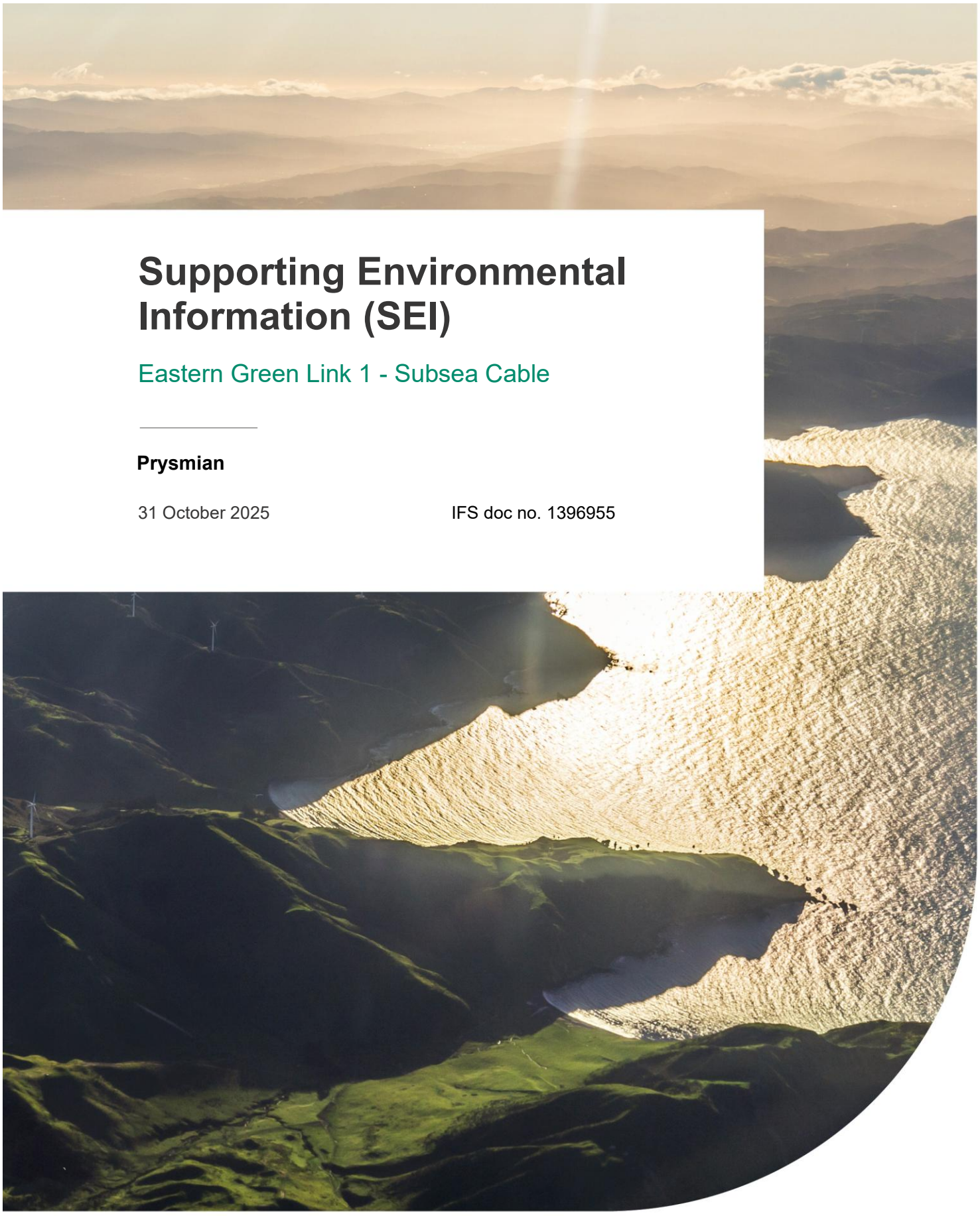

Supporting Environmental Information (SEI)

Eastern Green Link 1 - Subsea Cable

Prysmian

31 October 2025

IFS doc no. 1396955

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Document history

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Abbreviations

ADD	Acoustic Deterrent Device
AEZ	Archaeological Exclusion Zones
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
BMAPA	British Marine Aggregate Producers Association
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
cUXO	confirmed Unexploded Ordnance
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environmental Appraisal
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EGL1	Eastern Green Link 1
EOD	Explosive Ordnance Disposal
EPS-RA	European Protected Species Risk Assessment
EUNIS	European Nature Information System
FLO	Fisheries Liaison Officer
HVDC	High Voltage Direct Current
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
KP	Kilometre Point
LAT	Lowest Astronomical Tide
LPAs	Local Planning Authorities
MarLIN	Marine Life Information Network
MARPOL	Regulations for the Prevention of Pollution from Ships
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zones
MD-LOT	Marine Directorate Licensing and Operations Team
MHWS	Mean High Water Springs
MMMP	Marine Mammal Mitigation Plan
MMO	Marine Management Organisation, also Marine Mammal Observer
MU	Management Unit
MRCC	Maritime Rescue Co-ordination Centre
NAS	Noise Abatement System

NEQ	Net Explosive Quantity
NGET	National Grid Electricity Transmission
NLB	Northern Lighthouse Board
NM	Nautical Miles
NtM	Notice to Mariners
PAD	Protocol for Archaeological Discoveries
PPL	Prysmian Powerlink
PTS	Permanent Threshold Shift
pUXO	potential UXO
RIAA	Report to Inform Appropriate Assessment
ROV	Remotely Operated Vehicle
SAC	Special Areas of Conservation
SEI	Supporting Environmental Information
SEGL	Scotland to England Green Link
SEL_{sp}	Sound Exposure Level, single pulse
SLVIA	Seascape, Landscape and Visual Impact Assessment
SOLAS	International Convention for the Safety of Life at Sea
SNMP	Scottish National Marine Plan
SPA	Special Protection Area
SPL_{peak}	Peak Sound Pressure Level
SPT	Scottish Power Transmission
SSC	Suspended Sediment Concentrations
SSSI	Sites of Special Scientific Interest
TI	Target Investigation
UK	United Kingdom
UKHO	UK Hydrographic Office
UXO	Unexploded Ordnance
VHF	Very High Frequency
WSI	Written Scheme of Investigation

1. Introduction

Prysmian Power Link Group (PPL) has contracted Natural Power Consultants Ltd. (Natural Power) to provide a Supporting Environmental Information (SEI) report as part of the supporting documentation required for the submission of a Marine Licence Application (MLA) regarding the clearance of confirmed Unexploded Ordnance (cUXO) preceding installation of the Eastern Green Link 1 (EGL1) subsea cable. This SEI collates and presents relevant information for the proposed UXO clearance works in relation to the Marine (Scotland) Act 2010, and the Marine and Coastal Access Act 2009.

The SEI supports the MLA and informs Marine Directorate Licensing Operations Team (MD-LOT) /Marine Management Organisation (MMO) of the significance of effect on key environmental receptors resulting from the proposed UXO clearance activities. The approach is consistent with that taken for other similar projects and considers potential for significant effects both alone and cumulatively with other relevant plans, projects and activities.

This SEI (1396955) document has been prepared by Natural Power on behalf of PPL and will be submitted alongside a suite of supporting documents including:

- Report to Inform Appropriate Assessment (RIAA) (1369784);
- Marine Conservation Zone (MCZ) Assessment (1397056);
- European Protected Species Risk Assessment (EPS RA) (1400131); and
- Marine Mammal Mitigation Plan (MMMP) (1369788).

1.1. Background

The Eastern Green Link 1 (EGL1; hereafter referred to as the 'Marine Scheme') High Voltage Direct Current (HVDC) link (Figure 1.1) is being developed to connect electricity grid infrastructure between Torness in East Lothian (Scotland) and Hawthorn Pit in County Durham (England) by National Grid Electricity Transmission (NGET) and SP Energy Networks (SPEN) jointly (together, known as the Applicant). The Marine Scheme is considered to be a major reinforcement of the electricity transmission system which will provide additional north-south transmission capacity between southern Scotland and northern England.

PPL has been selected as Principal Contractor for the engineering, procurement, construction and installation of the onshore and offshore cables.

Prior to the commencement of cable installation, further surveys were undertaken in 2024 and 2025 to confirm that no new obstructions have appeared on the seabed since the original marine surveys were conducted (in 2020), and to re-confirm the viability of the corridor and exact cable route in relation to seabed conditions, bathymetry and other seabed features. Following these surveys a number of magnetic targets were identified as potential UXOs (pUXO) and require further analysis. The MLA for Marine Scheme did not require a statutory Environmental Impact Assessment (EIA) but was subject to a detailed Environmental Appraisal (EA) (AECOM, 2022).

The Marine Scheme is described below:

Commencing at Mean High Water Springs (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.

Marine Licences were granted by MD-LOT for Scottish waters and the MMO for English waters, licence reference numbers MS-00009880 and L/2023/00212/2, respectively.

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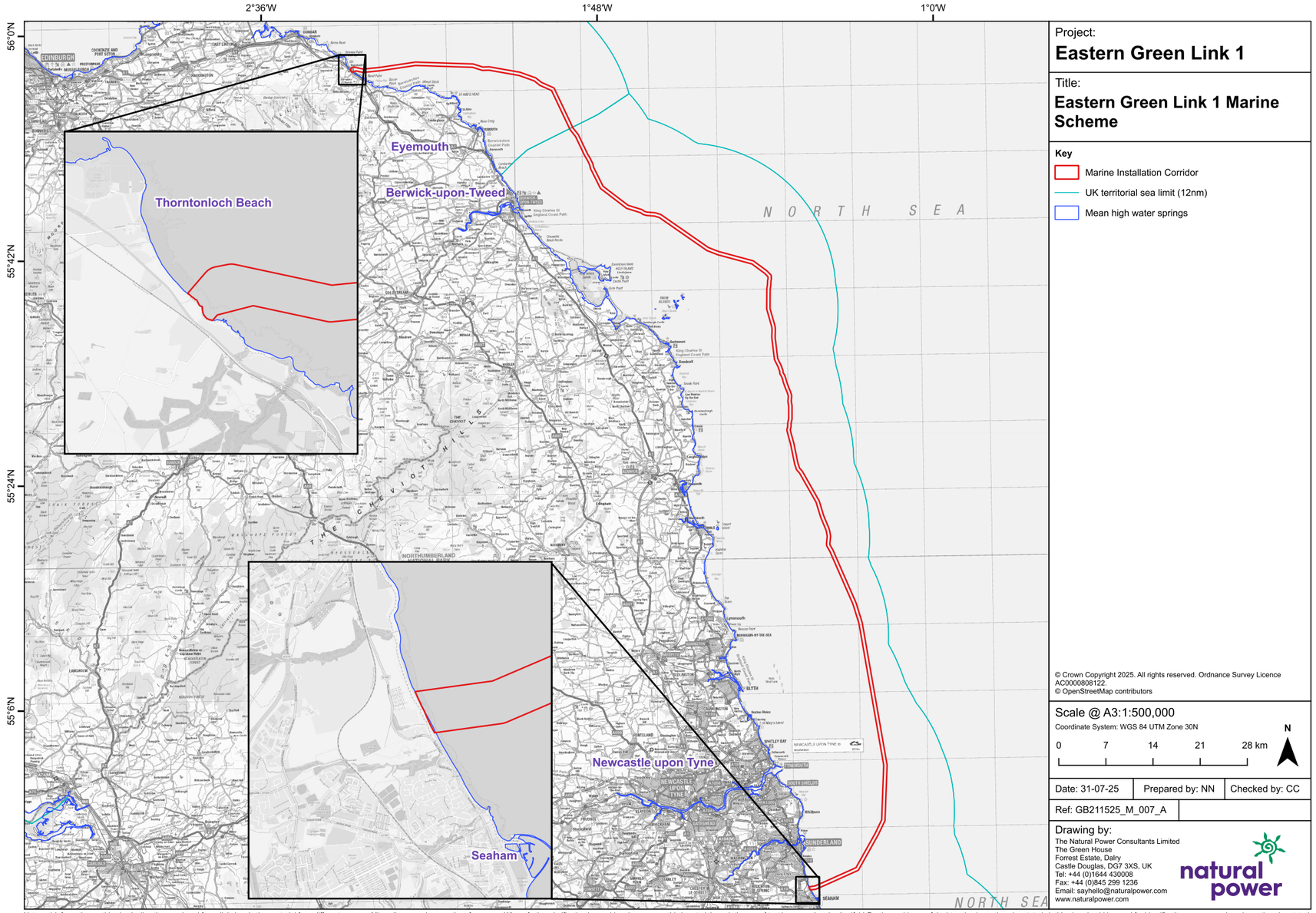

Project:
Eastern Green Link 1

Title:
Eastern Green Link 1 Marine Scheme

Key

- Marine Installation Corridor
- UK territorial sea limit (12nm)
- Mean high water springs

Scale @ A3:1:500,000

Coordinate System: WGS 84 UTM Zone 30N

0 7 14 21 28 km

N

Date: 31-07-25	Prepared by: NN	Checked by: CC
Ref: GB211525_M_007_A		

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Figure 1.1: The Eastern Green Link 1 Marine Scheme Location

1.2. Scope of this Document

The Applicant requires an additional Marine Licence application for the UXO clearance activities, should they be determined to be required, for the entire EGL1 Marine Scheme.

A hierarchical approach to addressing cUXO will be applied. This will be (in order of preference), avoidance, relocation, or clearance (deflagration or detonation). Should avoidance or relocation of UXO prove to be unfeasible following a cable micro-siting exercise, then clearance will be required.

The Marine Scheme lies within Scottish and English territorial waters and therefore Marine Licences will be required from both MD-LOT and the MMO. This document will be submitted in support of the Marine Licence applications to both Authorities.

UXO clearance was not assessed within the Environmental Assessment as part of the original application and there is potential for UXOs to be present along the Marine Scheme length.

Under the Marine (Scotland) Act 2010, and the Marine and Coastal Access Act 2009, a Marine Licence is required for UXO clearance activities.

This document has been produced to provide the supporting information to inform the MLAs and contains the following:

- Description of the UXO clearance activities (Section 2);
- Scope of assessment (Section 1);
- Environmental appraisal (Section 4);
- Summary and conclusions (Section 5); and
- References (Section 6).

The UXO clearance activities were considered against whether they could result in significant impacts on a range of marine receptors.

1.3. Marine Policy and Plans

1.3.1. England

In England, the Department for Environment, Food and Rural Affairs (DEFRA) is the overarching planning authority for marine areas, while the MMO undertakes several marine planning functions, including the development and implementation of marine plans. These plans provide policy and spatial guidance tailored to specific marine areas and ensure that activities align with UK-wide, national, and area-specific policy objectives. Marine plans encompass a wide range of objectives addressing activities, users, economic, social, environmental considerations, and cross-cutting issues such as coexistence opportunities.

Marine plans cover areas up to MHWS, whereas Local Planning Authorities (LPAs) oversee areas up to Mean Low Water Springs (MLWS). Consequently, LPAs play a vital role in integrating marine plans with land-use planning. The Marine Scheme crosses one marine plan area in England — the North East Inshore area — which, together with the offshore area, forms part of the North East Marine Plan sharing the same objectives (DEFRA, 2021).

In assessing MLAs, the MMO evaluates whether proposed activities are consistent with relevant marine plan objectives (see Table 1-1).

Table 1-1: How the objectives for the North East Inshore and North East Offshore Marine Plan (DEFRA, 2021) have been considered within the MLA for UXO Clearance Works

Objective Number	Purpose of Objective	Consideration of Objective
Achieving a sustainable marine economy		
1	Infrastructure is in place to support and promote safe, profitable and efficient marine businesses.	The UXO clearance works are being undertaken as part of the EGL1 Marine Scheme, which forms an economically sustainable activity within the North East Inshore Marine Plan area. The Marine Scheme will facilitate the export /import of sustainably generated energy, which forms part of the UK plans to achieve energy security and carbon reduction objectives.
2	The marine environment and its resources are used to maximise sustainable activity, prosperity and opportunities for all, now and in the future.	The proposed works will be undertaken in a sustainable manner, with avoidance of UXOs being undertaken where possible, and effects being mitigated where not possible.
3	Marine businesses are taking long-term strategic decisions and managing risks effectively. They are competitive and operating efficiently.	The EGL1 Marine Scheme is the result of long-term strategic decision making which aims to mitigate risks associated with the achievement of energy security and carbon reduction objectives. Ofgem considers the competitiveness and operational efficiency of such schemes.
4	Marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the market place.	See assessment in Section 4
Ensuring a strong, healthy and just society		
5	People appreciate the diversity of the marine environment, its seascapes, its natural and cultural heritage and its resources and can act responsibly.	See assessment in Section 4
6	The use of the marine environment is benefiting society as a whole, contributing to resilient and cohesive communities that can adapt to coastal erosion and flood risk, as well as contributing to physical and mental wellbeing.	The UXO clearance works are being undertaken as part of the EGL1 Marine Scheme, which forms an economically sustainable activity, benefiting the communities in the area. The Marine Scheme will facilitate the export /import of sustainably generated energy, which forms part of the UK plans to achieve energy security and carbon reduction objectives.
7	The coast, seas, oceans and their resources are safe to use.	The proposed works will not result in any reduction in the use or safety of the marine plan area. See assessment in Section 4
8	The marine environment plays an important role in mitigating climate change.	The UXO clearance works are being undertaken as part of the EGL1 Marine Scheme, which will facilitate the export / import of sustainably generated energy, which forms part of the UK plans to achieve energy security and carbon reduction objectives.

Objective Number	Purpose of Objective	Consideration of Objective
9	There is equitable access for those who want to use and enjoy the coast, seas and their wide range of resources and assets and recognition that for some island and peripheral communities the sea plays a significant role in their community.	The proposed works will not result in any significant change to accessing the marine plan area, and the resources or assets it contains.
10	Use of the marine environment will recognise, and integrate with, defence priorities, including the strengthening of international peace and stability and the defence of the UK and its interests.	The works will not result in any impacts to defence or stability.
Living within environmental limits		
11	Biodiversity is protected, conserved and, where appropriate, recovered, and loss has been halted.	See assessment in Section 4
12	Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems.	See assessment in Section 4
13	Our oceans support viable populations of representative, rare, vulnerable, and valued species.	See assessment in Section 4

1.3.2. Scotland

In Scotland, marine planning and licensing are overseen by The Marine Directorate, a directorate of the Scottish Government responsible for implementing the Marine (Scotland) Act 2010 and other relevant legislation. The Act establishes a legal framework for marine planning, conservation, and licensing within Scottish waters (up to 200 nautical miles).

The Marine Directorate develops and enforces Regional Marine Plans (RMPs) for inshore (0–12 nautical miles) and offshore (12–200 nautical miles) areas, under the overarching Scottish National Marine Plan (SNMP), published in 2015 and reviewed regularly. These plans provide spatial and policy frameworks to manage sustainable development and environmental protection in Scottish seas.

The Marine Scheme lies within the Forth and Tay (East Coast) Regional Marine Plan area[1], which covers the eastern seaboard of Scotland and which will include provisions relevant to offshore infrastructure projects.

Table 1-2 summarises how the objectives of the SNMP have been considered in relation to the UXO clearance activities.

[1] https://www.gov.scot/publications/marine-planning-regional-boundaries/

Table 1-2: How the relevant GEN Policies and Objectives for the SNMP Submarine Cables Objectives have been considered within the Marine Licence Application for UXO Clearance Works[2]

Policy / Objectives	Purpose of Objective	Consideration of Objective
GEN 1 General Planning Principle	There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.	GEN 1 is relevant to all marine activities, but it is especially relevant to key growth sectors, including grid improvements. This principle seeks to ensure that the development and use of the marine area is consistent with the National Marine Plan, ensuring activities are undertaken in a sustainable manner that protects and enhances Scotland's natural and historic marine environment. The UXO clearance works are part of the EGL1 Marine Scheme. The Marine Scheme will facilitate the export /import of sustainably generated energy, which forms part of the UK plan to achieve energy security and carbon reduction objectives.
GEN 2 Economic Benefit	Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.	The UXO clearance works are being undertaken as part of the EGL1 Marine Scheme, which forms an economically sustainable activity. The Marine Scheme will facilitate the export /import of sustainably generated energy, which forms part of the UK plan to achieve energy security and carbon reduction objectives.
GEN 3 Social benefit	Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan	The EGL1 Marine Scheme will not impact on tourism or recreation once complete, with minimal interference during the installation ensuring this policy objective is supported.
GEN 4 Co-existence	Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision-making processes, when consistent with policies and objectives of this Plan.	UXO clearance options will be short-term and spatially limited. Coordination with other sea users (e.g. fishing, shipping and offshore energy developers) will be maintained through marine notices, liaison with the Kingfisher Information Service and implementation of a Fisheries Liaison and Communication Plan to ensure safe and efficient coexistence of activities.
GEN 5 Climate change	Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change	The UXO clearance works are being undertaken as part of the EGL1 Marine Scheme, which will facilitate the export / import of sustainably generated energy, which forms part of the UK plan to achieve energy security and carbon reduction objectives.
GEN 6 Historic environment	Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a	See assessment in Section 4 ensuring this policy objective is supported.

[2] https://www.gov.scot/publications/scotlands-national-marine-plan/pages/15/ (accessed 09/10/2025)

Policy / Objectives	Purpose of Objective	Consideration of Objective
	manner proportionate to their significance.	
GEN 8 Coastal process and flooding	Developments and activities in the marine environment should be resilient to coastal change and flooding and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding.	The UXO clearance works are being undertaken as part of the EGL1 Marine Scheme, which forms an economically sustainable activity, benefiting the communities in the area. The Marine Scheme will facilitate the export /import of sustainably generated energy, which forms part of the UK plan to achieve energy security and carbon reduction objectives which will provide overall benefits to coastal flood risk.
GEN 9 Natural heritage	Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features. (c) Protect and, where appropriate, enhance the health of the marine area.	Appropriate Assessment and supporting surveys have been conducted to confirm minimal impact on SACs, SPAs, and other protected sites. Supporting assessments (RIAA, MCZ Assessment, EPS RA) confirm minimal impacts on protected sites and species. Clearance activities include environmental appraisal and mitigation measures to avoid harm to protected habitats and species ensuring this policy objective is supported.
GEN 10 Invasive non-native species	Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made	Section 3.1 describes the embedded mitigation measures for this work ensuring this policy objective is supported.
GEN 11 Marine litter	Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.	Section 3.1 describes the embedded mitigation measures for this work ensuring this policy objective is supported.
GEN 12 Water quality and resource	Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply	Activities are designed to avoid or mitigate adverse impacts, supporting ecosystem resilience and compliance with Good Environmental Status targets ensuring this policy objective is supported.
GEN 13 Noise	Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects	Section 3.1 describes the embedded mitigation measures for this work and Section 4 provides specific assessments of noise for the proposed UXO clearance work ensuring this policy objective is supported.
GEN 15 Planning alignment A	Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea	Coordination between Marine Scotland, NGET, SPEN, and local authorities ensures integration of Marine Licence with onshore infrastructure planning ensuring this policy objective is supported.

Policy / Objectives	Purpose of Objective	Consideration of Objective
GEN 16 Planning alignment B:	Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so.	Coordination between Marine Scotland, NGET, SPEN, and local authorities ensures integration of Marine Licence with onshore infrastructure planning ensuring this policy objective is supported.
GEN 17 Fairness	All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment.	Stakeholders, including regulators and local communities, have been consulted during project planning and survey stages ensuring this policy objective is supported.
GEN 18 Engagement	Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes	Stakeholders, including regulators and local communities, have been consulted during project planning and survey stages ensuring this policy objective is supported.
GEN 19 Sound evidence	Decision making in the marine environment will be based on sound scientific and socio–economic evidence	This document provides the SEI which will inform decision makers ensuring this policy objective is supported.
GEN 20 Adaptive management	Adaptive management practices should take account of new data and information in decision making, informing future decisions and future iterations of policy	Adaptive management measures will be implemented through environmental monitoring and post-clearance review to inform any future activities ensuring this policy objective is supported.
GEN 21 Cumulative impacts	Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation	Cumulative effects are considered within the Environmental Appraisal (Section 4) ensuring this policy objective is supported.
Submarine Cables 1	Protect submarine cables whilst achieving successful seabed user co-existence.	Cable will be buried and where this is not practicable, other protection will be installed, without compromising the seabed user co-existence ensuring this policy objective is supported.
Submarine Cables 2	Achieve the highest possible quality and safety standards and reduce risks to all seabed users and the marine environment.	UXO clearance is managed under strict safety protocols to avoid hazards to marine traffic and other users ensuring this policy objective is supported.
Submarine Cables 5	Support the generation, distribution and optimisation of electricity from traditional and renewable sources to Scotland, UK and beyond.	UXO clearance supports the EGL1 Marine Scheme, facilitating sustainable energy transmission and contributing to Scotland's climate and energy commitments.

2. Description of the UXO Clearance Activities

In order to undertake installation activities, a number of route preparation activities will be required to ensure that cable installation activities are performed safely without risk to personnel or equipment, including pre-installation surveys, route clearance, boulder clearance and UXO clearance. The MLA for UXO clearance works in the Marine Scheme aims to provide necessary information to support the ML decision making process by the Authorities.

2.1. Outline Programme

The EGL1 UXO clearance work is anticipated to take up to one month between Q2 and Q3 2026, following target inspection operations. The duration will depend on the exact number of UXO to be cleared but it is estimated a maximum of 60 days, including weather downtime. No more than one UXO detonation is expected to occur in a 24-hour period.

2.2. Outline Method Statement

In June 2025, offshore geophysical surveys were undertaken in order to identify pUXOs based on bathymetry, seabed data and magnetometry. After the survey was performed, a list of pUXOs was defined. Based on this initial list, engineering works were performed to avoid these pUXOs whenever possible. Where avoidance of pUXOs is not possible, a target inspection (activity outside of the scope of the present document) will be performed by experts to determine if the target is a cUXO.

UXO target inspection ('UXO TIs') was assessed and considered as part of the original 'main' EGL1 MLA (MLA/2022/00231), and UXO TIs are included within the consented EGL1 Marine Licence (L/2023/00212/2). As has been discussed and agreed with the MMO via regular post-consent / pre-construction engagement in 2024/2025, it is the intention of the Applicant and PPL alike to draw upon the existing Marine Licence for UXO TIs. Pursuant to this and as agreed with the MMO, a brief UXO TI method statement will be supplied to the MMO, alongside other minor / admin condition responses, in order to discharge this activity on the Marine Licence and 'unlock' use. A similar approach will be followed with MD-LOT to draw upon the existing Marine Licence (MS-00009880) for UXO TIs in Scotland.

Considering the timeline required for the submission of the licence, the final number (including location, size, type and exact methodology for clearance) of cUXO to be cleared is not known at this stage but it is based on the initial list of pUXOs and first re-routing.

2.2.1. pUXO Targets

The below table presents numbers regarding the UXO process (Table 2-1). Numbers identified by a (*) are those pUXO which are estimated to be confirmed following UXO target inspection.

The targets are located between 7 and 88.6m LAT (Lowest Astronomical Tide).

Table 2-1: Number and locations of pUXO targets and number of cUXO required to be cleared

Location	Total pUXO targets	pUXO targets to be inspected	Estimated UXO targets	UXO to be cleared
	Identified from UXO survey – full corridor		Identified after Target Inspection	Which remain after micro-siting exercise
Full route	554	70*	55*	**40***
Scotland	144	20*	15*	10*
England	410	50*	40*	30*

2.2.2. UXO Clearance

A hierarchy of options for managing UXOs are available:

- Micro-siting i.e., avoidance of UXO;
- Relocation ('lift and shift') of UXO (where deemed safe to do so); and
- The primary method for clearance is low order and high order will only be used following attempts to undertake low order clearance;
    - Low order (deflagration) – Low order technique causes UXO to burn out without detonating. A small charge is fired at the explosive fill of the UXO, causing the explosive content to ignite and burn out. The casing of the munition cracks open, but if successful, it should not detonate. Low order clearance methods will be utilised in the first instance.
    - High order (detonation) – An ordnance detonation that results in an explosive ordnance producing the designed/intended explosive yield. This is typically achieved by sympathetic detonation caused by a place donor charge.

It is anticipated that 90% of UXO targets will be cleared using low order clearance methods whilst up to 10% of UXO (maximum four UXOs) may require high order clearance methods (i.e., a maximum of 36 low order clearances and 4 high order clearances). It is likely that different types of UXO will be present (with a moderate likelihood to encounter HE bombs, sea mines and projectiles originating from WWI and WWII), many of which are likely to have been subject to degradation or burying over time. The largest UXO modelled for the worst-cast scenario has a Net Explosive Quantity (NEQ) of 722 kg (Appendix A).

Low order clearance is preferable to high order clearance as it avoids the high pressures associated with an explosion by using a small initiation explosive to 'burn away' the target explosive material within the UXO. Different sized initiation explosives may be required for different sized UXOs.

A detonation event is defined as a planned clearance through high order methods of a single UXO or of multiple UXO where they are suited together such that a single detonation can be used for clearance.

2.2.3. Vessels and Equipment

It has not yet been confirmed which vessels will be used for the UXO clearance work. It is anticipated that a maximum of four vessels will be required:

- An 'ROV (Remotely Operated Vehicle) support vessel' from which any charges will be set and on which the mitigation personnel will be based. It is likely that ultra short baseline (USBL) equipment will be used if ROVs are being used, for example to place donor charges;
- A 'dive support' vessel from which divers can be deployed
- A 'guard vessel' which will undertake preparation and implementation of the detonations and from which the Acoustic Deterrent Device (ADD) will be deployed; and
- A mitigation vessel for the deployment of a Noise Abatement System (NAS) if required.

Up to four vessels will be on site for a limited duration (anticipated a maximum of 60 days including weather downtime), with no more than one UXO detonation expected to occur in a 24-hour period. The potential for impact on the designated sites from the use of vessels will mainly be related to indirect disturbance both in terms of noise and physical presence. Vessels will undertake 24/7 working and the UXO clearance strategy will be planned to minimise vessel transit lengths between targets.

Notably, it is important to recognise that the presence of a multitude of vessels during the installation process has already been fully assessed and considered within the previous EA, supplied to the MMO in support of the original 'main' MLA (MLA/2022/00231) (AECOM, 2022). The MMO provided a favourable determination and deemed the limited vessel noise associated with the Marine Scheme to be acceptable.

2.3. Licensable Marine Activities

The following activities associated with the UXO clearance are considered to be licensable under the Marine (Scotland) Act 2010 (Category C Application) and the Marine and Coastal Access Act (2009):

- Deposit of any substance or object (England and Scotland); and
- Use of explosives (England and Scotland).

Disturbance to European Protected Species is not a licensable activity under these Acts but is regulated separately under the Conservation of Habitats and Species Regulations 2017 (as amended) and the Conservation (Natural Habitats (&c.) Regulations 1994 (as amended). This has been assessed within the accompanying European Protected Species Risk Assessment (EPS RA) (1400131) and the Marine Mammal Mitigation Plan (MMMP) (1369788). Where relevant, an EPS or a marine wildlife licence will be obtained prior to commencement of works.

3. Scope of Assessment

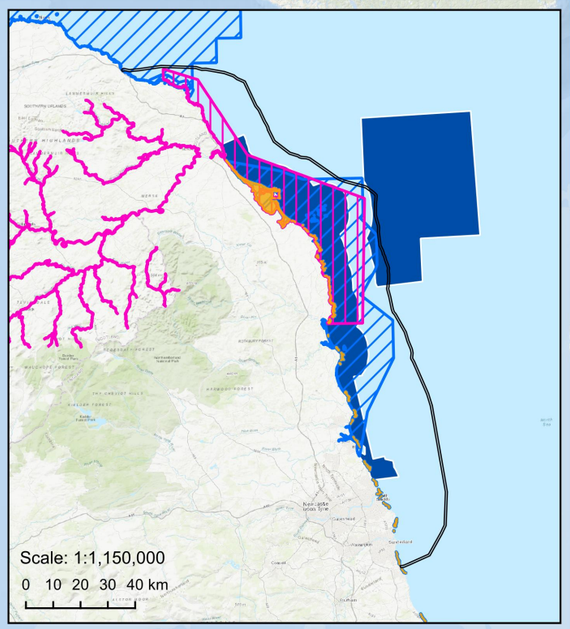
Consideration of potential impacts and mitigation measures to reduce the potential for significant environmental effects to occur are provided. This includes relevant designated sites where there is considered to be a potential for interaction with the proposed work (shortest straight-line distances provided) (Figure 3.1):

- Farnes East MCZ (direct overlap);
- Northumberland Marine SPA (direct overlap);
- Outer Firth of Forth and St Andrews Bay Complex SPA (direct overlap);
- Northumbria Coast SPA / Ramsar (0.26 km);
- Berwickshire and North Northumberland Coast SAC (0.35 km);
- Berwick to St Marys MCZ (1.4 km);
- St Abbs Head to Fast Castle SPA (herring and sandeel7 km);
- Farne Islands SPA (6.98 km);
- Coquet to St Marys MCZ (8.7 km);
- Lindisfarne SPA / Ramsar (8.95 km);
- Tweed Estuary SAC (12.00 km);
- Coquet Island SPA (14.51 km);
- River Tweed SAC (19.86 km); and
- Moray Firth SAC (> 200 km)

An assessment of potential impacts on the above designated sites and MCZs is provided in the RIAA (1369784) (Natural Power, 2025a) and MCZ Assessment (1397056) (Natural Power, 2025b), respectively.

6°36'W
2°36'W
1°24'E
5°24'E
57°36'N
55°36'N
53°36'N
51°36'N

Moray Firth SAC
Outer Firth of Forth and St Andrews Bay Complex SPA
St Abb's Head to Fast Castle SPA
Tweed Estuary SAC
Farnes East MCZ
River Tweed SAC
Berwick to St Mary's MCZ
Lindisfarne SPA and Ramsar
Farne Islands SPA
Coquet Island SPA
Northumberland Marine SPA
Northumbria Coast SPA and Ramsar
Coquet to St Mary's MCZ
Berwickshire and North Northumberland Coast SAC



Project:
Eastern Green Link 1

Title:
Figure 3.1: Location of EGL1 Marine Installation Corridor and Assessed Designated Sites

Key

- EGL1 Marine Installation Corridor

Designated Sites

- Special Area of Conservation (SAC)
- Marine Conservation Zone (MCZ)
- Special Protection Area (SPA)
- Ramsar

Sources: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors. Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community.
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Not to be used for Navigation.

Scale @ A3: 1:3,500,000
Coordinate System: WGS 84 UTM Zone 30N
Graticules: WGS 84
0 50 100 150 200 km
N

Date: 09-09-25	Prepared by: AC	Checked by: VR
Ref: GB211525_M_009_A		

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3.1. Embedded Mitigation

There are a number of embedded mitigation measures which will be implemented:

- A hierarchical approach to addressing cUXO will be applied. This will be (in order of preference), avoidance, relocation, or clearance (deflagration or detonation) to ensure the chances of high order detonation are reduced as low as possible;
- Compliance with IMO (International Maritime Organisation) conventions including COLREGs (Convention on the International Regulations for Preventing Collisions at Sea) and SOLAS (International Convention for the Safety of Life at Sea) to ensure standard levels of navigation and vessel safety are adhered to;
- Issue of Notice to Mariners (NtM) notifying of the type and location of the UXO clearance;
- Implementation of appropriate safety distances during UXO inspection;
- Waste management on board vessels is covered the Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008. These regulations implement revised Annex IV of MARPOL 73/78 (Regulations for the Prevention of Pollution by Sewage from Ships), and Annex V of MARPOL 73/78 (including amendments) (Regulations for the Prevention of Pollution by Garbage from Ships);
- Appropriate biosecurity, aimed at preventing Invasive Non-Native Species (INNS); and
- Any work to be undertaken will avoid all designated Archaeological Exclusion Zones (AEZs) specified for the Development. A Protocol for Archaeological Discoveries (PAD) has been prepared, in line with current consents for the installation works which will be provided to contractors. Specific mitigation includes:
  - Adherence to known AEZs;
  - Analysis of the survey data
  - Implementation of the agreed Written Scheme of Investigation (WSI)/PAD.

3.2. Evaluation of Potential Impacts

An evaluation of potential environmental impacts is provided in Table 3-1, below, with additional information provided in Section 4 (Environmental Appraisal), where necessary. The scale of potential impacts with high order detonation will vary depending on the UXO type, the quality, age, the amount of explosives it contains, location, degree of decomposition and location in relation to sensitive receptors (JNCC, 2025a). Where mitigation is considered to adequately be in place to minimise an impact to as low as reasonably practicable, e.g. accidental pollution events and introduction of INNS risk, no significant impacts are considered likely and these pathways are not considered further.

Table 3-1: Summary of Potential impacts Relating to the UXO Clearance Activities for EGL1

Receptor	Further consideration required	Reasoning
Physical Environment	Yes	UXO clearance activities may result in temporary effects on marine physical processes. The following impacts are considered in Section 4.1: • Temporary seabed disturbance.
Benthic Ecology	Yes	UXO clearance activities may result in temporary benthic habitat disturbance. The following impacts are considered in Section 4.2: • Seabed disturbance - temporary disturbance and temporary loss of habitat; and • Seabed disturbance - temporary increases in SSC.

Receptor	Further consideration required	Reasoning
Natural Fish and Shellfish	Yes	UXO clearance activities, may result in temporary fish and shellfish habitat disturbance. The following impacts are considered in Section 4.3: • Seabed disturbance - direct and indirect temporary habitat disturbance; • Seabed disturbance - temporary increases in SSC; and • Underwater noise – direct impacts on fish species.
Marine Mammals	Yes	UXO clearance activities may temporarily impact marine mammals. The following impacts are considered in Section 4.4: • Increased anthropogenic noise from UXO clearance work; • Increased anthropogenic noise from use of Ultra-short Baseline (USBL) equipment; • Risk of collision with vessels; and • Changes in turbidity.
Ornithology	Yes	UXO clearance activities will result in increased vessel presence over a short period of time, some minor temporary disturbance to ornithological receptors may occur. The following impacts are considered in Section 4.5: • Visual and noise related disturbance; and • Indirect effects through impacts on prey species.
Seascape, Landscape and Visual Impact Assessment (SLVIA)	No	No visual impact, other than localised and temporary vessel presence in an area of already high vessel traffic. Additional four vessels will not lead to a significant effect on seascape, landscape and visual receptors, in an area which already experiences heavy vessel usage. No further assessment required.
Cultural Heritage and Marine Archaeology	Yes	UXO clearance activities may result in sediment disturbance potentially affecting cultural heritage assets. The following impacts are considered in Section 4.6: • Seabed disturbance – damage to or removal of heritage features resulting from direct physical impacts.
Commercial Fisheries	Yes	UXO clearance activities will result in up to four additional vessels. Additional vessels working in the area has the potential for effects on the commercial fishing community. The following impacts are considered in Section 4.7: • Vessel presence - disruption to existing fishing activities from temporary loss or restricted access to fishing grounds and displacement of fishing vessels into other areas.

Receptor	Further consideration required	Reasoning
Shipping and Navigation	Yes	UXO clearance activities will result in up to four additional vessels. Additional vessels working in the area have the potential for effects on shipping and navigation in the area. The following impacts are considered in Section 4.8: • Vessel presence - increased vessels in the area.
Socio-Economics and Tourism	No	No potential for significant adverse effects to arise given the nature of the work (subtidally) offshore, the temporary and localised work, and as such no requirement for further assessment.
Military and Civil Aviation	No	Due to the distance from any military areas (further than the greatest predicted crater size of 10.5 m) there is no potential for significant adverse effects to arise. Military and civil aviation were scoped out of original assessment due to distance and therefore, this conclusion remains valid for the UXO clearance activities and as such there is no requirement for further assessment. Additional vessels associated with the UXO clearance work which could interact with military activities are covered in shipping and navigation (Section 4.8)
Other Human Considerations	No	There may be very short periods of time during the works when there could be disruption to other human users of the environment. Short term and partial closures are not predicted to result in any significant effects on other users as large areas of sea will remain accessible. As such there is no potential for significant adverse effects to arise, and no requirement for further assessment.
Climate Change and Greenhouse Gases	No	It is recognised that some greenhouse gas emissions, arising from vessel activity will be emitted as part of this proposed work. Due to the temporary and localised nature of the works, greenhouse gas emissions and waste materials are not considered to represent any potential for significant effects. It is considered that the works, as applied for, represent the lowest overall environmental effect. There is no potential for significant adverse effects to arise, and as such, no requirement for further assessment. Furthermore, the objective of the activities is to support the development of the EGL1 Marine Scheme which will transport energy, including that generated by renewable sources, and ultimately contribute to a reduction in the UK's greenhouse gas emissions.

3.3. Activities and Worst Case Scenario Parameters

To determine the potential for significant effect, the impacts which may arise as a result of the UXO clearance works are herein identified and assessed against the receptor group considering the following activities and worst case scenario (WCS) parameters associated with UXO clearance works:

- **Vessel presence:** The presence of an anticipated up to four additional vessels within the marine environment associated with UXO clearance activities has the potential to interfere with other vessels in the area and result in disturbance which may displace and/or otherwise disturb receptors present in the marine environment;
- **Underwater noise and vibration** due to detonation works. It is anticipated under the WCS that up to a maximum of 40 cUXO targets will require detonation along the cable route. These detonations will preferably be of low order, with high order only adopted at location where low order is not feasible. It is anticipated that 90% of UXO targets will be cleared using low order clearance methods whilst up to 10% of UXO (maximum four UXOs) may require high order clearance methods (i.e., a maximum of 36 low order clearances and 4 high order clearances). The potential area of effect is different for separate receptor groups and individual receptors, and is covered for fish and marine mammals in Section 4.3 and Section 4.4, respectively. The UXO detonation may be spread over the cable route and each will be a discrete event within the duration of the campaign (not expected to occur more than once in a 24 hour period. The EGL1 UXO clearance work is anticipated to take up to one month within Q2 and Q3, 2026 (over a maximum of 60 days, including weather downtime)). The potential for impacts on the sensitive receptors from the detonation works primarily relate to the direct impacts of physical and/or physiological effects (e.g., mortality, injury) and/or behavioural responses (e.g., disturbance) to marine receptors from noise. Underwater noise from other associated sources (e.g. underwater positioning equipment) is assessed for relevant receptors; and
- **Seabed disturbance** associated with detonations will vary with UXO type and size, as well as sediment characteristics. Any depressions produced are predicted to be between 0.9 – 3 m deep and range from 1.4 – 10.5 m in radius for high order clearance. There is also potential for increased Suspended Sediment Concentrations (SSCs) and associated redistribution and sedimentation, which has potential to expose or smother ecological receptors, including seabird prey species. Low order inspection and clearance will result in a negligibly small area of sediment disturbance, which would be imperceptible against natural processes.

Note that it is expected that the majority of cUXO which cannot be relocated or micro-routed around, will require low order deflagration. This process is minimally invasive, potentially requiring some excavation around the cUXO, however this will result in imperceptible effects within the wider environment. The resulting remaining material from the UXO will be picked up and brought aboard for disposal onshore, where practicable.

Study areas are dependent on the receptor and the impact assessed, and are defined within the relevant sections in the environmental appraisal (Section 4). This assessment first considers the project alone, and the potential for cumulative effects with other plans and projects.

3.4. Cumulative Assessment

The following long list of plans and project have been identified as having potential impact pathways to the same National Site Network sites as those identified for the EGL1 marine installation corridor:

- Scotland to England Green Link (SEGL), Eastern Link (EL) 1 – English Onshore Scheme;
- Scotland to England Green Link (SEGL), Eastern Link (EL) 1 – Scottish Onshore Scheme;
- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only);
- Blyth Offshore Demonstrator Array 4 (Phase 2);
- Inch Cape Offshore Wind Farm;
- Berwick and Marr Bank Offshore Wind Farm; and
- Neart na Gaoithe Offshore Wind farm.

Cumulative effects have been considered for each receptor group, for each impact and assessments are presented in Section 4.

4. Environmental Appraisal

This section presents the environmental topics considered based on the potential for an impact from the proposed UXO clearance works. Where identified as required (Table 3-1), further information and consideration of environmental effects arising from the UXO clearance activities are provided in this section through a review of existing EA assessment conclusions, followed by an updated assessment (and baseline where relevant) for the UXO clearance activities.

Study areas are dependent on the receptor and the impact assessed, and are defined where necessary within the relevant sections in the environmental appraisal below.

The UXO clearance activities are analogous to other installation phase work that may be undertaken for the installation of a subsea cable (i.e., short duration, localised, and utilised for facilitating the installation) and therefore it is considered that the baseline and relevant installation phase impacts from the existing EA are relevant to the consideration of whether significant effects may arise from the proposed work.

4.1. Physical Environment

4.1.1. Baseline

The majority of the EGL1 marine installation corridor is heterogeneous comprising varying proportions of gravel sand and fines (Chapter 7: Physical Environment of the EGL1 EA (AECOM, 2022)). Sediment coarseness decreased southwards along the marine installation corridor, and there were localised patches of coarse sediment along the marine installation corridor.

Depth varies along the marine installation corridor from 1.8 m below LAT to 88.6 m below LAT, with a trough (a channel) between sand waves between KP 45 to KP 65 (near Berwick upon Tweed) (Chapter 7 – Physical Environment of the EGL1 EA (AECOM, 2022)). Areas of outcropping rock are present, primarily at landfalls with discrete patches recorded along the marine installation corridor.

Ripples and megaripples were present throughout the area surveyed during the baseline but were predominantly orientates in a north-east to south-west direction, changing to south-east to north-west in shallow sections and sand waves were present in deeper areas (reaching up to 2.5 m high and 130 m in length) (Chapter 7: Physical Environment of the EGL1 EA (AECOM, 2022))

4.1.2. Existing EA Conclusions

The effects of the Marine Scheme on the physical environment of the area are set out in Chapter 7 – Physical Environment of the EGL1 EA (AECOM, 2022). The EA concluded that no significant effects are predicted during installation, operation (including maintenance and repair), and decommissioning of the Marine Scheme.

Update on Additional Relevant Findings

Considering the long term processes considered in the assessment, no additional information relevant to this assessment to be added.

4.1.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Temporary seabed disturbance leading to changes in seabed morphology and increased suspended sediments.

4.1.3.1. Temporary Seabed Disturbance

The UXO clearance activities along the EGL1 marine installation corridor assume seabed craters of a maximum radius of 10.5 m. The majority of the EGL1 marine installation corridor is comprised of a range of sediment particle sizes and due to the presence of soft mobile sediments along the marine installation corridor, it is expected that any

depressions created will naturally infill due to the natural marine processes in the area and should any depressions remain, it is not expected these will give rise to any significant alterations in hydrodynamic processes (including tidal regime or sediment transport).

The cUXO high order clearance activities will disturb, mobilise and release sediment into the water column, which will subsequently be dispersed by the natural currents and tides in the area. Any increases in SSC and associated deposition will be highly localised, temporary and considered unlikely to exceed the background levels found along the marine installation corridor and in the wider geographical area. Should SSC levels exceed background levels, the effect will be only for a short period of time and expected to be in line with storm event elevated levels, occurring naturally.

Each cUXO clearance 'event' (of which there are expected to be no more than one in a 24 hour period) will be spatially discrete with intermittent work. The maximum predicted depressions are 3 m deep and 10.5 m radius (Section 3.3).

The original EA concluded that the cable installation of the whole EGL1 Marine Scheme (much larger scale of work) would have a negligible effect on the physical environment and was therefore not significant.

Given the above and the EA which concluded the effects of the entire EGL1 cable installation was determined to be not significant, involving significantly more disturbance than UXO clearance activities, it is considered there is no potential for significant impacts of seabed disturbance on the physical environment.

4.1.3.2. Cumulative Assessment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the effect of temporary seabed disturbance on the marine physical environment, to include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only).

This list has been refined based on overlap of potential plans and projects with the potential for overlapping construction or installation with the UXO clearance activities. Given the limited potential for temporal overlap and the temporary localised nature of the work, with relatively limited seabed disturbance (considerably less than assessed in the EA for the cable installation), it can be concluded that the Marine Scheme's negligible contribution cumulatively with other plans and projects is not significant for temporary seabed disturbance.

4.1.4. Conclusion

Work at each cUXO location (and all cUXO combined) will cause temporary changes to the physical environment. The change to the physical environment from UXO clearance will result in a smaller area of temporary seabed disturbance than would be experienced during cable installation (which was assessed as not significant).The work will be localised, taking place over a short period of time, and that the area to be impacted is considerably less than cable installation (any craters will naturally infill through natural sediment transport regime in the area). It can therefore be concluded that no significant effects are predicted to arise on the physical environment either alone or cumulatively with other plans and projects, as a result of the UXO clearance activities.

4.2. Benthic Ecology

4.2.1. Baseline

The baseline investigations found that the subtidal benthic habitats identified around the marine installation corridor were generally dominated by areas of mud, sand, and coarse sediments as well as a number of sensitive seabed habitats such as subtidal sands and gravels and mud habitats in deep water. The intertidal habitat at the Scottish landfall is primarily rock platform with banks of gravel, which aligns with the European Nature Information System (EUNIS) broad scale habitat type A3 - Infralittoral rock and other hard substrata while the intertidal habitat at the English landfall is primarily sandy foreshore, with a rock platform backshore. There is evidence of Annex I Reefs features within the marine installation corridor (Fugro, 2021). Areas of the biotope 'Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock' (A4.214) were identified during the benthic survey and were

considered to qualify as Annex I Reef habitat (Fugro, 2021). Bedrock was also identified, including at a station within the Farnes East MCZ designated for bedrock features. A total of 19 EUNIS biotope complexes were recorded across the subtidal area of marine installation corridor during the benthic characterisation survey which can be split into three broad categories; Infralittoral rock and other hard substrata (A3), Circalittoral rock and other hard substrata (A4) and Sublittoral sediment (A5) (Table 4-1).

Table 4-1: Summary of subtidal broad-scale habitats and biotope complexes identified during baseline benthic surveys (Fugro, 2021 in Chapter 8: Benthic Ecology EGL1 EA (AECOM, 2022))

Broad Scale Habitat	Habitat Complex	Biotope Complex
Infralittoral rock and other hard substrata (A3)	Atlantic and Mediterranean high energy infralittoral rock (A3.1)	Foliose red seaweeds on exposed lower infralittoral rock (A3.116)
		Mixed Kelps with Scour-tolerant and Opportunistic Foliose Red Seaweeds on Scoured or Sand-covered Infralittoral Rock (A3.125)
	Atlantic and Mediterranean moderate energy infralittoral rock (A3.2)	Kelp and red seaweeds (moderate energy infralittoral rock (A3.21)
Circalittoral rock and other hard substrata (A4)	Atlantic and Mediterranean moderate energy circalittoral rock (A4.2)	Echinoderms and crustose communities on circalittoral Rock (A4.21)
		Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock (A4.214)
Sublittoral sediment (A5)	Sublittoral coarse sediment (A5.1)	Circalittoral coarse sediment (A5.14)
		Deep circalittoral coarse sediment (A5.15)
		Glycera lapidum in impoverished infralittoral mobile gravel and sand (A5.135)
	Sublittoral sand (A5.2)	Deep circalittoral sand (A5.27)
		Fabulina fabula and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (A5.242)
		Abra prismatica, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (A5.252)
		Circalittoral muddy sand (A5.26)
	Sublittoral mud (A5.3)	*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud (A5.351)
		Thyasira spp. and *Nuculoma tenuis* in circalittoral sandy mud (A5.352)
		Amphiura filiformis and *Nuculoma tenuis* in circalittoral and offshore muddy sand (A5.353)
	Sublittoral mixed sediments (A5.4)	Circalittoral mixed sediments (A5.44)
		Ophiothrix fragilis and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediments (A5.445)
		Deep circalittoral mixed sediments (A5.45)
		Polychaete-rich deep venus community in offshore mixed sediments (A5.451)

Communities found within the marine installation corridor include polychaetes, bivalves, crustaceans and brittlestars. Annelids dominate the marine installation corridor (ranging from 38.2 % to 53.6 % of the total diversity of animals present) with arthropods and molluscs following in second and third at most sampling stations. Sand and gravel habitats within the nearshore area serve as nursery grounds for juvenile commercial fish species as well as internationally important fish and shellfish species in deeper waters offshore. Mud habitats in deep water support species such as the Norway lobster (*Nephrops norvegicus*), the burrowing shrimp (*Callianassa subterranean*), seapen populations and brittlestars. Two non-native species (NNS), *Goniadella gracilis* (polychaete) and *Sargassum muticum* (brown algae), and two cryptogenic species, *Nereis zonata* (polychaete) and *Polydora cornuta* (polychaete), were recorded during the surveys.

One site designated to the protection of marine benthic habitats and species overlap with the marine installation corridor: the Farnes East MCZ. The Berwickshire and North Northumberland Coast SAC is located in both English and Scottish waters, is designated for several Annex I habitats and is located less than 350 m from the marine installation corridor. There are three other designated sites within 10 km of the installation corridor in English waters; Durham Coast SAC, Berwick to St Mary's MCZ and Coquet to St Mary's MCZ.

4.2.2. Existing EA Conclusions

The effects of the installation of the Marine Scheme on the benthic ecology of the area are set out in Chapter 8: Benthic Ecology of the EGL1 EA (AECOM, 2022), submitted as part of the original MLA. The EA concluded that no significant effects are predicted during installation, operation (including maintenance and repair), and decommissioning of the Marine Scheme.

Update on Additional Relevant Findings

Benthic baseline surveys for the Berwick Bank Cambois connection has limited overlap in data, however confirms and validates that the southern extent of the EGL1 marine installation corridor is comprised of mainly finer sediments (sand and muddy sand) (SSE Renewables, 2023a).

4.2.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Seabed disturbance - temporary disturbance and temporary loss of habitat; and
- Seabed disturbance - temporary increases in SSC leading to smothering.

4.2.3.1. Seabed Disturbance - Temporary Disturbance and Temporary Loss of Habitat

The UXO clearance activities may result in temporary habitat disturbance and temporary loss of habitat, albeit over a relatively small area of seabed with small, discrete locations disturbed in order to clear cUXO.

The extent and nature of seabed disturbance associated with detonations will vary with UXO type and size and sediment characteristics. In any given depth of water, there is a downward force which effectively increases the resistance of the seabed to sediment displacement and reduced the likeliness for sediment to distort or eject during high order detonation crater formation and a rapid decrease in crater size is experienced with increasing depth (JNCC, 2025a). From previous UXO clearance works, any high order clearance depressions produced are predicted to be between 0.9 – 3 m deep and range from 1.4 – 10.5 m in radius (East Anglia THREE ((MLA/2023/00532))[3]. Recent evidence (JNCC, 2025a) suggests however, that these values are highly precautionary and it has been shown that disposal operations of up to 250 kg NEQ did not produce craters exceeding approximately 5.5 m or a depth of approximately 2.5 m. Nonetheless, to ensure a precautionary approach to assessment, a radius of 10.5 m has been used in this assessment.

[3] Note: There is very limited open-source information on crater size produced by detonations underwater and there does not appear to be any comprehensive research on the topic. Information has therefore been sought from other work undertaken at other sites for similar activities.

The UXO clearance activities along the EGL1 marine installation corridor assume a maximum radius of 10.5 m, with an area of 1,385.6 m^2, noting only a maximum of 4 UXOs will be cleared using high order methods[4]

The majority of the route is comprised heterogeneous sediment, comprising varying proportions of gravel, sand and fine sediments. The marine installation corridor also featured sporadic patches of circalittoral rock in the offshore subtidal region, with cobbles and boulders present at landfall locations (Chapter 8: Benthic Ecology of the EGL1 EA (AECOM, 2022)).

Depending on the location of UXOs, rock and sediment habitats may be impacted by UXO detonations. UXO clearance activities will be temporary, short-term and highly localised. Small-scale displacement of sediment habitats through UXO clearance works is not considered to represent any greater than a negligible impact on sublittoral sedimentary habitats. Any areas of sediment disturbed through UXO clearance activities are predicted to recover in form and community in very short order, considering the large area of equivalent habitat from which species are able to recolonise the affected area. This is also true of rock habitats; habitats such as 'Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock' have low sensitivity to habitat disturbance with species expected to recover rapidly following the impact (Stamp *et. al*., 2003). Rock habitats have the potential to suffer some habitat loss from UXO clearance activities; where this is the case, areas of exposed rock are considered resilient and will recolonise and regenerate quickly from species on the surrounding rock habitat and planktonic larvae, with recovery evident in the short term (Tillin *et al.,* 2023). For protected marine features, separate RIAA and MCZ assessments (1369784 and 1397056, respectively) have been produced and submitted alongside this SEI. Given the above and that the residual effect from the EA was determined to be not significant for cable installation, which will involve significantly more disturbance than UXO clearance activities, it is considered there is no potential for significant impacts of habitat disturbance / loss on the benthic ecology.

4.2.3.2. Seabed Disturbance - Temporary Increase in SSC

The UXO clearance activities have the potential to physically disturb the seabed through detonation of cUXO, resulting in an increase in SSC within the water column.

Bedrock and stony reef habitats such as the ones present in the Marine Scheme area are not sensitive to light smothering and have low sensitivity to heavy smothering (< 5 cm is the benchmark used by the Marine Life Information Network (MarLIN) for light smothering and >5cm for heavy) (Stamp *et. al*., 2003, Tillin *et. al*., 2003). Whilst sediment habitats contain species which live in and on the sediment and as such are adapted to sediment deposition. The sediment arising from the activities will be limited in volume, being dispersed into a naturally dynamic system with cyclical changes in turbidity, and benthic features are largely adapted to such small fluctuations in rock and sediment habitats. The UXO clearance activities will be conducted over a small area and as such, limited arisings into the water column are expected and these will rapidly disperse and dilute. The original EA assessed full cable installation, which will involve greater levels of increases in SSC and deposition than those from UXO clearance activities and the impact was assessed as not significant for all benthic ecology receptors. Given this, it is considered there is no potential for significant impacts of temporary increase in SSC on the benthic ecology.

4.2.3.3. Cumulative Assessment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for temporary disturbance and temporary loss of habitat, and temporary increases in SSC to include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only);

The EGL1 UXO clearance work is anticipated within Q2 and Q3, 2026 which has the potential to overlap with the commencement of the Berwick Bank Cambois connection installation.

There is direct overlap of the Berwick Bank Cambois Connection with the marine installation corridor via a crossing offshore of Blyth where the Cambois connection landfalls. The potential also exists for temporal overlap in activities.

[4] Area (approximated as a circle) $A = \pi r^2 = \pi(10.5^2) = 346.4\, m^2$ x 4 (no.) = 1,385.6 m^2 = 0.0014 km^2

4.2.3.3.1. Seabed Disturbance - Temporary Disturbance and Temporary Loss of Habitat

It is anticipated that limited habitat will be disturbed and potentially lost overall which represents an imperceptible area of the available habitat in the wider area. Sedimentary habitats will also recover rapidly limiting the period over which cumulative impacts may arise.

It can be concluded that given the localised and temporary nature of the UXO clearance works, the Marine Scheme's contribution to cumulative temporary seabed disturbance and loss is negligible and will not lead to a significant cumulative impact.

4.2.3.3.2. Seabed Disturbance - Temporary Increase in SSC

The EIA for the Berwick Bank Cambois connection assessed 90% of sediment to settle within a relatively short distance and high concentrations of SSC would only be experienced for tens of metres, with a maximum detection at 10 km. Although the instantaneous increases are in SSC are high, these are transient with levels rapidly returning to background levels (within days) (SSE Renewables, 2023a).

Whilst there is direct overlap of the Berwick Bank Cambois Connection with the marine installation corridor, this is a crossing offshore of Blyth where the Cambois connection landfalls. The potential exists for temporal overlap in activities, however whilst UXO clearance is being undertaken the area would require clearance and safety zones would be in place.

It can be concluded that given the localised and temporary nature of the UXO clearance works, the Marine Scheme's negligible contribution cumulatively with other plans and projects is not significant for increases in SSC.

4.2.4. Conclusion

Work at each cUXO location will affect an imperceptible percentage of the habitat in the wider area for a short period of time. The impacts which may occur are considered to be significantly lesser in scale and magnitude than those already consented (and assessed as not significant) for installation of the EGL1 Marine Scheme and given the significantly smaller spatial and temporal scale of the UXO clearance activities compared to the wider installation activities, it can be concluded that no significant effects are predicted to arise on the benthic ecology of the area either alone or cumulatively with other plans and projects, as a result of the UXO clearance activities.

4.3. Fish and Shellfish Ecology

4.3.1. Baseline

A range of species were identified during baseline characterisation of the Marine Scheme (Fugro, 2021 in Chapter 8: Benthic Ecology EGL1 EA (AECOM, 2022) and publicly available report). Many of the species have commercial importance and have spawning and/or nursery grounds in the immediate area, including herring and sandeel. These include a number of fin fish, elasmobranchs and shellfish and several of these species are protected under national and international conservation legislation. These species include: Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), European eel (*Anguilla Anguilla*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), herring (*Clupea harengus*), mackerel (*Scomber scombrus*), haddock (*Melanogrammus Aeglefinus*), cod (*Gadus morhua*), whiting (*Merlangius merlangus*), Dover sole (*Solea solea*), plaice (*Pleuronectes platessa*), sandeel (*Ammodytidae* sp.), basking shark (*Cetorhinus maximus*), thornback ray (*Raja clavate*) and spotted ray *(Raja montagui*).

Herring

Herring are present in the area, with the marine installation corridor passing through a mapped herring spawning ground (Coull *et al.,* 1998; Figure 4.1). Herring in the area are most likely to originate from the Banks herring population, which spawn between August and October (ICES, 2014). However, based on work undertaken for Hornsea 4 (Orsted, 2022) to refine the spawning period, it was determined the peak spawning period for the Banks herring population is from 1st September to 16th October. The marine installation corridor is in an area of historically

low use by herring, however it is acknowledged that survey effort is not always consistent in this inshore area (ICES, 2024).

Sandeel

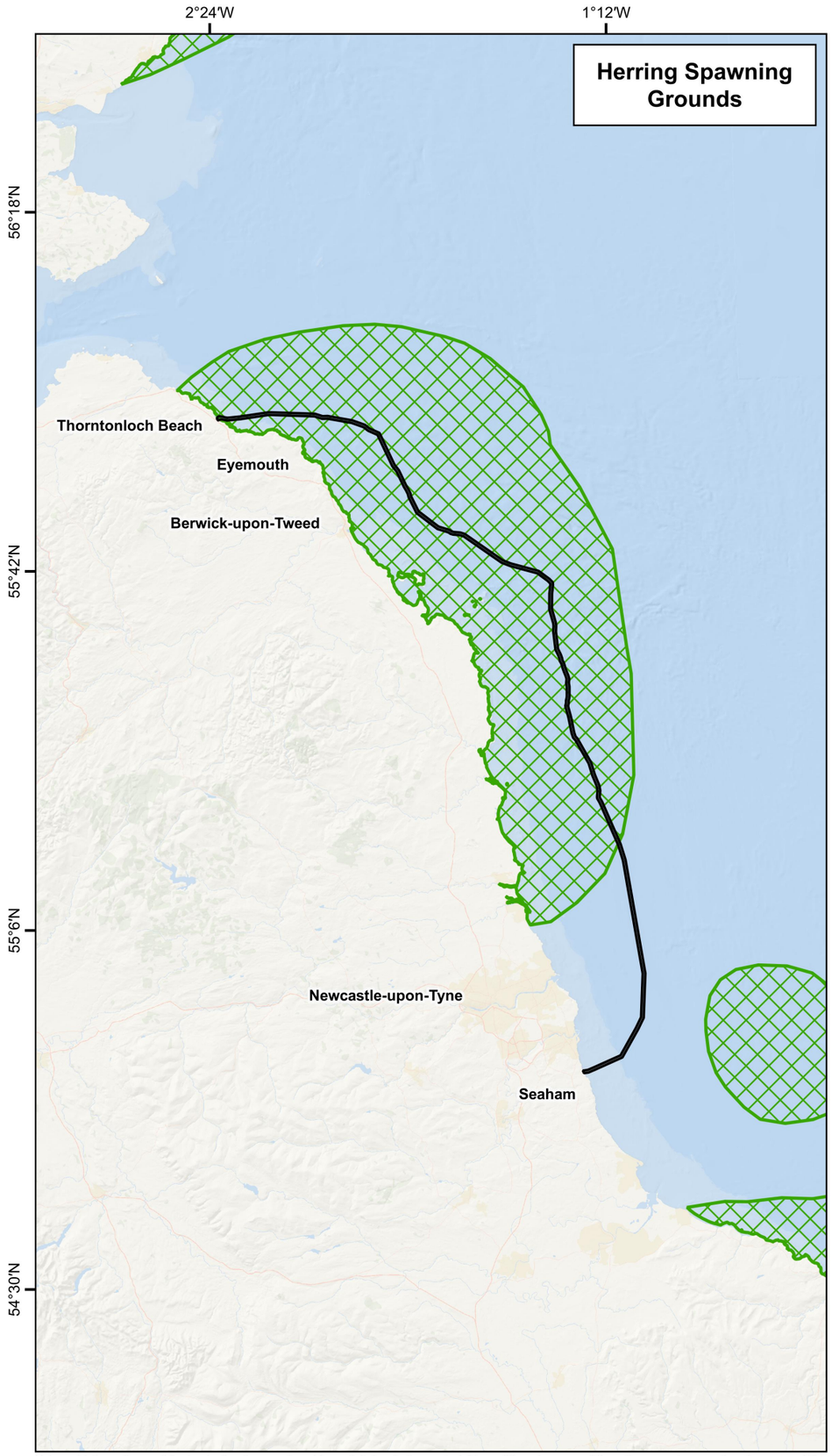
Sandeel are present in the area, with the marine installation corridor passing through a mapped sandeel spawning ground (Ellis *et al.* 2012; Coull *et al.,* 1998; Figure 4.1). Although largely resident, sandeel do move, but do not travel far from chosen location, remaining buried (NatureScot (2003) reporting sandeel rarely move more than 32 km). Sandeel exhibit complex seasonal and daily behaviour patterns and rarely emerge from the seabed, where they remain mostly buried, except to spawn and feed (NatureScot, 2023). Sandeel remain buried between September and February, except when they emerge between November and February to spawn (Wright & Bailey, 1996; Régnier *et al.*, 2017 in Marine Scotland, 2024; Ellis *et al.,* 2012). Limited evidence of sandeel within the marine installation corridor exists in England, however one individual was recorded near Torness in Scotland. Langton *et al.* (2021) mapped the species probability of presence and predicted density, and the marine installation corridor falls within areas of low predicted sandeel.

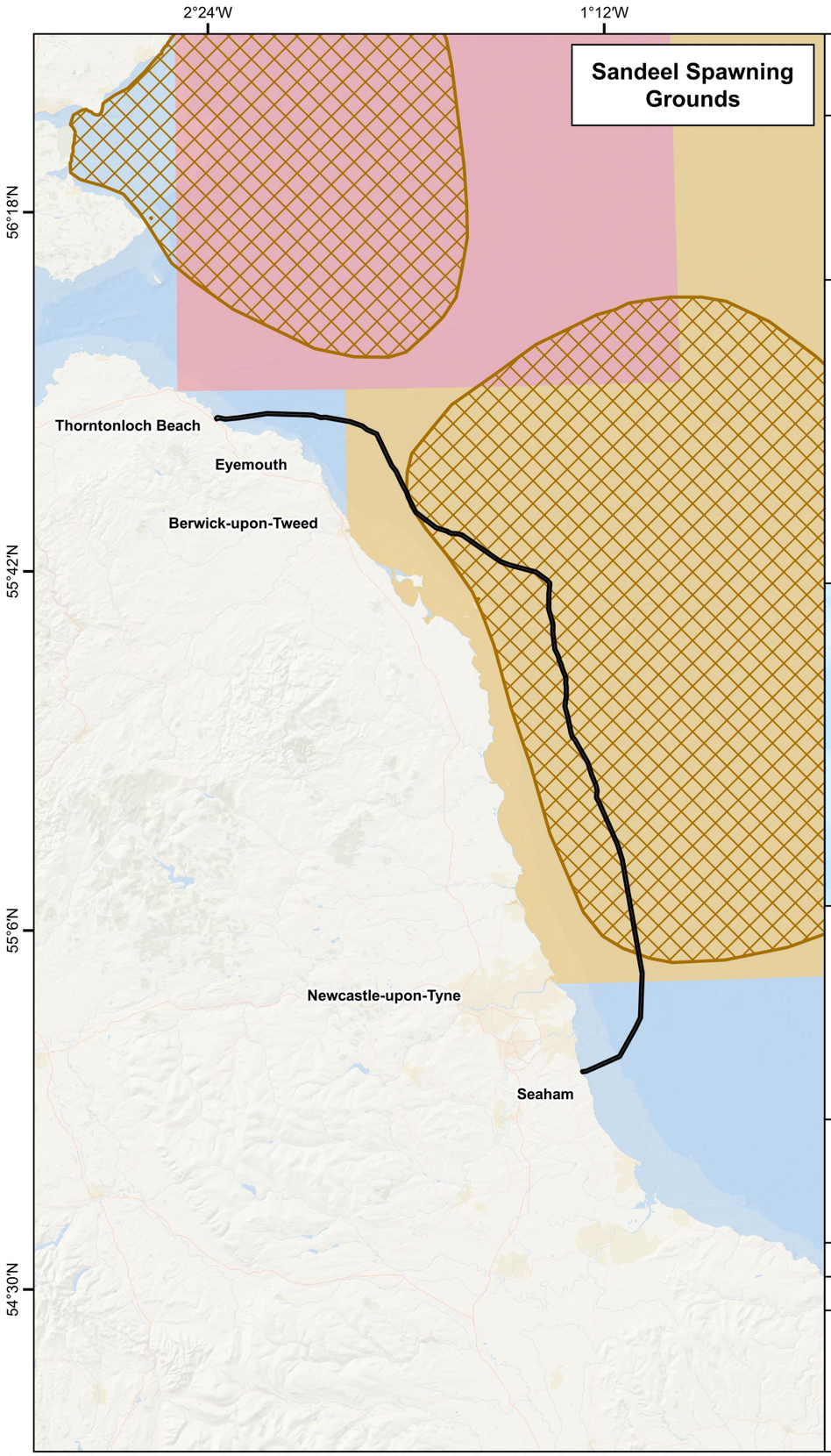
Shellfish

The area is also considered important for a range of commercially exploitable shellfish species (see also Commercial Fisheries, Section 4.7). Limited evidence was found of *Nephrops* within the marine installation corridor during baseline surveys with few individuals and limited burrows identified (Chapter 8: Benthic Ecology of the EGL1 EA (AECOM, 2022)). It is noted that they are a component of the Farnes East MCZ 'sea-pens and burrowing megafauna communities' (see MCZ Assessment (1397056)). Shellfish species identified within/having the potential to be within the Marine Scheme study area include king scallops (*Pecten maximus*), Norway lobster (*Nephrops norvegicus*), European lobster (*Homarus Gammarus*), edible crab (*Cancer pagurus*) and velvet swimming crabs (*Necora puber*) however there are no shellfish species which are afforded conservation protection known to be present in the study area.

Designated Sites

Of relevance to the Marine Scheme, there are a number of designated sites in English waters have migratory fish features including: Tweed Estuary SAC, and the River Tweed SAC considered in this assessment due to the requirement for fish to have to cross the marine installation corridor. Sites further afield are not considered due to the short term, temporary nature of the work. Fisheries sensitivity maps (Coull *et al*., 1998; Ellis, *et al*., 2012) indicates that the Marine Scheme is located within important spawning grounds for herring, whiting, sandeels, plaice, and *Nephrops*. High-intensity nursery grounds of herring, cod, and whiting were also identified within the study area, as were important grounds of sandeel, plaice, sprat, and *Nephrops*. Juvenile horse mackerel appear to be widespread exhibiting no spatially discrete nursery grounds within the study area.





Project:

Eastern Green Link 1

Title:

Figure 4.1: Location of Herring and Sandeel Spawning Grounds in Relation to the EGL1 Marine Installation Corridor

Key

EGL1 Marine Installation Corridor

Spawning Grounds (Coull et al. 1998)

Herring

Sandeel

Spawning Grounds (Ellis et al. 2012) - Intensity

Higher

Lower

Sources: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors. Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community.
Contains public sector information, licensed under the Open Government Licence v3.0.
Coull, K.A., Johnstone, R., and S.I. Rogers. 1998. Fisheries Sensitivity Maps in British Waters.
Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. 2012. Spawning and Nursery Grounds of Selected Fish Species in UK Waters.
MarineSpace Ltd, ABPmer Ltd, ERM Ltd, Fugro EMU Ltd and Marine Ecological Surveys Ltd., (2013a). Environmental Effect Pathways between Marine Aggregate Application Areas and Sandeel Habitat.
Not to be used for Navigation.

Scale @ A3: 1:500,000

Coordinate System: WGS 84 UTM Zone 30N
Graticules: WGS 84

0 5 10 15 20 km

N

Date: 09-09-25	Prepared by: AC	Checked by: VR
Ref: GB211525_M_010_A		

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4.3.2. Existing EA Conclusions

The effects of the installation of the Marine Scheme on the fish and shellfish ecology of the Marine Scheme study area are set out in Chapter 9: Fish and Shellfish Ecology of the EGL1 EA (AECOM, 2022), submitted as part of the original Marine Licence application. The EA concluded that, following Marine Scheme specific mitigation, no significant effects were predicted during installation, operation (including maintenance and repair), and decommissioning of the EGL1 Marine Scheme.

Update on Additional Relevant Findings

At the time of writing, there is no other additional information relevant to this assessment to be added.

4.3.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Seabed disturbance - direct and indirect temporary habitat disturbance;
- Seabed disturbance - temporary increases in SSC; and
- Underwater noise – direct impacts on fish species.

4.3.3.1. Seabed Disturbance - Temporary Disturbance and Temporary Loss of Habitat

The study area was defined during EA as extending 5 km either side of the centre line of the marine installation corridor. It is considered that any UXO activities would take place within this area and therefore it is used for this assessment.

The UXO clearance activities may result in both direct and indirect disturbance to fish habitat during the activities. During the UXO clearance activities, direct disturbance to the seafloor would occur, but there would also be a wider increase in SSC in the vicinity of the activities (see Section 4.1, Benthic Ecology). The proposed work will affect a negligibly small area of seabed (i.e., 1.4 – 10.5 m in radius), with small discrete locations disturbed in order to clear UXO.

A number of fish and shellfish species have spawning and nursery grounds within the study area including herring (*Clupea harengus*) and sandeel (*Ammodytidae* sp.) (Figure 4.1), sprat (*Sprattus sprattus*), mackerel (*Scomber scombrus*), haddock (*Melanogrammus aeglefinus*), cod (*Gadus morhua*), whiting (*Merlangius merlangus*), Dover sole (*Solea solea),* plaice (*Pleuronectes platessa*) and Norway lobster (*Nephrops norvegicus*) plus thornback ray (*Raja clavata*), spotted ray (*Raja montagui*), European hake (*Merluccius merluccius*) and horse mackerel (*Trachurus trachurus*) with nursery grounds only. With regards to spawning habitats, the majority of fish are pelagic spawners (releasing eggs into the water column) and therefore will not be directly affected by habitat disturbance. Some species, namely herring and sandeel, are demersal spawners, laying their eggs on the seabed, and requiring specific substrate and are considered separately below.

Herring and Sandeel

There is direct overlap with herring and sandeel spawning grounds, however it is considered that the area of disturbance will be highly localised and small with limited small scale sediment arisings, UXO clearance will result in a maximum estimated total area of seabed disturbance of 0.0014 km^2, equating to 0.0000004% of the total herring[5] and 0.0000015% sandeel[6] spawning grounds, respectively (Coull *et al*., 1998). It is noted that the Ellis *et al*., (2012) data is more recent, however data is less defined and therefore, using a precautionary approach, the Coull *et al.* (1998) data is used for this calculation.

[5] EGL1 Marine installation corridor overlap with herring spawning grounds (0.0014 / 338,740.39 km^2) *100 = 0.0000004%

[6] EGL1 Marine installation corridor overlap with sandeel spawning grounds (0.014 / 89,669.11 k m^2) *100 = 0.0000015%

Baseline surveys revealed that for both herring and sandeel limited discrete locations existed with suitable sediment. Limited evidence of sandeel within the marine installation corridor exists with one individual was recorded near Torness in Scotland during baseline surveys (AECOM, 2023).

The locations where suitable sediment exists were mapped during baseline surveys for the EA to conclude that preferred habitat is present along a large proportion of the marine installation corridor (AECOM, 2023, Figure 4.2), which overlaps known spawning grounds (Coull *et al.,* 1998). Despite this, it was concluded (AECOM, 2023) that the effects of the sediment disturbance during cable installation (considerably higher levels of disturbance compared to the UXO clearance activities) remained not significant for both herring and sandeel. Additionally, suitable sediment for herring and sandeel is widespread in the North Sea and is not restricted to only the Marine Scheme and surrounding study area.

This work is expected to be undertaken between Q2 and Q3, therefore possibly overlapping key herring spawning from 1st September to 16th October i.e., at the very end of the proposed programme (Orsted, 2022; Coull *et al.,* 1998). Sandeel spawning occurs between November and February (Ellis *et al.,* 2012) and therefore is outside of the proposed UXO clearance timing.

Given the limited evidence of herring and sandeel in the area, and the temporary and localised nature of the UXO clearance activities, it is considered that the work will not lead to a significant effect on herring or sandeel populations in the area.

Shellfish

There is the potential for shellfish in the area, however due to the general lack of evidence of presence along the marine installation corridor (AECOM, 2022) and considering the small scale of the works, and limited seabed disturbance that will arise, the activities will have no more than a negligible effect on shellfish species, with no population level consequences and it is considered that the work will not lead to a significant effect on identified shellfish species populations in the area.

Fish and Shellfish Conclusion – Temporary Disturbance

Although the area provides suitable sediment for herring and sandeel, considerable alternative habitat is available in the surrounding area and there is limited evidence of high usage of the area by sandeel and herring. Given that the residual effect from EA was determined to be not significant for cable installation, which will involve significantly more disturbance than UXO clearance activities, and the localised, and small scale of the UXO clearance works over a relatively short period of time, it is therefore considered there is no potential to adversely affect fish and shellfish species at a population level in the area through seabed disturbance with effects considered not significant.

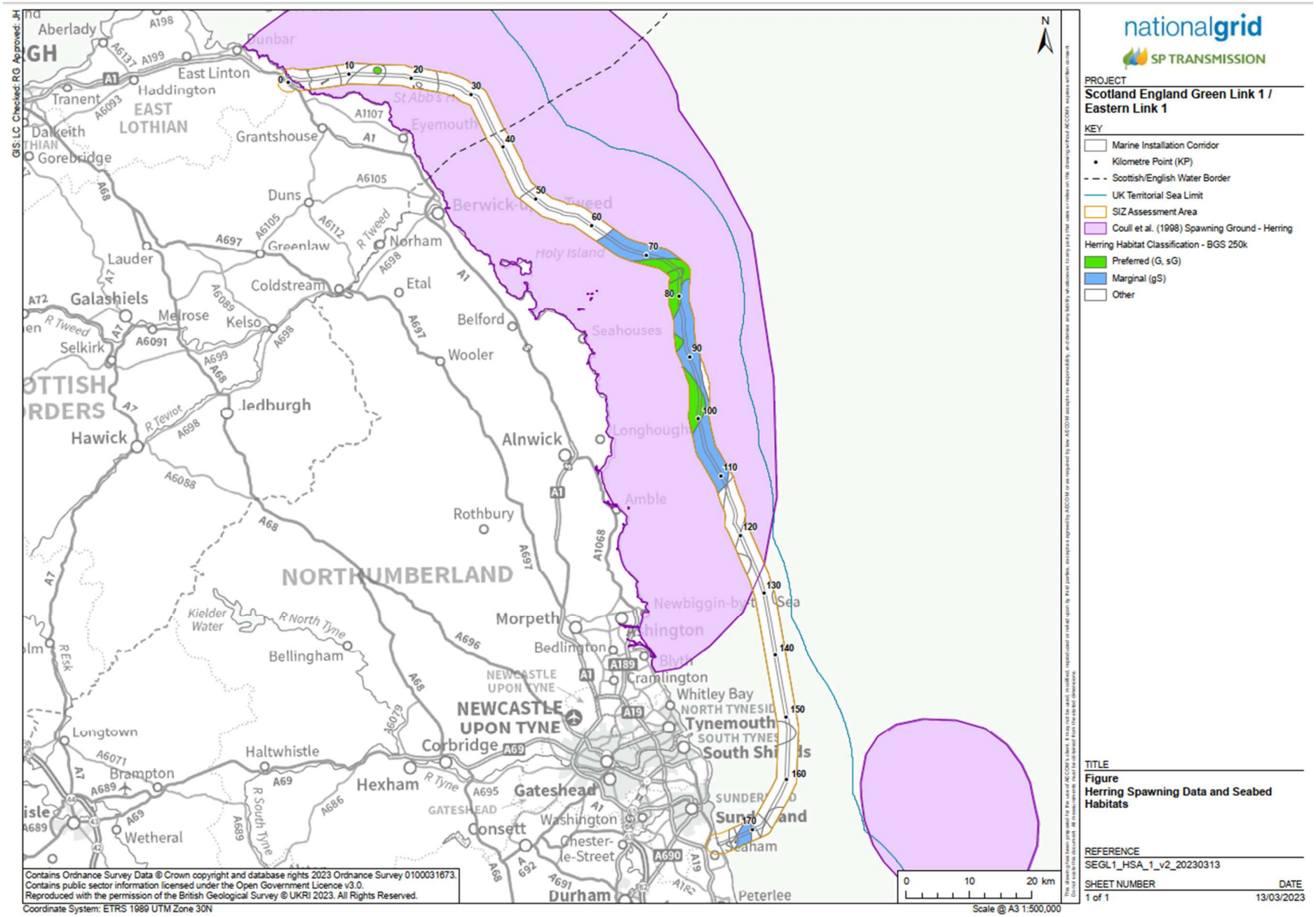

Figure 4.2 – Herring Spawning Habitat along the Marine Installation Corridor (Figure 3-1 taken from AECOM, 2023 – Supplementary Herring and Sandeel Spawning Report).

4.3.3.2. Seabed Disturbance - Temporary Increase in SSC

The UXO clearance activities have the potential to physically disturb the seabed through detonation of cUXO, resulting in an increase in SSC within the water column.

An increase in suspended sediment concentrations (SSC) will be an indirect impact arising from temporary disturbance. Herring are considered sensitive to elevated SSC and deposition, however they are highly mobile, able to avoid any temporary localised elevations in SSC. Other fish are mobile and therefore not impacted by increases in SSC and they have pelagic spawning activities, without the reliance on benthic habitat for egg laying. Shellfish present include *Nephrops*, lobster, crabs and scallop (Chapter 9 – Fish and Shellfish of the EGL1 EA (AECOM, 2022). The mobile nature of the decapods (*Nephrops*, lobsters and crabs) means they are able to move to avoid any temporary increases in SSC. Scallops are able to move short distances to avoid threats. However, adult scallops show limited sensitivity to high levels of SSC (Marshall and Wilson, 2008). SSC are predicted to return to background levels within days and not affect a large area due to dispersion and dilution. Sandeel are not considered sensitive to small increases in SSC as they spend most of their life buried, and area adapted for these conditions.

Although the area provides suitable sediment for herring and sandeel, considerable alternative habitat is available in the surrounding area and there is limited evidence of high usage of the area by sandeel and herring. Given that the residual effect from EA was determined to be not significant for cable installation, which will involve significantly more disturbance than UXO clearance activities, and the localised, and small scale of the UXO clearance works over a relatively short period of time, it is therefore considered there is no potential to adversely affect fish and shellfish species at a population level in the area through seabed disturbance with effects considered not significant.

4.3.3.3. Underwater Noise – Direct Impacts on Sensitive Fish Species

The UXO clearance works have the potential to impact fish and shellfish receptors (including eggs and larvae) via underwater noise and vibration associated with low order deflagration, and high order detonation UXO clearance activities.

A review of hearing sensitivity in fish developed categories that can be used when assessing the effects of sound (Popper *et al*., 2014). The categories are based on the presence or absence of a swim bladder and the potential for the swim bladder to enhance hearing sensitivity. These include:

- Fish species with no swim bladder or another gas filled chamber (e.g., flatfish). These species generally only detect particle motion and are less sensitive to sound pressure. However, some physiological injury could result from exposure to sound.
- Fish species with swim bladders in which hearing is separate from the swim bladder or any other gas filled chamber (e.g., Atlantic salmon). While hearing only involves particle motion, not sound pressure, these species are sensitive to physiological effects.
- Fish species in which hearing involves a swim bladder or other gas filled chamber (e.g., herring and cod). These species are sensitive to physiological effects being able to detect sound pressure and particle velocity.
- Fish eggs and larvae: The limited available data (e.g., larvae displaying similar startle thresholds) suggests larvae have similar hearing frequency ranges to those of adults. It is thought swim bladders may develop at a larval stage meaning there may be a susceptibility to pressure related trauma (Popper *et al.*, 2014).

In contrast, bioacoustics data (i.e., sound detection, acoustic behaviour, effects of anthropogenic sound) for shellfish is very limited which notably limits assessment of underwater noise on these species at this time.

Based on the criteria outlined by Popper *et al*., (2014), all fish species within 70 m of a low order detonation are at risk of mortality or potential mortal injury with these distances increasing for high order detonation (although low order deflagration, which results in lower sound source levels, is the preferential clearance method) (Subacoustech, 2025).

In the context of explosives and potential mortality, Popper *et al*., (2014) considers that the risks to mature individuals within all hearing groups are equivalent, with no frequency weighting considered to account for variations in hearing sensitivity (mortality and mortal injury 229 – 234 db peak). Calculated ranges for the risk of mortal injury to individuals

have been provided with the largest ranges associated with the greatest charge weights (Table 4-2), recognising that encountering UXO with the largest charge weight is unlikely.

Table 4-2: Summary of the mortality and potential mortal injury impact ranges for UXO clearance using the unweighted peak sound pressure level (SPL_{peak}) explosion noise criteria from Popper et al. (2014) for fish (from Subacoustech, 2025)

NEQ	Mortal and potential mortal injury estimated impact ranges (m)
0.25 kg	<50 – 70
30 kg	130 – 180
295 kg	400 – 670
325 kg	410 – 690
456 kg	460 – 770
555 kg	490 – 830
722 kg	540 – 900

The risks of mortality and morbid injury that explosive noises pose to fish larvae and eggs are not quantified by Popper *et al*., (2014); however, it is qualitatively stated that the risks are expected to be high within tens of metres of any detonation, but that risks would decrease to low levels at a range of hundreds of metres and beyond.

Assuming a circular area based on the largest predicted mortal injury and mortality value (Table 4-2), the maximum predicted distance noise will travel from each individual high order detonation equating to 0.066%[7] of the mapped herring spawning ground. This assumes that all four (10%) cUXOs assumed to require high order clearance methods under the worst case scenario assumptions, will occur within the herring spawning ground along the corridor, require the largest donor charge, and have potential impact ranges that do not overlap. Under these worst case assumptions, 2.6%[8] of the total herring spawning area would be impacted. However, this calculation is highly precautionary as the herring ground does not cover the entire route, and the likelihood of all four cUXO occurring in this corridor and requiring high order detonation is low. Additionally, the proposed works are expected to take place between Q2 and Q3 2026, which is at the latter end of the refined herring spawning season defined as 1st September to 16th October (Orsted, 2022).

Whilst the potential mortality and mortal injury impact ranges are localised to the noise source, behavioural responses will be seen in the wider area. Popper *et al.* (2014) does not provide quantitative thresholds for behavioural effects but does provide qualitative assessment of behavioural impacts. For all fish hearing groups, there would be a high risk of behavioural impacts within the near-field (within tens of metres) of the clearance activities. For fish with swim bladders, risks of behavioural impacts remain high within the intermediate-field (extending to hundreds of metres) but are likely reduced to be moderate levels for fish without swim bladders. Far-field behavioural effects (extending to thousands of metres) are considered to be a low risk. Risks to fish larvae and eggs are also considered to be high at near-field distances but reduce to low at intermediate- and far-field distances. It is also considered that behavioural responses will be short term in nature (i.e., during or immediately following the activity) and recoverable, particularly for fish with sensitive hearing where effects will be seen in the near and intermediate distances (Popper *et al.,* 2014).

A hierarchical approach to managing and mitigating UXOs on site will be considered from micro-siting and avoidance of UXO to high order clearance. Low order clearance will be utilised, where practicable, as a primary method for clearance, to reduce underwater noise generation.

[7] Area of effect for one cUXO= 3.142 * (0.9 km * 0.9 km) = 2.55 km^2. Percentage overlap with herring spawning ground = (2.55 / 3874.04) *100 = 0.066 %

[8] Area of effect for 4 cUXO = 2.55 km^2 * 4 = 10.2 km^2 = Percentage overlap with herring spawning ground = (10.2 / 3874.04) *100 = 0.26%.

It is considered fish have a high sensitivity to UXO clearance works, particularly high order detonations, however this receptor is mobile and the area of impact is relatively small when compared to these species' natural ranges. Whilst there may be direct mortality and mortal injury to individuals, this is not considered to impact the species at a population level. Taking into consideration the mitigation options, and limited and temporary nature of the clearance activities, any potential effects are therefore predicted to be temporary, localised and not significant.

4.3.3.4. Cumulative Assessment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for temporary disturbance and temporary loss of habitat, and increases in underwater noise include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only).

The EGL1 UXO clearance work is anticipated to take up to one month within Q2 and Q3, 2026 (over a maximum of 60 days, including weather downtime), which has the potential to overlap with the commencement of the Berwick Bank Cambois connection installation. There is direct overlap of the Berwick Bank Cambois Connection with the marine installation corridor via a crossing offshore of Blyth where the Cambois connection landfalls.

This list has been refined based on overlap of potential plans and projects within key (herring and sandeel) spawning grounds which may have a temporal overlap with their construction periods and the UXO clearance activities.

4.3.3.4.1. Seabed Disturbance - Temporary Disturbance and Temporary Loss of Habitat and Temporary Increases in SSC

The Cambois connection overlaps the herring spawning ground at the southerly extent where there are areas of high herring spawning confidence and medium sandeel sediment confidence (SSE Renewables, 2023c).

Whilst there is direct overlap of the Berwick Bank Cambois Connection with the marine installation corridor, this is a crossing offshore of Blyth where the Cambois connection landfalls. There is evidence of use of the area by sandeel and herring (SSE Renewables, 2023c), however the area represents a small area in context of the wider distribution of suitable habitats. There is the potential for temporal overlap with herring spawning activities (ICES, 2014), however the proposed timing of the work is outside of sandeel spawning season (Ellis *et al*., 2012) and only represents a limited temporal overlap with the herring spawning season as defined by Coull *et al.* (1998) and refined by Orsted (2022) i.e., 1st September to 16th October. The potential exists for temporal overlap in activities, however whilst UXO clearance is being undertaken the area would require clearance and safety zones would be in place.

It can be concluded that given the localised and temporary nature of the UXO clearance works, the limited opportunity for temporal overlap in activities and the key species biology, the Marine Scheme's negligible contribution cumulatively with other plans and projects is not significant for temporary disturbance, temporary loss of habitat, and temporary increases in SSC.

Given that the residual effect from the EA was determined to be not significant for cable installation, which will involve significantly more disturbance than UXO clearance activities, and the localised, and small scale of the UXO clearance works over a relatively short period of time, it is therefore considered there is no potential to adversely affect fish and shellfish species at a population level in the area through seabed disturbance with effects considered not significant.

4.3.3.4.2. Underwater Noise – Direct Impacts on Sensitive Fish Species

The potential overlap of potential plans and projects within key noise sensitive species habitat (herring) spawning ground which may have a temporal overlap with their construction periods and the UXO clearance activities.

Although the UXO clearance will elicit noise into the environment, the cabling activities for the Cambois connection are not considered to impact noise sensitive fish (SSE Renewables, 2023d) and it was considered that UXO clearance would not be required based on the cable corridor width (SSE Renewables, 2023e) therefore the Marine Scheme's negligible contribution cumulatively with other plans and projects is not significant for underwater noise.

4.3.4. Conclusion

Work at each cUXO location (and all cUXO combined) will affect an imperceptible percentage of the habitat in the wider area, including key herring and sandeel spawning grounds, for a short period of time. The sediment disturbance impacts which may occur are considered to be significantly lesser in scale and magnitude than those already consented (and assessed as not significant) for installation of the EGL1 Marine Scheme. Hearing sensitive fish are present in the marine installation corridor and, although noise levels anticipated are higher than those assessed in the EA for installation activities, these are assessed as not significant for the UXO clearance activities. It can therefore be concluded that no significant effects are predicted to arise on the fish and shellfish ecology of the area either alone or cumulatively with other plans and projects, as a result of the UXO clearance activities.

4.4. Marine Mammals

4.4.1. Baseline

Four cetacean species and two seal species are considered to occur on a relatively common basis in the vicinity the Marine Scheme: Harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), white-beaked dolphin (*Lagenorhynchus albirostris*), minke whale (*Balaenoptera acutorostrata*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) (Arso Civil *et al*., 2021; Carter *et al.,* 2022; Cheney *et al*., 2024; Gilles *et al*., 2023; IAMMWG, 2023). Occasional visitors to the region include common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), white-sided dolphin (*Lagenorhynchus acutus*), killer whale (*Orcinus orca*) and long-finned pilot whale (*Globicephala melas*). Sightings of humpback whale (*Megaptera novaeangliae*) and fin whale (*Balaenoptera physalus*) have also been recorded[9].

4.4.1.1. Harbour Porpoise

The harbour porpoise is widespread around the UK, including the North Sea, Irish Sea, the seas west of Ireland and Scotland, and northwards to Orkney and Shetland. Since the 1990s it has become much less common around the Northern Isles, but it appears to be returning to the English Channel and southern North Sea, where it was infrequent in the late 1980s. The recent SCANS-IV survey, the latest in a series of large-scale surveys for cetaceans in European Atlantic waters, showed that the harbour porpoise population in the North Sea is stable and there is very little difference in the estimated abundance between 2016 and 2022 (Gilles *et al*., 2023).

Harbour porpoise density in the vicinity of the Marine Scheme, from SCANS-IV, is provided in Table 4.3. The Scottish section of the subsea cable route is located entirely in SCANS-IV survey block NS-D while the English portion intersects both SCANS-IV survey block NS-D and block NS-C.

The relevant Inter-Agency Marine Mammal Working Group (IAMMWG) Management Unit (MU) abundance estimate is also provided in Table 4.3; the abundance of the UK portion of the MU has been used as the reference population.

The closest designated site (Special Area of Conservation (SAC)) for harbour porpoises (Southern North Sea SAC) is approximately 111 km south-east from the subsea cable route at its closest point.

Table 4.3: Harbour porpoise density and reference population abundance

SCANS-IV Survey Block	Density (animals per km^2)	Management Unit	Abundance	95% confidence interval (CI)
NS-C	0.6027	North Sea	346,601	289,498 - 419,967
NS-D	0.5985	UK portion of North Sea	159,632	127,442 – 199,954

Source: Gilles et al. (2023); IAMMWG (2023).

[9] https://www.seawatchfoundation.org.uk/recentsightings/

4.4.1.2. Bottlenose Dolphin

Both inshore and offshore bottlenose dolphin ecotypes are recognised in UK waters and are likely to occur in the vicinity of the Project. The Scottish section of the subsea cable route is located entirely within SCANS-IV survey block NS-D (for which there is no density estimate) whilst the English portion intersects block NS-C in addition to block NS-D. The density of bottlenose dolphins in the vicinity of the Marine Scheme, from SCANS-IV block NS-C (Gilles *et al*., 2023), is provided in Table 4.4. It should be noted that, due to their social structure and behaviour, density estimates are not always representative for the dolphin species; because individuals tend to occur in clusters or groups, rather than singly, use of a flat density surface can lead to conservative estimates of the number of individuals which have the potential to be impacted.

The relevant IAMMWG MU abundance estimate is also provided in Table 4.4; the abundance of the UK portion of the MU has been used as the reference population. The Coastal East Scotland MU abundance has not been used because this MU lies to the north of the subsea cable route.

The closest designated site for bottlenose dolphins (Moray Firth SAC) is approximately 280 km north-northwest from the subsea cable route at its closest point, however, with the southerly expansion of the east Scotland bottlenose dolphin population the potential for connectivity between the proposed work and individuals from the population which uses this SAC is high.

Table 4.4: Bottlenose dolphin density and reference population abundance

SCANS-IV Survey Block	Density (animals per km^2)	Management Unit	Abundance	95% confidence interval (CI)
NS-C	0.0419	Greater North Sea	2,022	548 - 7453
NS-D	n/a	UK portion of Greater North Sea	1,885	476 – 7,461

Source: Gilles et al. (2023); IAMMWG (2023).

4.4.1.3. White-Beaked Dolphin

White-beaked dolphins in UK waters predominantly occur offshore. Their greatest densities have been recorded around Shetland, in the northern North Sea and off northwest Scotland (Gilles *et al.,* 2023). The density of white-beaked dolphins in the vicinity of the subsea cable route, from SCANS-IV, is provided in Table 4.5. The Scottish section of the subsea cable route is located entirely in SCANS-IV survey block NS-D whilst the English portion intersects block NS-C in addition to block NS-D. It should be noted that, due to their social structure and behaviour, density estimates are not always representative for the dolphin species; because individuals tend to occur in clusters or groups, rather than singly, use of a flat density surface can lead to conservative estimates of the number of individuals which have the potential to be impacted.

The relevant IAMMWG MU abundance estimate is also provided in Table 4.5; the abundance of the UK portion of the MU has been used as the reference population.

There are no designated sites (SACs) for white-beaked dolphins (this species is not listed on Annex II of the Habitats Directive).

Table 4.5: White-beaked dolphin density and reference population abundance

SCANS-IV Survey Block	Density (animals per km^2)	Management Unit	Abundance	95% confidence interval (CI)
NS-C	0.0149	Celtic and Greater North Seas	43,951	28,439 - 67,924
NS-D	0.0799	UK portion of Celtic and Greater North Seas	34,025	20,026 – 57,807

Source: Gilles et al. (2023); IAMMWG (2023).

4.4.1.4. Minke Whale

Minke whales are the smallest of the baleen whales and are widespread around the UK. There is evidence that their distribution in the North Sea shifted south between 1994 and 2005 (Hammond *et al*., 2013). The most recent SCANS survey showed many sightings further south in the North Sea than previously seen (Gilles *et al.,* 2023). Their abundance in the North Sea (between 1989 and 2022) appears to be relatively stable (Gilles *et al.,* 2023).

Minke whale density in the vicinity of the subsea cable route, from SCANS-IV, is provided in Table 4.6. The Scottish section of the subsea cable route is located entirely in SCANS-IV survey block NS-D whilst the English portion intersects block NS-C in addition to block NS-D.

The relevant IAMMWG MU abundance estimate is also provided in Table 4.6; the abundance of the UK portion of the MU has been used as the reference population.

There are no designated sites (SACs) for minke whales (the species is not listed on Annex II of the Habitats Directive). There is, however, a Marine Protected Area (MPA) for minke whale (the Southern Trench MPA) which is approximately 168 km north-northwest from the subsea cable route at its closest point.

Table 4.6: Minke whale density and reference population abundance

SCANS-IV Survey Block	Density (animals per km^2)	Management Unit	Abundance	95% confidence interval (CI)
NS-C NS-D	0.0068 0.0419	Celtic and Greater North Seas	20,118	14,061 - 28,786
		UK portion of Celtic and Greater North Seas	10,288	6,210 – 17,042

Source: Gilles et al. (2023); IAMMWG (2023).

4.4.1.5. Seals

Two seal species occur on a relatively common basis in the North Sea: Grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) (Carter *et al.,* 2022).

The subsea cable route does not directly overlap with any designated seal haul out sites. However, the Fast Castle seal haul of site is in the near vicinity of the cable route, being located approximately 1.5 km southeast of the landfall site in Torness.

Grey Seals

Grey seals are among the rarest seals in the world; the UK population represents about 40% of the world population and 95% of the European population. Grey seals spend most of the year at sea and may range widely in search of prey. They come ashore in the autumn forming breeding colonies on rocky shores, beaches, and in caves often on small largely uninhabited islands.

The greatest densities of grey seals in relation to the subsea cable route are found in the Berwickshire and North Northumberland Coast SAC (designated for this species) which is approximately 350 m from the subsea cable route at its closest point.

Harbour Seals

Harbour seals have a near circumpolar distribution, with at least four subspecies recognised worldwide. Only the eastern Atlantic subspecies occurs in Europe. The UK population represents about 5% of the world population and approximately 50% of the European population. Harbour seals are the characteristic seal of sandflats and estuaries but are also found on rocky shores. As pups swim almost immediately after birth, harbour seals can breed in sheltered tidal areas where sand/mud banks allow access to deep water.

Harbour seals are not common in the vicinity of the subsea cable route. The closest SAC for harbour seal (Firth of Tay and Eden Estuary SAC) is approximately 50 km northwest from the subsea cable route at its closest point.

Seal Densities and Reference Populations

At-sea density surfaces for grey seal and harbour seal were derived by scaling the UK-wide relative density surfaces provided by Carter *et al.* (2022). Carter *et al.* (2022) used telemetry data from grey (n = 114) and harbour (n = 239) seals, collected from 26 sites across the UK and Ireland between 2005 and 2019.

Using the at-sea density surfaces an average density was calculated for the Marine Scheme plus a 26 km buffer (the largest potential impact range from UXO clearance, see Section 4.4.3.1) for both grey seals (1.126 animals per km^2) and harbour seals (0.008 animals per km^2).

For management purposes the UK and Ireland seal populations have been divided into MUs. The Marine Scheme is located within the East Scotland and Northeast England Seal MUs. For harbour seals the latest population estimates for these two Seal MUs were combined (530 individuals) and used as the reference population (SCOS, 2024). For grey seals there is evidence from telemetry studies of connectivity between these two Seal MUs and the Moray Firth Seal MU (Thompson *et al.,* 2017). Therefore, for grey seals, the latest Potential Biological Removal (PBR) N_{min} values for the East Scotland and Moray Firth Seal MUs and the latest scaled (to account for the proportion of the population at sea) August count for the Northeast England Seal MU[10] were combined (32,603 individuals) and used as the reference population (SCOS, 2024).

4.4.2. Existing EA Conclusions

The effects of the installation of the Marine Scheme on the marine mammals of the area are set out in Chapter 10: Marine Mammals of the EGL1 EA (AECOM, 2022), submitted as part of the original MLA. The Environmental Appraisal Report concluded that no significant effects are predicted during installation, operation (including maintenance and repair), and decommissioning of the Marine Scheme.

Update on Additional Relevant Findings

Marine mammal data published since the 2022 EGL1 EA was submitted includes new data on the density and abundance of cetaceans (i.e. SCANS IV (Gilles *et al*., 2023)) and seals (i.e. Carter *et al.* (2022)). There is also new information available on the MU reference populations for cetaceans (i.e. IAMMWG (2023) and Cheney *et al*., 2024) and population estimates for seals (SCOS, 2024). This updated information has been used to compile the marine mammal baseline presented above (4.4.1) and used to inform the conclusions below.

4.4.3. Effect of the UXO Clearance Activities

During the UXO clearance work, there is potential for marine mammals to be impacted. The main activities associated with the work which may impact these species are:

- Increased anthropogenic noise from UXO clearance work;
- Increased anthropogenic noise from use of USBL equipment;
- Risk of collision with vessels; and
- Changes in turbidity.

4.4.3.1. Increased Anthropogenic Noise from UXO Clearance Work

Pre-mitigation Effects

A detailed assessment of the potential effects of increased anthropogenic noise from UXO clearance work on marine mammals, including an overview of the potential effects of anthropogenic noise on marine mammals (i.e. lethal effects and physical injury, auditory injury and behavioural responses) has been undertaken in a dedicated EPS RA (1400131) document. Additionally, a MMMP (1369788) has been developed to support the application.

[10] PBR N_{min} values are not available for the Northeast England Seal MU.

The assessment undertaken in the EPS RA used predicted impact ranges from the proposed UXO clearance work modelled by Subacoustech Environmental (Morgan, 2025). Modelling was carried out for all four marine mammal hearing groups.

Lethal Effects and Physical Injury

Although the potential for lethal effects and physical injury was not modelled it is assumed that, in the absence of mitigation, they may occur as a result of the proposed UXO clearance work should individuals be present in close proximity to any high order detonations.

Auditory Injury (PTS)

The modelled PTS impact ranges for each marine mammal hearing group for the various potential charge weights are shown in Table 4.7 below. For low order clearance the greatest of the PTS impact ranges (Peak Sound Pressure Level (SPL_{peak})) is for very high frequency cetaceans at 0.99 km. For high order clearance the largest impact was from the 722 kg charge weight (including donor) for the SPL_{peak} threshold with a PTS impact range of 14 km for very high frequency cetaceans.

The number of individuals of each EPS assessed which have the potential to be impacted by PTS from the UXO clearance activities pre-mitigation is presented in Section 5.2.2 of the EPS RA (1400131).

Table 4.7: Summary of the impulsive PTS impact ranges for low order and high order UXO clearance for relevant marine mammal hearing groups

Charge weight + donor (kg)	Impact Range (km)							
	Low frequency cetaceans		High frequency cetaceans		Very high frequency cetaceans		Phocid carnivores in water	
	SPL_{peak}	SEL_{sp}	SPL_{peak}	SEL_{sp}	SPL_{peak}	SEL_{sp}	SPL_{peak}	SEL_{sp}
0.25 (low order)	0.17	0.23	0.06	0.05	0.99	0.09	0.19	0.05
30	0.87	2.3	0.28	0.05	4.9	0.6	0.96	0.42
295	1.8	7.2	0.6	0.05	10	1.2	2	1.2
325	1.9	7.5	0.62	0.05	10	1.2	2.1	1.3
456	2.1	8.9	0.7	0.05	12	1.3	2.3	1.5
555	2.3	9.7	0.75	0.06	12	1.4	2.5	1.7
722	2.5	11	0.81	0.06	14	1.5	2.7	1.9

Source: Morgan (2025)

Behavioural Responses

Behavioural responses may arise where an activity is audible and at a level above ambient noise. Due to the very short duration and likely small number of potential acoustic events during the proposed UXO clearance work, behavioural responses are likely to only occur in the very short term (in response to the detonation sequence on a given day should high order clearance be required). Studies looking at the effects of a commercial two-dimensional seismic survey and ADD playbacks on cetaceans in the Moray Firth found that fine-scale behavioural responses by harbour porpoise occurred during the work, but that animals were typically detected again at affected sites within a few hours (Thompson *et al.,* 2013; Thompson *et al.,* 2020). Therefore, following cessation of each detonation event, it is considered likely that any behavioural effects will be reversible and that animals will resume normal behaviour within the short term.

Effective Deterrence Ranges (EDRs) have been developed to help assess the worst-case daily disturbance footprint for anthropogenic noise sources (JNCC, 2025b)[11]. These EDRs were derived for harbour porpoises but, without suitable alternatives, are assumed to apply to all marine mammal receptors.

For UXO clearance the following EDRs (for harbour porpoise) were used for all species:

- Low order clearance: 5 km (JNCC, 2025b); and
- High order clearance: 26 km (JNCC, 2025b).

These EDRs were used to estimate the number of individuals which have the potential to be exposed to sound levels which may induce a behavioural response. The area of the zone of potential effect (assuming that spreading is approximately spherical) was calculated using the equation area = πr^2 where r = 5 for low, and 26 for high order clearance and equates to:

- Low order clearance: 78.5 km^2; and
- High order clearance: 2123.7 km^2.

The number of individuals with potential to be present within these zones was then estimated using the density information presented in Section 4.4.1 for both low order (Table 4.8) and high order clearance (Table 4.9).

Table 4.8: Number of individuals which may exhibit behavioural responses following low order clearance using the 5 km EDR (JNCC, 2025b)

Species	Number of individuals	% of reference population	% of UK portion of reference population
Harbour porpoise	47	0.014	0.030
Bottlenose dolphin	3	0.163	0.175
White-beaked dolphin	6	0.014	0.018
Minke whale	3	0.016	0.032
Grey seal	88	0.271	n/a
Harbour seal	1	0.119	n/a

Table 4.9: Number of individuals which may exhibit behavioural responses following high order clearance using the 26 km EDR (JNCC, 2025b)

Species	Number of individuals	% of reference population	% of UK portion of reference population
Harbour porpoise	1280	0.369	0.802
Bottlenose dolphin	89	4.401	4.721
White-beaked dolphin	170	0.386	0.499
Minke whale	89	0.442	0.865
Grey seal	2391	7.333	n/a
Harbour seal	17	3.221	n/a

Mitigation Measures

In order to ensure the absence of marine mammals in the vicinity of the UXO clearance work mitigation will be put in place. This mitigation has been designed around the greatest (i.e., worst case) potential impact ranges which are those for very high frequency cetaceans (i.e., harbour porpoise). If the potential impacts on harbour porpoise are predicted to be negated through mitigation, this will also be the case for all other marine mammal species.

[11] It is recognised that the EDRs for assessing the significance of noise disturbance in harbour porpoise SACs, including from UXO clearance, have recently been updated (JNCC, 2025c). However, these were not available at the time of undertaking this assessment and therefore have not been used. As the previous EDRs (as applied here) are larger than those in the updated guidance, this is considered a conservative approach.

The mitigation follows:

- The Joint Nature Conservation Committee (JNCC) guidelines for minimising the risk of injury to marine mammals from UXO clearance (JNCC, 2025d);
- The Marine environment: unexploded ordnance clearance Joint Position Statement which states that low noise methods of clearance should be the default clearance method (DEFRA *et al*., 2025);
- The 2023 JNCC guidance for the use of Passive Acoustic Monitoring (PAM) in UK waters for minimising the risk of injury to marine mammals from offshore activities (JNCC, 2023); and
- The EGL-1 Marine Mammal Mitigation Protocol (MMMP) for UXO Clearance (1369788).

The proposed mitigation is summarised in Table 4.10.

Table 4.10: Summary of mitigation.

Approach	Mitigation Measures
Micro-siting of the subsea cable route	The subsea cable route will be 'micro-sited' to avoid the UXO and prevent the need for a detonation where deemed safe to do so
Lift and shift	The 'lift and shift' approach (to move the UXO to another location) will be considered on a case-by-case basis where deemed safe to do so
Low order clearance	Pre-work search (min. 60 mins) Low order clearance Post-detonation search (min. 15 mins)
High order clearance	Pre-work search (min. 60 mins) Use of an ADD (see Table 4.11) Use of a NAS (UXO >30 kg) High order clearance Post-detonation search (min. 15 mins)

Further details on the mitigation are:

- Methods to avoid the need for UXO clearance will be considered for every cUXO in the first instance. If deemed safe do so alternative methods include:
  - Micro-siting i.e., avoidance of UXO; and
  - Relocation ('lift and shift') of UXO (where deemed safe to do so)[12].
- Work will only commence during the hours of daylight and in good weather conditions (i.e., when conditions are suitable for visual monitoring and visibility exceeds 1 km (so the entire mitigation zone can be seen) and sea state is below Beaufort sea state 4).
- Low order clearance methods will be used in the first instance. Three attempts will be made before moving to high order clearance methods. High order clearance will only be used by exception with evidence provided to demonstrate that low order clearance has not been successful;
- At least two dedicated Marine Mammal Observers[13] (MMOs) and one dedicated PAM operator[14] will conduct a minimum 60-minute visual and passive acoustic pre-work search of a 1 km radius mitigation zone to ensure the

[12] It should be noted that if relocation ('lift and shift') of any UXO is undertaken, and it is deemed that there is a potential of detonation, then the full mitigation procedure for the corresponding UXO charge weight should be undertaken.

[13] MMOs will be trained (i.e., JNCC MMO certified) and experienced (i.e., experienced MMOs will have at least 20 weeks of experience within UK waters over the past 10 years (and be familiar with the identification of the marine mammal species likely to be encountered in the area) and practical experience of implementing the JNCC guidelines. Newly qualified MMOs will not work in isolation for their first few jobs).

[14] PAM operators will be suitably trained and have an appropriate level of experience of conducting PAM for mitigation (i.e., experienced PAM operators will have at least 20 weeks of experience and newly qualified PAM operators should not work in isolation for their first five PAM jobs (JNCC, 2023b)).

absence of marine mammals in the zone prior to the start of operations. The MMOs and PAM equipment and operator will be positioned such that they can effectively search the mitigation zone. Should a marine mammal be detected in the mitigation zone during the pre-work search by the MMOs or PAM operator, and it cannot be confirmed that the animal has moved out of the mitigation zone at the end of the search, a minimum of a 20-minute delay from the time of the last detection will be required prior to any clearance work taking place;

- For all planned high order UXO clearance an ADD will be used to encourage animals to flee from the zone of potential harm. Indicative periods of ADD use are shown in Table 4.11. The ADD used will be selected based on its effectiveness to adequately deter the marine mammal species of concern in the area around the subsea cable route (McGarry *et al.,* 2020).
- Where required, the ADD procedure will start after at least 30 minutes of the pre-work search has been conducted. The pre-work search by both the MMOs and PAM operator will continue throughout the period of ADD use and during the detonation procedure;
- Where high order clearance of > 30 kg in weight is planned, a NAS (e.g., bubble curtain) will be used in order to reduce potential noise impacts (JNCC, 2025d). It is thought that using a NAS will result in a 6 dB reduction in peak sound pressure level and therefore reduce the radius, within which the level is above a given threshold, by around half (as a minimum), and the corresponding area by about 75% (Verfuss *et al.* 2019); and
- Following detonation of the UXO, a visual search of at least 15 minutes' duration will be conducted within the mitigation zone by the MMOs and PAM operator (JNCC, 2025d).

Table 4.11: Outline of mitigation (pre-work search and indicative periods of ADD use) time for each UXO charge weight (plus donor charge)

Clearance type	UXO charge weight (kg)	Noise Abatement Required	Visual and PAM pre-work search (mins)		Total mitigation time (mins)
			Pre-ADD use search	Period of ADD use	
Low order	0.25	NAS Not Required	60	0	60
High order	30		30	44	74
	295	NAS Required	30	45	75
	325		30	45	75
	456		30	56	86
	555		30	56	86
	722		30	67	97

Post-mitigation Effects

Lethal Effects and Physical Injury

It is likely that the visual and passive acoustic pre-work search of the 1 km radius mitigation zone alone will be sufficient to negate the potential for lethal effects and physical injury. With this, in combination with the other mitigation procedures outlined, individuals will not be present in close proximity to the proposed UXO clearance work and the potential for lethal effects and physical injury is nil.

Auditory Injury

It is likely that pre-work searches (1 km radius zone) alone will be sufficient to negate the potential for auditory injury as a result of low order clearance work using a 0.25 kg initiation explosive. The use of an ADD or NAS will not be required.

For all high order UXO clearance ADD use will be required to ensure no individuals of all marine mammal species will be present in the zone of potential effect for auditory injury. The ADD use durations were calculated based on the time needed to clear the greatest (i.e., worst case) potential impact ranges (relating to SPL_{peak}) for very high frequency cetaceans (i.e., harbour porpoise for each UXO charge weight using a conservative flee speed of 1.5 m/s.

The ADD durations were adjusted to include the 1 km mitigation zone cleared during the pre-work search and the reduction in Permanent Threshold Shift (PTS) impact range from the use of a NAS for high order clearance >30 kg.

With the implementation of the mitigation measures (pre-work search, use of an ADD and NAS) no individuals of any marine mammal species will be present within the zone of potential effect for auditory injury for either low order or high order UXO clearance.

Behavioural Responses

Behavioural responses will likely be short term; Thompson *et al*. (2020) showed that the minimum time to the first porpoise detection following a 15 minute ADD playback was 133 minutes for all C-PODs within 1 km of the playbacks. Suitable local alternative habitat is likely to be available in the meantime therefore the energetic costs of fleeing should be able to be met relatively quickly. Because each piece of clearance work will only take a few hours, it is unlikely that animals of all marine mammal species will be excluded from key areas for significant periods of time.

For low order clearance, the number of individuals which have the potential to be exposed to sound levels which may induce a behavioural response is the same as pre-mitigation (not withstanding that the 1 km mitigation zone will be clear of animals following the pre-work search).

Behavioural responses (for high order clearance) will not be reduced through use of an ADD because this approach relies on inducing a behavioural response in order that animals move out of the area of a more deleterious potential effect. As such, the number of individuals likely to exhibit a behavioural response from clearance of UXO ≤ 30 kg (i.e. without the use of a NAS) will be similar to the number estimated pre-mitigation.

The potential for behavioural responses will be reduced by use of a NAS for high order clearances > 30 kg. The 15 km EDR for harbour porpoises provided in the JNCC Marine Noise Registry Help and Guidance (JNCC, 2025b) for high order UXO clearance with noise abatement has been used to estimate the number of individuals in the zone (the area of which is 706.9 km^2) which may exhibit behavioural responses for all species (Table 4-12).

Table 4-12: Number of individuals which may exhibit behavioural responses following high order UXO clearance with noise abatement using the 15 km EDR (JNCC, 2025b)

Species	Number of individuals	% of reference population	% of UK portion of reference population
Harbour porpoise	426	0.123	0.267
Bottlenose dolphin	30	1.465	1.571
White-beaked dolphin	56	0.129	0.166
Minke whale	30	0.147	0.288
Grey seal	796	2.441	-
Harbour seal	6	1.072	-

4.4.3.2. Increased Anthropogenic Noise from Use of USBL Equipment

It is likely that ultra short baseline (USBL) equipment will be used if ROVs are being used during the UXO clearance work, for example to place donor charges. The typical frequency range of USBLs is 18-55 kHz which is within the hearing range of marine mammals. As long as the source level of the USBLs used is less than 202 dB re 1 µPa (the lowest of the SPL_{peak} thresholds for auditory injury) there is no potential for auditory injury (USBLs typically have source levels of c.194 dB re 1 µPa). Potential for disturbance is small scale, short-term, sporadic and without any likely negative impact on the species – and therefore considered to be trivial.

4.4.3.3. Risk of Collision with Vessels

The presence of a small number of UXO clearance/guard vessels will be very spatially and temporally limited and is not considered to notably increase vessel traffic in the area above baseline levels. The vessels will either be stationary or moving slowly during the proposed work. Where possible and appropriate, vessels will not exceed 14 knots when transiting to and between work sites.

The species present within the inshore and offshore waters around the subsea cable route are considered to be habituated to the presence of vessels. They are predominately small and agile making them less susceptible to collisions than, for example, large whale species.

Although the consequences of a collision (i.e., mortality, injury) may be severe, the likelihood of occurrence is very low for these species in this area and therefore the risk is considered to be negligible for marine mammals. Nonetheless, during transits, when vessel speed may be greater, transit watches will be conducted.

Mitigation measures

An observer on the bridge of all vessels will keep watch for marine mammals during all transits to and from the work sites. Any sightings will be communicated to the Officer on watch as soon as is practicable who will ensure that marine mammals are avoided where safe to do so. At all times the Officer on watch will minimise high powered manoeuvres or rapid changes of course, where this does not impair safety, to avoid collisions.

The observer may be the Master of the vessel, a member of the bridge crew, another member of the ship's crew or an MMO as appropriate. Observers and the vessel operator will be briefed on the Scottish Marine Wildlife Watching Code[15] and Basking Shark Code of Conduct[16].

4.4.3.4. Changes in Turbidity

Unlike low order, high order detonation of UXOs (should they be required) is likely to cause a temporary local increase in suspended sediment concentrations (SSCs) and therefore turbidity. Although SSCs may have settled by the time animals return to the UXO location, marine mammals are used to navigating and foraging in highly turbid environments (e.g., areas where the tide is running) and are therefore expected to be unaffected by such perturbations. Only a small area will be affected, with suitable alternative habitat being available locally in the meantime. The risk of changes in turbidity affecting navigation and foraging success is therefore considered to be negligible.

4.4.3.5. Cumulative Assessment

Increased Anthropogenic Noise from UXO Clearance Work

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the effect of increased underwater noise from UXO clearance work on marine mammal receptors, and include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only); and
- Inch Cape Offshore Wind Farm (Export cable only).

The list of potential plans and projects was refined using a 26 km screening range from the Marine Scheme and also whether there is temporal overlap of their construction periods and the UXO clearance activities. Twenty-six km has been used in line with the EDR for high order UXO clearance (JNCC, 2020; JNCC, 2025b). Plans and projects beyond this distance are considered to have no potential for connectivity considering the small spatial scale and temporal nature of the work.

The EGL1 UXO clearance work is anticipated to take up to one month within Q2 and Q3, 2026 (over a maximum of 60 days, including weather downtime), which has the potential to overlap with the commencement of the Berwick Bank Cambois Connection installation and construction of the Inch Cape Offshore Wind Farm Export Cable Corridor (ECC).

With mitigation there is no risk of PTS as a result of either low order or high order UXO clearance work at the Marine Scheme. It is considered that this is also the case for any construction activities at the Berwick Bank Offshore Wind

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15 Scottish Marine Wildlife Watching Code | NatureScot

16 Download.ashx (sharktrust.org)

Farm Cambois Connection and the Inch Cape Offshore Wind Farm ECC which will also have any necessary mitigation measures in place to avoid auditory injury to marine mammals.

The underwater noise generated by UXO clearance work will be audible to marine mammals and may therefore cause behavioural responses up to a maximum of 26 km from the Marine Scheme. However, any potential behavioural effects will be short-term, sporadic, reversible, and without any likely negative effect on the species concerned. As a result, in regard to disturbance, the Marine Scheme will only have a negligible contribution cumulatively with any disturbance to marine mammals from the other plans and projects.

It is therefore concluded that the Marine Scheme's contribution cumulatively with the contribution of other projects is not significant for increased underwater noise from UXO clearance work.

Increased Anthropogenic Noise from Use of USBL Equipment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the effect of increased underwater noise from use of USBL equipment on marine mammal receptors, and includes:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only).

The list of potential plans and projects was refined using a 5 km screening range from the Marine Scheme and also whether there is temporal overlap of their construction periods and the UXO clearance activities. Five km has been used in line with the EDR for geophysical survey equipment (JNCC, 2025b). Plans and projects beyond this distance are considered to have no potential for connectivity considering the small spatial scale and temporal nature of the work.

Considering the conclusions of the assessment of increased underwater noise from use of USBL equipment for the Marine Scheme alone (i.e. no potential for auditory injury and behavioural disturbance being trivial) the Marine Scheme's contribution cumulatively with the contribution of other projects is not significant for this impact.

Risk of Collision with Vessels

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the risk of collision with vessels on marine mammal receptors, and includes:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only).

Only projects with direct overlap with the Marine Scheme were considered for this impact and where there is temporal overlap of their construction periods and the UXO clearance activities.

Considering the conclusions of the assessment of collision risk with vessels for the Marine Scheme alone (i.e. negligible with the implementation of mitigation) the Marine Scheme's contribution cumulatively with the contribution of other projects is not significant for this impact.

Changes in Turbidity

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the risk of changes in turbidity on marine mammal receptors, and includes:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only).

Only projects with direct overlap with the Marine Scheme were considered for this impact and where there is temporal overlap of their construction periods and the UXO clearance activities.

Considering the conclusions of the assessment of changes in turbidity for the Marine Scheme alone (i.e. negligible) the Marine Scheme's contribution cumulatively with the contribution of other projects is not significant for this impact.

4.4.4. Conclusion

Following implementation of the mitigation measures outlined, there is no potential for auditory injury to marine mammals from either low or high order UXO clearance activities at the Marine Scheme alone or cumulatively with the contribution of other projects. There is considered to be potential for a temporary behavioural response by a

small number of individuals in response to both low and high order UXO clearance and the use of USBL equipment, however, this is not considered to be detrimental to the maintenance of the populations of the species concerned at a Favourable Conservation Status (FCS) in their natural range. Therefore, as concluded in the accompanying EPS Risk Assessment (1400131), a licence (to disturb) will be required and can be granted for the UXO clearance work in Scottish territorial waters. In the context of the Regulations as applied in English territorial waters, and both Scottish and English offshore waters (i.e. beyond 12 nautical miles), EPS and Marine Wildlife Licences (to disturb) will not be required.

It is also concluded that the potential for collisions (with vessels) and the risk of changes in turbidity as a result of the UXO clearance work affecting navigation and foraging success is negligible for all species.

4.5. Ornithology

4.5.1. Baseline

For ornithology, the study area is defined as the Marine Scheme, plus all sites that lie within or at least partly overlap with a 25 km buffer thereof. The Marine Scheme is situated within, passes through or lies in close proximity (i.e. within a 25 km buffer of) a number of European designated sites for ornithological features. The Marine Scheme passes directly through two sites internationally designated for the protection of seabirds: Outer Firth of Forth and St Andrews Bay Complex SPA as it leaves the Scottish landfall; and Northumberland Marine SPA for a short distance as the route passes Holy Island south of Berwick-upon-Tweed.

The Outer Firth of Forth and St Andrews Bay Complex SPA is designated for 21 seabird and waterbird species (both breeding and overwintering), as well as foraging grounds for breeding populations of seabirds such as common tern (*Sterna hirundo*), Arctic tern (*Sterna paradisaea*) and shag (*Gulosus aristotelis*). The Northumberland Marine SPA is designated for a range of breeding birds, including Arctic tern, common tern, guillemot (*Uria aalge*), little tern (*Sternula albifrons*), puffin (*Fratercula arctica*), roseate tern (*Sterna dougallii*) and Sandwich tern (*Thalasseus sandvicensis*) as well as a wider breeding seabird assemblage. In addition to this, the following sites designated for the protection of marine and coastal birds are located within the study area: St Abb's Head to Fast Castle SPA; Lindisfarne SPA/Ramsar site/SSSI (Sites of Special Scientific Interest); Northumbria Coast SPA/Ramsar site, including Durham Coast SSSI; Farne Islands SPA/SSSI; and Coquet Island SPA/SSSI.

Many of the sites are designated for breeding seabird features, with the breeding season for most seabird species falling between April and August. Outside the breeding season, the wider area is used for foraging, resting and roosting by seabirds. Adult seabirds with active nests are likely to be constrained by foraging distance from the location of the colony.

4.5.2. Summary of EAR conclusions

The effects of the installation of the Marine Scheme on the ornithology of the area are set out in Chapter 11: Ornithology of the 2022 of the EGL1 EA (AECOM, 2022), submitted as part of the original Marine Licence application. The Environmental Appraisal Report concluded that no significant effects are predicted during installation, operation (including maintenance and repair), and decommissioning of the EGL1 Marine Scheme.

Update on Additional Relevant Findings

Ornithological data published since the 2022 EGL1 EA include a seasonal (October to December 2023) Natural England commissioned ornithological and marine mammal characterisation surveys for the POSEIDON project (APEM, 2024). Surveys were carried out using a Digital Aerial Survey (DAS) methodology and the region covered by this report covers a marine area of approximately 42,050 km^2, extending from waters offshore from Arbroath at its northernmost extent and Bridlington at the southernmost reaches. The range of ornithological species recorded during the survey campaign aligns with those expected to be present within the region during the months of October to December and does not contradict the baseline upon which the original EA (AECOM, 2022) was carried out. Species recorded include gulls (including kittiwake (*Rissa tridactyla*), great black-backed gull (*Larus* marinus) and

herring gull (*Larus argentatus*)), auks (including guillemot, razorbill (*Alca torda*), puffin and little auk (*Alle alle*)) as well as fulmar (*Fulmarus glacialis*), gannet (*Morus bassanus*) and great northern diver (*Gavia immer*).

The British Trust for Ornithology (BTO) Seabird Monitoring Programme (SMP) annual report provides information on trends and productivity for seabirds in the UK. The most recently published SMP report (Harris *et al*., 2024) provides an assessment of the health of UK seabird populations, utilising a plot colony count methodology. The status and trends of seabird colonies within the region of EGL1 (i.e. the UK east coast) presented in the report indicate that the population trends of relevant species continue on the trajectory upon which the original 2022 EGL1 MLA was based.

4.5.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Visual and noise related disturbance; and
- Indirect effects through impacts on prey species.

4.5.3.1. Visual and noise related disturbance

The UXO clearance vessels will be present within the context of existing sources of disturbance such as commercial shipping, recreational boating etc. Up to 40 cUXO are assumed to occur across the Marine Scheme.

This work has the potential to disturb (and displace) birds at various life stages. Disturbance can temporarily displace birds or can affect foraging behaviour, and therefore overall survival.

There is potential for noise created during denotation of a high order UXO to disturb and displace underwater-foraging birds, as loud percussive noises may elicit a startle response, resulting in cessation of foraging activities and/or dispersal from an area (Anderson *et al*., 2020). It is recognised that the nature of such acoustic disturbances have the greatest potential to elicit this type of startle response. However, it is expected that, in most cases, concentrations of birds will not be present in close proximity to clearance operations as a result of having already been displaced to alternative suitable habitat due to the vessel activity at the location of the clearance activities. As such, potential for further disturbance is minimised.

The UXO clearance works will be undertaken in an environment with existing sources of anthropogenic underwater and in-air noise from vessel movements (e.g., commercial shipping, fishing and ferries). The clearance work is considered temporary as it would constitute approximately 40 cUXO clearance events, and of these it is considered approximately only 4 (i.e. 10%) will be through high order clearance, and with the campaign conducted over one relatively short period.

The duration of UXO clearance at any one location will be of limited temporal and spatial extent. Given the large area for the predicted activities to take place and the extensive, additional feeding / loafing habitat in the area for any displaced birds, there is no potential for the work to result in significant effects as a result of disturbance to ornithology receptors.

4.5.3.2. Indirect Effects through Impacts to Prey Species

Bird species have the potential to show distributional changes due to impacts on prey species. Prey availability has been correlated with breeding success (Bustnes *et al*., 2013). Fish such as herring and sandeel are a key prey resource, which both have the potential to be impacted by disturbance to the specific sediment, essential for successful spawning and completion of the lifecycle. Long term studies in the Firth of Forth highlighted a long-term decline in the overall prevalence of sandeel in kittiwake chick diet, concomitant with an increase in the relative prevalence of clupeids in Scottish waters (Wanless *et al*., 2018) indicating adaptable diet. Disruption to the prey habitat at any one location is anticipated to be temporary and of short duration. In addition, there is extensive adjacent equivalent prey habitat in the surrounding area whereby prey availability will not be affected by the UXO clearance activities. As such, it is considered there is no potential for the work to result in significant effects as a result of indirect impacts to prey species.

4.5.3.3. Cumulative assessment

4.5.3.3.1. Visual and noise related disturbance

Given that the proposed UXO clearance activities, which will be very localised in terms of spatial extent and of short duration, will not result in any significant adverse effects on any ornithological receptor, it is considered that there is no potential for any significant cumulative effects to arise.

All effects of the EGL1 Marine Scheme installation were considered to be not-significant, as are any effects that may result from the UXO clearance activities. It is considered that all effects at a cumulative level will not be significant, due to the short duration of works, and limited spatial scale over which activities are expected to take place.

4.5.3.3.2. Indirect Effects through Impacts to Prey Species

Given that the proposed UXO clearance activities, which will be very localised in terms of spatial extent and of short duration, will not result in any significant adverse effects to the prey species of any ornithological receptor, it is considered that there is no potential for any significant cumulative effects to arise via secondary impacts to ornithological features through impacts to their prey species.

All effects of the EGL1 Marine Scheme installation were considered to be not-significant, as are any effects that may result from the UXO clearance activities. It is considered that all effects at a cumulative level will not be significant, due to the short duration of works, and limited spatial scale over which activities are expected to take place.

4.5.4. Conclusion

Work at each cUXO location (and all cUXO combined) will affect an imperceptible percentage of the marine habitat available to seabirds in the wider area for a short period of time. In terms of the direct impacts of noise and vibration to ornithological interests, acoustic disturbance impacts which may occur are considered to be significantly lesser in scale and magnitude than those already consented (and assessed as not significant) for installation of the EGL1 Marine Scheme.

In relation to indirect impacts to seabirds through impacts to their prey species, hearing-sensitive fish are anticipated to be present in the marine installation corridor and, although noise levels anticipated are higher than those assessed in the EA for installation activities, these are assessed as not significant for the UXO clearance activities.

Given the significantly smaller spatial and temporal scale of the UXO clearance activities compared to the wider installation activities, it can be concluded that no significant effects are predicted to arise to ornithological interests within the region either alone or cumulatively with other plans and projects, as a result of the UXO clearance activities.

4.6. Cultural Heritage and Marine Archaeology

4.6.1. Baseline

Eleven palaeogeographic features of archaeological potential have been identified within the geophysical study area (one within Scottish territorial waters and ten within English territorial waters) and a total of 247 features have been identified as being of possible archaeological potential within the geophysical study area, discriminated as follows: 32 A1 anomalies (anthropogenic origin of archaeological interest); and 215 A2 anomalies (uncertain origin of possible archaeological interest). Within Scottish waters there is one chartered wreck and one identified and named wreck site within the marine installation corridor while there are nine in English waters, four of which have been named and identified. There are no known aircraft crash sites within the marine installation corridor (Chapter 12-Marine Archaeology of the EGL1 EA (AECOM, 2022)).

The EA determined archaeological features are distributed along the entire marine installation corridor, with some forming distinct clusters and groupings (Chapter 12- Marine Archaeology of the EGL1 EA (AECOM, 2022)) and the

potential exists for further unknown cultural heritage features to be identified including prehistoric, maritime and aviation features from the pUXO geophysical survey.

4.6.2. Existing EA Conclusions

The effects of the installation of the Marine Scheme on the Cultural Heritage and Marine Archaeology of the area are set out in Chapter 12: Marine Archaeology of the of the EGL1 EA (AECOM, 2022), submitted as part of the original MLA. The Environmental Appraisal Report concluded that no significant effects are predicted during installation, operation (including maintenance and repair), and decommissioning of the EGL1 Marine Scheme.

Update on Additional Relevant Findings

At the time of writing, there is no other additional information relevant to this assessment to be added.

4.6.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Seabed disturbance – damage to or removal of heritage features resulting from direct physical impacts.

4.6.3.1. Seabed Disturbance - Damage to or Removal of Heritage Features Resulting from Direct Physical Impacts

High order (detonation) UXO clearance activities have the potential to directly affect marine cultural heritage and marine archaeology (partial or total destruction) through direct impacts to the seabed. Although it is acknowledged that low order deflagration methods may require some light disturbance to the seabed via jetting methods, these are not considered to directly affect the marine cultural heritage unless the cUXO is in very close proximity.

There are a number of known archaeological features along the Marine Scheme area, and there is the possibility that un-recorded assets will be identified during the works, despite the activities being minimally invasive. Few previously unrecorded features are expected however, given the dynamic nature of the North Sea, the potential for movement or exposure of archaeological assets cannot be entirely ruled out.

The UXO clearance works will involve seabed interaction, however the potential for interaction with any archaeological features is considered minimal.

Any work to be undertaken will avoid all designated AEZs specified for the Development. A PAD has been written, in line with current consents for the installation works.

Specific mitigations include:

- Review of the summer 2025 geophysical survey data to confirm the latest seabed conditions and verify absence of new anomalies;
- Adherence to known AEZ; and
- Implementation of a PAD, similar to the established Protocol for Archaeological Discoveries: Offshore Renewables Project (The Crown Estate 2014) and the Marine Aggregate Industry Protocol for the Reporting of Finds of Archaeological Interest (BMAPA and English Heritage, (now Historic England) 2005).

Should any archaeological material require relocation, Historic England or Historic Environment Scotland will be consulted and a method agreed before any relocation of archaeological features commences. The activities taking place will be intermittent, of short duration and limited in scale with minimal interaction with the seabed and it is therefore considered that there is no potential for the work to result in significant effects on the marine archaeology as a result of the UXO clearance activities.

4.6.3.2. Cumulative Assessment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the effect of UXO clearance activities on marine archaeology and cultural heritage assets, to include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only);

The Berwick Bank Offshore Wind Farm export cable was excluded from the original cable installation EA (Chapter 16: Cumulative and In-Combination Effects EGL1 EA (AECOM, 2022)), however due to the consented Cambios Connection, this is included in this assessment.

Due to the mitigation proposed above, no significant effects are anticipated on marine archaeology and cultural heritage either alone or cumulatively with other plans and projects, as a result of the UXO clearance activities. Given the implementation of AEZ avoidance, PAD procedures, and prior survey coverage, any residual effects are anticipated to be negligible.

4.6.4. Conclusion

With appropriate mitigation, no significant effects are predicted to arise on the cultural heritage and marine archaeology receptors as a result of the UXO clearance activities. The impacts which may occur are also considered to be lesser in scale and magnitude than those already consented (and assessed as not significant) for installation of the EGL1 Marine Scheme which will involve considerably more interaction with the seabed.

4.7. Commercial Fisheries

4.7.1. Baseline

The principal fishing activities of relevance to the Marine Scheme have been identified through analysis of available fisheries data and from information gathered during consultation with fisheries stakeholders and include the following:

- Potting / creeling for lobster and crab;
- Demersal trawling (predominantly for *Nephrops* and to a lesser extent squid); and
- Scallop dredging.

In the study area, potting / creeling is predominantly undertaken by vessels under 10 m in length. These vessels tend to concentrate their activity in inshore areas within the 6 nautical miles limit, although some vessels target areas further offshore. During consultation, potting grounds were identified by fisheries stakeholders along various areas that overlap with the marine installation corridor, including in the following sections: Kilometre Point (KP) 1 to KP 95; KP 97 to KP 117; KP 145 to 159 and KP 166 to KP 176.

The marine installation corridor also overlaps with a small section of the Firth of Forth (in Scottish waters) and Farn Deeps (in English waters) *Nephrops* grounds (from KP 8 to KP 25 and from KP 120 to KP 167, respectively) which are targeted by demersal trawlers. Some of the Scottish demersal trawlers consulted reported squid as a secondary target species. Squid grounds were identified in areas between KP 1 and KP 63.

The analysis of fisheries data and information collected during consultation indicates that scallop dredging activity is undertaken at relatively low levels in areas of relevance to the Marine Scheme and that is predominantly carried out by nomadic vessels in transit between more productive fishing grounds. Albeit limited, some activity by scallop dredgers has been recorded in the areas of the cable installation corridor that overlap with ICES (International Council for the Exploration of the Sea) rectangles 40E7, 40E8 and 39E8 (between KP 1 and KP 119).

4.7.2. Existing EA Conclusions

The effects of the potential interaction of the Marine Scheme with the commercial fisheries of the area are set out in Chapter 14: Commercial Fisheries of the EGL1 EA (AECOM, 2022), submitted as part of the Marine Licence Application. The EA concluded that, following Marine Scheme specific mitigation, no significant effects were predicted during installation, operation (including maintenance and repair), and decommissioning of the EGL1 Marine Scheme, for all receptors.

Update on Additional Relevant Findings

Commercial fisheries data published since the 2022 EGL1 MLA include landings data by ICES rectangle for UK-registered vessels, covering the years 2019-2023 (MMO, 2024) and gridded fisheries data within Scottish waters for Scottish fishing vessels under 12 m overall length for the years 2018-2022 (Marine Scotland, 2024). However, fishing patterns of the principal fishing activities / receptors of relevance to the Marine Scheme that have been identified through analysis of available fisheries data and from information gathered during consultation with fisheries stakeholders as referred in Section 4.7.1 above are consistent over time. Therefore, the baseline and conclusions presented within the 2022 EGL1 MLA remain appropriate.

4.7.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Vessel Presence - disruption to existing fishing activities from temporary loss or restricted access to fishing grounds and displacement of fishing vessels into other areas.

4.7.3.1. Vessel Presence - Disruption to Existing Fishing Activities

The work will be undertaken along the marine installation corridor, however in any given area the work will be relatively short term, highly localised and small scale. Additionally, the vessels will work in an area with a high presence of vessel traffic and the work undertaken will have predictable and slow vessel movements. Vessel presence (along with the requirement to keep a safe distance during UXO clearance works) from the planned UXO clearance activities therefore have the potential to result in temporary, short term and highly localised disruption of fishing activities within the vicinity of detonation activities.

The Marine Scheme has a Fisheries Liaison Officer (FLO) who will ensure effective, ongoing communication between EGL1 and the fisheries stakeholders, which will include communication surrounding these activities. The FLO will ensure key information surrounding the work, including timings and location, is communicated on an ongoing basis. Prior to any work being undertaken, and during the work, all appropriate notices and communications will be shared via NtMs and navigational warnings.

Through good communication and cooperation, there will be no significant disruption to commercial fishery receptors, and no significant impact on this receptor group.

4.7.3.2. Cumulative Assessment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the effect of Vessel Presence - Disruption to Existing Fishing Activities, to include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only);

Any temporary loss of fishing grounds and associated displacement resulting from the UXO clearance works or relevant other projects would be highly localised around current operations and of very short duration. Safety zones / advisory safety zones may be in place at a given time. In all cases, implementation of good practice embedded mitigation measures are expected, including use of a FLO for good communication with the fishing community. Considering this, there is no potential for significant cumulative effects to arise on commercial fishery receptors from the UXO clearance activities along with any other plan or project.

4.7.4. Conclusion

Considering the mitigation in place, no significant effects are predicted to arise on the commercial fisheries receptors of the area as a result of the UXO clearance activities. The impacts which may occur are also considered to be lesser in scale and magnitude than those already consented (and assessed as not significant) for installation of the EGL1 Marine Scheme.

4.8. Shipping and Navigation

4.8.1. Baseline

The marine installation corridor for the Marine Scheme runs parallel to the east coast of the UK, south of the Firth of Forth which is an area with busy shipping, fishing and recreational vessel use. Harbours and Ports that influence this area include; Dunbar Harbour (fishing and recreation use), Eyemouth Harbour (a base for fishing vessels and recreational vessels and the Operations and Maintenance base for the Neart na Gaoithe Offshore Wind Farm), the Port of Sunderland (cargo handling port), Seaham Harbour (commercial port), the Port of Tyne (commercial deep-sea port) and Hartlepool (renewables and oil and gas hub (UKHO, 2018)). This area is known for boating as well as diving spots.

The most frequently recorded Automatic Identification System (AIS) vessel tracks in the study area were from fishing vessels with 49.7% of all tracks across the summer and winter seasons, with “cargo/tanker” and “other” vessels following at 22.3% and 16.9% of tracks respectively. “Offshore industry”, “passenger” and “recreational” tracks were relatively low, at 3.6%, 2.8% and 4.7% of all tracks, respectively.

4.8.2. Existing EA Conclusions

The effects of the installation of the Marine Scheme on the shipping and navigation of the area are set out in Chapter 13: Shipping and Navigation of the EGL1 EA (AECOM, 2022), submitted as part of the original Marine Licence application. The Environmental Appraisal Report concluded that the residual risks predicted during installation, operation (including maintenance and repair), and decommissioning of the EGL1 Marine Scheme are determined to be As Low As Reasonably Practicable (ALARP) which is not significant.

Update on Additional Relevant Findings

At the time of writing, there is no other additional information relevant to this assessment to be added.

4.8.3. Effect of the UXO Clearance Activities

Potential effects from the UXO clearance activities include:

- Vessel presence - increased vessels in the area.

4.8.3.1. Vessel Presence – Increased Vessels in the Area

The planned UXO clearance activities have the potential for short term, localised disruption to shipping activities within the vicinity of the detonation activities. Ongoing communication would be shared via all the Kingfisher Bulletin updates and issue of NtMs. It is anticipated the UXO vessel will use Very High Frequency (VHF) radio to transmit warnings advising any transient shipping that clearance works are taking place.it will be necessary for the vessel to communicate the exact locations, including exclusion zones, to all vessels throughout the UXO clearance activities. Vessels will display lights and signals in accordance with the requirements of the International Regulations for the Prevention of Collisions at Sea. The Marine Scheme will consult with and actively maintain communications about the proposed works with the Northern Lighthouse Board (NLB), the Maritime and Coastguard Agency (MCA), the UK Hydrographic Office (UKHO) and the relevant Maritime Rescue Co-ordination Centre (MRCC).

Other standard mitigation measures will be implemented to ensure impacts to shipping and navigation is kept to a minimum, including NtM and Kingfisher Bulletin notices will be issued in advance of the planned activities.

The work will be temporary in nature, localised and covering a small spatial scale. Parts of the route have existing busy shipping areas and the presence of the four anticipated vessels associated with this work would not materially contribute to an increase in overall vessel traffic giving rise to potential significant effects.

4.8.3.2. Cumulative Assessment

The long list of plans and projects presented in Section 3.4 has been refined for consideration in this cumulative assessment for the effect of increased vessels in the area, to include:

- Berwick Bank Offshore Wind Farm Cambois Connection (Export cable only);

Additionally, increased vessels within the marine cable corridor at the same time, will increase collision risk. However, given that UXO clearance required exclusion zones to be in place, there is a considerably reduced likelihood of collision. The UXO clearance activities will be carried out over a relatively short period of time, and appropriate notification will be issued, informing sea users of the work. It can be concluded that given the localised and temporary nature of the UXO clearance works, the Marine Scheme's negligible contribution cumulatively with other plans and projects is not significant for increases in vessel presence.

4.8.4. Conclusion

The additional vessels associated with the UXO clearance activities will not have an impact on the current vessel use of the area. Any closures of areas during cUXO removal will be suitable notified (NtM). The numbers of vessels required for the UXO clearance activities are much fewer, and will be present for a much shorter period of time compared to the requirements for the cable installation, which were assessed in the EA as not significant. Given the limited additional vessels and the temporary nature of the UXO clearance work compared to the wider installation activities, and the mitigation which will be in place, it can be concluded that no significant effects are predicted to arise on the shipping and navigation of the area either alone or cumulatively with other plans and projects, as a result of the UXO clearance activities.

5. SEI Summary and Conclusion

A hierarchical approach to managing cUXO clearance will be applied, with high order detonation used only as a last resort. For the purposes of the MLA, it is assumed that while there may be up to 40 cUXO requiring clearance along the marine installation corridor, only up to four of these may require high order detonation.

The UXO clearance activities will take place within the existing consented Marine Scheme area (where all similar impacts assessed for cable installation were not significant). This work is considered, in most instances (noise being the only exception) to result in impacts less than those originally assessed. Noise impacts remain not-significant for UXO clearance activities. The work will be undertaken over a relatively short time period and will be temporary in nature and highly localised. All appropriate mitigation will be in place to ensure any potential effects are reduced.

Based on the above considerations of impacts on all potential environmental receptors, it can be concluded that the UXO clearance activities (described in Section 2) will not result in any potential significant effects, taking into consideration appropriate mitigation as detailed.

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Appendix A – UXO Clearance at EGL1: Underwater Noise Impact Assessment

UXO Clearance at EGL1: Underwater Noise Impact Assessment

Issy Morgan

31st October 2025

Subacoustech Environmental Report No.
P426R0104

Submitted to: Conor Cronin

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Executive Summary

An assessment has been undertaken to model the potential effects of underwater noise on marine mammals and fish from planned unexploded ordinance (UXO) clearance, associated with the development of Eastern Green Link 1 in the North Sea. The assessment covers clearance of various UXO targets using both high-order detonation and low-order deflagration (which does not produce a detonation beyond the donor charge), though low-order deflagration is being prioritised wherever feasible.

Predictions of the sound levels generated by these activities were made using the methodology outlined in Soloway and Dahl (2014). These predictions were then interpreted using the guidelines provided in Southall *et al.* (2019) for marine mammals, and Popper *et al*. (2014) for fish, to estimate the impact of the sound levels on these receptors. The largest distance predicted for the risk of permanent auditory injury in marine mammals from a low order deflagration, as per Southall et al. (2019) impact criteria, is for harbour porpoise under the $L_{p,\text{pk}}$ metric, if they are within 990 m. Using the $L_{E,p,\text{wtd}}$ metric, LF cetaceans have the largest permanent auditory injury range of all marine mammals of 230 m from the source. All types of fish morphologies, as per Popper et al. (2014) are at risk of mortality or potential mortal injury if they are within 70 m of a low order deflagration, according to the $L_{p,\text{pk}}$ metric. In the event of a high order detonation, all impact ranges are much greater, although this is not expected.

Finally, it should be highlighted that recent research has shown that Soloway and Dahl (2014) could overestimate $L_{p,\text{pk}}$ noise levels but under-estimate $L_{E,p,\text{wtd}}$ noise levels in some instances. Additionally, their predictions do not account for environmental factors, so the estimated impact ranges should be viewed as indicative of potential effects on receptors during UXO clearance

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Terminology

Decibel (dB)	A customary scale commonly used (in various ways) for reporting levels of sound. The dB represents a ratio/comparison of a sound measurement (e.g sound pressure) over a fixed reference level. The dB symbol is followed by a second symbol identifying the specific reference value (e.g., re 1 µPa).
Peak pressure	The highest pressure above or below ambient that is associated with a sound wave.
Peak-to-peak pressure	The sum of the highest positive and negative pressures that are associated with a sound wave.
Permanent Threshold Shift (PTS)	A permanent total or partial loss of hearing caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity.
Root Mean Square (RMS)	The square root of the arithmetic average of the squared pressures. Used as a measure of the average sound pressure level.
RMS Sound Pressure Level ($L_{p,\mathrm{RMS}}$)	The RMS sound pressure expressed in dB. One measure used to characterise impulsive sound. (dB re 1 µPa)
Sound Exposure Level (SEL or $L_{E,p}$)	The constant sound level acting for one second, which has the same amount of acoustic energy, as indicated by the square of the sound pressure, as the original sound. It is the time-integrated, sound-pressure-squared level that is typically used to compare transient sound events having different time durations, pressure levels, and temporal characteristics.
Sound Exposure Level, single pulse ($\mathrm{SEL_{sp}}$ or $L_{E,p,sp}$)	Calculation of the sound exposure level representative of a single noise impulse, typically a pile strike.
Sound Pressure Level (SPL or L_p)	The sound pressure level is an expression of sound pressure using the decibel (dB) scale; the standard frequency pressures of which are 1 µPa for water and 20 µPa for air.
Sound Pressure Level Peak ($\mathrm{SPL_{peak}}$ or $L_{p,\mathrm{pk}}$)	The highest (zero-peak) positive or negative sound pressure, in decibels.
Temporary Threshold Shift (TTS)	Temporary reduction of hearing acuity because of exposure to sound over time. The mechanisms underlying TTS are not well understood, but there may be some temporary damage to the sensory cells. The duration of TTS varies depending on the nature of the stimulus.
Unweighted sound level	Sound levels which are “raw” or have not been adjusted in any way, for example to account for the hearing ability of a species.
Weighted sound level	A sound level which has been adjusted with respect to a “weighting envelope” in the frequency domain, typically to make an unweighted level relevant to a particular species.

Units

dB	Decibel (sound pressure)
kg	Kilogram (mass)
km	Kilometre (distance)
m	Metre (distance)
ms^{-1}	Metres per second (speed)
Pa	Pascal (pressure)
Pa^2s	Pascal squared seconds (acoustic energy)
µPa	Micropascal (pressure)

Acronyms

EGL1	Eastern Green Link 1
HF	High-Frequency Cetaceans
LF	Low-Frequency Cetaceans
NEQ	Net Explosive Quantity
PCW	Phocid Carnivores in Water
PPV	Peak Particle Velocity
PTS	Permanent Threshold Shift
SE	Sound Exposure
SEL ($L_{E,p}$)	Sound Exposure Level
SEL_{sp} ($L_{E,p,sp}$)	Single Pulse Sound Exposure Level
SPL	Sound Pressure Level
SPL_{peak} ($L_{p,pk}$)	Peak Sound Pressure Level
$SPL_{peak\text{-}to\text{-}peak}$ ($L_{p,pk\text{-}pk}$)	Peak-to-peak Sound Pressure Level
SPL_{RMS} ($L_{p,RMS}$)	Root Mean Squared Sound Pressure Level
TTS	Temporary Threshold Shift
VHF	Very High-Frequency Cetaceans
UXO	Unexploded Ordinance

1 Introduction

1.1 Project Overview

Natural Power have requested an underwater noise assessment for anticipated unexploded ordinance (UXO) clearance activities related to the construction of the Eastern Green Link 1 (EGL1) underwater cable, located in the North Sea, UK. EGL1 is a planned 196 km cable under the seabed, running from Thorntonloch Beach in East Lothian, Scotland to the beach just north of Seaham in County Durham, England. Before construction can begin, there is a potential need to clear UXO currently located on or close to the seabed along the planned cable route. These activities are likely to generate high levels of underwater noise that may impact marine life. Therefore, as part of a Marine License application for UXO clearance, the potential noise levels associated with the UXO clearance and impacts this may have on relevant marine fauna in the region must be assessed.

This report provides the results and findings of the underwater noise assessment of the anticipated UXO clearance activities. The assessment predicts sound pressure levels and sound exposure levels generated during these activities, which are used to assess the impact of these levels on sensitive marine animals in the region, with particular focus on the impact on marine mammals and fish.

1.2 Sound Sources

Various UXO devices requiring clearance could be present on site, with sizes ranging from 25 kg to 697 kg. This is based on the range of devices that have been found in similar projects in the North Sea, although this has not yet been confirmed by survey on the EGL1 route. Both high-order (full detonation of the device) and low order (destruction of the device without detonation) clearance scenarios have been assessed, although a low order technique is being prioritised wherever feasible. Source noise level and propagation produced by the techniques are provided in Sections 3.1 and 3.2.

1.3 Document Overview

This report presents a detailed assessment of the potential underwater noise from the anticipated UXO clearance activities in the North Sea, and covers the following:

- Section 2: Review of background information on measuring and assessing underwater noise.
- Section 3: Discussion of the method for sound level prediction, including assumptions for these estimates.
- Section 4: Interpretation of the results using suitable noise metrics and criteria.
- Section 5: Discussion
- Section 6: Summary and Conclusion

2 Underwater Noise Concepts

Sound travels much faster in water (approximately 1,500 ms^{-1}) than in air (343 ms^{-1}) as water is relatively incompressible and has a higher density than air. This affects the way in which sound measurements are expressed between the two mediums, which means that underwater sound levels are not directly comparable to airborne sound levels. This is noted for context but this report does not contain or include any reference to airborne sound levels.

2.1 Units of Measurement

Sound measurements are usually expressed using the decibel (dB) scale, which is a logarithmic measure of sound. The dB scale represents a ratio, and therefore, it is used with a reference unit, which is the base from which the ratio is expressed. The fundamental definition of the dB scale is given in in Equation 1:

(1)

$$Sound\ pressure\ level\ (L_p) = 20 \log_{10}\left(\frac{P}{P_{ref}}\right)$$

where P is pressure, measured in Pascals (Pa), and P_{ref} is the reference pressure, given as 1 µPa (1x10^{-6} Pa) as defined in ISO 18405:2017 for underwater noise. Noise can be quantified using various metrics depending on the nature of the sound, as discussed below.

2.1.1 Sound Pressure Level

Sound Pressure Level (SPL or L_p) is a measure of the pressure variation caused by sound waves, expressed in decibels (dB), as seen in Equation 1. Variations of L_p are used depending on the noise source being measured. Unless otherwise defined, all L_p noise levels in this report are referenced to 1 µPa.

2.1.1.1 Level of the Mean Squared Sound Pressure

An unweighted sound pressure level, averaged over a measurement period, known as a root mean squared (RMS) sound pressure level (SPL_{RMS} or $L_{p,RMS}$), can be used to represent the noise levels. The $L_{p,RMS}$ can vary significantly depending on the measurement duration.

2.1.1.2 Level of the Peak Sound Pressure

Transient, impulsive pressure waves, such as generated from explosions are usually expressed using the level of peak sound pressure (SPL_{peak} or $L_{p,pk}$). This is calculated using the maximum pressure variation from positive to zero, representing the peak change in pressure as the transient wave propagates. A further variation of this is the peak-to-peak sound pressure level ($SPL_{peak\text{-}peak}$ or $L_{p,pk\text{-}pk}$) which considers the maximum pressure variation from positive to negative. For a symmetrically distributed wave, the peak-to-peak pressure is twice the peak level, or 6 dB higher.

2.1.2 Sound Exposure Level

Sound Exposure Level (SEL or $L_{E,p}$) is a measure of Sound Exposure (SE), which represents the total acoustic energy of a sound event in decibels (dB), accounting for both the sound's intensity and duration. $L_{E,p}$ provides a way to quantify the total energy in a sound, making it useful for assessing the impact of both continuous and transient sounds. Variations of $L_{E,p}$ are used depending on the noise source being measured. For context, $L_{E,p}$ can be compared $L_{p,RMS}$ using Equation 2:

(2)

$$L_{E,p} = L_{p,RMS} + 10 \times \log_{10} T$$

where the $L_{p,RMS}$ is a measure of the average level of broadband noise and the $L_{E,p}$ sums the cumulative broadband noise energy. For continuous sounds shorter than one second, the $L_{E,p}$ is lower than the $L_{p,RMS}$. For durations longer than one second, the $L_{E,p}$ exceeds the $L_{p,RMS}$ (e.g., a 10-second sound results in a 10 dB higher $L_{E,p}$ and a 100-second sound results in a 20 dB higher $L_{E,p}$). Unless otherwise defined, all $L_{E,p}$ noise levels in this report are referenced to 1 µPa^{2}s.

2.1.2.1 Single Pulse Sound Exposure Level

Single Pulse Sound Exposure Level (SEL_{sp} or $L_{E,p,sp}$) refers to the total acoustic energy from a single, loud, short duration noise event (such as a blast or impact) measured over a specified duration. This can be expressed using Equation 3:

(3)

$$L_{E,p,sp} = 10 \times \log_{10} \left(\frac{\int_0^T p^2(t)dt}{p^2_{ref} T_{ref}} \right)$$

where p is the acoustic pressure in Pascals, T is the total duration of sound in seconds, and t is time in seconds.

Since explosives are a single event which therefore generate only a single pulse that does not accumulate, reference to single pulse in the notation is not necessary and $L_{E,p}$ will be used to describe all SE metrics.

2.2 Properties of Sound

Sound can be categorised loosely into two types: impulsive and non-impulsive. These can be defined as:

- Impulsive: a sound with a high peak sound pressure, short duration, fast rise-time and broad frequency content at the source. (e.g seismic airguns, explosives (including UXO clearance), impact piling)
- Non-impulsive: a steady-state sound. It does not necessarily have to have a long duration (e.g vibropiling, drilling)

These differences are crucial for assessing auditory injury, as impulsive sound is typically more harmful than non-impulsive sound. Different metrics are needed to describe these distinct sound sources:

- Impulsive: Use $L_{p,pk}$, $L_{E,p,sp}$ etc.
- Non-impulsive: Use $L_{p,RMS}$ etc.

Noise from UXO clearance will be assumed to be impulsive in this assessment.

2.3 Analysis of Environmental Effects: Assessment Criteria

Over the past 20 years, it has become clear that human-generated underwater noise impacts marine animals. The severity of these effects depends on factors like sound level, frequency, exposure duration, and repetition rate (Hastings and Popper, 2005). As a result, research on aquatic animals' hearing abilities has grown, with studies focused on high-level sound sources such as seismic airguns, impact piling, and blasting, which have the most immediate environmental effects, though interest in chronic sound exposure is rising.

The impacts of underwater sound on marine animals can be broadly summarised as follows:

- Physical traumatic injury and fatality.
- Auditory injury (either permanent or temporary).

The following sections outline the underwater noise criteria used in this study for marine mammals and fish in the North Sea.

2.3.1 Marine Mammals

2.3.1.1 Southall *et al.* (2019): Auditory Injury (PTS and TTS) criteria

Southall *et al*. (2019) is one of the most recognised references for marine mammal hearing thresholds and aligns with the thresholds provided in the National Marine Fisheries Service (NMFS, 2018) guidance. At the time of undertaking the assessment in April, although NMFS (2024) had been published as an updated weighting criteria and impact threshold, no UK regulators had provided guidance that the updated thresholds were acceptable and should be used in modelling assessments. Therefore, at the time of assessment Southall *et al.* (2019) was the most trusted criteria.

The Southall *et al.* (2019) guidance categorises marine mammals into groups based on species with similar auditory capabilities and applies filters to the unweighted noise levels to approximate their hearing sensitivities. These groups are summarised in Table 2-1, with auditory weighting functions in Figure 2-1. Additional groups for sirenians and other marine carnivores are provided but not included in this study, as these species are not common in the North Sea. It should be noted that the inclusion of "wtd" in $L_{E,p,wtd}$ notation refers to a $L_{E,p}$ with an appropriate Southall *et al.* (2019) marine mammal weighting function applied.

Table 2-1: Marine mammal hearing groups (from Southall et al., 2019).

Hearing group	Auditory Weighting Function	Generalised hearing range	Species group	Example species
Low-frequency Cetaceans	LF	7 Hz to 35 kHz	Baleen whales	Sei Whale, Fin Whale, Minke Whale, Humpback Whale
High-frequency Cetaceans	HF	150 Hz to 160 kHz	Toothed whales, including dolphins and beaked whales	Bottlenose Dolphin, White-beaked Dolphin, Risso's Dolphin, Common Dolphin, Orca, Sperm Whale, Pilot Whale, Northern Bottlenose Whale
Very high-frequency Cetaceans	VHF	275 Hz to 160 kHz	True porpoise	Harbour porpoise
Phocid carnivores in water	PCW	50 Hz to 86 kHz	True seals	Harbour seal, Grey Seal

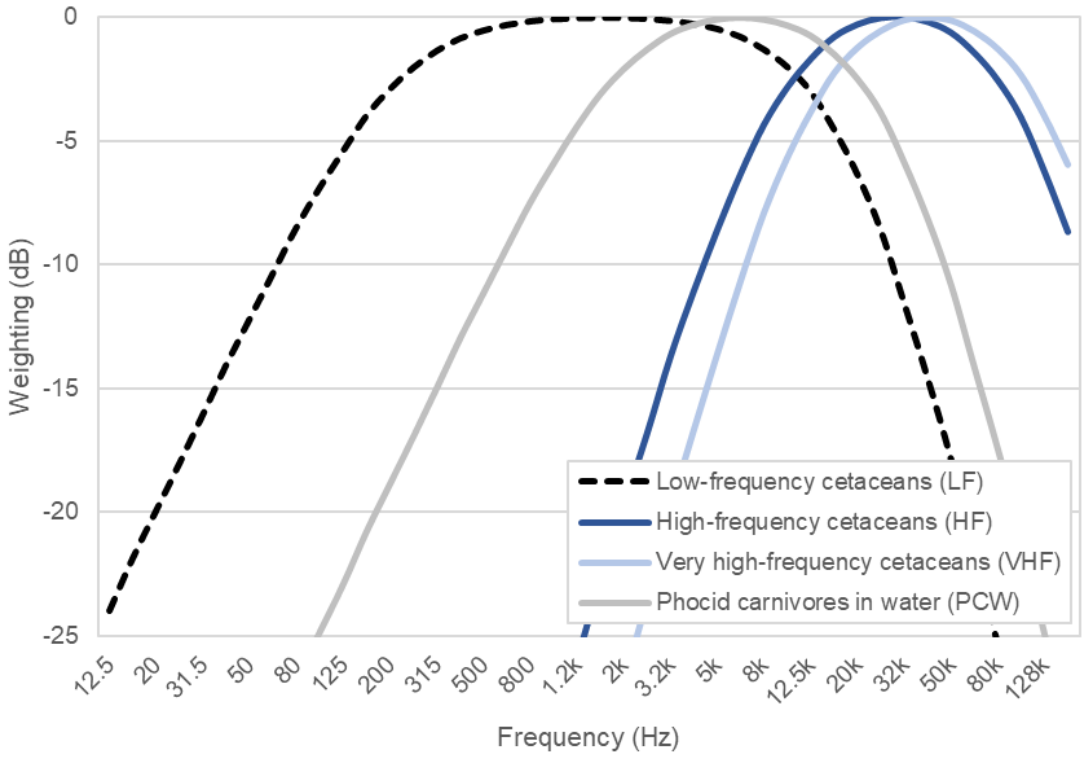

Figure 2-1: Auditory weighting functions for low-frequency cetaceans (LF), high-frequency cetaceans (HF), very high-frequency cetaceans (VHF), and phocid carnivores in water (PCW) (from Southall et al., 2019)

Southall *et al.* (2019) presents noise impact thresholds for marine mammal groups based on:

- The sound type (impulsive vs non-impulsive)
- The type of auditory injury of concern

Impact ranges based on impulsive criteria are recommended for most sources, except clearly non-impulsive ones. However, if the predicted range exceeds 3.5 km (see Section 1.2.1), the true impact range is likely to lie between the impulsive and non-impulsive ranges. Thus, both criteria are considered unless the sound source is explicitly non-impulsive.

Southall *et al.* (2019) presents specific impact thresholds for impulsive and non-impulsive sounds, based on different levels of auditory injury associated the characteristics of these sounds. Auditory injury is categorised into two types:

- PTS (permanent threshold shift): the greatest severity, which is unrecoverable (but incremental) reduction in hearing sensitivity.
- TTS (temporary threshold shift): the least severity, which is a short-term reduction in hearing sensitivity.

TTS represents the potential auditory impact with the most extensive range, but PTS represents the most significant and permanent impairment, making it the key impact threshold.

Since UXO detonations are an impulsive sound source, this study considered the impulsive sound criteria for marine mammal PTS and TTS thresholds from Southall *et al.* (2019), which is summarised in Table 2-2. However, since the sound is expected to propagate beyond 3.5 km from the source, the non-impulsive sound criteria has also been considered, which is summarised in Table 2-3.

Table 2-2: The Southall et al. (2019) $L_{p,pk}$ and $L_{E,p,wtd}$ criteria for PTS and TTS in marine mammals, associated with impulsive noise sources.

Southall *et al*. (2019)	$L_{p,pk}$ (dB re 1 µPa)		$L_{E,p,wtd}$ (dB re 1 µPa^{2}s)	
	PTS	TTS	PTS	TTS
LF Cetaceans	219	213	183	168
HF Cetaceans	230	224	185	170
VHF Cetaceans	202	196	155	140
PCW Pinnipeds	218	212	185	170

Table 2-3: The Southall et al. (2019) $L_{E,p,wtd}$ criteria for PTS and TTS in marine mammals, associated with non-impulsive noise sources.

Southall *et al*. (2019)	$L_{E,p,wtd}$ (dB re 1 µPa^{2}s)	
	PTS	TTS
LF Cetaceans	199	179
HF Cetaceans	198	178
VHF Cetaceans	173	153
PCW Pinnipeds	201	181

2.3.2 *Fish*

2.3.2.1 Popper *et al.* (2014): Mortality, injury and behavioural effects

Popper *et al.* (2014) offers updated guidelines on underwater noise impacts to marine fauna (excluding marine mammals). Unlike earlier studies, It categorises fish based on physiological morphology, particularly swim bladder function, that affect hearing sensitivity and provides criteria for key anthropogenic sound sources. Marine faunae are grouped into sea turtles, eggs and larvae, and three fish hearing categories:

- Fish: no swim bladder
- Fish: swim bladder not involved in hearing
- Fish: Swim bladder involved in hearing.

Popper *et al.* (2014) then provides impact thresholds for each marine faunae category related to sound exposure, including:

- Mortality and potential mortal injury: immediate or delayed death.
- Impairment, such as:
    - Recoverable injury: injuries unlikely to result in mortality.
    - Temporary Threshold Shift (TTS): short or long-term changes in hearing sensitivity that may or may not reduce fitness.
    - Masking: Reduction in sound detectability due to the simultaneous presence of another sound.
- Behavioural effects: substantial change in behaviour for the animals exposed to a sound (long or short term).

Despite emerging evidence of fish sensitivity to particle motion (see Section 1.2.2), the Popper *et al.* (2014) criteria provide a quantitative criterion as thresholds for impact onsets in terms of sound pressure related functions (e.g., $L_{p,pk}$, $L_{p,RMS}$, $L_{E,p}$). When the available data is insufficient to provide a quantitative criterion, Popper *et al.* (2014) provides a relative assessment of risk, qualified as either high, moderate, or low, based on the receptor. These risks are assessed for three approximate distances relative to the sound source; the near-field (tens of meters), intermediate-field (hundreds of meters) or far-field (thousands of meters).

Since both UXO clearance techniques involve a detonation of either the UXO itself during the high order detonation or of the donor charge as part of the low order deflagration, this study uses the criteria from Popper *et al.* (2014) for explosions as a proxy for this noise source, which is summarised in Table 2-4.

Table 2-4: Recommended guidelines for explosions according to Popper et al. (2014) for fish, sea turtles and eggs and larvae (N = Near-field; I = Intermediate-field; F = Far-field).

Popper *et al*. (2014) criteria for Explosions					
Type of fish	**Mortality and potential mortal injury**	**Impairment**			**Behaviour**
		Recoverable injury	**TTS**	**Masking**	
Fish: no swim bladder	**229 – 234 $L_{p,pk}$**	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	NA	(N) High (I) Moderate (F) Low
Fish: swim bladder not involved in hearing	**229 – 234 $L_{p,pk}$**	(N) High (I) High (F) Low	(N) High (I) Moderate (F) Low	NA	(N) High (I) High (F) Low
Fish: swim bladder involved in hearing	**229 – 234 $L_{p,pk}$**	(N) High (I) High (F) Low	(N) High (I) High (F) Low	NA	(N) High (I) High (F) Low
Sea Turtles	**229 – 234 $L_{p,pk}$**	(N) High (I) High (F) Low	(N) High (I) High (F) Low	NA	(N) High (I) High (F) Low
Eggs and Larvae	> 13 mm/s peak velocity	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	NA	(N) High (I) Low (F) Low

3 Underwater Noise Level Prediction: Methodology

3.1 Clearance Methodology

Accurate prediction of sound generated during UXO clearance requires an understanding of the techniques used. UXO clearance typically involves one of two methods: high order detonation or low order deflagration (which does not result in detonation beyond that of the donor charge), each producing different acoustic signatures.

3.1.1 High Order Clearance

High-order UXO clearance is the traditional approach for UXO disposal. A smaller donor charge detonated adjacent to the UXO and produces a shock wave that triggers the UXO, causing a large explosion and potential environmental damage. The main sound considered in an impact assessment is the sound generated by the detonation of the main UXO target, combined with the detonation of the donor charge. In most cases, only one donor detonation is required to clear the target.

3.1.2 Low Order Clearance

Low-order clearance aims to neutralise the UXO with minimal explosive force, reducing sound levels, seabed disturbance, and potential risk of harm to marine life. This technique uses deflagration, which uses a small, shaped charge (typically 250 g or less) to breach the casing and burn the internal explosive material of the target UXO. This disrupts the target without generating a high order detonation. In most cases, low order clearance is the preferred method of UXO clearance over high order clearance.

The donor charge detonation and burning process both generate sound, with the low order donor charge producing more sound (Cheong *et al*. 2020), however, both produce much less than a high order detonation. There is no correlation between sound levels and the explosive potential of the target UXO during low-order deflagration, suggesting the sound primarily comes from the clearance charge, and not the UXO itself (Oliva *et al. 2024;* Cheong *et al*. 2020). Low-order clearance may leave residual explosive material, requiring additional deflagration or removal. In some rare cases, deflagration could unintentionally trigger a high-order event.

3.2 Sound Level Prediction

3.2.1 Sound Sources (Potential UXO Devices)

The sound generated by explosive detonations is influenced by many factors, but only the charge weight (based on the TNT equivalent) is easily quantifiable. Other variables such as design, composition, age, position, orientation, and sediment cover are typically unknown at this assessment stage, resulting in significant uncertainty in source level estimates. To account for this, a worst-case scenario is assumed, where the UXO is treated as undamaged, uncovered, and in 'as-new' condition. This is especially relevant for larger devices, which are expected to have some degradation. However, it should be noted that this approach often leads to an overestimation of sound levels.

The net explosive quantity (NEQ) for potential UXO devices is presented in Table 3-1. While not exhaustive, this range likely encompasses the largest expected devices. For high order detonations, the UXOs will be detonated using a smaller donor charge with a separate NEQ, which varies depending on the NEQ of the target UXO. Since the donor charge contributes to the sound generated via this clearance technique, it has been included in the total NEQ for each device for associated calculations. For low order deflagration, sound is primarily generated by the smaller charge, and therefore, predictions for low order deflagration use a representative charge weight of 0.25 kg (250 g). A worst-case high order detonation scenario has also been considered for comparison.

Table 3-1: NEQ values of potential devices associated with low order clearance and high order clearance.

Clearance	Device Type	Net Explosive Quantity (kg)		
		UXO	Donor	Total
Low Order	Shaped charge	0.25	n/a	0.25
High Order	SC50	25	5	30
	SC500	270	25	295
	GY (EMCII)	300	25	325
	Mark A mine	431	25	456
	SC1000	530	25	555
	LMB mine	697	25	722

3.2.2 Sound Level Prediction (Soloway and Dahl, 2014)

Estimation of the source sound level for each combined charge weight was carried out in accordance with the methodology of Soloway and Dahl (2014), which follows Arons (1954) and Marine Technology Directorate Ltd (MTD, 1996). Soloway and Dahl (2014) provide models that can be used to characterise sound levels at a given distance, meaning that the maximum distance at which a receptor-based noise threshold is exceeded (e.g Southall *et al.,* 2019; Popper *et al.,* 2014) can be calculated. This technique is widely accepted by regulators in the prediction of impact ranges associated with UXO clearance.

Soloway and Dahl (2014) provide a model to estimate the sound levels generated by underwater explosions, which includes an empirical model $L_{p,\mathrm{pk}}$ and a semi-empirical model for $L_{E,p}$ based on measured data. These formulas use geometric spreading to estimate sound levels and the propagation of the sound using only distance and TNT equivalent charge weight as inputs. These establish a trend based on measurements of underwater blast in open water given by, for $L_{p,\mathrm{pk}}$ in Equation 4:

(4)

$$L_{p,pk} = 52.4 \times 10^{6} \left(\frac{R}{W^{1/3}}\right)^{-1.13}$$

and for $L_{E,p}$ in Equation 5:

(5)

$$L_{E,p} = 6.14 \times \log_{10}\left(W^{1/3}\left(\frac{R}{W^{1/3}}\right)^{-2.12}\right) + 219$$

where R is the measurement range in meters (m), and W is the NEQ of the UXO (kg). These equations offer a relatively straightforward method for estimating the range of effect. However, it should be noted that the model is not spatially explicit, as it does not account for variations in bathymetry or seabed type. Consequently, the results are independent of the UXOs specific location. A summary of the unweighted UXO source levels (i.e. by convention at 1 m from the source) calculated using this method for modelling are given in Table 3-2.

Table 3-2: Summary of the unweighted $L_{p,pk}$ and $L_{E,p}$ source levels used for UXO modelling

Total UXO NEQ (kg)	Estimated Source Level @ 1 m	
	$L_{p,pk}$ (dB re 1 µPa)	$L_{E,p}$ (dB re 1 µPa^{2}s)
0.25	269.8	215.2
30	285.4	228.4
295	292.9	234.8
325	293.2	235.0
456	294.3	236.0
555	295.0	236.5
722	295.9	237.2

Equations 4 and 5 are derived from UXO noise measurements taken over short ranges from the source. The acoustic signature of a UXO detonation is generally broadband across the frequency range but is predominantly a low frequency noise source. Therefore, to facilitate accurate calculation over greater distances, a sound absorption coefficient has been introduced, which accounts for frequency dependent absorption that becomes apparent with long range propagation. In this instance, a 0.003 dB/km attenuation correction was added to Equations 4 and 5, which is representative of the primarily low frequency nature (63 Hz to 200 Hz, Ainslie and McColm, 1998) of explosive noise. This has been standard practice in all recent UXO assessments using the Soloway and Dahl (2014) methodology.

3.2.3 Impact Range Assessment

A frequency spectrum derived from UXO measurements (Cook and Banda, 2021) was adjusted to achieve the approximate source levels presented in Table 3-2. An example of the 1/3rd octave spectrum used is shown in Figure 3-1. Spectrums associated with each predicted sound level were weighted using the marine mammal weightings from Southall *et al.* (2019), detailed in Figure 2-1.

These weighted levels were then assessed against the Southall *et al.* (2019) guidelines to estimate the range at which thresholds for impulsive and non-impulsive sounds might be exceeded for marine mammals. Separately, sound levels calculated using the equations from Soloway and Dahl (2014) were assessed against the Popper *et al.* (2014) guidelines to predict the range at which explosive thresholds would be exceeded for fish.

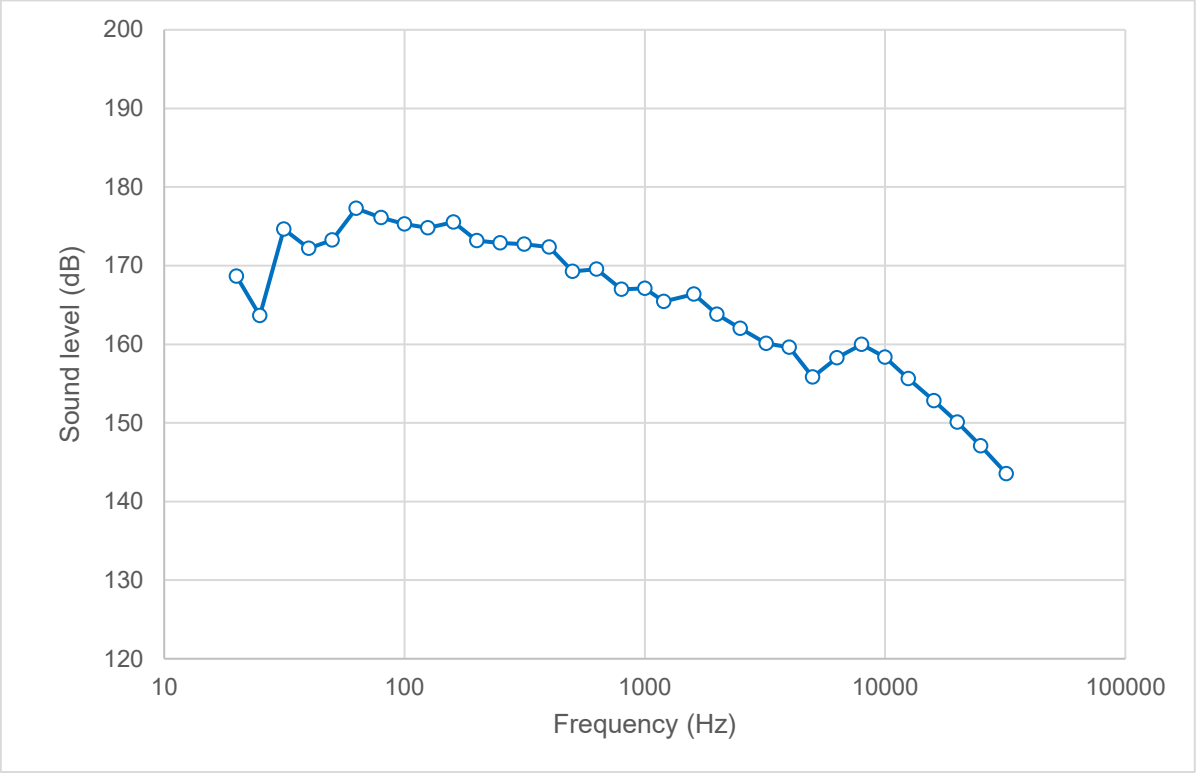

Figure 3-1 – UXO noise frequency spectrum containing 1/3rd octave band levels used in impact range prediction.

4 Underwater Noise Level Prediction: Results

Table 4-1 to Table 4-3 present the impact ranges for UXO detonation, considering various charge weights and impact criteria. Ranges smaller than 50 m have not been presented.

4.1 Marine Mammals

Using the $L_{p,pk}$ criteria from *Southall et al.* (2019) applied to the predicted marine mammal weighted sound levels, the VHF cetacean group are predicted to have the largest PTS impact ranges of all marine mammals considered. For low order clearance (0.25 kg), animals within 990 m of the detonation are likely to exceed the PTS threshold for VHF cetaceans. These results, along with PTS impact ranges predicted for other species groups, and TTS impact ranges predicted across all groups, are presented in Table 4-1. Predictions for PTS and TTS ranges across other various UXO charge weights for high order detonations are also presented in Table 4-1.

Table 4-1: Estimated impact ranges for UXO detonations across various NEQs (UXO plus donor charge) using the Southall et al. (2019) $L_{p,pk}$ marine mammal criteria for impulsive noise sources.

Southall *et al*. (2019) criteria $L_{p,pk}$ (Impulsive)		Estimated impact range (m)						
		0.25 kg	30 kg	295 kg	325 kg	456 kg	555 kg	722 kg
LF Cetaceans	PTS	**170**	870	1,800	1,900	2,100	2,300	2500
	TTS	**320**	1,600	3,400	3,500	3,900	4,200	4,600
HF Cetaceans	PTS	**60**	280	600	620	700	750	810
	TTS	**100**	520	1,100	1,100	1,200	1,300	1,500
VHF Cetaceans	PTS	**990**	4,900	10,000	10,000	12,000	12,000	14,000
	TTS	**1,800**	9,000	19,000	19,000	22,000	23,000	25,000
PCW Pinnipeds	PTS	**190**	960	2,000	2,100	2,300	2,500	2,700
	TTS	**360**	1,700	3,800	3,900	4,300	4,600	5,100

When the $L_{E,p,wtd}$ criteria for impulsive noise are applied to the predicted sound levels, the LF cetacean group are predicted to have the largest PTS impact ranges. For low order clearance (0.25 kg), animals within 230 m of the detonation are predicted exceed the PTS threshold for LF cetaceans, under the impulsive criteria. These results, along with PTS impact ranges predicted for other species groups, and TTS impact ranges predicted across all groups, are presented in Table 4-2. Predictions for PTS and TTS ranges across other various UXO charge weights for high order detonations are also presented in Table 4-2.

Table 4-2: Estimated impact ranges for UXO detonations across various NEQs (UXO plus donor charge) using the Southall et al. (2019) $L_{E,p,wtd}$ marine mammal criteria for impulsive noise sources.

Southall *et al.* (2019) criteria $L_{E,p,wtd}$ (Impulsive)		Estimated impact range (m)						
		0.25 kg	30 kg	295 kg	325 kg	456 kg	555 kg	722 kg
LF Cetaceans	PTS	**230**	2,300	7,200	7,500	8,900	9.700	11,000
	TTS	**3,200**	31,000	82,000	86,000	98,000	100,000	110,000
HF Cetaceans	PTS	**< 50**	< 50	< 50	< 50	50	60	60
	TTS	**< 50**	160	430	440	500	540	600
VHF Cetaceans	PTS	**90**	600	1,200	1,200	1,300	1,400	1,500
	TTS	**750**	2,500	3,600	3,700	3,900	4,000	4,100
PCW Pinnipeds	PTS	**< 50**	420	1,200	1,300	1,500	1,700	1,900
	TTS	**570**	5,600	15,000	16,000	18,000	20,000	22,000

4.2 Fish

According to the $L_{p,pk}$ metric from the Popper et al (2014) guidelines, for a low order deflagration, the maximum predicted range for the threshold of mortality and potential mortal injury is predicted for all fish groups at between < 50 - 70 m from the detonation. These results, along with other fish groups, and impact ranges for other effects, are provided in Table 4-3. Predictions for PTS and TTS ranges across other various UXO charge weights for high order detonations are also presented in Table 4-3.

Table 4-3: Estimated impact ranges for the UXO detonations across various NEQs (UXO plus donor charge) using the Popper et al (2014) $L_{p,pk}$ fish criteria for explosions.

Popper *et al.* (2014) criteria $L_{p,pk}$	Estimated impact range (m)						
	0.25 kg	30 kg	295 kg	325 kg	456 kg	555 kg	722 kg
Mortal and potential mortal injury	**< 50 – 70**	180 - 130	400 – 670	410 – 690	460 – 770	490 – 830	540 - 900

5 Discussion

5.1 Prediction Validation

The methods employed by Soloway and Dahl (2014) are recognised as the best available method for sound level prediction for UXO clearance. The sound levels predicted here remain appropriate for the purposes of this report. However, the results have been validated against other measured datasets.

5.1.1 Peak of the Sound Pressure Level

The approach, based on Soloway and Dahl (2014), was validated for the $L_{p,pk}$ metric using raw underwater noise data from two recent UXO clearance studies. One dataset, from Robinson *et al.* (2022), was collected in the Moray Firth at the Moray East offshore windfarm (avg. depth ~45 m). While 17 UXO targets were identified, most charge weights were unspecified; therefore, average values ranging from 0.5 kg to 295.5 kg were used, with donor charges between 6 kg and 25 kg. Comparison of this dataset with modelling predictions shows that the measured $L_{p,pk}$ levels are approximately 40 dB lower than predicted $L_{p,pk}$ across each charge size modelled. This difference was consistent with increased range between 1,500 m – 6,000 m.

SMRU Consulting (SMRUC, 2022) provided a UXO clearance dataset using the Hydra low-yield method, collected between May and October 2021 at the Seagreen Alpha and Bravo offshore windfarms in the outer Firth of Forth and Tay, Scotland (avg. depth ~55 m). Three UXOs were monitored: two 25 kg sea mines and one 227 kg buoyant mine. Each detonation used a 750 g Semtex donor charge, with recordings at 500 m and 1,500 m. The comparison is shown in Figure 5-1.

Both datasets demonstrate deviation between measured values and predicted values, where measured $L_{p,pk}$ values were less than predicted by both models, confirming its precautionary nature. Deviations of measured values from predicted values could be due to:

- Limitations in the prediction model (e.g. the model doesn't consider bathymetry, sediment type etc.)
- Differences in the sound produced by the explosive due to the detonation configuration.
- Degradation in the devices over the long period of time they remained underwater.

Modelled predictions differ more from the Robinson *et al.* (2022) dataset than from SMRUC (2022), with Robinson *et al.*'s data being significantly quieter than predicted by Soloway and Dahl (2014). This likely reflects the use of low-yield methods and newer, intact donor charges, which differ from actual UXO devices.

The primary conclusion that can be drawn from this comparison is that the model used represents a precautionary prediction for the $L_{p,pk}$ metric across the dataset for high order UXO clearance, and thus provides a conservative approach, with reassurance that a high order clearance on site is likely to be significantly quieter than predicted by the model.

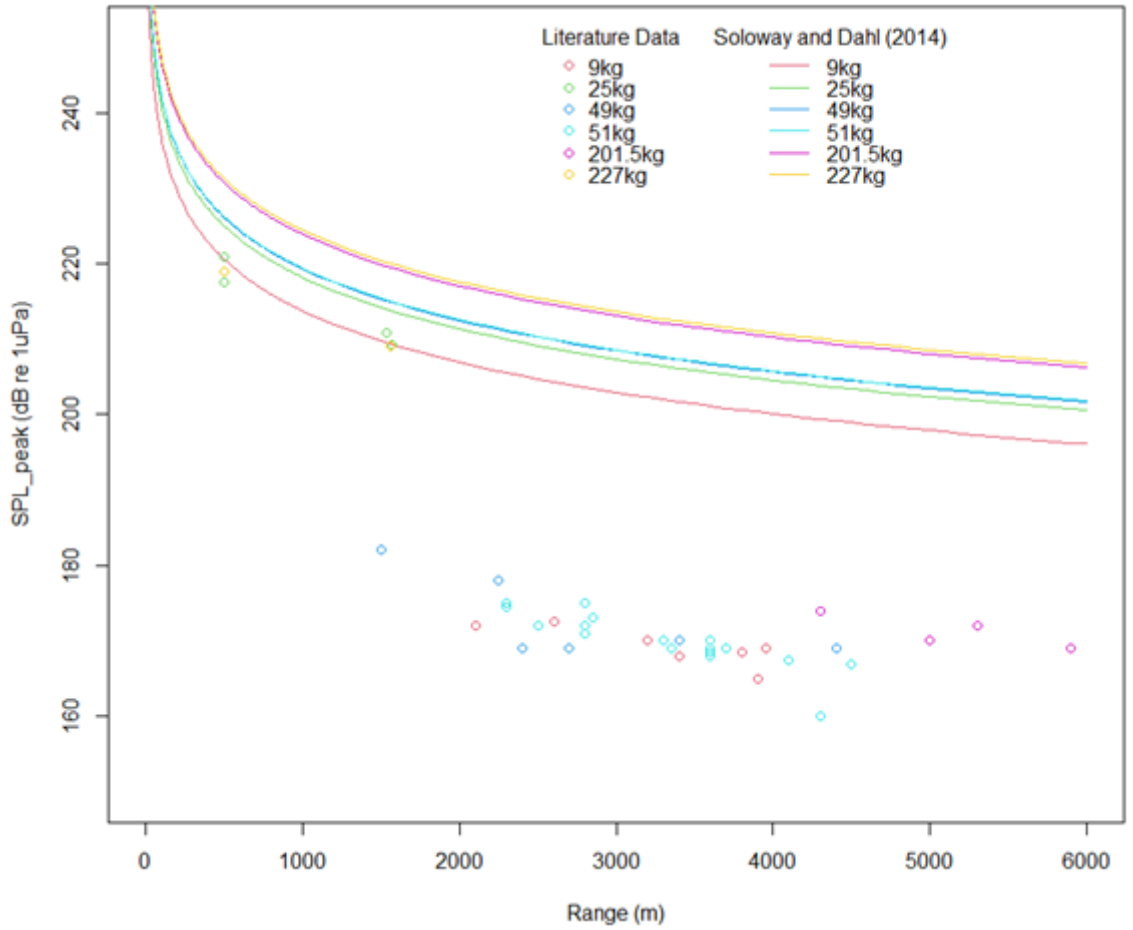

Figure 5-1 - $L_{p,pk}$ vs range of various charge weights. O = data obtained from literature (Robinson et al. (2022) and SMRUC (2022), solid lines = modelled predictions using Soloway and Dahl (2014), dotted lines = modelled predictions using MTD.

5.1.2 Sound Exposure Level predictions

The approach, based on Soloway and Dahl (2014), was also validated for the $L_{E,p}$ metric using raw underwater noise data from UXO clearance measured by Subacoustech in the North Sea. Raw data measured by Midforth (2024) for low order deflagration, using a charge weight of 0.25 kg was reported to have a source level of 231 dB $L_{E,p}$ at 1 m from the source. This level is 15.8 dB more than predicted for this charge weight using Soloway and Dahl (2014).

It is becoming increasingly apparent that the methodology from Soloway and Dahl (2014) is likely to be underestimating the $L_{E,p}$, meaning that is does not provide a precautionary estimate for the sound levels that may be generated by UXO detonations, and the sound levels, and the subsequent effects on marine life (in this instance, the predicted impact ranges) may be higher than predicted. The $L_{E,p}$ sound levels predicted here using Soloway and Dahl (2014), and the subsequent predicted impact ranges, should be taken with caution. In this instance, and until an improved calculation methodology is developed, it is suggested that reference to the results using sound levels predicted using the $L_{p,pk}$ would provide a more confident prediction.

5.2 Limitations

It should be noted that $L_{p,pk}$ values are difficult to predict accurately over long distances (von Benda-Beckmann et al., 2015), and the Soloway and Dahl (2014) equations do not account for frequency when considering transmission loss. Hence, they are considered somewhat conservative for large distances as frequency would affect the level of sound absorption over these ranges. Soloway and Dahl (2014) validated their method only for small charges and ranges under 1 km. However, their results align with von Benda-Beckmann *et al.* (2014), who measured 263 kg charges at greater distances. While the addition of an attenuation correction over long distances applied here attempts to reduce this uncertainty, the predicted sound levels for the $L_{p,pk}$ metric may still overestimate at long range.

Another limitation of the Soloway and Dahl (2014) equation is that it does not consider bathymetry, nor weather conditions, which can also contribute to propagation loss. Furthermore, Soloway and Dahl (2014) also does not account for variations in sound levels at different depths in the water column. Animals near the surface may experience lower noise exposure due to acoustic effects (MTD, 1996), meaning the actual risk to these animals could be less than predicted. As such, the impact ranges in this assessment are considered conservative with respect to depth-related exposure.

6 Conclusion

Subacoustech Environmental, on behalf of Natural Power, have undertaken an underwater noise assessment in anticipation of UXO clearance activities taking place in North Sea, as part of the installation of the EGL1 underwater cable.

The level of underwater sound generated was predicted using the methodology outlined in Soloway and Dahl (2014). This calculation procedure considers the charge weight of the UXO or low order clearance charge to predict $L_{p,\text{pk}}$ and $L_{E,p}$ for various types of UXO expected in the area. The predicted sound levels were then interpreted in accordance with the guidelines outlined in Southall *et al.* (2019) for marine mammals in relation to impulsive noise sources, and Popper *et al*. (2014) for fish in relation to explosives.

Using the Southall *et al.* (2019) guidance for marine mammals, the VHF cetacean group is predicted to have the largest PTS impact range. Animals within 990 m of a low order deflagration are predicted to exceed the $L_{p,\text{pk}}$ VHF PTS threshold. When the total noise output is considered, the LF cetacean group is considered to have the largest PTS impact range. As a worst-case, animals within 230 m of a low order deflagration are predicted to surpass the LF cetacean $L_{E,p}$ PTS threshold. For fish, using the Popper *et al.* (2014) guidance, mortality and potential mortal injury is predicted for all fish morphologies that are within 70 m of a low order deflagration. It should be noted that for both marine mammals and fish, the impact ranges are larger for high order detonations, with greater impact ranges associated with greater UXO charge weights, although low order clearance is being prioritised wherever feasible.

Finally, it should be noted that the method by Soloway and Dahl (2014) have been shown to overestimate $L_{p,\text{pk}}$ metrics, but more importantly, underestimate $L_{E,p}$ metrics. Furthermore, the accuracy of predictions decreases with distance from the source, and the model does not consider environmental factors that may contribute to the propagation loss of sound. Therefore, as with most mathematical modelling, the impact ranges presented here should be taken as indicative in determining the effects that may occur in receptors during the proposed operations. However, the results predicted using $L_{p,\text{pk}}$ metrics are likely to provide a more confident prediction of the sound levels likely generated by these activities than the predictions using the $L_{E,p}$ metrics.

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