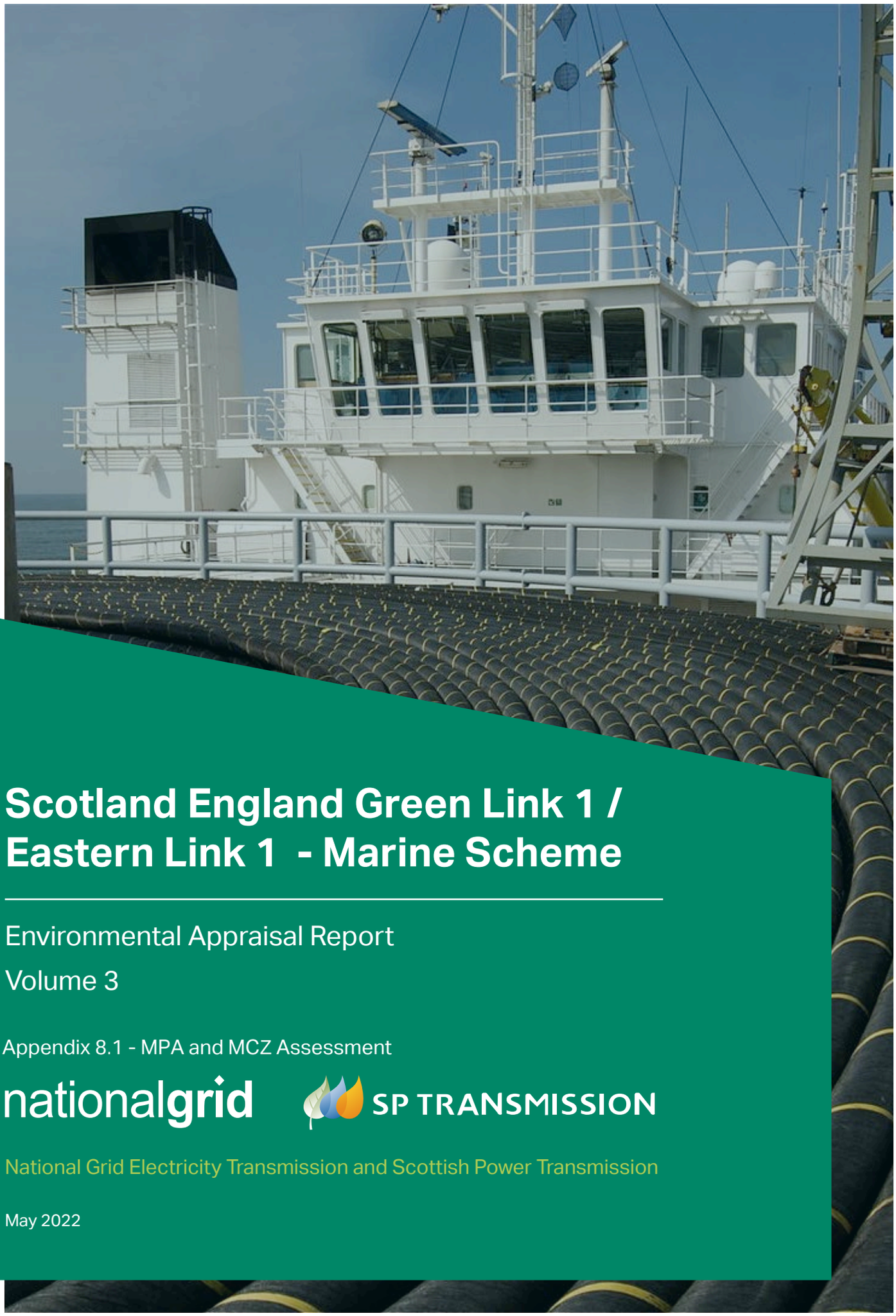

Scotland England Green Link 1 / Eastern Link 1 - Marine Scheme

Environmental Appraisal Report

Volume 3

Appendix 8.1 - MPA and MCZ Assessment

nationalgrid SP TRANSMISSION

National Grid Electricity Transmission and Scottish Power Transmission

May 2022

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Table of Contents

1. Introduction 1
1.1 Overview 1
1.2 Report Scope 1
1.3 Project Description 3
1.4 Legislative Framework 4
2. Assessment Methodology 5
3. Potential Impacts, Effects and Zones of Influence 7
3.1 Temporary Physical Disturbance to Benthic Habitats and Species 8
3.2 Visual or air-borne sound disturbance to avifauna on the sea surface, as a result of the presence of cable installation vessels 8
3.3 Disturbance to seabed and/or water quality due to increased SSC resulting in changes in avifauna prey availability 8
3.4 Permanent Loss - Subtidal Benthic Habitats and Species 8
3.5 SSC - Subtidal Habitats and Species 9
3.6 Water Quality - Intertidal and Subtidal Benthic Habitats and Species 9
3.7 EMF – Benthic Habitats and Species 9
3.8 Thermal Emissions – Benthic Habitats and Species 9
4. Screening 10
4.1 MPA (Scotland) Screening Assessment 10
4.2 MCZ (England) Screening Assessment 11
5. Stage 1 Assessment 14
5.1 MPA (Scotland) Impact Assessment 14
5.2 MCZ (England) Impact Assessment 14
6. Summary and Conclusions 21
7. References 23

Figures

Figure 1-1: The Marine Scheme Cable Route and MPA and MCZs in the Study Area 2
Figure 2-1: Summary of the MCZ assessment process used by the MMO in Marine Licence decision making (MMO, 2013) 6
Figure 4-1: MPA / MCZ screening process 10

Tables

Table 3-1: Summary of impact pathways and associated ZoIs that could affect benthic habitats and species and seabirds from the EAR 7
Table 4-1: Screening for MCZs 13
Table 5-1: Summary of rock placement and associated habitat in Farnes East MCZ 16

1. Introduction

1.1 Overview

National Grid Electricity Transmission (NGET) and Scottish Power Transmission (SPT) are jointly developing proposals for a subsea High Voltage Direct Current (HVDC) Link between Torness in East Lothian and Hawthorn Pit in County Durham, referred to as Scotland England Green Link 1 (SEGL1) / Eastern Link 1 (EL1) (hereafter referred to as 'the Project') (EAR Volume 2 Chapter 2: Project Description).

As part of the Project, NGET and SPT will be submitting Marine Licence applications to the Marine Scotland Licensing Operations Team (MS-LOT) and the Marine Management Organisation (MMO) for the marine elements of the Project referred to as the 'Marine Scheme'.

1.2 Report Scope

Specific consideration of the potential for impacts on Scottish Marine Protected Areas (MPAs) and English Marine Conservation Zones (MCZs) is required for any Marine Licence application in Scottish and English waters respectively. The need for the consideration of MPAs is set out in Section 83 of the Marine (Scotland) Act 2010, and the need for consideration of MCZs is set out in Section 126 of the Marine and Coastal Access Act 2009 (hereafter referred to as "MCAA 2009").

The purpose of this report is to inform the MPA / MCZ assessment process in determining whether the Marine Scheme is capable of significantly affecting:

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

This MPA / MCZ assessment provides a description of the Marine Scheme (Section 1.3), identifies the potential impact pathways that could arise from the planned activities (Section 3) and identifies the MPA / MCZ sites that could be affected (Section 4). The route followed by the Marine Scheme, in the context of relevant MPA and MCZ locations is provided in Figure 1-1.

The assessment process for MCZs considered during the licensing process is outlined by the MMO in the guidance document 'Marine conservation zones and marine licensing' (MMO, 2013). No formal guidance on the MPA assessment process has been issued by Marine Scotland. This assessment follows the steps and procedures set out in the MMO (2013) guidance document for MCZs and is intended to support consideration of potential impacts on MPAs and MCZs by MS-LOT and the MMO respectively. A summary of the assessment process is provided in Figure 2-1.

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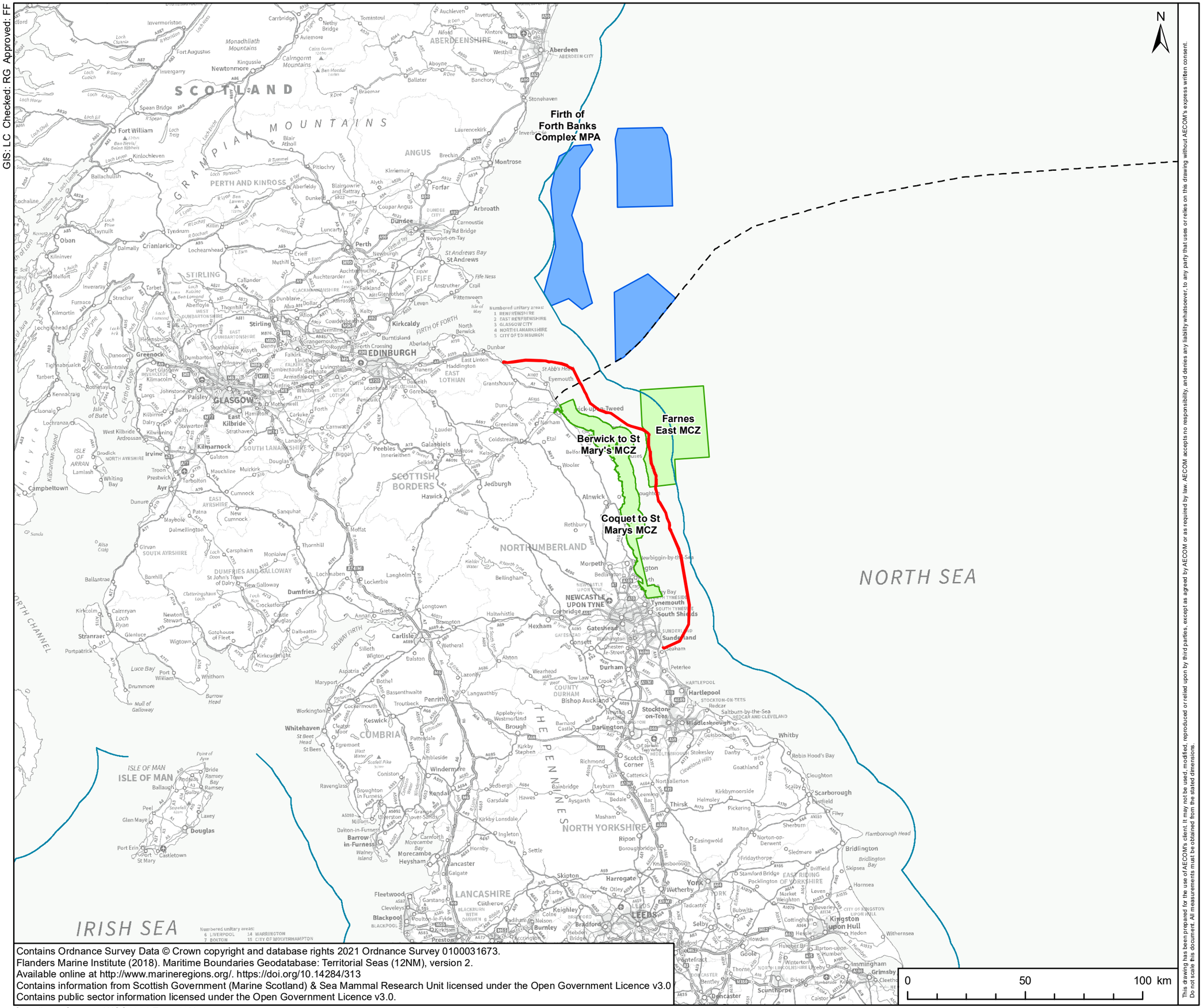

Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:1,500,000

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SP TRANSMISSION

PROJECT

Scotland England Green Link 1 / Eastern Link 1

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border
- Nature Conservation Marine Protected Area (MPA)
- Marine Conservation Zone (MCZ)

TITLE

Figure 1-1
Marine Protected Areas and Marine Conservation Zones within the SEGL1 Study Area

REFERENCE

SEGL1_M_EAR_10-1_v2_20220316

SHEET NUMBER: 1 of 1

DATE: 16/03/2022

1.3 Project Description

The Project is a major reinforcement of the electricity transmission system which will provide additional north-south transmission capacity between southern Scotland and northern England. This reinforcement is an essential part of a wider strategy of ensuring an efficient network that can facilitate achieving the net-zero targets the UK government has set. This MPA and MCZ Assessment refers to the Marine Scheme, which extends from Torness, East Lothian, to Hawthorn Pit, County Durham. The Project comprises of the following three components:

- **Scottish Onshore Scheme**: A converter station located in the Torness area, to the east of the Dunbar Energy Recovery Centre and a new 400kV substation at Branxton in East Lothian, Scotland, with approximately 7.5 km of buried HVDC cable to a landfall south-east of Thorntonloch Beach. The converter station and substation will be connected by approximately 5 km of High Voltage Alternating Current (HVAC) cable. The substation connects the Project to the existing transmission system. The scope of the Scottish Onshore Scheme ends at MLWS and a separate consent application has been made to East Lothian District Council;
- **Marine Scheme**: Commencing at MHWS at Thorntonloch Beach, East Lothian, approximately 176 km of subsea HVDC cable, comprising 37.5 km in Scottish waters and 138.5 km in English waters, will extend to MHWS at Seaham, County Durham. This is subject to MLAs to MS-LOT and the MMO, which this EAR supports; and
- **English Onshore Scheme**: Commencing at MLWS approximately 10 km of underground HVDC cable will be laid from the landfall north of Seaham, west along the Sunderland City/County Durham administrative boundary and then south-west through County Durham, to a converter station at Hawthorn Pit. The converter station will be connected to a new 400 kV substation by approximately 1 km of HVAC cable. The new 400 kV substation will connect the Project to the existing 275 kV Hawthorn Pit substation and the existing electricity transmission system. This is subject to a separate consent application which will be made to Durham County Council.

The Marine Scheme will provide 2 Giga Watts (GW) of transmission reinforcement from Scotland to England. It comprises a subsea HVDC cable system, within a marine installation corridor approximately 176 km long and up to 500 m wide.

The marine installation corridor extends from MHWS at the landfall on Thorntonloch Beach, Scotland, crossing Scottish and English territorial seas to MHWS at the landfall at Seaham, England. The marine installation corridor follows a broadly north to south alignment from the kilometre point (KP) 0, at the Scottish landfall, to KP 176 at the English landfall, as shown in EAR Volume 2 - Chapter 1: Introduction, Figure 1-3. Approximately 37.5 km of the marine installation corridor lies within Scottish territorial waters, and approximately 138.5 km within English territorial waters.

The Scottish and English elements of the Marine Scheme fall within the regulatory responsibilities of the Marine Scotland - Licensing Operations Team (MS-LOT) and the Marine Management Organisation (MMO), respectively.

Horizontal Directional Drilling (HDD) will be used to achieve landfall in both Scotland and England, with drilling works undertaken from temporary drilling compounds, one within each of the Scottish and English Onshore Schemes. Use of HDD means there will be no trenching works in the intertidal zone (between MHWS and MLWS). Installation of the subsea cable will be carried out in several campaigns, the length of which will be related to the cable carrying capacity of the main installation vessel.

A technical feasibility study of route options was completed as part of the 2018/2019 Network Options Appraisal (NOA). The proposed marine survey corridor between Torness and Hawthorn Pit was established as part of the Phase 3 Options Appraisal (EAR Volume 2 Chapter 5). A number of designations including the Northumberland Marine Special Protection Area (SPA), Berwickshire and North Northumberland SPA and the Farnes East MCZ are all located and overlap, covering an extensive area to the east of the Farne Islands.

Careful routeing consideration was given to this area and the resulting 26 km interaction with the Farnes East MCZ and 17.2 km interaction with the Outer Firth of Forth and St Andrews Bay Complex SPA allowed other designated areas (Berwickshire and North Northumberland Coast SAC and Berwick to

St Mary's MCZ) to be completely avoided. Alternative routeing to avoid all designations wasn't considered feasible as it would have required an additional estimated 40 km of cable routeing with all the associated impacts both from an environmental and installation standpoint. The Farnes East MCZ is principally designated for Annex I rock habitat. The 26 km interaction with this MCZ is principally in mud, sand and gravel habitats. The receptors within the other designated sites (Berwickshire and North Northumberland Coast SAC and Berwick to St Mary's MCZ) would have been potentially more sensitive to effects of Marine Scheme. Further information can be found in EAR Volume 2 Chapter 5: Alternatives and Design Development.

1.4 Legislative Framework

MPAs are designated under the Marine (Scotland) Act 2010 and MCZs under the MCAA 2009, in order to protect a range of important marine habitats, species and geological formations in Scottish and English waters 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 and North Sea.

1.4.1 Marine Protected Areas (Scotland)

The development of the Scottish MPA network has involved work between Marine Scotland, the Joint Nature Conservation Committee (JNCC), Natural England (NE), Historic Environment Scotland, the Scottish Environment Protection Agency (SEPA) and NatureScot (formerly Scottish Natural Heritage (SNH)). The approach for identifying MPAs followed a science-based process as set out in the Scottish MPA Selection Guidelines[1].

Section 83 of the Marine (Scotland) Act 2010 places specific duties on Marine Scotland relating to MPAs and marine license decision making. Section 83 applies where:

- A public authority has the function of determining an application (whenever made) for authorisation of the doing of any act; and
- The act is capable of affecting (other than insignificantly):
  - A protected feature in a Nature Conservation MPA;
  - A stated purpose for a Demonstration and Research MPA;
  - A marine historic asset in a Historic MPA; and
  - Any ecological or geomorphological process on which the conservation of any protected feature in a Nature Conservation MPA, or on which the stated purpose for a Demonstration and Research MPA, is (wholly or in part) dependent.

To ensure Marine Scotland remains compliant with Marine (Scotland) Act 2010, specific consideration must be given to MPAs during the Marine Licence decision making process.

1.4.2 Marine Conservation Zones (England)

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

Under Section 126 of the MCAA, the MMO has a duty to consider MCZs during Marine Licence decision making. 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 Assessment (this is fully explained in Section 2).

Section 126 of the MCAA (2009) places specific duties on the MMO relating to MCZs and Marine Licence decision making. Section 126 applies where:

1 https://www.webarchive.org.uk/wayback/archive/3000/https://www.gov.scot/Resource/0051/00515466.pdf

- 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; and
  - Any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or part) dependent.

To ensure the MMO remains compliant with MCAA 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) to be provided.

2. Assessment Methodology

Guidance published by the MMO (2013) describes how MCZ Assessments could be undertaken during the process of marine license 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 Figure 2-1.

- **Screening** – Determine whether the licensable activity is taking place within or 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 of 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 activity which would create a substantially lower risk of hindering the achieving of the site conservation 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 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 activity will have on the MCZ.

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

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.

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.

In the absence of formal guidance from MS-LOT in relation to the assessment of Scottish MPAs during the licence decision making process, the MMO guidance (2013) for English MCZ assessments will be applied to Scottish MPAs to ensure adequate information is provided to enable Marine Scotland to appropriately consider MPAs, thereby remaining compliant with the Marine (Scotland) Act 2010.

In line with the precautionary approach encouraged by the MMO, the screening process has considered any MCZ / MPA site within 10 km of the Marine Scheme. This is considered to be a sufficiently precautionary buffer around the Project that exceeds the maximum ZoI of project related activities that are likely to impact MCZ / MPA designated features in this instance.

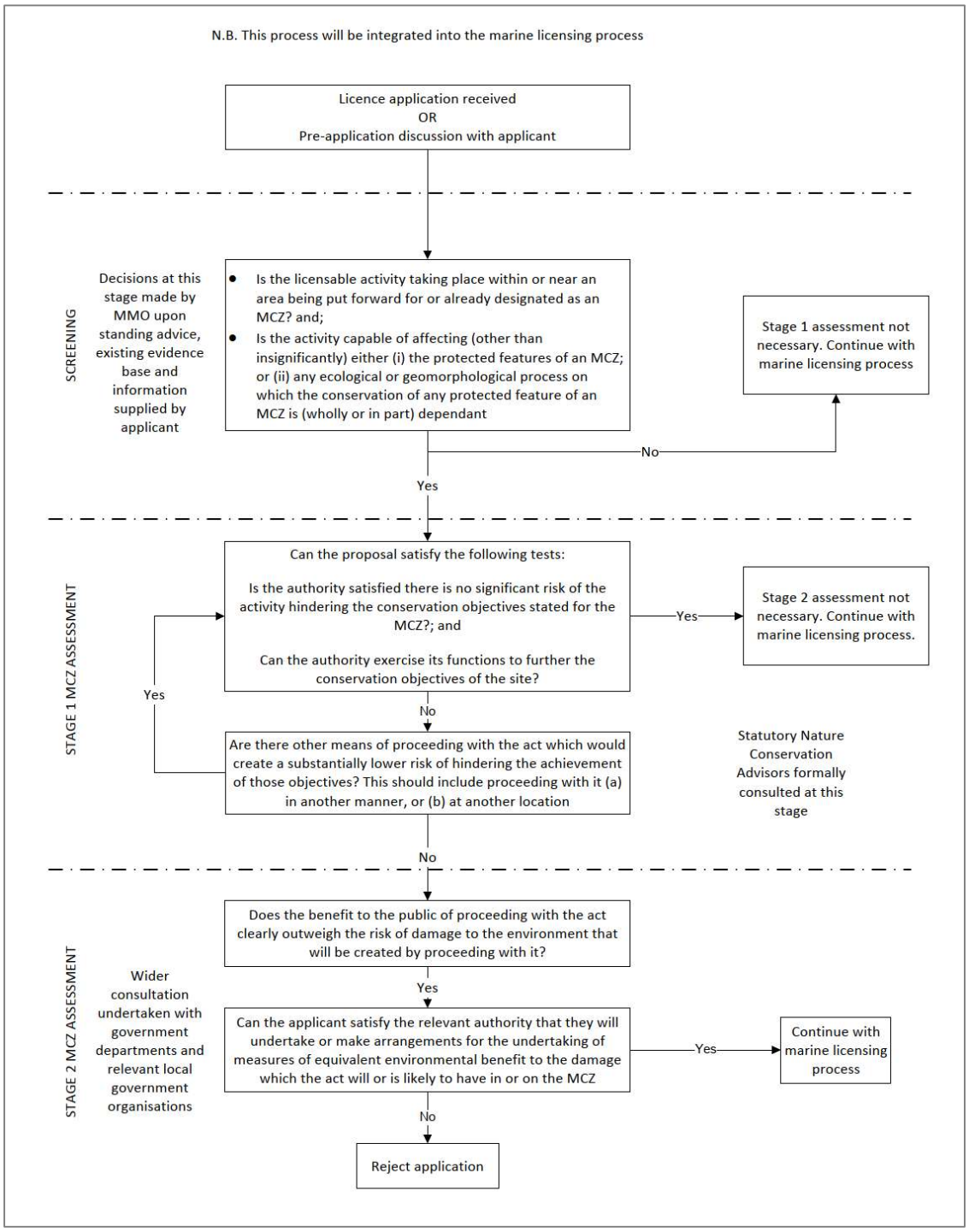

Figure 2-1: Summary of the MCZ assessment process used by the MMO in Marine Licence decision making (MMO, 2013)

3. Potential Impacts, Effects and Zones of Influence

The Oil Spill Prevention, Administration and Response 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 Marine Scheme.

The designated features of identified MPAs and MCZs fall into one of three categories: 'intertidal and subtidal benthic habitats', 'subtidal benthic species' or the 'presence of birds'. The impact pathways and associated Zone of Influence (ZoI), 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 ZoI which have been established through technical work completed as part of the EAR are presented in Table 3-1.

Table 3-1: Summary of impact pathways and associated ZoIs that could affect benthic habitats and species and seabirds from the EAR

Potential impact	Zone of Influence
Route preparation and cable installation	
Temporary physical disturbance to benthic habitats and species	Maximum disturbance footprints are 50 m for pre-installation and 30 m for installation
Visual or air-borne sound disturbance to avifauna on the sea surface, as a result of the presence of cable installation vessels	Displacement of birds is not expected at more than 1 km from the source of disturbance.
Disturbance to seabed and/or water quality due to increased Suspended Sediment Concentrations (SSC) resulting in changes in avifauna prey availability	1.4 km is expected to be the maximum distance to which an increase in SSC could occur from the source of disturbance within the marine installation corridor.
Permanent loss of subtidal benthic habitats and species due to placement of hard substrates on the seabed	Rock berm width a maximum of 7 m
Temporary increase in SSC sediment deposition leading to contaminant **mobilisation,** turbidity and smothering effects on subtidal habitats and species	1.4 km is expected to be the maximum distance to which an increase in SSC could occur from the source of disturbance within the marine installation corridor.
Changes to marine water quality effects from the use of HDD drilling fluids and accidental leaks and spills from vessels, including loss of fuel oils	Footprint of the proposed works plus 1.4 km buffer; based on professional judgement and consideration of worst-case for fine particulates (EAR Volume 2 Chapter 7: Physical Environment)
Cable operation and maintenance	
Disturbance to benthic habitats and species due to subsea cable electromagnetic field (EMF) emissions	For the separated cables, the magnetic field resulted in a combined field slightly above the background level at 20 m from the cable.
Disturbance to benthic habitats and species due to subsea cable thermal emissions	Approximately 1 m from the cable, dependent upon the heat carrying capacity of particular sediments.
Maintenance the same as route preparation and cable installation	As above
Decommissioning	
Potential effects the same as route preparation and cable installation	As above

Additional information on the impact pathways outlined in Table 3-1 are provided in the following sections.

3.1 Temporary Physical Disturbance to Benthic Habitats and Species

Construction activities associated with route preparation and cable installation can lead to direct physical disturbance (i.e. reworking) 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 sedentary or less mobile receptors, the likely impacts are physiological/morphological damage and mortality.

Potential effects of maintenance and decommissioning are envisaged to be the same as installation activities.

3.2 Visual or air-borne sound disturbance to avifauna on the sea surface, as a result of the presence of cable installation vessels

During subsea cable laying, the physical presence of vessels and disturbance associated with installation works have the potential to cause visual or air-borne sound disturbance to avifauna. Disturbance can lead to a number of physiological and behavioural responses which can affect demographic characters of the bird population. Responses to disturbance can result in loss of energy as a result of displacement, impaired breeding, unrest through increased vigilance, disruption to incubation, and increased nest failures due to predation and nest abandonment.

Potential effects of maintenance and decommissioning are envisaged to be the same as installation activities.

3.3 Disturbance to seabed and/or water quality due to increased SSC resulting in changes in avifauna prey availability

Various activities associated with the route preparation and cable installation phases of the Marine Scheme may result in disturbance and displacement of ornithological prey receptors. These activities include HDD at both landfall locations, route preparation activities, cable burial and rock protection placement. Such activities can have an indirect impact on availability of seabird foraging grounds due to temporary or permanent disturbance and/or loss of seabed habitat (See Section 3.4.)

Potential effects of maintenance and decommissioning are envisaged to be the same or less than as installation activities.

3.4 Permanent Loss - Subtidal Benthic Habitats and Species

The permanent placement of cable protection such as rock placement, concrete mattresses or other types of cable protection on the seabed could 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, including invasive non-native species (INNS), to colonise areas that might have previously been unsuitable.

Potential effects of maintenance and decommissioning are envisaged to be the same as installation activities.

3.5 SSC - Subtidal Habitats and Species

Construction activities have the potential to increase SSCs, disturbing the seabed and creating a sediment 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 affect rates of photosynthesis and an increase in sediment load can 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, may also be released into the water column and can alter marine water quality with subsequent indirect effects on benthic species.

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.

Potential effects of maintenance and decommissioning are envisaged to be the same as installation activities.

3.6 Water Quality - Intertidal and Subtidal Benthic Habitats and Species

Changes to marine water quality arising from the use of HDD drilling fluids and additives, accidental leaks and spills from vessels and the release of sediment bound contaminants and bacteria has the potential to indirectly affect benthic habitats and species through toxicity and bacteriological contamination. Whilst no works are planned in the intertidal any change to water quality in the nearshore could affect intertidal areas during high tide.

Potential effects of maintenance and decommissioning are envisaged to be the same as installation activities.

3.7 EMF – Benthic Habitats and Species

During operation HVDC cables such as the EL 1 / SEGL 1 emit electromagnetic fields which have the potential to cause a change in the detectable level of these fields in the immediate vicinity of the cable. The cable design includes a metallic outer sheath so the cables themselves will produce no external electrical field themselves though there is potential for induced electrical fields via the movement of the sea through the cable's magnetic field (EAR Volume 2 Chapter 2: Project Description; Appendix 2.1: Eastern Link EMF and Compass Deviation Assessment).

The design for the Marine Scheme comprises two HVDC cables laid either in two separate parallel trenches (unbundled) or else in a single trench with the cables bundled together. If the two-trench approach is used the cables will be spaced 30 m apart. For both approaches the target burial depth is 1.5 m and the minimum depth without cable protection will be 0.6 m. In a two-cable configuration the distance between the cables generates a stronger magnetic field than that generated by a bundled, single-trench configuration. Therefore, the appraisal considers the 2-trench scenario only, as the worst-case situation that will also encompass any potential effect should the cables be bundled.

3.8 Thermal Emissions – Benthic Habitats and Species

The operation of buried subsea HVDC cables generates heat due to resistance in the conductor components which can warm the cable surface and adjacent environment (i.e. sediments). 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 seabed, which is influenced by sediment grain size in particular.

4. Screening

The assessment approach applied during the MPA / MCZ screening is based on the guidance document 'Marine conservation zones and marine licensing' (MMO, 2013) and presented in Figure 4-1.

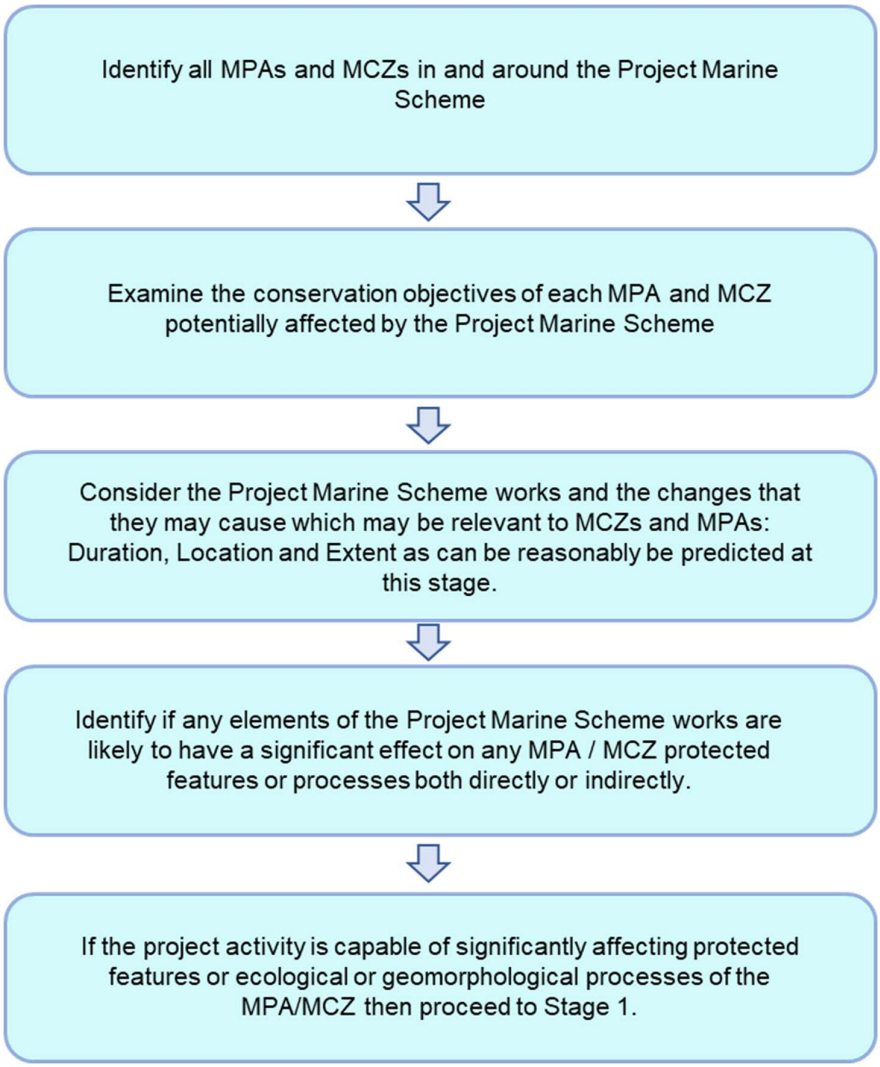

Figure 4-1: MPA / MCZ screening process

A Geographic Information System (GIS) was used to map boundaries of MPA and MCZ sites in relation to the Marine Scheme. To determine whether a sensitive receptor has the potential to interact with the Marine Scheme it is necessary to understand the nature of and existing baseline for the designated biodiversity features. Information on the designated biodiversity features for the MPAs / MCZs screened into this assessment are presented in Table 4-1.

This information has been used to inform the examination of designated biodiversity features of the MPA / MCZs against potential impacts to determine if there is a pathway for effect.

4.1 MPA (Scotland) Screening Assessment

Based on the application of the MMO (2013) MCZ Assessment Guidelines to Scottish MPAs, it is considered that Section 83 of the Marine (Scotland) Act 2010 would apply if it is determined through the course of screening that "*the activity is capable of affecting (other than insignificantly) either: (i) a protected feature in a Nature Conservation MPA; (ii) a stated purpose for a Demonstration and*

Research MPA; (iii) a marine historic asset in a Historic MPA; or (iv) any ecological or geomorphological process on which the conservation of any protected feature in a Nature Conservation MPA, or on which the stated purpose for a Demonstration and Research MPA, is (wholly or in part) dependent".

The Marine Scheme does not directly pass through any MPAs and no MPAs were identified within 10 km of the Marine Scheme in Scottish Waters. Therefore, MPAs are not considered further in this assessment.

4.2 MCZ (England) Screening Assessment

The MCZ Assessment Guidelines (MMO, Marine conservation zones and marine licensing, 2013) indicate that following the identification of MCZs to be considered, Section 126 would apply if it is determined through the course of screening that "*the activity is capable of affecting (other than insignificantly) either (i) the protected features of 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."*

Two MCZ sites have been screened out and one screened in, as detailed below and summarised in Table 4-1.

4.2.1 Farnes East MCZ

Overview

The Marine Scheme passes through the Farnes East MCZ for approximately 26 km. The site is designated for moderate energy circalittoral rock, subtidal coarse sediment, subtidal sand, subtidal mud, subtidal mixed sediments and seapen and burrowing megafauna communities. The shallower areas of the site, in the west, are dominated by subtidal coarse sediment and subtidal mixed sediments, while the eastern half of the site consists largely of subtidal sand. The current status for ocean quahog and seapen and burrowing megafauna communities in the Farnes East MCZ are to '*recover to favourable condition'*.

The sedimentary habitats in Farnes East MCZ also support ocean quahog (*Arctica islandica*), a bivalve mollusc that is slow growing and can live for over 100 years. This species is a designating feature of the MCZ. The ocean quahog is also an OSPAR Threatened and/or Declining species and a species Feature of Conservation Importance listed on the Ecological Network Guidance (ENG). Previous surveys within the Farnes East MCZ have identified individuals of ocean quahog (mostly juveniles) predominately in the east and southwest of the site (CEFAS, 2015).

Two species of seapen; slender seapen (*Virgularia mirabilis*) and phosphorescent seapen (*Pennatula phosphorea*) have been observed living on the mud habitat in the MCZ. Norway lobster (*Nephrops norvegicus*) are also present within the deep mud habitat, constructing burrows, mainly emerging in the evening to feed. As a result, as well as being designated for the broad-scale habitat subtidal mud, the habitat feature of conservation importance; seapen and burrowing megafauna communities, is also protected in Farnes East MCZ. This habitat is also designated on the OSPAR List of Threatened and/or Declining Species and Habitats. Previous survey data within the Farnes East MCZ have recorded limited observations of this habitat predominantly located in patches of subtidal mud in the south east of the MCZ.

Conservation Objective

Subject to natural change, the moderate energy circalittoral rock, subtidal coarse sediment, subtidal sand, subtidal mud, subtidal mixed sediments and seapen, and burrowing megafauna communities' features are to remain in or be brought into favourable condition, such that their:

- Extent is stable or increasing; and
- Structures and functions, quality, and the composition of their characteristic biological communities are such as to ensure that they are in a condition which is healthy and not deteriorating.

Subject to natural change, the ocean quahog feature is to remain in or be brought into favourable condition, such that:

- The quality and extent of its habitat is stable or increasing; and
- The population structure allows numbers to be maintained or increased.

Screening

Farnes East MCZ falls within the ZoI for all identified impact pathways (Table 3-1):

- Temporary physical disturbance to benthic habitats and species;
- Permanent loss of subtidal benthic habitats and species due to placement of hard substrates on the seabed;
- Temporary increase in suspended sediment concentrations (SSC) sediment deposition leading to contaminant mobilisation turbidity and smothering effects on subtidal habitats and species;
- Changes to marine water quality effects from the use of HDD drilling fluids and accidental leaks and spills from vessels, including loss of fuel oils;
- Disturbance to benthic habitats and species due to subsea cable thermal emissions; and
- Disturbance to benthic habitats and species due to subsea cable EMF emissions.

Due to the potential for a number of different impacts to habitats and species the Farnes East MCZ has been screened in for Stage 1 assessment.

4.2.2 Berwick to St Mary's MCZ

Overview

Berwick to St Mary's MCZ is located approximately 1.4 km from the Marine Scheme at the closest point and is designated for its nationally important numbers of breeding common eider. The area also supports regionally and nationally (England) important numbers of common eider in the non-breeding season. The eider is known to dive for crustaceans and molluscs, up to water depths of 15 m, and they can also be found rafting and preening on the sea surface.

Conservation Objective

This site was designated on the 31 May 2019. The conservation aims of the MCZ, for both breeding and non-breeding common eider *Somateria mollissima*, is to provide a critical seaward maintenance and foraging extension surrounding the breeding colony at Coquet Island and Farne Islands. Detailed conservation objectives for this site are yet to be published.

Screening

MMO (2018) suggest that the eider is less sensitive to disturbance and/or displacement from vessel activity than species such as the common scoter and red-throated diver, with displacement ranges being no greater 1 km in studies reported and some evidence to suggest habituation to boat traffic in some areas. Based on a distance of 1.4 km from the Marine Scheme, this MCZ is considered to fall outside the ZoI of the following project related impact pathways (Table 3-1):

- Visual or air-borne sound disturbance to birds on the sea surface, as a result of the presence of cable installation vessels; and
- Disturbance to seabed and/or water quality due to increased SSC resulting in changes in avifauna prey availability.

Potential disturbance of common eider within the Berwick to St Mary's MCZ has been screened out and does not require Stage 1 assessment.

4.2.3 Coquet to St Mary's MCZ

Overview

Coquet to St Mary's MCZ is an inshore site located along the Northumberland coast. The site covers 192 km² of intertidal and offshore waters from near Alnwick in the north to near Whitley Bay in the south. It includes areas around St Mary's Island and Coquet Island.

This site is located approximately 8.7 km from the Marine Scheme route and is designated to protect several different types of rock and sediment habitats on the shore and the seabed. Some of the habitats in the site, such as intertidal sediment and mud, do not currently have enough protection in the region and their designation at this site helps to fill gaps within the MPA network. These complex habitats and communities also support mobile species such as starfish, sea urchins, crabs, and lobsters. When this site was surveyed, the first ever observation of an Arctic cushion star, a starfish, on the English coast was recorded (Defra, 2016) (Table 4-1).

Conservation Objective

The key conservation objective is to ensure that the protected broad-scale habitats are maintained in favourable condition if they are already in favourable condition or be brought into favourable condition if they are not already in favourable condition

Screening

This MCZ falls outside of the ZoIs associated with the impact pathways identified in Table 3-1 that have the potential to affect the designated features.

Therefore, St Mary's MCZ has been screened out and does not require a Stage 1 assessment.

Table 4-1: Screening for MCZs

Site Name	Proposed or Designated Biodiversity Features	Distance to Marine Scheme (km)	Potential Impact Pathway	Likelihood of Interaction
Farnes East MCZ	• Moderate energy circalittoral rock • Subtidal coarse sediment • Subtidal mixed sediments • Subtidal sand • Subtidal mud • Seapen and burrowing megafauna communities • Ocean quahog (*Arctica islandica*)	0 (within)	Identified in Section 4.2.1.	**Possible** - Due to the potential for a number of different impacts to benthic habitats and species the Farnes East MCZ has been screened in for Stage 1 assessment.
Berwick to St Mary's MCZ	• Eider	1.4 km	No potential pathways identified.	**Screened Out** – This MCZ falls outside the potential ZoI for noise and visual disturbance for eider. The Berwick to St Mary's MCZ is screened out for Stage 1 assessment.
Coquet to St Mary's MCZ	• Intertidal rock (low, moderate and high energy) • Intertidal sediments – mixed, coarse, sand and muddy sand, mud • Intertidal under-boulder communities • Peat and clay exposures • Infralittoral rock (moderate and high energy) • Moderate energy circalittoral rock • Subtidal sediments – coarse, mixed, sand, mud	8.7 km	No potential pathways identified.	**Screened Out** - This MCZ falls outside of the ZoIs associated with the impact pathways that have the potential to affect the designated features and therefore, Coquet to St Mary's MCZ has been screened out and does not require a Stage 1 assessment.

5. Stage 1 Assessment

5.1 MPA (Scotland) Impact Assessment

No MPAs have been screened in for assessment.

5.2 MCZ (England) Impact Assessment

The Berwick to St Mary's MCZ and the Coquet to St Mary's MCZ have been screened out of assessment.

The key potential impacts and pathways for the Farnes East MCZ, which is screened in for assessment, are appraised below.

5.2.1 Farnes East MCZ

Temporary physical disturbance to benthic habitats and species

The Marine Scheme passes through the Farnes East MCZ for approximately 26 km within the south-western corner of the Farnes East MCZ (Figure 1-1). Construction activities associated with preparation of the marine installation corridor and cable installation can result in temporary physical disturbance of seabed sediments. The activities capable of disturbing the seabed include clearing the seabed of obstacles and any trenching, ploughing or jetting cable burial activities. There will be no anchoring disturbance as all cable lay vessels will hold position using dynamic positioning and the need for pre-sweep has not been identified for any section of the route (EAR Volume 2 - Chapter 2: Project Description).

Route preparation for the marine installation corridor will require clearance using grapnelling or ploughing to remove obstacles such as boulders, debris, and any end-of-life installations. Following this, cable installation typically involves trenching and backfilling, ploughing or jetting, which will further disturb the seabed and suspend sediments, to a width of 15 m per cable, a total of 30 m (see EAR Volume 2 Chapter 2: Project Description). However, pre-installation displacement ploughs would result in the widest disturbance swathe, at between 10 and 25 m per cable. The assessment has assumed a worst-case scenario of a disturbance swathe of up to 25 m wide per cable (which would also include any disturbance effects from cable route clearance), giving a total disturbance footprint width of 50 m.

The seabed of the Farnes East MCZ is predominantly composed of various subtidal sediments. The shallower areas of the site, in the west, are dominated by subtidal coarse sediment and subtidal mixed sediments, while the eastern half of the site consists largely of subtidal sand. The evidence collected during monitoring surveys indicates that the MCZ is predominantly sediment based habitats, except for small patches of moderate energy circalittoral rock identified through the site. The seabed data collected during the benthic survey carried out for the Marine Scheme came from a combination of grab sampling, drop-down video (DDV) and video transects, within the marine installation corridor (Fugro, 2021). Seabed data from a total of five grab and DDV stations (ST17 to ST21) and eight transects (TR07 to TR14) were collected within the Farnes East MCZ.

Analysis of the survey data together with the remote sensing data show that the seabed sediment in the MCZ section of the marine installation corridor (from approximately KP 74 to KP99) was overwhelming dominated by circalittoral mixed sediment (A5.45), which accounted for approximately 89% of the habitat identified. In places, the mixed sediments were found in a mosaic with patches of coarse sediment (A5.15) (Fugro, 2021).

Seapens and burrowing megafauna (A5.361) is a key protected feature of the MCZ but this habitat was not observed at any of the stations or transects taken within the marine installation corridor in the MCZ. There were also no observations of the sea pens *Pennatula phosphorea* and *Virgularia* sp., the characteristic burrowing megafauna *Nephrops norvegicus*, or its burrows, within the marine installation corridor in the MCZ. It was concluded that there was limited potential for this key habitat to occur within the area of the marine installation corridor within the MCZ (Fugro, 2021). The presence of Annex I

habitat 'Reefs' was identified in the presence of small, localised patches (at KP75.4 and KP84.2) of bedrock reef representative of the designated broad-scale habitat moderate energy circalittoral rock and one transect (at KP76) had habitat with a medium resemblance to a stony reef.

Similarly, *A. islandica* was not observed in photographic data or within the fauna samples taken within the MCZ. However, several other taxa described in the MCZ site overview were recorded, including the anemones *Edwardsia claparedii* and *Cerianthus lloydii*, segmented worms *Galathowenia oculata*, hydroids, bryozoans and sponges.

However, based on the habitat types identified in the benthic survey there will be temporary disturbance to two main habitat types, mixed and coarse sediments, and their associated communities. Where small patches of bedrock are present the marine installation corridor is wide enough to allow for micro-siting when required.

Effective burial, whilst causing seabed disturbance at the time of installation, is a key factor in determining the total disturbance regime, because it minimises the need for repairs and remedial action including later reburial. A cable burial risk assessment and rock protection review has identified all areas within the marine installation corridor where it is thought effective burial is possible, and so where rock placement would not be required. For the marine installation corridor within the Farnes East MCZ, approximately 19.0 km of the total 26 km (i.e. 73%), has been identified as requiring some form of rock protection, because of the mixed and coarse sediments present, and the impact of this is considered below (see separate section below).

Most investigations and reviews have found that seabed disturbance from cable installation was temporary and of a limited spatial extent. However, a more recent review found evidence some installation trenches were observed a number of years after installation though they were generally shallow and had undergone some evidence of in-filling and recovery (RPS, 2019). Studies of recovery from aggregate dredging found longer recovery times for coarse, gravelly and mixed sediments, with recovery timescales, usually within five years. However, the degree of disturbance from cable installation is much smaller in extent than aggregate dredging, and cable installation includes backfilling, and so recovery times are likely to be shorter. For example, in some cable installation projects such as the Humber Gateway, there was no evidence of cable burial or trenches a few years after installation (RPS, 2019). However, there is much variability, both across projects and at small spatial scales within projects, indicating recovery is likely to be site specific and dependant on local sediment transport processes.

To conclude, considering the limited spatial extent of expected activities, the absence of the most sensitive receptors, particularly the ocean quahog and the biotope *Seapens and burrowing megafauna in circalittoral fine mud* habitats, from the marine installation corridor, the extent of any temporary disturbance to protected features is of a low magnitude and recovery likely to occur within a few to several years. Therefore, the impact to the designated features of the Farnes East MCZ, from temporary disturbance, is considered to be minor/negligible and unlikely to affect the stated management approaches. Section 126(5) of the MCAA can therefore be discharged by the MMO because section 126(6) of the MCAA is discharged on the basis that there is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the MCZ.

Assessment Conclusion	Conservation objectives will not be hindered.

Permanent loss of subtidal benthic habitats and species due to placement of hard substrates on the seabed

After cable installation burial, protection through burial (the preferred option) or other placement or rock or similar is required to ensure the integrity of the asset; the cable burial risk assessment has identified areas that will require additional protection. In some areas of the Farnes East MCZ it will be necessary to supplement cable protection with the placement of suitable rock material where full burial is not possible. There are no crossings requiring the placement of concrete mattressing in the MCZ.

The total distance in which rock placement will be required within the MCZ is approximately 19.0 km, for habitats that have been identified as either mixed or coarse deep circalittoral sediment (Table 5-1).

All locations had either boulders or shallow sediments overlying bedrock present, where full protection levels of burial will not be possible. However, none of the locations require 100% rock placement coverage and the majority (57%) will receive rock placement to achieve 25-50% coverage (Table 5-1).

Of all the rock placement locations, only the first three in Table 5-1 have been identified as possible stony reef. None were considered to be representative of the biotope *seapens and burrowing megafauna* (Fugro, 2021).

Table 5-1: Summary of rock placement and associated habitat in Farnes East MCZ

From (KP)	To (KP)	Distance (km)	% Rock Cover	EUNIS Code	EUNIS Habitat Description
74.6	77.5	2.90	25	A5.45	Deep circalittoral mixed sediments
78.4	80.9	2.50			
81.72	82.32	0.60			
84.8	85	0.20			
85.00	88.51	0.03	75	A5.15	Deep circalittoral coarse sediment
		0.26			
		3.21		A5.45	Deep circalittoral mixed sediments
90.4	90.6	0.20	25	A5.15	Deep circalittoral coarse sediment
90.6	94.4	0.74	75	A5.45	Deep circalittoral mixed sediments
		3.06		A5.15	Deep circalittoral coarse sediment
95.9	96.3	0.40	25	A5.15	Deep circalittoral coarse sediment
97	97.7	0.15	50	A5.45	Deep circalittoral mixed sediments
		0.55		A5.15	Deep circalittoral coarse sediment
97.7	98.5	0.45	25	A5.15	Deep circalittoral coarse sediment
		0.35		A5.27 / A5.45	Deep circalittoral sand / Deep circalittoral mixed sediments
98.5	99.4	0.25	75	A5.15	Deep circalittoral coarse sediment
		0.65		A5.27 / A5.45	Deep circalittoral sand / Deep circalittoral mixed sediments
99.5	102	0.41	50	A5.15	Deep circalittoral coarse sediment
		0.98		A5.27 / A5.45	Deep circalittoral sand / Deep circalittoral mixed sediments
		1.11		A5.27	Deep circalittoral sand

Thus, some degree of permanent habitat loss could occur within the MCZ where rock placement replaces an existing habitat, with the scale of effect depending on the nature of protection material and similarity to the existing habitat. Local conditions will have a significant effect on the type, size and design of rock protection. For example, water depth helps to determine the significance of wave action at the seabed. Shallow waters mean the movement of water is greater and therefore the level of energy to potentially move rocks is higher, leading to a choice of larger grades of rock to support greater stability. However, the rock protection in the MCZ is taking place in deep water, typically over 60 m water depth, beyond the depth at which wave action is likely to affect the seabed. Therefore, a greater choice of rock sizes will be available for protection, which may allow a closer match between existing conditions and the profile of sediment particles sizes selected for rock placement.

The degree of change of habitat type, and consequent effect on benthic ecology communities, will depend on the material used for cable protection. For example, the addition of rock protection within a muddy or sandy sediment environment would be expected to be a more profound change of habitat compared to the introduction of rock into a naturally rocky or coarse sediment (e.g. cobbles and boulders) dominated environment, such as is present in the marine installation corridor in the MCZ.

Thus, some habitat loss associated with rock placement will be permanent, though there is the potential for similar communities of infaunal and epifaunal communities found in mixed and coarse sediments to develop, particularly as the levels of rock placement is of low coverage in most locations.

A review of impacts of cable protection on benthic environments similar to those identified by the benthic survey within the Farnes East MCZ, indicated some scouring of the seabed with rock placement, although this varied across sites (RPS, 2019). Little information is available regarding the subsequent impacts to benthic habitats, but they will heavily depend on the type of sediment or substrate in the receiving environment (RPS, 2019). The selection of rock placement material will be made with regard to the nature of the sediment and the water depth, such that there will not be a significant change in habitat type.

The maximum width of the rock placement berm within the marine installation corridor will be up to 7 m per cable (EAR Volume 2 - Chapter 2: Project Description), giving a total estimated maximum area of 0.133 km^2 of rock placement per cable and a total area of 0.266 km^2. This represents 0.028 % of the total habitat of the MCZ (which is 945 km^2). The habitat affected will be mixed and coarse sediments, where the change in sediment type and the sensitivity of the habitats, will be much lower than for the burrowing mud habitat and species found elsewhere in the site. Given the small extent of rock placement, and the ability of the material to reflect some characteristics of the existing habitats, allowing similar communities to develop, the impact of rock placement in the Farnes East MCZ is considered to be minor and unlikely to affect the stated conservation objectives. Section 126(5) of the MCAA can therefore be discharged by the MMO because section 126(6) of the MCAA is discharged on the basis that there is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the MCZ.

Assessment Conclusion	Conservation objectives will not be hindered.

Temporary increase in suspended sediment concentrations (SSC), sediment deposition leading to contaminant mobilisation, turbidity and smothering effects on subtidal habitats and species

Cable route clearing and cable installation will disturb seabed sediments which is likely to contribute to temporary increases in SSC and sediment deposition. As the marine installation corridor passes through the Farnes East MCZ, the MCZ falls within the ZoI for sediment suspension/deposition.

Large increases in SSC and sediment deposition can have significant impacts on marine organisms, with the potential to entirely smother benthic life (Pineda, et al., 2017). Sessile benthic organisms are particularly at risk as many are filter feeders and increased sediment loads can clog their feeding apparatus (Pineda, et al., 2017). Suspended benthic sediments can also resuspend any contaminants that have settled in the environment, which can also be ingested by organisms (Bancon-Montigny, et al., 2019).

Calculations have been undertaken to estimate the extent of sediment dispersion before deposition as a result of installation activities. The method for these calculations, and the results, are reported in further detail in EAR Volume 2 - Chapter 7: Physical Environment.

The extent of the effect depends on sediment particle size and the level of water movement. The distance travelled before deposition by suspended coarse sand is expected to be around 200 m which means that sediment would remain within the marine installation corridor (500 m wide). Fine sands and silts may however be transported beyond the marine installation corridor with any fine sand settling on the seabed up to 1.4 km from the point where it is mobilised. Based on the calculated settling velocities any silt-sized material may remain in suspension for several days and may therefore travel significant distances. However, given that dispersion processes will also act to dilute the concentration of silt carried in suspension, elevated concentration levels at a distance of 1.4 km from the source will be negligible. It is considered that there will be no significant elevated concentration of SSC beyond the travel distance calculated for fine sand which corresponds to 1.4 km from the point of mobilisation within the marine installation corridor.

Based on these calculations, any measurable change in suspended sediment concentrations will be temporary and localised, i.e. mostly within the bottom 5 m of the water column and also within the extent of the marine installation corridor. The finer fractions that are transported further will be diluted so that the suspended sediment concentration will be low and the deposition thickness on the seabed, where the sediment is able to settle, will be negligible.

Each of the biotopes and species that are designating features of the MCZ (Table 4-1) support diverse benthic communities, which could be impacted by increased sediment loads.

Survey data (grabs, ROV and remote sensing data) show that the seabed in the MCZ section of the marine installation corridor (from approximately KP 74 to KP99) was overwhelming dominated by circalittoral mixed sediment (A5.45), which accounted for approximately 89 % of the habitat identified. The remainder of the area comprised coarse sediments and in places, mixed sediments in a mosaic with patches of coarse sediment (Table 5-1) (Fugro, 2021).

A review of cable installation activities in similar sediment habitats found no significant changes to communities in a range of sediment types, falling within local natural variability (RPS, 2019). Habitats which were comprised mostly of sediments, such as subtidal sands and gravels, often recovered swiftly after disturbance, quickly reflecting pre-construction baselines and adjacent unimpacted areas (RPS, 2019). Areas with a higher composition of fine sediments (e.g. sandy muds and muddy sands) showed remnants of trenching and light scaring, although of a low relief (RPS, 2019).

The biotope ‘seapens and burrowing megafauna’ and the designating ocean quahog were not found within the marine installation corridor and there were also no observations of individual seapens, *Nephrops* or its burrows though they may be present beyond the marine installation corridor.

Sessile organisms such as seapens are thought to be at a higher risk of impact by cable installation activities due to their inability to avoid disturbances. However, seapens appear relatively insensitive to smothering and turbid conditions, with quick recovery rates to short-term changes in conditions (Hill et al., 2020). Burrowing megafauna associated with this community include the Norway lobster *Nephrops norvegicus*. Individuals and burrows of this species were identified during the benthic survey, but occurrence was sporadic, and none were observed within the MCZ though they may be present outside the marine installation corridor. This species can burrow down to depths of 20-30 cm (Bell et al., 2006), suggesting that small-scale increases in deposition will not pose a major risk to species included in the community.

The predicted temporary increase to SSC levels and associated depositional loads from operations in comparison to natural background levels is expected to be relatively minor. When considering this in conjunction with the absence of ocean quahogs and the EUNIS habitat A5.361 - *Seapens and burrowing megafauna in circalittoral fine mud habitats* / established communities within marine installation corridor which passes through the MCZ (Fugro, 2021), alongside the recoverability of subtidal sand and gravels, it is unlikely that increased SSC and sediment deposition will affect the protected features and stated conservation objectives for this MCZ and the impact is considered to be negligible. Section 126 of the MCAA can be discharged by the MMO because section 126(6) of the MCAA is discharged on the basis that there is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the MCZ.

Assessment Conclusion	Conservation objectives will not be hindered.

Changes to marine water quality effects from the use of HDD drilling fluids and accidental leaks and spills from vessels, including loss of fuel oils

Operational discharge from construction works to the marine environment has the potential to alter water quality which could affect sensitive habitats and protected species. The only planned discharges into the marine environment come from the HDD operations planned in the nearshore environment at both landfall locations. However, the nearest landfall, at Seaham, is approximately 70 km from the Farnes East MCZ. Considering the distance of the MCZ from the HDD location and the likely swift dispersal and degradation of released fluids, changes to water quality from HDD drilling fluids are

unlikely to impact the protected features and conservation objectives of the MCZ, meeting Section 126 of the MCAA.

The risk of accidental release of pollutants (e.g. fuels, oils, and chemicals) from vessels, however, is present throughout the entire length of the marine installation corridor. Contaminants have the potential to settle within benthic sediments and affect the communities present. Studies have indicated that benthic sediments contaminated with oils and hydrocarbons resulted in a reduced density of macrofauna, as well as differences in recruitment and development of assemblages (Berge, 1990; Stark, Snape, & Riddle, 2003).

Within the Farnes East MCZ, moderate energy circalittoral rock, subtidal coarse sediment, subtidal sand, subtidal mud, subtidal mixed sediments, *seapen and burrowing megafauna communities*, and ocean quahog aggregations (Table 4-1) were identified as protected features, each of which are vulnerable to impacts from accidental spillage. Only the mixed and coarse sediments were identified within the marine installation corridor.

Drilling fluids will be selected from the OSPAR List of Substances/Preparations Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment (PLONOR). Industry standard drilling fluids and additives required during the HDD operations will also be biodegradable. For example, the most widely used fluid, bentonite, consists predominately of clay minerals. This PLONOR substance is generally considered to be an inert, and generally non-polluting substance. Bentonite is also not listed under the Environmental Quality Standards Directive.

To be included as a PLONOR substance there must be clear evidence of low bioaccumulation (log POW < 3 or BCF < 100 or molecular weight > 700 g/mol), low toxicity (LC50 or EC50 > 100 mg/l) of the substance, and it must be readily biodegradable (OSPAR, 2019). A review by Aslan et al. (2019) found no evidence of a lethal response or reduced survival in bivalve molluscs or crustaceans, in conditions representative of realistic concentrations for discharges in an open marine environment such as the open coasts where the breakouts are located.

Embedded mitigation measures will be implemented to minimise the release of drilling fluid leaks from the end of the ducts. The discharged drilling fluids will also be subject to immediate dilution and rapid dispersal within the marine environment, particularly as the release will be in the shallow nearshore area where there is likely to be significant wave and tidal water movement.

To ensure the risk of accidental spills is as low as reasonably practicable (ALARP), the project will undertake a risk assessment and produce environmental management and contingency plans as a matter of course. Health, Safety, and Environment (HSE) procedures will also be implemented, with strict weather and personnel limits to reduce any risk of accidental spillage. Furthermore, preparedness and swift response is essential for effective spill management and as such, response plans will be in place should an incident occur.

Although spills are highly likely to impact any benthic habitat or species regardless of protection status, with necessary Safety, Health, and Environment (SHE) measures the likelihood of this occurring is very low. However, should any accidental release of contaminants occur it would likely be small in volume, and rapidly dispersed and diluted by waves and tides. As such, accidental release of contaminants is unlikely to affect the protected features and stated conservation objectives of the Farnes East MCZ and the impact is minor. Section 126 of the MCAA can be discharged by the MMO because section 126(6) of the MCAA is discharged on the basis that there is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the MCZ.

Assessment Conclusion	Conservation objectives will not be hindered.

Disturbance to subtidal benthic habitats and species due to subsea electromagnetic field (EMF) emissions

The design for the Marine Scheme comprises two HVDC cables laid either in two separate parallel trenches (unbundled) or else in a single trench with the cables bundled together. If the two-trench approach is used the cables will be spaced 30 m apart (referred to as a ‘30 m separated bipole’). For

both approaches the target burial depth is 1.5 m and the minimum depth without cable protection will be 0.6 m. In a two-cable configuration the distance between the cables generates a stronger magnetic field than that generated by a bundled, single-trench configuration. Therefore, the appraisal considers the 2-trench scenario only, as the worst-case situation that will also encompass any potential effect should the cables be bundled.

Modelling, completed specifically for the Marine Scheme, provides data on the level and attenuation of the EMF emissions anticipated for both possible design options (Appendix 2.1: Eastern Link EMF and Compass Deviation Assessment). The modelling accounts for cable configuration, the design of HVDC cable, and the properties of electromagnetic fields in water (magnetic fields attenuate rapidly in water) with and without the influence of background geomagnetic fields. These estimates indicate that EMF from a 30 m separated bipole configuration, buried at a depth of 1 m reduces to a background level at a distance of between 5 and 10 m of the cable, both vertically and horizontally. In comparison, maximum magnetic field in a bundled bipole configuration is significantly lower.

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. For example, it has been shown that in addition to visual and hydrodynamic cues, the spiny lobster *Panulirus argus* uses the Earth's magnetic field to orient (Boles & Lohmann, 2003). This lobster is a Caribbean species, but it suggests some crustaceans have the ability to detect EMF. In another study, the blue mussel, *Mytilus edulis*, the brown shrimp, *Crangon crangon* and the crab, *Rhithropanopeus harrisii*, were all exposed to a static B-field of 3.7 µT (37 G) for several weeks. No differences in survival between experimental and control animals was detected (Bochert & Zettler, Long-term Exposure of Several Marine Benthic Animals to Static Magnetic Fields, 2004).

In a more recent laboratory study, Scott et al. (2021) found behavioural responses to EMF in the edible crab *Cancer pagurus*, exposed to EMF over 24 hours at strengths of 500 and 1000 µT. The crabs showed a clear attraction to EMF at these levels, with a significant reduction in time spent roaming. The EMF strength at the cable is predicted to be 400 µT, reducing to less than 200 µT a metre away from the cables (Appendix 2.1). In this same study, EMF exposure at 250 µT was found to have limited physiological and behavioural impacts, indicating a possible strength dependent response. This negligible effect was also seen in enclosure experiments with the lobster *Homerus americanus*, around an active HVDC cable (Hutchison Z. , Gill, Sigray, Haibo, & King, 2020). Behavioural responses were observed but these were subtle, and no significant difference was observed in the total distance travelled or speed of movement

Therefore, it appears some detection in benthic invertebrates may be possible but there have been no negative impacts observed at the EMF levels predicted for the Marine Scheme. Considering the limited extent of the ZoI for EMF in the benthos, any effects in the MCZ would only affect a relatively small number of animals. In addition, most animals will have the ability to move away from any EMF emissions. Thus, whilst EMF will be emitted whenever the cable is active, and is therefore a permanent effect, the small spatial extent and largely behavioural responses, the magnitude of the effect is considered to be negligible and unlikely that EMF emissions will affect the protected features and stated conservation objectives for this MCZ. Therefore, Section 126 of the MCAA can be discharged by the MMO because section 126(6) of the MCAA is discharged on the basis that there is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the MCZ.

Assessment Conclusion	Conservation objectives will not be hindered.

Disturbance to subtidal benthic habitats and species due to subsea cable thermal emissions

High-voltage submarine power cables have been shown to generate and dissipate heat when active, reaching surface temperatures of up to 70°C (Emeana, et al., 2016). Such heat has the potential to cause sediment dwelling and demersal organisms to move away from the affected area. Increased heat may also alter physico-chemical conditions and bacterial activity in surrounding sediments, contributing to altered faunal composition and localised ecological shifts (Meissner, Schabelon, Bellebaum, & Sordyl, 2008). While the full effect of temperature changes on sediment composition and related biogeochemical cycling are unknown, preliminary studies have indicated shifts in bacterial community

composition with increased temperatures, with corresponding changes in NH4 concentration and nitrogen cycling (Hicks, et al., 2018).

The Marine Scheme cable design comprises two HVDC cables, which could be laid in parallel trenches spaced up to 30 m apart, or bundled together in a single trench, in each case buried at a target depth of 1.5 m. Heat dissipation modelling for bundled cables buried at a depth of 1.5 m indicates that within 50 cm of the surface the increase in sediment temperature is limited to approximately 3°C, based on a maximum surface sediment temperature of 15°C (EAR Volume 2 Chapter 2: Project Description). For unbundled cables the heat profile of each individual cable at the surface may be lower than the bundled cables but the affected area will be around each of the two separate cables, rather than a single bundled entity.

The protected features of the Farnes East MCZ include moderate energy circalittoral rock, subtidal coarse sediment, subtidal sand, subtidal mud, subtidal mixed sediments, *seapen and burrowing megafauna communities*, and ocean quahog aggregations (Table 4-1).

The sediment type within the marine installation corridor in the Farnes East MCZ is dominated (~890%) by mixed and coarse sediments (EUNIS biotopes A5.45 and A5.15 respectively), with small, localised patches of bedrock reef (Fugro, 2021). These habitats support a wide variety of benthic and demersal fauna. No seapens or *Nephrops* individuals or burrows were observed within the MCZ during the survey, so any presence is likely to be sporadic and the habitats in the marine installation corridor within the MCZ were not considered representative of the sensitive MCZ designated habitat of seapens and burrowing megafauna. The protected bivalve, the ocean quahog was also not found during the benthic survey.

Sediment particle size composition has been found to influence heat transfer, with coarse silts experiencing the greatest temperature change, but to a shorter distance from the source, while fine and coarse sands had a lower temperature change but a greater affected distance (Emeana, et al., 2016). However, whilst the sediment surrounding the cable route may be heated there is negligible capability to heat the overlying water column because of the very high heat capacity of water.

The habitats identified are likely to support both infaunal and epifaunal organisms. Most of the infaunal organisms will be present in the upper layers of the sediment only, likely to a maximum of 20 m sediment depth, and so any increase in temperature will be very small. Movement into adjacent areas of sediment, away from any small increase in temperature, will be possible for most infaunal organisms. The epifaunal community will comprise a number of animals that are unable to move away but as this faunal group sits largely within the water column, they will not be within the ZoI for thermal effects.

When considering the coarser substrates observed within the Farnes MCZ during the benthic baseline survey and the very limited spatial extent of impact, it is unlikely that the protected features and conservation objectives of the Farnes MCZ will be affected and the impact will be negligible. Therefore Section 126 of the MCAA can be discharged by the MMO because section 126(6) of the MCAA is discharged on the basis that there is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the MCZ.

Assessment Conclusion	Conservation objectives will not be hindered.

6. Summary and Conclusions

This report has been produced to provide the necessary information to allow MS-LOT and the MMO to meet their specific duty for MPA/MCZs as outlined in Section 83 of the Marine (Scotland) Act and Section 126 of the MCAA (2009). The first stage of the assessment process was screening to identify if MPAs/MCZs within 10 km of the Marine Scheme should be taken through the full assessment in the Stage 1 Assessment process.

The screening concluded that a possible risk of the Marine Scheme affecting the designated features and/ or conservation objectives of each MPA/ MCZ was present. During this process, the Firth of Forth

Banks Complex MPA in Scottish waters, as well as the Berwick to St Mary's and the Coquet to St Mary's MCZs in English waters, were ruled out for the subsequent assessment as they fell outside of the distance of all predicted ZoIs.

There is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the Berwick to St Mary's MCZ or the Coquet to St Mary's MCZ. This means that section 126(5) of the MCAA is discharged in respect of these MCZs and that the MMO can grant authorisation because the condition at section 126(6) of the MCAA is satisfied in respect of these MCZs.

There is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the Firth of Forth Banks Complex MPA. This means that section 83(4) of the Marine (Scotland) Act is discharged in respect of this MPA and that MS LOT can grant authorisation because the condition at section 83(4)(a) of the Marine (Scotland) Act is satisfied in respect of this MPA.

A Stage 1 Assessment was completed for the Farnes East MCZ in England, due to the site falling within the ZoIs of the following impact pathways:

- Temporary physical disturbance to benthic habitats and species;
- Permanent loss of subtidal benthic habitats and species due to placement of hard substrates on the seabed;
- Disturbance to benthic habitats and species due to subsea cable thermal emissions;
- Temporary increase in suspended sediment concentrations (SSC) and deposition leading to physical disturbance and/or loss of benthic habitats and species and barrier to migration;
- Changes to marine water quality from the use of drilling fluids and the release of sediment bound contaminants and bacteria leading to indirect effects on benthic habitats and species;
- Disturbance to benthic habitats and species due to subsea cable thermal emissions; and
- Disturbance to benthic habitats and species due to subsea cable electromagnetic field (EMF) emissions

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

There is no significant risk of the Marine Scheme hindering the achievement of the conservation objectives stated for the Farnes East MCZ. This means that section 126(5) of the MCAA is discharged and the MMO can grant authorisation because the condition at section 126(6) of the MCAA is satisfied

There is no requirement to undertake a stage 2 assessment or satisfy the conditions at section 126(7) of the MCAA in respect of the Farnes East MCZ.

It has therefore been demonstrated that the conditions of Section 83 of the Marine (Scotland) Act and Section 126 of the MCAA, as determined under stage 1 of the MCZ assessment process, are met and that there is no significant risk to any of the identified designated features or conservation objectives of the sites as a result of Marine Scheme related activities.

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