is designated for subtidal mixed sediments (Table 4.5.4) and site management aims to recover these habitats to favourable condition. The site is dominated by these sediments ranging from pebbles to finer silts and finer mud sediments that are important as nursery and spawning grounds for many fish species, including Dover sole, lemon sole and sand eels (Ref 4.39)

5.4.7.14 Based on a distance of 9 km, this MCZ is considered to fall outside of the ZoI of all of Proposed Project related impact pathways identified in Table 4.5.3 for the protected features of the site. Therefore, Orford Inshore MCZ has been **screened out** and does not require a Stage 1 assessment (Table 4.5.4).

Dover to Deal MCZ

5.4.7.15 Dover to Deal MCZ covers an area of 10 km^2, and protects a number of habitats and species, including intertidal and subtidal habitat and native oyster (Table 4.5.4). The sites conservation objectives aim to maintain these features in a favourable condition. The site helps to protect intertidal underboulder communities, where large boulders provide conditions for algae to thrive, and mobile animals such as sea slugs and brittlestars. Crabs, fish, and young lobsters also scavenge for food and seek shelter amongst the boulders. These unique littoral chalk communities of seaweeds, and the animals that associate with them, are limited within Britain. The site also includes the best example in the region of wave-cut platforms, as well as Ross worm reefs on the lower shore (Ref 4.40).

5.4.7.16 Based on a distance of 12 km, this MCZ is considered to fall outside of the ZoI of all of Proposed Project related impact pathways identified in Table 4.5.3 for the protected features of the site. Therefore, Orford Inshore MCZ has been **screened out** and does not require a Stage 1 assessment (Table 4.5.4).

Foreland MCZ

5.4.7.17 Foreland MCZ contains a variety of different habitats ranging from subtidal sand to coarse sediments and rocky habitats and supports a wide diversity of species, as well as the English Channel outburst flood feature. The site covers an area of 244 km^2, with a large proportion of the site consisting of the designated subtidal sand feature (Table 4.5.4) that provide habitats to animals such as worms, bivalves, burrowing anemones, sand eels and fish (Ref 4.41). This feature has a conservation objective to maintain its favourable condition.

5.4.7.18 Other features that have the conservation objective to recover to favourable condition include coarser sediment, as well as rock habitats subject to moderate to high wave energy or tidal currents. These are dominated by animal communities as there is insufficient sunlight for seaweed growth. The types of animals that thrive here include sponges and cup corals, alongside anemones and sea squirts. Commercially valuable crustaceans, such as lobsters and crabs, shelter within rocky crevices and a range of fish species forage in this habitat.

5.4.7.19 Based on a distance of 25 km, this MCZ is considered to fall outside of the ZoI of all of Proposed Project related impact pathways identified in Table 4.5.3 for the protected features of the site. Therefore, Orford Inshore MCZ has been **screened out** and does not require a Stage 1 assessment (Table 4.5.4).

Medway Estuary MCZ

5.4.7.20 The MCZ encompasses the Medway Estuary and extends seaward between the Medway and the Thames estuary. The MCZ area is also protected by the Medway Estuary and Marshes Ramsar, SPA, and SSSI. This MCZ covers an area of 59.96 km^2.

5.4.7.21 Within the site there is a complex and dynamic estuarine ecosystem. The mix of fresh and marine waters combined with tidal movement create changing levels of salinity and nutrients that provide a fertile environment for large populations of animals, particularly invertebrates, fish, and birds. Numerous species of commercially important fish including bass, herring, cod, plaice, and sole use the area as a nursery ground.

5.4.7.22 Two species and eight different habitats and their associated wildlife are protected by the Medway Estuary MCZ (Table 4.5.4).

5.4.7.23 The nationally scarce tentacled lagoon-worm, *Alkmaria romijni*, is found within the Medway estuary. This species creates and lives in tubes within the mud habitats of the estuary. These worms have a number of tentacles around their mouths which they use for gathering food from the surrounding muddy sediments. The tentacled lagoon-worm is particularly vulnerable to threats that cause changes in its habitat.

5.4.7.24 In 2019 an additional feature, smelt, *Osmerus eperlanus*, was added to the designation of the MCZ with the conservation objective to recover to favourable condition. Smelt were once widespread in estuaries in the UK but have declined considerably over the past 200 years (Ref 4.42). They are known to congregate in large shoals in lower estuaries and to migrate into freshwater where they spawn in spring. Estuaries, such as the Medway, therefore, provide critical habitats for smelt lifecycles. Smelt are viewed as an indicator of ecosystem health, being very sensitive to a broad range of environmental degradations, including overfishing, loss of spawning habitat, blockage to migration and water quality impacts.

5.4.7.25 The Medway Estuary MCZ falls outside of the ZoIs associated with the impact pathways. However, smelt have the potential to migrate through the Study Area and be impacted by the Proposed Project activities, including from the following impact pathways:

- Temporary increase in SSC;
- Underwater noise; and
- Effect of EMF emissions.

5.4.7.26 The Medway Estuary MCZ has been **screened in for Stage 1 assessment** using the precautionary principle, to ensure that the impact pathways that may affect the 'smelt *O. eperlanus'* protected feature is considered further and assessed.

Table 4.5.4. Summary of Marine Conservation Zones (MCZ) screened into the Stage 1 of the MCZ Assessment of the Offshore Scheme

Site name	Protected features	Distance from Offshore Scheme (km)	Potential impact pathway	Screening decision
Goodwin Sands MCZ	Subtidal coarse sediment; Subtidal sand; Blue mussel *Mytilus edulis* beds; Moderate energy circalittoral rock; and Ross worm *Sabellaria spinulosa* reefs.	0	Temporary physical disturbance to subtidal benthic habitats and species; Permanent loss of subtidal benthic habitats and species; Temporary increase in suspended sediment concentrations (SSC); Underwater noise; Effects of electromagnetic field (EMF) emissions; and Thermal emissions.	Due to the potential for temporary physical disturbance and permanent loss of subtidal benthic habitats and species, temporary increase in SSC, underwater noise, and effects of EMF and thermal emissions to have an impact on the conservation objectives of the habitat features of Goodwin Sands MCZ, this site has been **screened in for Stage 1 assessment.**
Thanet Coast MCZ	Blue mussel *Mytilus edulis* beds; Moderate energy circalittoral rock; Moderate energy infralittoral rock; Peat and clay exposures; Ross worm *Sabellaria spinulosa* reefs;	< 1	Temporary increase in SSC.	Due to the potential for temporary increase in SSC to have an impact on the conservation objectives of the habitat and sessile species features of Thanet Coast MCZ, this site has been **screened in for Stage 1 assessment.**

Site name	Protected features	Distance from Offshore Scheme (km)	Potential impact pathway	Screening decision
	Stalked jellyfish *Calvadosia cruxmelitensis;* Stalked jellyfish *Haliclystus* spp.; Subtidal chalk; Subtidal coarse sediment; Subtidal mixed sediments; and Subtidal sand.			
Kentish Knock East MCZ	Subtidal sand; Subtidal coarse sediment; and Subtidal mixed sediment.	1	Temporary increase in SSC.	Due to the potential for temporary increase in SSC to have an impact on the conservation objectives of the habitat features of Kentish Knock East MCZ, this site has been **screened in for Stage 1 assessment.**
Orford Inshore MCZ	Subtidal mixed sediment.	9	No potential pathways identified.	This MCZ falls outside of the ZoIs associated with the impact pathways that have the potential to affect the protected features and therefore, Orford Inshore MCZ has been **screened out** and does not require a Stage 1 assessment.
Dover to Deal MCZ	High energy intertidal rock; Intertidal coarse sediment; Intertidal sand and muddy sand;	12	No potential pathways identified.	This MCZ falls outside of the ZoIs associated with the impact pathways that have the potential to affect the protected features and therefore, Dover to Deal MCZ has been

Site name	Protected features	Distance from Offshore Scheme (km)	Potential impact pathway	Screening decision
	Intertidal underboulder communities; Littoral chalk communities; Low energy intertidal rock; Moderate energy infralittoral rock; Moderate energy intertidal rock; Native Oyster *Ostrea edulis*; Subtidal chalk; Subtidal mixed sediments; Subtidal sand; Blue mussel beds; High energy circalittoral rock; Moderate energy circalittoral rock; and Ross worm *Sabellaria spinulosa* reefs.			**screened out** and does not require a Stage 1 assessment.
Foreland MCZ	English Channel outburst flood feature; Subtidal sand; High energy circalittoral rock; Moderate energy circalittoral rock; and Subtidal coarse sediment.	25	No potential pathways identified.	This MCZ falls outside of the ZoIs associated with the impact pathways that have the potential to affect the protected features and therefore, Foreland MCZ has been **screened out** and does not require a Stage 1 assessment.

Site name	Protected features	Distance from Offshore Scheme (km)	Potential impact pathway	Screening decision
Medway Estuary MCZ	Estuarine rock habitats; Intertidal mixed sediments; Intertidal sand and muddy sand; Low energy intertidal rock; Peat and clay exposures; Subtidal coarse sediment; Subtidal mud; Subtidal sand; Tentacled lagoon-worm *Alkmaria romijini*; and Smelt *Osmerus eperlanus.*	42	Temporary increase in SSC; Underwater noise; and Effects of EMF emissions	This MCZ falls outside of the ZoIs associated with the impact pathways. However, smelt have the potential to migrate through the Study Area and be impacted by the Proposed Project activities. Due to the potential for temporary increase in SSC, Underwater noise, and effects of EMF emissions to have an impact on the conservation objectives of the 'Smelt *O. eperlanus*' of Medway Estuary MCZ, this site has been **screened in for Stage 1 assessment.**

5.4.8 Stage 1 Assessment

5.4.8.1 For the sensitivity test outlined in section 5.4.5, preliminary effects reported would not be any different if the works were to commence in any year up to year five.

Goodwin Sands MCZ

5.4.8.2 The Offshore Scheme currently passes through Goodwin Sands MCZ. However, there is a planned survey for Autumn 2023 to explore potential routing outside of the MCZ. Further detail on these surveys are outlined in **Volume 1, Part 4, Chapter 1: Evolution of the Offshore Scheme.** This site is designated for the protection of the following features:

- Subtidal coarse sediment;
- Subtidal sand;
- Blue mussel *Mytilus edulis* beds;
- Moderate energy circalittoral rock; and
- Ross worm *Sabellaria spinulosa* reefs.

5.4.8.3 A dedicated benthic survey was commissioned to characterise benthic ecological conditions and benthic habitats within the Offshore Scheme (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). Where the Offshore Scheme passes through the Goodwin Sands MCZ, this survey report has been used in the following assessment to understand the benthic ecology present where the Offshore Scheme overlaps with the MCZ.

5.4.8.4 During the benthic survey, five grab samples were taken from within the MCZ. At three of these grab sample stations, the protected feature 'subtidal sand' was identified, however none of the other protected features were identified. Although, juvenile blue mussels were identified within four of the grab samples, but these were not seen in aggregations of continuous reef, and therefore no mussel beds were observed. Moreover, it was found that of the grab samples from within the MCZ, fauna was particularly sparse. For further information regarding the baseline for benthic ecology, see **Volume 1, Part 4, Chapter 3, Benthic Ecology**.

Temporary physical disturbance to subtidal benthic habitats and species

5.4.8.5 Proposed Project activities will result in short term physical disturbance to, and temporary loss of, seabed habitats. Sensitivity to the impact of habitat disturbance varies between habitats and species, depending on the stability of the habitat and its resilience to disturbance, and the vulnerability of individual species to mechanical disturbance.

5.4.8.6 Sediment habitats such as 'subtidal coarse sediment' and 'subtidal sand' are dynamic as they are frequently subjected to significant wave and tidal energy, are often low in biodiversity because of the natural disturbance regime, as was seen in the benthic survey (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). These habitats are therefore, considered to have high capacity to tolerate physical disturbance. It is expected that these habitat features would recover from penetration, abrasion, and disturbance, returning to baseline conditions within a short period of time

(expected to be <12 months) (Ref 4.43), therefore not hindering the conservation objectives for these features.

5.4.8.7 'Moderate energy circalittoral rock' habitat supports higher biodiversity, supporting stable communities which likely to be vulnerable to physical disturbance. However, due to the temporary and localised nature of installation activities and the small-scale installation footprint, temporary physical disturbance is not anticipated to hinder the conservation objective for this feature. Moreover, the Benthic survey did not evidence their presence at the location of the Offshore Scheme (**Volume 2**, **Appendix 4.3A**).

5.4.8.8 For many infaunal species, displacement will have only a temporary impact as fauna will be able to redistribute once the installation spread has moved away. Epifaunal species are generally unable to move away and so are vulnerable to physical disturbance. This may impact the formation of biogenic habitats such as 'blue mussel *M. edulis* beds' and 'ross worm *S. spinulosa* reefs'. The benthic survey did not evidence the presence of these features at the location of the Offshore Scheme (**Appendix 4.3A**). However, as these features were not identified in the Offshore Scheme the conservation objectives of these features are not anticipated to be hindered.

Permanent loss of subtidal benthic habitats and species

5.4.8.9 The total footprint of permanent habitat loss as a result of placement of cable protection, including rock berms and concrete mattresses is approximately 0.13 km^2. Of this, it is anticipated that an area of 0.01 km^2 of habitat will be permanently lost within Goodwin Sands MCZ.

5.4.8.10 Sediment habitats such as 'subtidal coarse sediment' and 'subtidal sand' are dynamic as they are frequently subjected to significant wave and tidal energy, are often low in biodiversity because of the natural disturbance regime, as was seen in the benthic survey (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). These habitats are therefore, considered to have high capacity to tolerate physical disturbance, and it is expected that any loss of this habitat would be highly localised and small in scale, therefore not hindering the conservation objectives for these features.

5.4.8.11 'Moderate energy circalittoral rock' habitat supports higher biodiversity, supporting stable communities which likely to be vulnerable to physical disturbance. However, the Benthic survey did not evidence their presence at the location of the Offshore Scheme (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). Moreover, where possible the rock protection will be of a similar material to the receiving environment though this may only be achievable in small areas. Therefore, due to the small-scale footprint of habitat loss, Proposed Project activities are not anticipated to hinder the conservation objective for this feature.

5.4.8.12 For mobile species, loss of habitat will have only a temporary impact as fauna will be able to move away and redistribute once the installation spread has moved away. However, there may be small losses of sessile species, which may impact the formation of biogenic habitats such as 'blue mussel *M. edulis* beds' and 'ross worm *S. spinulosa* reefs'. However, the benthic survey did not evidence the presence of these features at the location of the Offshore Scheme (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). Moreover, as any permanent losses are anticipated to be highly localised and small in scale, the conservation objectives of these features are not anticipated to be hindered.

5.4.8.13 Given the small spatial scale of permanent losses, this impact is not expected to compromise the functional integrity of general habitats and species or hinder the conservation objectives of the site.

Temporary increase in SSC

5.4.8.14 Seabed disturbance from pre-installation (cable route clearance and pre-sweeping, if required) and construction or maintenance activities (cable trenching) have the potential to increase SSC. The removal of the cable during decommissioning would also be expected to increase SSC. This can create a sediment plume in the water column that can travel away from the Offshore Scheme before the sediment is deposited on the seabed. Any mobilised sediment associated with the Proposed Project activities is anticipated to be short-term.

5.4.8.15 There are several potential effects to benthic receptors, associated with increased SSC and sediment deposition including:

- reduced photosynthesis due to increased turbidity, resulting in reduced primary production in marine seaweed and algae;
- smothering of invertebrate species and clogging of respiratory and feeding apparatus; and
- indirect effects of the release of contaminants, such as heavy metals and hydrocarbons, during sediment mobilisation, on benthic species.

5.4.8.16 Sediments with a high proportion of fine particulate material will remain in suspension longest and settle to the seabed more slowly. Dispersion processes will act to dilute the small proportion of fine sediment carried in suspension. These finer fractions that are transported further will also be rapidly diluted. (**Volume 1, Part 4, Chapter 2 Physical Environment**). The deposition thickness on the seabed, where the sediment will settle, will be negligible and highly localised.

5.4.8.17 Sediment habitats such as ‘subtidal coarse sediment’ and ‘subtidal sand’ are dynamic as they are frequently subjected to varying levels of turbidity and energy. Thus, their sensitivity to increased SSC is considered to be low. These habitats are also often low in biodiversity because of the natural disturbance regime, as was seen in the benthic survey (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). These habitats are therefore, considered to have high capacity to tolerate increased SSC, and it is expected that any impacts will be temporary and will not hinder the conservation objectives for these features.

5.4.8.18 ‘Moderate energy circalittoral rock’ habitat supports higher biodiversity, supporting stable communities, with some species vulnerable to increased SSC. However, the Benthic survey did not evidence their presence at the location of the Offshore Scheme (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). Moreover, any mobilised sediment as a result of Proposed Project activities will be highly localised and short-term. Thus, Proposed Project activities are not anticipated to hinder the conservation objective for this feature.

5.4.8.19 Increased SSC and sediment deposition can have significant impacts on marine organisms, with the potential to entirely smother benthic life. Sessile benthic organisms are particularly at risk as many are filter feeders, and increased sediment loads can clog their systems (Ref 4.44). However, the benthic survey did not evidence the presence of biogenic habitats such as ‘blue mussel *M. edulis* beds’ and ‘ross worm *S. spinulosa* reefs’ at the location of the Offshore Scheme (**Volume 2, Part 4, Appendix**

4.3A, Benthic Characterisation Report). Moreover, as any impacts are anticipated to be temporary and small in scale, the conservation objectives of these features are not anticipated to be hindered. These habitats can support diverse epifaunal communities, with some species vulnerable to increased SSC.

5.4.8.20 With an increase in SSC, sediment contaminants could also be mobilised at these locations if above threshold levels. Heavy metal concentrations were found to vary throughout the Offshore Scheme but at levels consistent with general background levels for this region of the North Sea (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). Therefore, it is not anticipated that the mobilisation of contaminants will hinder the conservation objectives of the site.

5.4.8.21 Overall, the predicted temporary increase to SSC levels and associated depositional loads in comparison to background levels is expected to be relatively minor. Therefore, the impact to the protected features of the Goodwin Sands MCZ is unlikely to affect the conservation objectives of the site.

Underwater noise

5.4.8.22 The activities associated with the construction, maintenance and decommissioning of the Offshore Scheme include:

- Sub-Bottom Profiler – operating frequency of 0.5-12 kHz;
- acoustic positioning – operating frequency of 21-31 kHz;
- cable installation – operating frequency of 1-15 kHz;
- cable lay vessel (operating with dynamic positioning) – operating frequency of 0.005-3.2 kHz;
- support vessels – operating at a variety of frequencies, as vessels are continuously moving, any impacts will be transient and short term; and
- clearance of UXO - the loudest source of underwater sound that could be generated by the Proposed Project, with a large impact radius. However, UXO detonation will be subject to a separate marine licence application and so is not considered further in this assessment.

5.4.8.23 Sensitivity to the impact of underwater sound on ‘subtidal coarse sediment’, ‘subtidal sand’ and ‘Moderate energy circalittoral rock’, depends on the sensitivity of the species associated with the habitats. Marine invertebrates are believed to be sensitive to particle motion rather than to sound pressure (Ref 4.10), although few formal studies have been conducted on the impacts of underwater sound. At present there are no published sensitivity thresholds for invertebrates and observed responses are generally in relation to higher intensity sound sources such as from seismic surveys.

5.4.8.24 The effects of underwater sound on invertebrates have been demonstrated within the literature. For example, a species of bivalve, *Ruditapes philippinarum*, demonstrated behavioural responses to impact pile driving sound source levels (Ref 4.12). Moreover, repeated exposure to sound levels has seen to result in a species tolerance and habituation to noise (Ref 4.13). Field based studies revealed no evidence of increased mortality in scallops, clams, or lobsters following airgun exposure (Ref 4.12). These studies found responses in invertebrates ranged widely depending on species, but there was little evidence of increased mortality or ecosystem impacts. Although there was evidence of behavioural responses in lab studies with specific species, there was also evidence that habituation is possible.

5.4.8.25 Although there is currently very limited evidence on the effects of underwater sound on marine invertebrates, current data suggest that the effect of the type and duration of underwater sound generated by the Proposed Project activities will not have an impact benthic ecology. Moreover, during the benthic survey, fauna was found to be sparse within Offshore Scheme within the Goodwin Sands MCZ (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**), with no evidence of the presence of biogenic habitats such as 'blue mussel *M. edulis* beds' and 'ross worm *S. spinulosa* reefs. Therefore, underwater sound is not expected to pose a likely significant risk to the conservation objectives of the protected features of Goodwin Sands MCZ.

Effects of EMF emissions

5.4.8.26 Operation of the HVDC cables generates EMF emissions which may be detected by invertebrate species and could impact behaviour and ability to navigate. The worst-case scenario for the Offshore Scheme (**Volume 2, Part 4, Appendix 4.8.B, Electromagnetic Deviation Study**), indicates field intensities between 53 and 126 µT at the seabed surface, and that the geometric field was reduced to background levels within around 8 m from the cable, having only a very localised effect.

5.4.8.27 The impact of EMF emissions depends on the sensitivity of the species associated with benthic habitats.

5.4.8.28 The Offshore Scheme passes through the Goodwin Sands MCZ. The only feature of this designated site identified within the Offshore Scheme was 'subtidal sands' and was associated with sparse fauna (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**).

5.4.8.29 There is very little information about the sensitivity of benthic species to EMF but there have been a small number of investigations in laboratory experiments. There is evidence from studies that some benthic invertebrates are able to detect EMF. For example, the brown crab, *Cancer pagurus*, showed a clear attraction to EMF of 2,800 µT, although physiological and behavioural impacts were limited (Ref 4.45). In another study, the blue mussel, *Mytilus edulis*, was exposed to 3,700 µT for three months, and differences in survival between experimental and control animals were detected (Ref 4.46). However, the EMF emitted by the Offshore Scheme is significantly lower than the field strength used in these studies.

5.4.8.30 Therefore, it is concluded that detection by invertebrates may be possible, but that at the levels of EMF produced by the cable responses are negligible. Considering the localised nature of the impact, it is not anticipated that EMF emissions will pose a likely significant risk to the conservation objectives of the protected features of Goodwin Sands MCZ.

Thermal emissions

5.4.8.31 Marine HVDC power cables have been shown to generate and dissipate heat when active, reaching cable surface temperatures of up to 70°C. Such heat has the potential to cause sediment dwelling and demersal mobile organisms to move away from the affected area. Increased heat may also alter physio-chemical conditions for epifaunal species and bacterial activity (with shifts in bacterial community composition and changes in nitrogen cycling) in surrounding sediments, contributing to altered faunal composition and localised ecological shifts (Ref 4.21; Ref 4.22).

5.4.8.32 Sensitivity to the thermal emissions depends on the sensitivity of the species associated with benthic habitats, as well as the sediment particle size composition (Ref

4.9), with coarser sediments with higher permeability transferring heat further but with a lower increase in temperature. Whilst the sediment surrounding the cable may be heated, there is negligible capability to heat the overlying water column because of the very high heat capacity of water, meaning there would be no effects on epibenthic communities.

5.4.8.33 The Offshore Scheme passes through the Goodwin Sands MCZ. The only feature of this designated site identified within the Offshore Scheme was 'subtidal sands' and was associated with sparse fauna (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**).

5.4.8.34 Heat dissipation modelling undertaken for a similar cable installation project (Ref 4.23), indicated that within 50 cm of the seabed surface the increase in sediment temperature was limited to approximately 3°C. Due to natural seasonal changes in water temperature, a temperature change of a few degrees higher than ambient is regarded as an insignificant temperature increase. Moreover, seawater at the seabed surface will have a cooling effect and will dissipate any temperature increases further. Although thermal effects would be long-term and occurring continuously for the operational lifetime of the Offshore Scheme, the temperature increase is low level and likely to be only a few degrees higher than ambient at the shallow sediment depths (<20 cm). Coupled with the fact that any impacts would be highly localised, and that there are natural seasonal changes in water temperature, it is not anticipated that thermal emissions will pose a likely significant risk to the conservation objectives of the protected features of Goodwin Sands MCZ.

Assessment conclusion

5.4.8.35 The potential impact pathways associated with the Proposed Project activities are not anticipated to hinder the conservation objectives of this MCZ. Therefore, it is concluded that **Goodwin Sands MCZ does not require a Stage 2 assessment** and will not be assessed further.

Thanet Coast MCZ

5.4.8.36 Thanet Coast MCZ is designated for the protection of the following features:

- Blue mussel *Mytilus edulis* beds;
- Moderate energy circalittoral rock;
- Peat and clay exposures;
- Ross worm *Sabellaria spinulosa* reefs;
- Stalked jellyfish *Calvadosia cruxmelitensis*;
- *Haliclystus* spp.;
- Subtidal chalk;
- Subtidal coarse sediment;
- Subtidal mixed sediments; and
- Subtidal sand.

Temporary increase in SSC

5.4.8.37 Seabed disturbance from pre-installation (cable route clearance and pre-sweeping, if required) and construction or maintenance activities (cable trenching) have the potential to increase SSC. The removal of the cable during decommissioning would also be expected to increase SSC. This can create a sediment plume in the water column that can travel away from the Offshore Scheme before the sediment is deposited on the seabed. Any increase in SSC and mobilisation of sediment associated with the Proposed Project activities is anticipated to be short-term.

5.4.8.38 There are several potential effects to benthic receptors, associated with increased SSC and sediment deposition including:

- reduced photosynthesis due to increased turbidity, resulting in reduced primary production in marine seaweed and algae;
- smothering of invertebrate species and clogging of respiratory and feeding apparatus; and
- indirect effects of the release of contaminants, such as heavy metals and hydrocarbons, during sediment mobilisation, on benthic species.

5.4.8.39 Sediments with a high proportion of fine particulate material will remain in suspension longest and settle to the seabed more slowly. Dispersion processes will act to dilute the small proportion of fine sediment carried in suspension. These finer fractions that are transported further will also be rapidly diluted (**Volume 1, Part 4, Chapter 2 Physical Environment**). The deposition thickness on the seabed, where the sediment will settle, will be negligible and highly localised.

5.4.8.40 Sediment habitats such as ‘subtidal sand’ are often dynamic as they are frequently subjected to varying levels of energy and hence turbidity. Thus, their sensitivity to increased SSC is considered to be low. These habitats are also often low in biodiversity because of the natural disturbance regime. These habitats are therefore, considered to have high capacity to tolerate increased SSC, and it is expected that any impacts will be temporary and will not hinder the conservation objectives for these features. Coarse and mixed sediments can support epifaunal organisms and so have some species that may be vulnerable to increased SSC. However, any mobilised sediment as a result of Proposed Project activities will be highly localised and short-term. Thus, Proposed Project activities are not anticipated to hinder the conservation objective for this feature.

5.4.8.41 ‘Moderate energy circalittoral rock’, ‘subtidal chalk’, and ‘peat clay exposures’ are habitats that support higher biodiversity, supporting stable communities, with some species vulnerable to increased SSC. However, any mobilised sediment as a result of Proposed Project activities will be highly localised and short-term. Thus, Proposed Project activities are not anticipated to hinder the conservation objective for this feature.

5.4.8.42 Increased SSC and sediment deposition can have significant impacts on marine organisms, with the potential to entirely smother benthic life. Sessile benthic organisms are particularly at risk as many are filter feeders, and increased sediment loads can clog their systems (Ref 4.44), this includes species that form the biogenic reef features ‘blue mussel M. edulis beds’ and ‘ross worm *S. spinulosa* reefs’, as well as the species features of stalked jellyfish (*Calvadosia cruxmelitensis*; *Haliclystus* spp.) that associate with algae and seagrass. Moreover, as any impacts are anticipated to be temporary and small in scale, the conservation objectives of these features are not anticipated to

be hindered. These habitats can support diverse epifaunal communities, with some species vulnerable to increased SSC.

5.4.8.43 With an increase in SSC, sediment contaminants could also be mobilised at these locations if above threshold levels. Heavy metal concentrations were found to vary throughout the Offshore Scheme, but at levels consistent with general background levels for this region of the North Sea. Therefore, it is not anticipated that the mobilisation of contaminants will hinder the conservation objectives of the site.

5.4.8.44 Overall, the predicted temporary increase to SSC levels and associated depositional loads in comparison to background levels is expected to be relatively minor. Therefore, the impact to the protected features of the Thanet Coast MCZ is unlikely to affect the conservation objectives of the site.

Assessment conclusion

5.4.8.45 The potential impact pathways associated with the Proposed Project activities are not anticipated to hinder the conservation objectives of this MCZ. Therefore, it is concluded that **Thanet Coast MCZ does not require a Stage 2 assessment** and will not be assessed further.

Kentish Knock East MCZ

5.4.8.46 Kentish Knock East MCZ is designated for the protection of the following features:

- Subtidal sand;
- Subtidal coarse sediment; and
- Subtidal mixed sediment.

Temporary increase in SSC

5.4.8.47 Seabed disturbance from pre-installation (cable route clearance and pre-sweeping, if required) and construction or maintenance activities (cable trenching) have the potential to increase SSC. The removal of the cable during decommissioning would also be expected to increase SSC. This can create a sediment plume in the water column that can travel away from the Offshore Scheme before the sediment is deposited on the seabed. Any mobilised sediment associated with the Proposed Project activities is anticipated to be short-term.

5.4.8.48 There are several potential effects to benthic receptors, associated with increased SSC and sediment deposition including:

- reduced photosynthesis due to increased turbidity, resulting in reduced primary production in marine seaweed and algae;
- smothering of invertebrate species and clogging of respiratory and feeding apparatus; and
- indirect effects of the release of contaminants, such as heavy metals and hydrocarbons, during sediment mobilisation, on benthic species.

5.4.8.49 Sediments with a high proportion of fine particulate material will remain in suspension longest and settle to the seabed more slowly. Dispersion processes will act to dilute the small proportion of fine sediment carried in suspension. These finer fractions that are transported further will also be rapidly diluted (**Volume 1, Part 4, Chapter 2**

Physical Environment). The deposition thickness on the seabed, where the sediment will settle, will be negligible and highly localised.

5.4.8.50 Sediment habitats such as 'subtidal sand' are often dynamic and frequently subjected to varying levels of energy. Thus, their sensitivity to increased SSC is considered to be low. These habitats are also often low in biodiversity because of the natural disturbance regime. These habitats are therefore, considered to have high capacity to tolerate increased SSC, and it is expected that any impacts will be temporary and will not hinder the conservation objectives for these features.

5.4.8.51 Coarse and mixed sediments can support epifaunal organisms and so have some species that may be vulnerable to increased SSC. However, any mobilised sediment as a result of Proposed Project activities will be highly localised and short-term. Thus, Proposed Project activities are not anticipated to hinder the conservation objective for this feature.

5.4.8.52 With an increase in SSC, sediment contaminants could also be mobilised at these locations if above threshold levels. Heavy metal concentrations were found to vary throughout the Offshore Scheme but at levels consistent with general background levels for this region of the North Sea. Therefore, it is not anticipated that the mobilisation of contaminants will hinder the conservation objectives of the site.

5.4.8.53 Overall, the predicted temporary increase to SSC levels and associated depositional loads in comparison to background levels is expected to be relatively minor. Therefore, the impact to the protected features of the Thanet Coast MCZ is unlikely to affect the conservation objectives of the site.

Assessment conclusion

5.4.8.54 The potential impact pathways associated with the Proposed Project activities are not anticipated to hinder the conservation objectives of this MCZ. Therefore, it is concluded that **Kentish Knock East MCZ does not require a Stage 2 assessment** and will not be assessed further.

Medway Estuary MCZ

5.4.8.55 Medway Estuary MCZ is designated for the protection of the following features:

- Estuarine rock habitats;
- Intertidal mixed sediments;
- Intertidal sand and muddy sand;
- Low energy intertidal rock;
- Peat and clay exposures;
- Subtidal coarse sediment;
- Subtidal mud;
- Subtidal sand;
- Tentacled lagoon-worm *Alkmaria romijini*; and
- Smelt *Osmerus eperlanus*.

5.4.8.56 The Medway Estuary MCZ was screened into the Stage 1 assessment based on the application of the precautionary principle. This MCZ is beyond the ZoI of potential impact pathways (Table 4.5.3), however smelt have the potential to migrate through the Study Area identified during the Screening Stage (section 215.4.7). Therefore, the protected feature 'Smelt *O. eperlanus'* has been screened into the stage 1 assessment to be considered further.

5.4.8.57 The European smelt is an anadromous species that are occasionally recorded in inshore waters but are most commonly found in lower river reaches and upper estuarine habitats (Ref 4.47). Smelt migrate to and congregate in large shoals in lower reaches of estuaries to feed before moving to freshwaters to spawn in spring; post-larval juveniles then utilise estuarine nursery habitats.

5.4.8.58 Once widespread in UK estuaries smelt have experienced significant population declines. The Medway Estuary MCZ was designated in 2019 for smelt as it is considered to provide critical habitat for this species. It is believed that adult smelt aggregate in the lower Thames estuary, in February and March, before commencing their upstream migration to spawn in March and April (Ref 4.48).

5.4.8.59 For further information regarding the ecological baseline for smelt, see **Volume 1, Part 4, Chapter 4, Fish and Shellfish Ecology.**

Temporary increase in SSC

5.4.8.60 Seabed disturbance from the construction, maintenance, and decommissioning activities have the potential to increase SSC. The removal of the cable during decommissioning would also be expected to increase SSC. This can create a sediment plume in the water column that can travel away from the Offshore Scheme before the sediment is deposited on the seabed. Any mobilised sediment associated with the Proposed Project activities is anticipated to be short-term.

5.4.8.61 There are several potential effects to migratory fish, such as smelt, associated with increased SSC and sediment deposition including:

- the clogging of respiratory apparatus;
- reduced feeding success of visual predators due to decreased visibility;
- effects related to toxic conditions if sediments in suspension are contaminated; and
- potential barrier to the movement and migration of fish from increased SSC.

5.4.8.62 Sediments with a high proportion of fine particulate material will remain in suspension longest and settle to the seabed more slowly. Dispersion processes will act to dilute the small proportion of fine sediment carried in suspension. These finer fractions that are transported further will also be rapidly diluted (**Volume 1, Part 4, Chapter 2 Physical Environment**). The deposition thickness on the seabed, where the sediment will settle, will be negligible and highly localised.

5.4.8.63 Smelt have been shown to spend the majority of their time in the upper reaches of the water column, so are unlikely to encounter mobilised sediment close to the bottom of the water column (roughly <5 m). Therefore, it is unlikely that increased SSC would act as a barrier to migration between marine and freshwater environments. Furthermore, the Medway Estuary is 42 km west of the Offshore Scheme, and as mobile receptors, it is assumed that smelt would be able to avoid or move away from less favourable conditions. Therefore, it is assumed that the SSC concentrations are not likely to pose a significant risk to the 'smelt *O. eperlanus'* protected feature.

5.4.8.64 Moreover, with an increase in SSC, sediment contaminants could also be mobilised at these locations if above threshold levels. Heavy metal concentrations were found to vary throughout the but at levels consistent with general background levels for this region of the North Sea (**Volume 2, Part 4, Appendix 4.3A, Benthic Characterisation Report**). Therefore, an impact to the conservation objectives of the 'smelt *O. eperlanus'* protected feature of Medway Estuary MCZ is not anticipated.

Underwater noise

5.4.8.65 The activities associated with the construction, maintenance and decommissioning of the Offshore Scheme include:

- preinstallation geophysical surveys:
  - MBES – operating frequency of 170-450 kHz;
  - SSS – operating frequency of 300-600 kHz; and
  - SBP – operating frequency of 0.5-12 kHz;
- acoustic positioning – operating frequency of 21-31 kHz;
- cable installation – operating frequency of 1-15 kHz;
- cable lay vessel (operating with dynamic positioning) – operating frequency of 0.005-3.2 kHz; and
- support vessels – operating at a variety of frequencies, as vessels are continuously moving, any impacts will be transient and short term.

5.4.8.66 A species sensitivity to sound varies according to the sound frequency. For most fish, sound above 1 kHz is not audible. This suggests that of the activities associated with the Proposed Project, only SBP and the use of vessels are thought to generate noise that may impact fish species.

5.4.8.67 Fish have been grouped into three categories by Popper *et al.,* (Ref 4.49), based on their physiology: low sensitivity; medium sensitivity; and high sensitivity to underwater sound. Smelt are considered to have a medium sensitivity as they have a swim bladder that is not involved with hearing. Smelt are susceptible to barotrauma although hearing only involves particle motion, not sound pressure.

5.4.8.68 The noise generated by SBP activities is expected to be temporary, only associated with construction works. Similarly, as vessels associated with activities are expected to be continuously moving, the underwater noise generated will be transient and hence short term and highly localised to the vessel itself.

5.4.8.69 Moreover, smelt are understood to be highly mobile within the wider Thames estuary, and thus are expected to have moved away from any sources of underwater noise before entering the potential injury zone (which will only be in the immediate vicinity of vessels or construction equipment), returning to normal activities once the sound source has stopped/moved away. Therefore, underwater noise is not anticipated to impact the 'smelt *O. eperlanus'* protected feature of Medway Estuary MCZ is unlikely to hinder the conservation objectives of the site.

Effects of EMF emissions

5.4.8.70 EMF emissions from the cables have the potential to disturb foraging behaviour and inhibit migratory success through displacement of migratory fish, including smelt. This

has been demonstrated in studies with other migratory species, the effects of exposure to artificially created EMF have been seen to include a reduction in swimming speed in European eel (Ref 4.50), and attraction to magnetic fields in free swimming trout larvae (Ref 4.51).

5.4.8.71 EMF emissions will be generated during the operation of the HVDC cables associated with the Offshore Scheme The worst-case scenario for the Offshore Scheme (**Volume 2, Part 4, Appendix 4.8.B, Electromagnetic Deviation Study**), indicates field intensities between 53 and 126 µT at the seabed surface, and that the geometric field was reduced to background levels within around 8 m from the cable, having only a very localised effect. The bundled cable will also meet the MMO criteria of having less than 3° compass deviation over 95% of the route.

5.4.8.72 Furthermore, as part of the design controls and management measures for the Proposed Project, the cable burial depth will be a minimum of 1.5 m. This will minimise the effects of EMF for fish receptors, in accordance with the Department of Energy and Climate Change report (Ref 4.52) and MMO recommendations.

5.4.8.73 Due to the localised effect of the EMF emissions, and the design controls in place to reduce any impacts, it is not anticipated that there will be any impact to smelt in the vicinity of the Offshore Scheme. Therefore, the impact of EMF emissions to the 'smelt *O. eperlanus'* protected feature of Medway Estuary MCZ is unlikely to affect the conservation objectives of the site.

Assessment conclusion

5.4.8.74 The potential impact pathways associated with the Proposed Project activities are not anticipated to hinder the conservation objectives of this MCZ. Therefore, it is concluded that **Medway Estuary MCZ does not require a Stage 2 assessment** and will not be assessed further.

5.4.9 In-combination Effects

5.4.9.1 The MCAA (Ref 4.1) does not provide any explicit legislative requirement for consideration of cumulative effects on the protected features of MCZs. However, the MMO guidelines (Ref 4.2) state that the MMO considers that in order for the MMO to fully discharge its duties under Section 69 of the MCAA, cumulative effects must be considered.

5.4.9.2 This section discusses the other relevant plans and projects that could occur simultaneously and sequentially (depending on timelines) with the Proposed Project Offshore Scheme. Note that this is a preliminary assessment. A full assessment will accompany the ES. All the potential in-combination effects discussed below would be construction or decommissioning period impacts on the MCZs mentioned below. Once the schemes are operational the only potential for in combination effects would be if they required maintenance simultaneously.

NeuConnect Interconnector

5.4.9.3 A proposed 1.4 GW capacity offshore multipurpose HVDC interconnector project from Wilhemshaven, Germany to the Isle of Grain, Kent developed by Meridam, Allianz Capital and Kansai Electric Power. This project aims to be the first energy connection between the UK and Germany in order to transfer energy between the two countries and increase grid capacity for increased electricity demand and supply from offshore

wind assets. The offshore aspects of this development are the HVDC subsea cable and cable landfall location.

5.4.9.4 An Environmental Statement was written in 2019, and an Environmental Appraisal Report in 2020. Due to the location of the offshore aspects of the project, the HVDC subsea cable, there is potential for 'in combination' effects on the features of Medway Estuary MCZ.

5.4.9.5 The NeuConnect Interconnector is anticipated to pass through the Medway Estuary MCZ. However, The Medway Estuary MCZ is over 42 km from the current Offshore Scheme, significantly beyond any ZoI for project activities and therefore, it has been concluded that there will be no 'in-combination' effect on the benthic features.

5.4.9.6 The Medway Estuary MCZ was assessed in Stage 1 (section 5.4.8) for any impacts on the smelt feature. It was concluded that there is no likely significant risk posed by the Offshore Scheme. Moreover, installation activities for either project would only be at any particular location for short periods of time, thus would not pose a significant 'in-combination' effect with the NeuConnect Interconnector.

GridLink Interconnector

5.4.9.7 A proposed 1.4 GW capacity offshore project from Dunkerque, France to Kingsnorth, Kent developed by iCON Infrastructure LLP, aims to transfer energy between UK and France. Additionally, it aims to improve grid capacity for increases in offshore wind electricity generation. The offshore, coastal, and intertidal components of the project will consist of HVDC subsea cable and landfall location.

5.4.9.8 A Marine Environmental Report was completed in 2021. Due to the location of the offshore aspects of the project, HVDC subsea cable and landfall location, there was reported to be potential for 'in combination' effects on features of Goodwin Sands MCZ and Thanet Coast MCZ as GridLink passes directly through each of these sites.

5.4.9.9 Construction of GridLink Interconnector is anticipated to start in late 2023 and to be operational in 2026. Thus, it is unlikely that there will be a temporal overlap in construction activities of the Offshore Scheme and GridLink. There could, however, be sequential effects that could act in combination.

5.4.9.10 Goodwin Sands MCZ and Thanet Coast MCZ are designated for benthic habitats. The impact pathway with the potential to affect these features is SSC resulting from seabed activities. However, the GridLink route is over 3 km away from both MCZ areas and so any cumulative effect of SSC and resulting deposition is unlikely and in-combination effects can be ruled out.

North Falls Offshore Windfarm

5.4.9.11 The main North Falls Offshore Wind Array, developed by SSE and RWE, will be located off the Essex and Suffolk coastline. The wider array will be split over two separate arrays cumulatively consisting of 71 wind turbine generators across a 150 km^2 area. The maximum wind turbine height will be 397 m above Mean High Water Spring (MHWS) and will be supported by either monopile, pin pile, suction caisson, or Gravity Base Structure foundations.

5.4.9.12 A Preliminary Environmental Impact Report was produced in 2023, including an MCZ Assessment (Ref. 4.53). This Assessment concluded that there is potential for 'in combination' effects with other projects on features of Kentish Knock East MCZ. The Offshore Scheme is 1 km from the boundary of Kentish Knock East MCZ, within the

preliminary potential ZoI for underwater sound and SSC. There are no receptors designated for this MCZ that are sensitive to underwater sound and so this pathway can be screened out. For SSC, the MCZ is just over 6.5 km from the North Falls project area and so any interaction in relation to SSC is highly unlikely. Thus, in-combination effects from the Offshore Scheme and North Falls are highly unlikely to occur.

East Anglia ONE North Offshore Windfarm

5.4.9.13 A proposed 208 km^2 wind farm developed by Scottish Power Renewables consisting of 67 turbines with a combined electricity generation capacity of 800 MW. This project is an extension of the existing East Anglia ONE array and is part of the East Anglia Hub which includes three arrays off the coast of Suffolk.

5.4.9.14 This project was consented in 2022. Construction is due to commence in 2023 and finish in 2026 it is likely that construction will be completed before construction of the Offshore Scheme. Therefore, it is not anticipated that there will be any 'in-combination' effects on any MCZs.

East Anglia TWO Offshore Windfarm

5.4.9.15 A proposed 255 km^2 wind farm developed by Scottish Power Renewables consisting of 75 turbines. Each turbine will have an electricity generation capacity of 19 MW and 22 m high.

5.4.9.16 This project has been consented but is not yet operational. Construction on the project is planned for 2025 with completion in 2030. The export cable corridor is approximately 350 m from the northern extent of the Offshore Scheme, in shallow waters close to the landfall. Thus, there is potential for some overlap in the ZoI for increased SSC. However, the closest MCZ, the Orford Inshore MCZ, is almost 12 km away from this region of potential overlap, significantly beyond any potential effect zone. Thus, it is not anticipated that there will be any 'in-combination' effects on any MCZs.

East Anglia THREE Offshore Windfarm

5.4.9.17 A proposed 370 km^2 wind farm developed by Scottish Power Renewables (SPR) and Vattenfall consisting of 120 to 240 wind turbines with a combined electricity generation capacity of 1200 MW. It is part of the East Anglia Hub which includes three arrays off the coast of Suffolk, with the East Anglia THREE array being 79 km from Lowestoft, Suffolk. All wind turbines are located in a water depth of 35 m to 45 m.

5.4.9.18 Consent for the project was received in August 2017 and construction commenced in July 2022. The project is scheduled to be completed by 2026 and no temporal interaction with the Offshore Scheme is anticipated. However, should East Anglia THREE be delayed the Offshore Scheme is almost 9 km away from the nearest MCZ, the Orford Inshore MCZ, significantly beyond any project ZoI. Thus, any in-combination effects are considered highly unlikely.

Nautilus Offshore Interconnector

5.4.9.19 A 1.4 GW capacity connection between Belgium with the Suffolk Coast being developed by National Grid Ventures. The aim will be to increase transfer in offshore wind electricity generation and improve grid capacity in both countries to achieve this. The offshore aspect of the development includes Subsea HVDC connecting the Belgian landfall with the UK landfall in Suffolk and Offshore HVDC converter platform.

5.4.9.20 The project website for this Interconnector notes that NGV holds a connection agreement on the Isle of Grain in Kent, as part of its development portfolio, and they are currently investigating if this could be a potential location for landfall.

5.4.9.21 There is no detailed ecological impact assessment in the public domain at time of writing, but the Planning Inspectorate website notes than an application is expected in 2024.

Five Estuaries Offshore Windfarm

5.4.9.22 A proposed 149 km^2 wind farm, 37 km off the Suffolk Coast is being developed. The array consists of 79 turbines with a combined electricity generation capacity of 50 GW. Each turbine will be between 397m high.

5.4.9.23 An EIA Scoping Report was produced in 2021. Due to the location of the offshore aspects of the project, HVDC subsea cable and landfall location, the project reported there is potential for 'in combination' effects on features of Kentish Knock East MCZ. The Offshore Scheme is approximately 1 km from this MCZ. However, the red line boundary for the Five Estuaries project is at least 6.5 km from the MCZ and thus any in-combination effects on the MCZ are considered to be unlikely.

5.4.10 Summary and Conclusions

5.4.10.1 This report has been produced to provide the necessary information to allow the Planning Inspectorate to meet their specific duty for MCZs as outlined in section 126 of the MCAA (Ref 4.1). The first stage of the assessment process was screening to identify if the MCZs should be taken through the full assessment in the stage 1 assessment process.

5.4.10.2 The screening concluded that there was a likely significant risk of the Offshore Scheme affecting the designated features and/or conservation objectives of one or more MCZs. During this process, Orford Inshore MCZ, Dover to Deal MCZ, and Foreland MCZ were screened out for the subsequent assessment.

5.4.10.3 Stage 1 assessments were completed for Goodwin Sands MCZ, Thanet Coast MCZ, Kentish Knock East MCZ, and Medway Estuary MCZ due to their sites falling within the ZoIs of the following impact pathways:

- Temporary physical disturbance to subtidal benthic habitats and species (Goodwin Sands MCZ only);
- Permanent loss of subtidal benthic habitats and species (Goodwin Sands MCZ and only);
- Temporary increase in SSC (Goodwin Sands MCZ, Thanet Coast MCZ, Kentish Knock East MCZ, and Medway Estuary MCZ);
- Underwater noise (Goodwin Sands MCZ and Medway Estuary MCZ only);
- Effects of EMF emissions (Goodwin Sands MCZ and Medway Estuary MCZ only); and
- Thermal emissions (Goodwin Sands MCZ only).

5.4.10.4 The Stage 1 assessment found that these impact pathways are not considered to have significant effects on the designated features or conservation objectives of these MCZs.

5.4.10.5 An assessment of in-combination effects from the Offshore Scheme and currently known other projects on MCZs concluded there were no interactions that could result in in-combination effects on any designating feature of any MCZ.

5.4.10.6 It has been concluded that the conditions of Section 126 of the MCAA (Ref 4.1) as determined under Stage 1 of the MCZ assessment process, can be met and that there is **no likely significant risk to any of the identified designated features or conservation objectives of the sites as a result of Proposed Project related activities.**

5.4.11 References

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