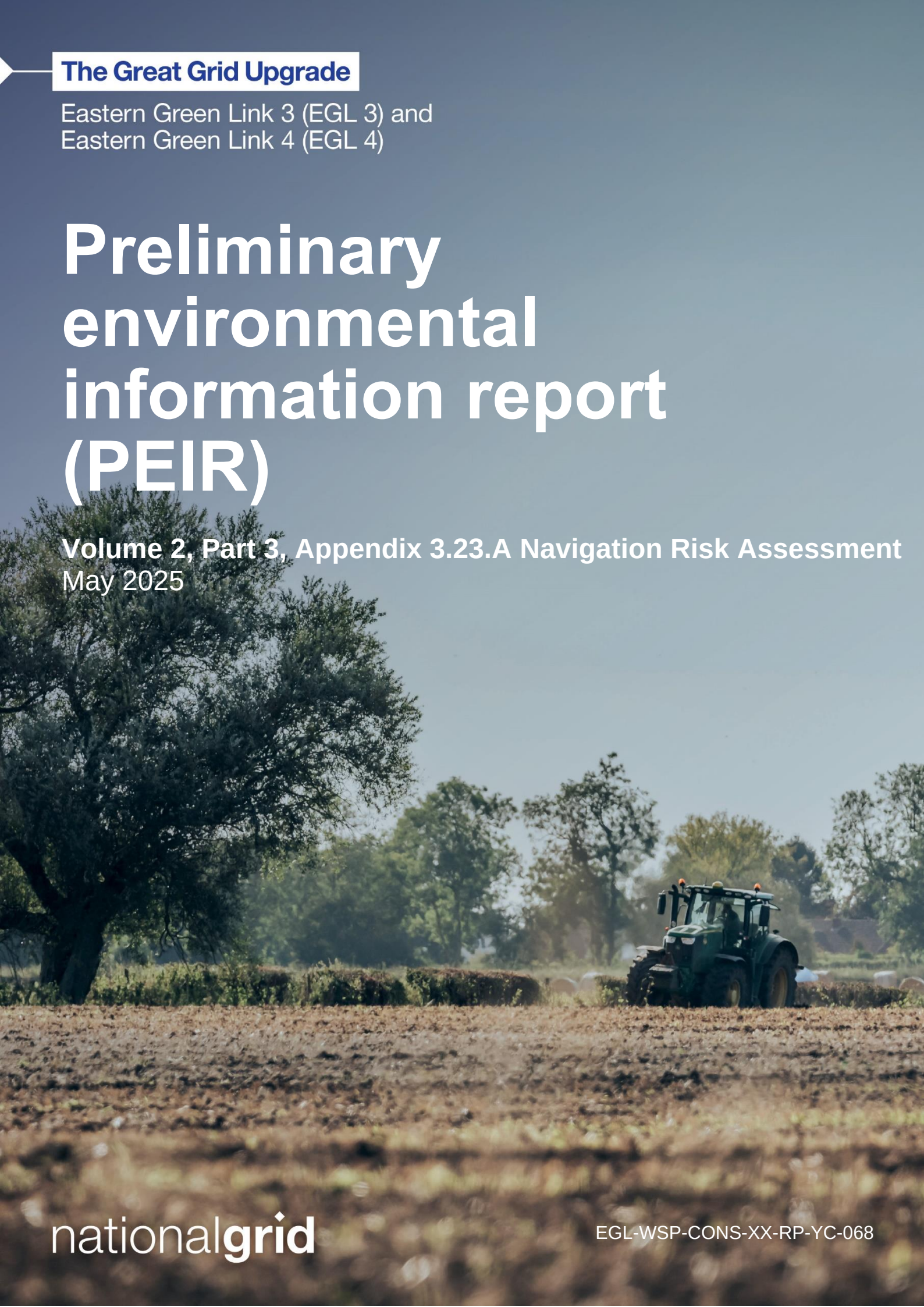
The Great Grid Upgrade

Eastern Green Link 3 (EGL 3) and
Eastern Green Link 4 (EGL 4)

Preliminary environmental information report (PEIR)

Volume 2, Part 3, Appendix 3.23.A Navigation Risk Assessment

May 2025



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EGL-WSP-CONS-XX-RP-YC-068

Contents

3.23.A. Navigational Risk Assessment

3.23.A.1 Overview

3.23.A.1.1 This technical appendix sets out the approach to the Navigational Risk Assessment (NRA) for the English Offshore Scheme of the Eastern Green Link 3 (EGL 3) Project and the Eastern Green Link 4 (EGL 4) Project. This document is an appendix to **Volume 1, Part 3, Chapter 23: Shipping and Navigation**.

3.23.A.1.2 The purpose of this NRA is to identify and assess the potential impacts arising from the construction, operation (including maintenance and repair during the operational life) of the EGL Project and the EGL 4 Project in relation to shipping activity and key navigation features. The English Offshore Scheme is expected to have a life span of approximately 40 years.

3.23.A.1.3 There are currently no specific plans to decommission the EGL 3 Project and the EGL 4 Project. It is expected that the transmission of electricity would continue for as long as there is a business case for doing so and that any decommissioning activity would occur decades into the future. It is expected that an assessment in accordance with the legislation and guidance at the time of decommissioning would be undertaken. However, no impacts greater than those assessed in this NRA for the construction or operational phase are anticipated. Once decommissioned, the EGL 3 Project and the EGL 4 Project are not expected to have ongoing shipping and navigation impacts.

3.23.A.1.4 This NRA is a working document that would be updated as the Project develops and through consultation with stakeholders.

3.23.A.2 Shipping and navigation Study Area

3.23.A.2.1 The study area for shipping and navigation includes the draft Order Limits plus an additional 5 Nautical Miles (NM) either side to ensure that all shipping patterns and navigational features are captured.

3.23.A.2.2 Anderby Creek is the co-located landfall for both EGL 3 and EGL 4. EGL 3 has been routed around the Holderness Offshore Marine Conservation Zone (MCZ) to the proposed Scottish Landfall at Sandford Bay, Peterhead. EGL 4 transects the southeastern corner of the MCZ and lands at Kinghorn in the Firth of Forth. In this NRA for English waters, the study area past the Scottish border is not considered.

3.23.A.3 Guidance

3.23.A.3.1 This NRA and risk matrix has been prepared in accordance with the guidance below:

- International Maritime Organisation (IMO) Guidelines for Formal Safety Assessment (FSA) – MSC-MEPC.2/Circ.12/Rev.2 (IMO, 2018, Ref 3.23.A.1).

3.23.A.3.2 Consideration to linear structures such as marine cables in relation to offshore renewable structures has been considered using:

- Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response. (MCA, 2021, Ref 3.23.A.2).
- MCA MGN 372 Amendment 1 “Offshore Renewable Energy Installations (OREIs) - Guidance to Mariners operating in the vicinity of UK OREIs” (MCA, 2022, Ref 3.23.A.3).
- MCA Methodology for Assessing the Marine Navigational Safety Risks & Emergency Response of OREIs Version 3.1 (MCA, 2023, Ref 4).

3.23.A.3.3 The assessment has been informed by the above guidance which states that the assessment stage should follow a clear progression; from the characterisation of the hazard, the risk that hazard has on, in the case of this assessment, the existing shipping baseline and the steps & risk controls that are in place to reduce the overall impact of the hazard to As Low As Reasonably Practicable (ALARP).

3.23.A.4 Data sources

Background studies

3.23.A.4.1 Primary sources of background information used in this NRA are as follows:

- Ossian NRA (https://marine.gov.scot/sites/default/files/volume_3_-_technical_reports_-_appendix_13.1_-_navigation_risk_assessment.pdf,Anatec, 2024, Ref 3.23.A.5).
- EGL 3 Project and EGL 4 Project EMF Study (EEN/637/NOTE2025 v1). (**Volume 2, Part 1, Appendix 1.4.A Electromagnetic Field (EMF) Study**).
- Commercial Fisheries Report for EGL 3 and EGL 4 (EGL 3 & 4_Baseline_Fisheries_Report_20230111_FINAL, Brown & May Marine, 2023, Ref 3.23.A.7).

3.23.A.4.2 As part of the cable route selection process, the EGL 3 Project and EGL 4 Project have been routed away from high vessel densities and anchorages where possible in the feasibility stage.

3.23.A.4.3 A desk-based study to assess commercial fishing activity using publicly available data was undertaken by Brown and May Marine Ltd. in March 2023 to understand the spatial and temporal distribution of fishing activity within the study area. AIS data from UK and European fishing vessels over 15 m in length and VMS data from UK registered commercial fishing vessels over 12 m in length has also been obtained and interrogated to assess the distribution of fishing effort. It should be noted that vessels under 12 m are not presently captured within this data, the majority of these vessels tend to be inshore creel/potting vessels which is recognised as important fisheries within the study area. Aerial surveillance data gathered by the MMO has also been used to augment a qualitative assessment of the smaller fishing boats operating in the area. In addition, information and consultation has been sought from the relevant IFCAs including Eastern, North-Eastern and Northumberland. For further details, please refer to **Volume 1, Part 3, Chapter 24: Commercial Fisheries**.

3.23.A.4.4 The Ossian NRA has been referenced particularly for cumulative effects due to close proximity to the Ossian export cable corridor in English waters. In the NRA, a cumulative vessel routeing assessment was undertaken to estimate deviations around OREI developments.

3.23.A.4.5 An Electromagnetic Field (EMF) study has been completed by the Applicant (**Volume 2, Part 1, Appendix 1.4.A Electromagnetic Field (EMF) Study),** which informs further assessment about the risk to marine navigational equipment due to potential compass deviations and any mitigation measures if required.

3.23.A.4.6 The NRA involved a high-level information gathering exercise in order to determine the baseline shipping and navigation conditions.

3.23.A.4.7 Data sources used to inform the baseline characterisation of shipping and navigation is presented as an overview in **Table 3.23.A-1**.

Table 3.23.A-1 - Data sources overview

Data Source	Description
MariTrace Automatic Identification System (AIS) Vessel Data	5-minute time series data of shipping activities from 01/12/2023 to 30/11/2024 (12 months of data). Purchased from MariTrace.
Royal Yachting Association (RYA) UK Coastal Atlas of Recreational Boating 2.1	AIS dataset of recreational vessels. Purchased from RYA.
European Marine Observation and Data Network (EMODnet) vessel density maps of European waters	Coarse-grained vessel density maps. Publicly available at https://www.emodnet-humanactivities.eu/view-data.php (Ref 3.23.A.8)
MMO Fishing Data	UK sea fisheries annual statistics from 2023. Publicly available at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2023 (Ref 3.23.A.9)
Royal National Lifeboat Institution (RNLI) Incidents Data	RNLI 2019-2024 datasets including Returns of Service, lifeboat stations, and support centres. Publicly available at https://data-rnli.opendata.arcgis.com/. (Ref 3.23.A.10)
Marine Accident Investigation Branch (MAIB) reports and occurrences	MAIB incident reports and occurrences. Publicly available at the data portal here https://maps.dft.gov.uk/maib-data-portal/web-pages/pbi_dashboard.html (Ref 3.23.A.11)
Marine Themes Vector Data	Marine Themes Vector data tiles including anchorage areas, marine use areas, aquaculture, navigational lines, navigational routes, beacons and buoys. Purchased from FIND Mapping.
Admiralty Charts	Admiralty charts via a Web Mapping Service (WMS) feed. Purchased from MarineFind.

Publicly available data

- As per Regulation 19 of Chapter V, Safety of Navigation, of the Annex to the International Convention for the Safety of Life at Sea (SOLAS V), 1 July 2002 (Ref 3.23.A.12), an AIS must be installed and operated on:
- All ships of 300 gross tonnage and upwards engaged on international voyages,
- Cargo ships of greater than 500 gross tonnage not engaged on international voyages, and
- All passenger vessels irrespective of size.

3.23.A.4.8 AIS has increasingly been installed on vessels by other maritime users on smaller craft including yachts, fishing vessels and pleasure craft. AIS can therefore be considered as the most reliable indicator of marine traffic, with data gaps for smaller vessels being supplemented by additional data on recreational vessels. EMODnet vessel density maps are created from publicly shared AIS data, which is an automatic tracking system used to identify and locate vessels by electronically exchanging data with other nearby ships, AIS coastal stations and satellites. They provide the total ship presence time for ship categories for every month (vessel hours per month) on a 1 km grid that follows the European Economic Area (EEA)/Inspire standards. The International Maritime Organisation (IMO) requires AIS transponders to be fitted aboard international voyaging ships with gross tonnage of 300 or more tonnes, and all passenger ships regardless of size (IMO, 2018, Ref 3.23.A.1). This would cover almost all commercial vessels and most private vessels; however, some smaller fishing and recreational vessels could be missing from the AIS dataset.

3.23.A.4.9 To supplement this, AIS data from recreational vessels sourced from the Royal Yachting Association (RYA) have been used to give a picture of the most utilised routes and areas by leisure boaters which may not have an AIS transponder fitted.

3.23.A.4.10 Publicly available vessel data has been cross-referenced with the live traffic maps on the Marine Traffic website (Ref 3.23.A.13, not available to purchase/download) to ensure that shipping patterns, usage of anchorages and usage of ports remain unchanged. Furthermore, the vessel density for purchased data is in a finer resolution (0.08 km grid) than the publicly available data, therefore, smaller shipping patterns in vessels can be identified.

Site-specific data

3.23.A.4.11 The Applicant holds AIS data purchased from MariTrace for the entire area (01/12/2023 – 30/11/2024, 12 months of data). This 5-minute time series data has been used to create vessel density maps. The AIS data extends outside the 5 NM study area to cover previously identified potential routes for the EGL 3 Project and EGL 4 Project and provide a characterisation of general vessel behaviour in the area.

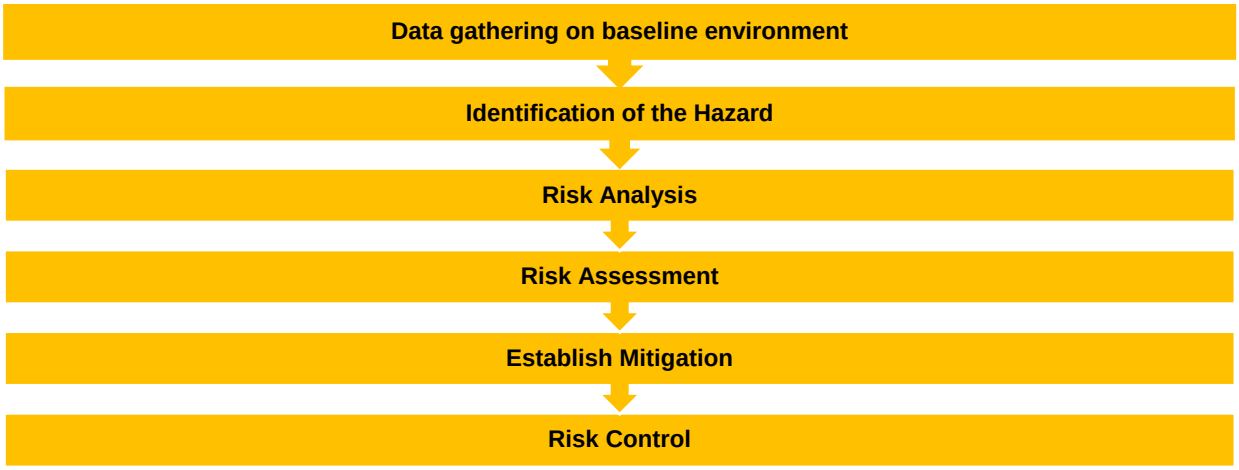
3.23.A.4.12 Where relevant, commercial fishing vessel activity would be assessed using Vessel Monitoring System (VMS) data, as presented in **Volume 1, Part 3, Chapter 24: Commercial Fisheries**.

3.23.A.5 Methodology

3.23.A.5.1 The assessment process involves the following main steps presented in **Plate 3.23.A-1**. The NRA is undertaken based on IMO standards (IMO, 2018, Ref 3.23.A.1) and using MGNs (MCA, 2021; MCA, 2022; MCA, 2023, Ref 3.23.A.2,3,4). In carrying out these assessments, as far as reasonably possible, all phases of the English Offshore Scheme's life are addressed, i.e., construction, operation and maintenance, and decommissioning. The NRA approach has also been informed by the scoping opinion alongside consultation with specific shipping and navigation stakeholders (please refer to **Volume 1, Part 3, Chapter 23: Shipping and Navigation** for further information).

3.23.A.5.2 The methodology for accomplishing each step is described below.

Plate 3.23.A-1: Assessment steps for the NRA



3.23.A.5.3 The definition of "hazard" and "risk" for the NRA are:

- **Hazard** - A potential source of marine incidences and collisions to the existing baseline of other marine users; and
- **Risk** - The probability of suffering harm, loss or displacement and is a measure of the probability (frequency) and consequence of a hazard.

3.23.A.5.4 Below, **Table 3.23.A-2** illustrates a high-level summary of each step of the NRA.

Table 3.23.A-2 - NRA methodology steps

Data Requirement	Method	Data Sources
Baseline Assessment	Establish current shipping conditions and features that exist within the study area. A specialist study to provide data on maritime activity, shipping intensity and density in the study area and a risk assessment of potential shipping hazards such as collision risk and anchoring risks.	EMODnet vessel density maps of European waters (Ref 3.23.A.8) AIS datasets (01/12/2023 – 30/11/2024) Admiralty charts Royal Yachting Association (RYA) UK Coastal Atlas of Recreational Boating Marine Management Organisation (MMO) Fishing Data (Ref 3.23.A.9)

Data Requirement	Method	Data Sources
	A 5 NM buffer is applied around the proposed draft Order Limits to ensure that all shipping patterns and navigational features are captured.	Marine Traffic (Ref 3.23.A.13) Royal National Lifeboat Institution (RNLI) Incidents Data (Ref 3.23.A.10) Marine Accident Investigation Branch (MAIB) data portal (Ref 3.23.A.11) Port Authority Information as required Sailing and Pilot books Project-specific reports and studies
Consultation	Proactive consultation with key ports authorities (e.g. ABP Humber) and the Maritime and Coastguard Agency (MCA), alongside other maritime stakeholders (e.g. local sailing clubs, RYA, Trinity House, Chamber of Shipping).	Stakeholder consultation meetings Scoping opinion responses
Hazard Identification	Identify known hazards expected to be encountered as a result of the offshore operations and presence of project vessels.	Data gathered from the baseline assessment Potential hazards raised by stakeholders during consultation Shipping and navigation HAZID workshops
Risk Analysis	Determine the impact of hazards on navigational safety, displacement of vessels, and human safety in terms of frequency and consequence, developed using IMO guidelines. Cumulative effects have been evaluated at a high-level by considering other existing and planned projects and the cumulative impact pathways as a result.	Hazard identification phase IMO Guidelines (IMO, 2018, Ref 3.23.A.1)
Risk Assessment	Risks are examined using a risk matrix, which illustrates the combination of the frequency and the consequence of the hazard to establish the potential impact.	Frequency & consequences from the risk analysis phase
Mitigation	Environmental measures for each hazard are established to (in preferential order): prevent/avoid, reduce, or offset the potential risk. Gaps in existing procedures and areas in which mitigation may need	International Regulations for Preventing Collisions at Sea (COLREGs) IMO Guidelines UK Standards European Subsea Cable Association Guidance

Data Requirement	Method	Data Sources
	to be enhanced would also be considered. Care to be taken to ensure that any new hazards created as a result are themselves identified and managed.	Shipping and navigation HAZID workshops
Risk Control	Reduce risks on the existing shipping baseline to As Low As Reasonably Practicable (ALARP) using environmental measures. Additional analysis, consultation and enhanced environmental measures are normally needed for risks that are assessed as Major after reducing risks to ALARP. Where further mitigation is not possible, a residual hazard may remain.	Stakeholder consultation if required

Risk analysis methodology

3.23.A.5.5 The risk analysis introduces the concept of risk in a qualitative way in order to prioritise the hazards identified during the hazard identification process and assess their impact on navigational safety.

3.23.A.5.6 The definitions of hazards utilised in the NRA have been developed using the IMO guidelines and stakeholder consultation, which includes the following possible consequences of hazards:

- Effect on human safety;
- Effect on vessel(s) / property;
- Displacement of vessel(s);
- Business / reputational effects; and
- Environmental effects

3.23.A.5.7 Risk is the combination of frequency and consequence which are defined in **Table 3.23.A-3** and **Table 3.23.A-4** below, which are used to determine the inherent and residual risk ratings.

Table 3.23.A-3 - Definitions and categories of frequency

Frequency Value	Description	Definition
1	Extremely Remote	Likely to occur once in the lifetime of the Project (assumed as 40 years) or less
2	Remote	Likely to occur once a decade
3	Probable	Likely to occur once per year
4	Very Probable	Likely to occur once per month
5	Frequent	Likely to occur once per week or more

Table 3.23.A-4 - Definitions and categories of consequence

Consequence Value	Description	Definition				
		Effects on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects
1	Minor	Single or minor injuries	Single local equipment damage	Temporal displacement of vessel (hours)	No negative publicity. No perceptible impact.	No response needed. However, minor emissions as a result.
2	Significant	Multiple minor injuries	Multiple local equipment damage	Temporal displacement of vessel (days)	Minor reputational risks. Local negative publicity.	Tier 1 response - local assistance needed.
3	Severe	Multiple or severe injuries	Non-severe ship and equipment damage	Temporal displacement of vessel (weeks)	Moderate reputational risks. Regional negative publicity.	Tier 2 response - may not require external assistance
4	Serious	Single fatality or multiple severe injuries	Severe damage to ship and equipment	Temporal displacement of vessel (months)	National reputational risks and negative publicity.	Tier 2 response - would require external assistance.
5	Catastrophic	Multiple fatalities	Total loss of ship and equipment	Permanent displacement of vessels	International reputational risks and negative publicity.	Tier 3 response - national assistance needed.

3.23.A.5.8 Please refer to the consultation and stakeholder engagement section (**Section 3.23.A.10**) for further information on how the frequency categories have been updated as per MCA feedback on the risk matrix.

3.23.A.5.9 Risk prioritisation is an important part of the NRA process; the greater the potential of a hazard, the greater the need to ensure that there are environmental and project specific measures in place to control the risk.

Risk assessment

3.23.A.5.10 IMO guidelines define a hazard as “something with the potential to cause harm, loss or injury” the realisation of which results in potential accidents and, in this case, vessel displacement. The potential for a hazard to be realised can be combined with an estimated (or known) consequence of the outcome. This combination is termed “risk”. Risk is therefore a measure of the frequency and consequence of a hazard. One way to compare risk levels is to use a matrix approach.

3.23.A.5.11 To undertake the risk assessment, a risk matrix approach has been utilised, which examines the frequency and consequence of a hazard to determine the combined risk. The risk matrix contains risk ratings based on both the consequence and the frequency of the hazard. Risk ratings are calculated **Table 3.23.A-5**, which can be interpreted using the definitions of the risk level and tolerability in **Table 3.23.A-6**.

3.23.A.5.12 For example, where the frequency of a hazard has been assessed as extremely remote and the consequence assessed as minor, the risk can be said to be negligible. On the other end of the scale, where hazards are assessed as frequent and the consequence catastrophic, then risk is intolerable.

3.23.A.5.13 The risk matrix identifies areas where the level of risk to the baseline shipping and navigation environment would need to be reduced to ALARP. Risk control (see **Section Risk control**), in the form of mitigation (i.e. environmental measures and project-specific measure**s**), is required to reduce the risk ratings (and therefore the effects on the baseline shipping and navigation environment) to ALARP. Where risks are not able to be mitigated further in accordance with ALARP, these are deemed intolerable.

Table 3.23.A-5 - Risk rating matrix based on consequence and frequency

		Consequence				
		Minor	Significant	Severe	Serious	Catastrophic
sniFrequency	Extremely Remote	1	2	3	4	5
	Remote	2	4	6	8	10
	Probable	3	6	9	12	15
	Very Probable	4	8	12	16	20
	Frequent	5	10	15	20	25

Table 3.23.A-6 - Definition of risk levels and tolerance

Score	Risk level	Definition	Tolerability
1-2	Negligible	A hazard which causes noticeable changes in the navigation environment but without effecting its sensitivities. Generally considered as insignificant.	Acceptable
3-4	Minor	A hazard that alters the character of the navigation environment in a manner that is consistent with existing baseline. Hazards are generally considered as minor and adequately controlled by best practice and legal controls. Opportunities to reduce hazards further through mitigation may be limited and are unlikely to be cost effective.	Tolerable with embedded controls
5-9	Moderate	A hazard which, by its frequency and consequence alters the aspect of the navigation environment. Generally considered as Moderate but effects are those, considered to be tolerable. However, it is expected that the hazard has been subject to feasible and cost-effective mitigation and has been reduced to ALARP and that no further measures are feasible.	Tolerable with additional project-specific controls
10-14	Major	An effect which, by its frequency and consequence alters most of the aspects of the navigation environment. Generally regarded as unacceptable prior to any mitigation measures being considered.	Unacceptable
15-25	Intolerable	Regarded as intolerable prior to any mitigation measures being considered.	Intolerable

3.23.A.5.14 After determining the risk ratings for each hazard before and after mitigation measures, the resultant risk matrix is split into two halves – the first describes the frequency and consequences before mitigation (inherent risk); the second half describes the frequency and consequences after mitigation measures have been applied (residual risk).

Establish mitigation

3.23.A.5.15 The risk assessment includes a review of existing hazards and their associated mitigation. As a result, new mitigation (or changes to existing mitigation) may be identified for consideration, both where there are gaps in existing procedures and where mitigation need to be enhanced.

3.23.A.5.16 Care should be taken to ensure that any new hazards created as a result are themselves identified and managed. The overall risk to the existing baseline during this stage would allow recommendations to be made to enhance safety.

3.23.A.5.17 Mitigation measures are the actions or systems proposed to manage or reduce the potential adverse effects identified. Mitigation measures are sometimes confused with measures taken to ensure legal compliance, which can be similar. Legislation is often designed to ensure effects to the environment are minimised.

3.23.A.5.18 A standard hierarchical approach to identifying mitigation requirements has been used to inform the NRA:

- **Avoid or Prevent:** In the first instance, mitigation should seek to avoid or prevent the adverse effect at source for example, by routeing the marine cables away from a hazard.
- **Reduce:** If the effect is unavoidable, mitigation measures should be implemented which seek to reduce the significance of the hazard. ed to ensure effects to the environment are minimised.
- **Offset:** If the hazard can neither be avoided nor reduced, mitigation should seek to offset the hazard through the implementation of compensatory mitigation.

3.23.A.5.19 Mitigation measures fall into two categories: mitigation which forms part of the Project design which are referred to as **Environmental Measures**; and mitigation which has been agreed as an additional control for the EGL 3 Project and EGL 4 Project, which is referred to as **Project-Specific Measures**.

Risk control

3.23.A.5.20 The aim of assessing the Project operations on the existing shipping baseline is to reduce risk to ALARP.

3.23.A.5.21 The risk assessment is repeated taking into consideration the application of embedded Environmental Measures and Project-Specific Measures. This determines the risk level of the hazard with mitigation applied. When the risk assessment is carried out after mitigation is applied, the resulting risk level is referred to as ALARP.

3.23.A.5.22 Residual risks that have been assessed as Major or above after considering mitigation would normally require additional analysis and consultation to discuss and possibly further mitigate hazards where possible.

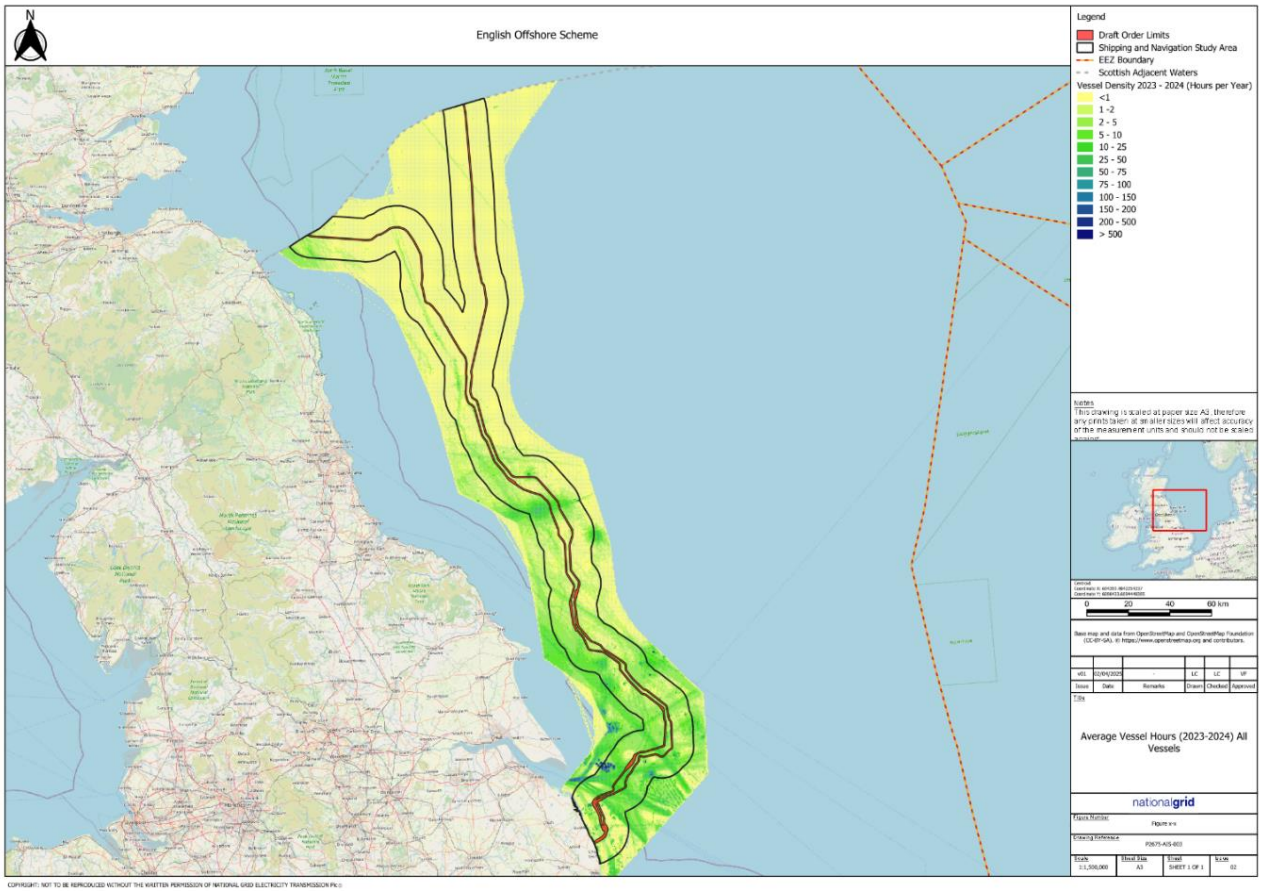
3.23.A.5.23 Where further mitigation is not possible, a residual risk may remain.

3.23.A.6 Existing shipping and navigation baseline

AIS data

3.23.A.6.1 AIS data has been used to determine the size and quantity of vessels which operate in the vicinity of the study area. It should be noted that in England, vessels under 12 m are not required to carry AIS equipment. A series of charts for AIS data by vessel type and for AIS data by month are displayed in **Volume 2, Part 3, Appendix 3.23.A Figures**, which are referred to in the interpretation of the AIS data below. **Plate 3.23.A-2** displays all vessels present for the years' worth of data.

Plate 3.23.A-2: AIS data of all vessels for full year



3.23.A.6.2 In English waters, there are three main shipping lanes or areas within the study area identified by AIS data as shown in **Plate 3.23.A-2**. Most vessel traffic exists around the Anderby Creek Landfall area and numerous shipping lanes to and from the Humber Estuary. The draft Order Limits have been routed to minimise interaction with high levels of vessel activity where appropriate.

3.23.A.6.3 High vessel activity is found in English waters within and in close vicinity to the Humber Estuary – at the mouth, to the North-West of the EGL 3 Project and EGL 4 Project, vessel densities of over 500 vessel hours per year are present within the study area. Vessels travelling to/from the Associated British Ports (ABP) Humber ports transect the study area offshore of Lincolnshire in multiple locations perpendicular to the EGL 3 Project and EGL 4 Project. Further offshore, there is another shipping channel oriented northwest-southeast transecting the study area, which reflects shipping traffic from North-East England to the East of England (e.g. Great Yarmouth, Lowestoft).

3.23.A.6.4 To a lesser extent, there are shipping lanes out of Bridlington, Scarborough and Whitby, which mostly comprise of cargo and tanker vessels. Furthermore, a shipping lane is visible leaving Middlesbrough orientated in a Northeast – Southwest direction; the study area crosses perpendicular to this lane.

3.23.A.6.5 Vessels to the north of East Anglia can be shown to skirt around the existing OWF developments (e.g. Triton Knoll, Hornsea Projects, Race Bank) and those under development (e.g. Outer Dowsing).

3.23.A.6.6 **Plate 3.23.A-3** below illustrates the distribution of vessels categorised by vessel type within the study area. In total, 3801 AIS data points were analysed within the study area. The highest constituent are cargo vessels (49.1%).

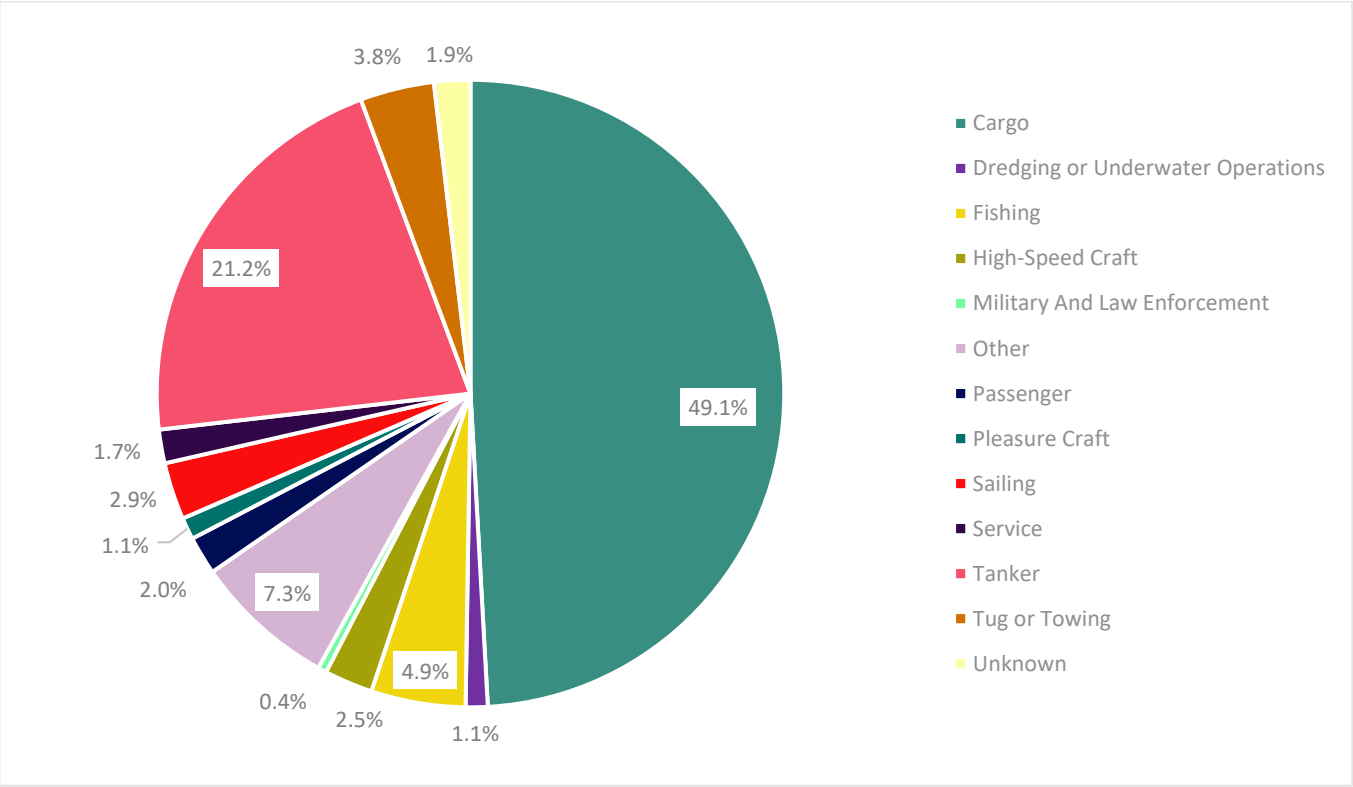
3.23.A.6.7 Cargo vessels comprise the highest proportion of vessel types identified within the study area, with 1867 cargo vessels data points (49.1% of the total vessels). Cargo vessels are seen within the AIS dataset traversing over the study area in the shipping lanes between the Humber Estuary, East Anglia and the North-East, with the greatest intensity of cargo vessels present at the Humber Deep Water Anchorage approximately 8-10 km to the West of the EGL 4 Project, partly inside the study area. This anchorage is 2.5 km to the South-East of the Humber Gateway OWF, which is fully commissioned.

3.23.A.6.8 Tankers (21.2% of the total vessels) follow a similar spatial pattern to the cargo vessels, with the exception of fewer vessels crossing the study area in an East-West direction to travel to European ports. Similar to cargo vessels, there are a high number of tanker vessels present at the deep-water anchorage near the Humber Gateway OWF.

3.23.A.6.9 Fishing vessels comprise of a smaller component of the total vessels (4.9%), but there are more dense areas of fishing vessels in the AIS data offshore Middlesborough to the East of the draft Order Limits within the study area. Considering that Lincolnshire is known as a busy fishing area (mainly static gear), the AIS dataset may not necessarily be representative for fishing vessels that may have their AIS transponders turned off.

3.23.A.6.10 A small constituent of vessel types are service vessels, which make up 1.7%. There are a few vessel hot spots for service vessels which are likely to be due to transient project work or occurrences, for example stand-by safety vessels for emergency responses. These hot spots come and go as shown on the monthly AIS charts in **Volume 2, Part 3, Appendix 3.23.A Figures.**

Plate 3.23.A-3: Vessel type distribution in the English Offshore Scheme



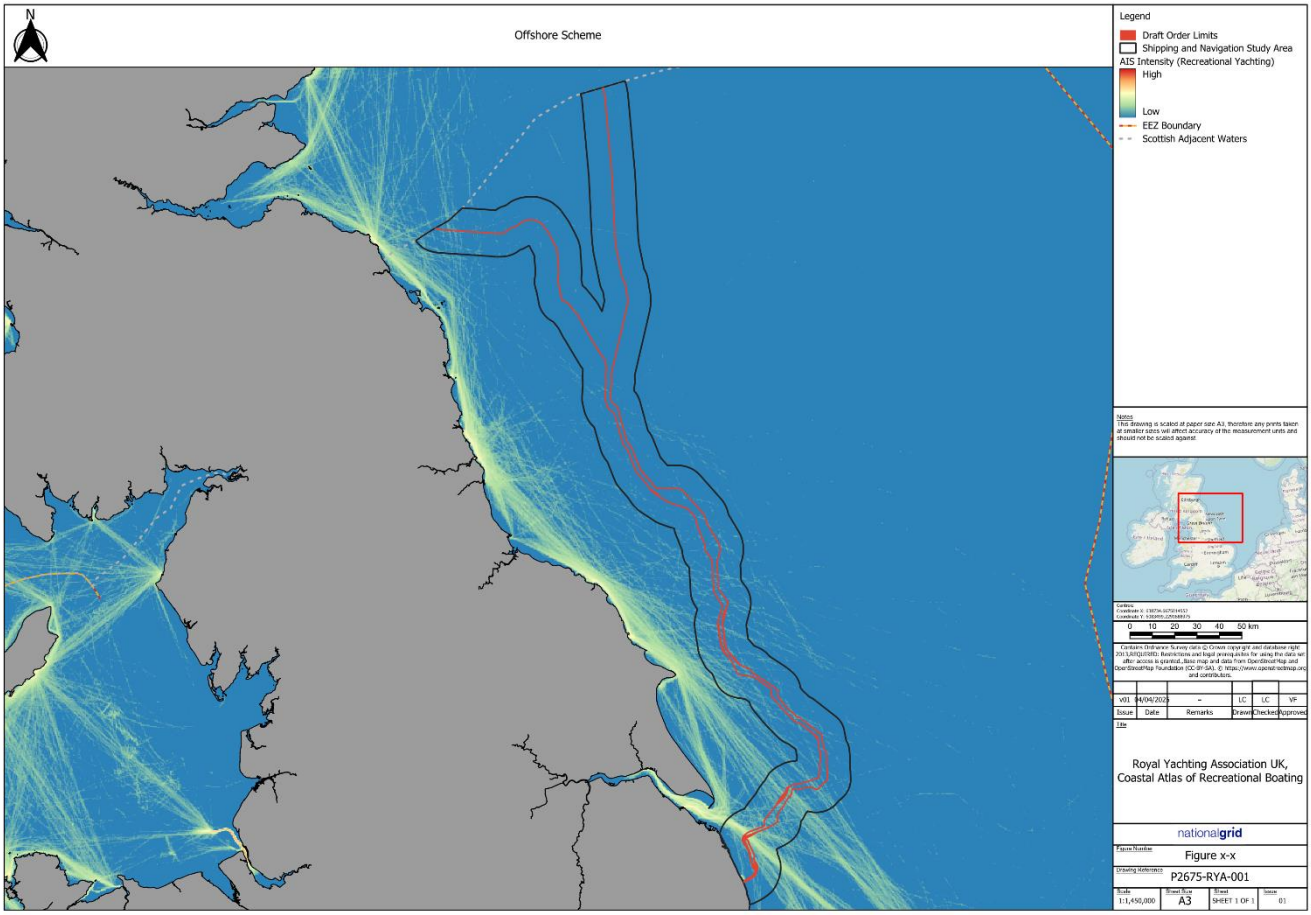
3.23.A.7 Recreational vessel activity

3.23.A.7.1 Royal Yachting Association (RYA) AIS data is displayed in **Plate 3.23.A-4**, indicating the locations of marinas, RYA clubs and RYA training centres along the East coast of the UK. The study area consists of low to medium activity for recreational vessel.

3.23.A.7.2 In proximity of the Anderby Creek Landfall, there is a RYA affiliated club at Saltfleet Haven for recreational vessels within the study area. In addition to this, further North into the Humber, there is the Humber Mouth Yacht Club, the Humber Cruising Association, the Grimsby & Cleethorpes Yacht Club, and the Merchant Navy Association Boat Club. Further South below Skegness, there is the Gibraltar Point Sailing Club. As shown on **Plate 3.23.A-4**, recreational vessel AIS data is low intensity and, despite being inside a boating zone, there is a lack of AIS data showing recreational vessels traverse the coastline near the landfall zone; AIS data present around the Anderby Creek Landfall suggests that recreational vessels typically travel to/from the Humber.

3.23.A.7.3 Most of the study area, with the exception of the nearshore area, is situated away from recreational vessel activity and therefore has limited interaction.

Plate 3.23.A-4: Recreational vessel AIS data



3.23.A.8 Marine incidents

3.23.A.8.1 This section reviews maritime incidents that have occurred within 5 NM of the English Offshore Scheme within the shipping and navigation study area The analysis is intended to provide a general indication as to whether the area the study area is currently a low or high-risk area in terms of maritime incidents. If it were found that the proposed development resided in a high-risk area for incidents, this may indicate that the development could add to the existing maritime safety risks in the area.

3.23.A.8.2 The most recently available 5 years of data from RNLI and the last 5 years of MAIB reports have been analysed. It is noted that the same incident data could have been recorded by both sources.

RNLI

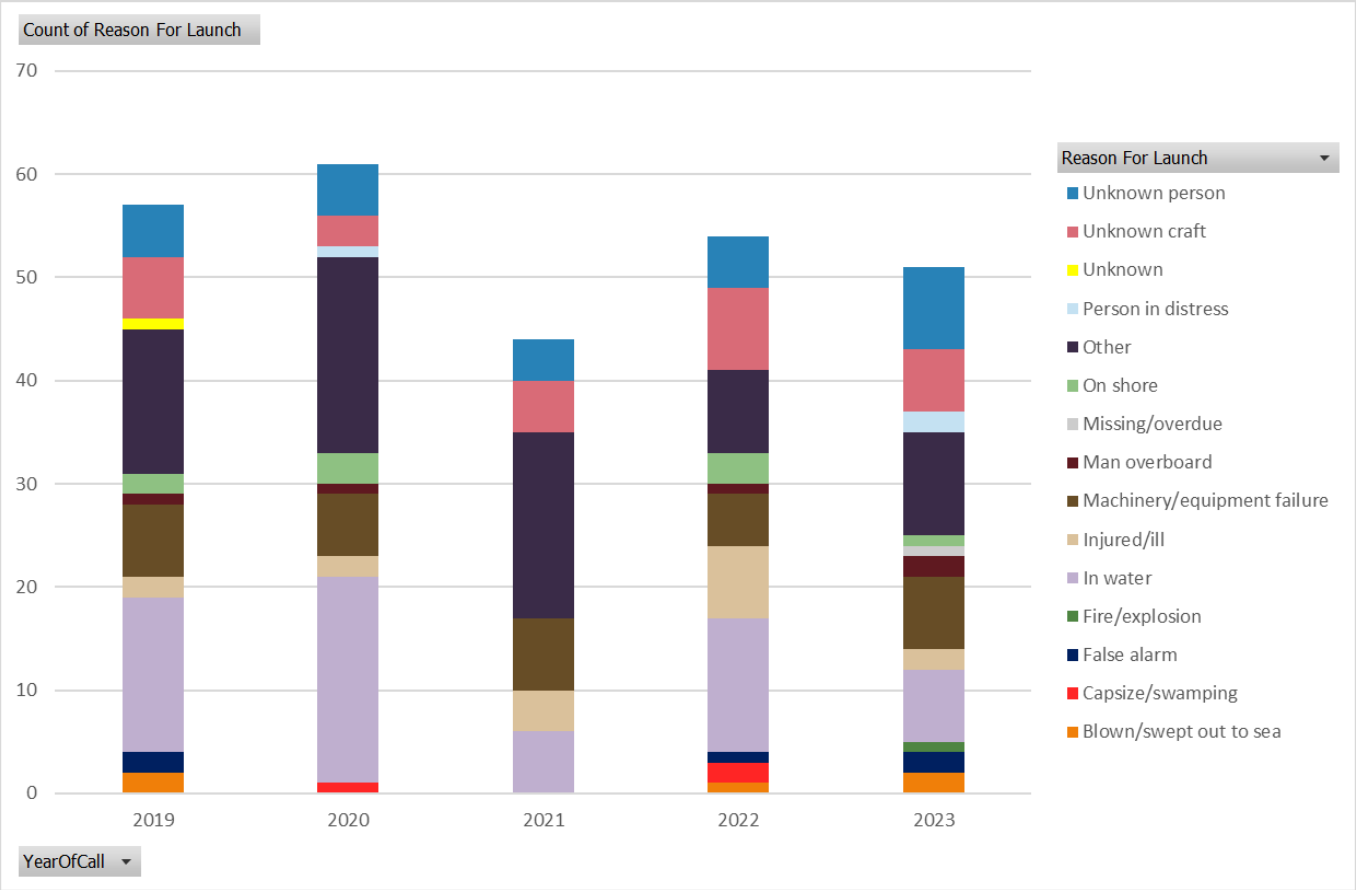
3.23.A.8.3 RNLI incident data for English waters is illustrated in charts in **Volume 2, Part 3, Appendix 3.23.A Figures**.

3.23.A.8.4 Return of Service incidents are concentrated around the Anderby Creek Landfall, as illustrated in **Volume 2, Part 3, Appendix 3.23.A Figures**. A total of 267 incidents have been recorded between 2019 and 2023 – the distribution of incidents requiring RNLI assistance across the years are displayed in **Plate 3.23.A-5**. RNLI data prior to 2019 has not been considered as it is no longer made publicly available.

3.23.A.8.5 **Plate 3.23.A-5** shows that 'Other' (dark purple) comprises the largest proportion of RNLI incident data at 25.8% with 69 incidents, the majority of other incidents occur along the coastline at the Anderby Creek Landfall site. The next most frequent reason for launch is 'In Water' (light purple), which comprises 61 of the incidents (22.9%).

3.23.A.8.6 There are no RNLI incidents related to collisions within the study area during this time period.

Plate 3.23.A-5: RNLI incident distribution by type for English waters



Marine Accident Investigation Board (MAIB)

3.23.A.8.7 All UK-flagged commercial vessels are required by law to report accidents to MAIB. Non-UK flagged vessels do not have to report unless they are within a UK port/harbour or are within UK 12 NM and carrying passengers to or from a UK port. However, the MAIB would always record details of significant accidents of which they are notified by bodies such as the Coastguard. The MCA, harbour authorities and inland waterway authorities also have a duty to report accidents to the MAIB.

3.23.A.8.8 The last five years of annual MAIB reports from 2019 to 2024 have been analysed to determine if any accidents have occurred within or nearby to the study area. Furthermore, the MAIB have released a data portal where marine incident data is updated bi-annually; the data portal provides information on incidents which do not have published reports. The data portal covers occurrences from 01/01/2022 to 31/12/2024. The findings from both MAIB data sources have been summarised below in **Table 3.23.A-7**.

Table 3.23.A-7 - Overview of MAIB data portal occurrences (2022 – 2024)

Date Occurred	Severity	Main Incident	Description	Occurrence Location	Latitude	Longitude
01/03/2024	Marine Incident	Damage / Loss of Equipment	Container ship's pilot ladder did not conform to SOLAS regulations	Coastal waters <= 12 nm	53.4959	0.3182
01/05/2024	Very Serious	Accident to person(s)	No information available. See MAIB investigation report, when available	Coastal waters <= 12 nm	53.4979	0.4733
01/05/2024	Marine Incident	Contact	A search and rescue vessel made contact with carriage during recovery	Coastal waters <= 12 nm	53.34067	0.270333
01/06/2024	Less Serious	Accident to person(s)	Service vessel's crew member caught finger resulting in closed fracture	Coastal waters <= 12 nm	53.26983	0.505667
01/07/2024	Marine Incident	Accident to person(s)	A research vessel crew member was struck by a winch handle whilst recovering an anchor	Coastal waters <= 12 nm	53.31283	0.328
01/12/2024	Marine Incident	Damage / Loss of Equipment	Oil tanker's pilot ladder did not conform to SOLAS regulations	Coastal waters <= 12 nm	53.5074	0.24
01/03/2022	Less Serious	Grounding / Stranding	A search and rescue vessel grounded on a beach after trying to recover to its launch carriage	Coastal waters <= 12 nm	53.3458	0.2649

Date Occurred	Severity	Main Incident	Description	Occurrence Location	Latitude	Longitude
01/03/2022	Marine Incident	Fire / Explosion	Crew supply vessel suffered a fire in starboard main engine exhaust stack	Coastal waters <= 12 nm	53.54383	0.4245
01/03/2022	Marine Incident	Damage / Loss of Equipment	A fishing vessel lost its propeller and was towed to port	Coastal waters <= 12 nm	53.54028	0.438833
01/06/2022	Marine Incident	Flooding / Foundering	Recreational craft started to take on water	Coastal waters <= 12 nm	53.3747	0.2586
01/01/2023	Marine Incident	Damage / Loss of Equipment	Bulk carrier's pilot ladder not rigged per SOLAS regulations.	Coastal waters <= 12 nm	53.5188	0.2626
01/06/2023	Serious	Fire / Explosion	Crew transfer vessel suffered an engine fire, which was extinguished and the vessel towed back to port	Coastal waters <= 12 nm	53.3255	0.3755
01/06/2023	Marine Incident	Damage / Loss of Equipment	A bulk carrier's pilot ladder did not conform to SOLAS regulations.	Coastal waters <= 12 nm	53.5165	0.3862
01/12/2024	Marine Incident	Loss Of Control	Fishing vessel lost propulsion resulting in tow.	Open sea -> Within EEZ	54.27555	0.24055
01/05/2023	Marine Incident	Loss Of Control	Fishing vessel fouled its prop and were towed by sister vessel.	Open sea -> Within EEZ	53.5235	0.574167

Date Occurred	Severity	Main Incident	Description	Occurrence Location	Latitude	Longitude
01/05/2023	Marine Incident	Loss of Control	Diving vessel suffered machinery failure and resulted in no Injuries	Open sea -> Within EEZ	53.5899	0.776883
01/04/2024	Marine Incident	Accident to person(s)	Cargo vessels crew member fell overboard during a POB exercise, resulting in no injuries.	Open sea -> Outside EEZ	54.06833	0.675

3.23.A.8.9 There is a total of 17 MAIB incidents found within the shipping and navigation study area between 2019 and 2024, corresponding to an average of 3.4 incidents per year.

3.23.A.8.10 It is worth noting that none of the MAIB incidents relate to a collision with other vessels. However, there is one very serious incident from May 2024 that does not yet have information made available.

North Sea Collision (March 2025)

3.23.A.8.11 A very serious incident that is not captured in the data ranges of the MAIB and RNLI datasets is a collision between the Solong (container ship) and the Stena Immaculate (aviation fuel tanker) on 10/03/2025. This incident is undergoing investigation by the MAIB and the authorities. An interim report has been made available on 03/04/2025.

3.23.A.8.12 The Stena Immaculate was at anchor close to the approach of the River Humber, 26 km north-east of Spurn Head and 21 km from the draft Order Limits (closest to the EGL 4 Project). One member of the Solong's crew is believed to have suffered a fatality. The exact causes of the incident are not yet known but the interim MAIB report describes neither vessel having a dedicated lookout on the bridge and poor visibility at the time. The extent of pollution from the vessels is also being investigated.

3.23.A.9 Key navigational features in English waters

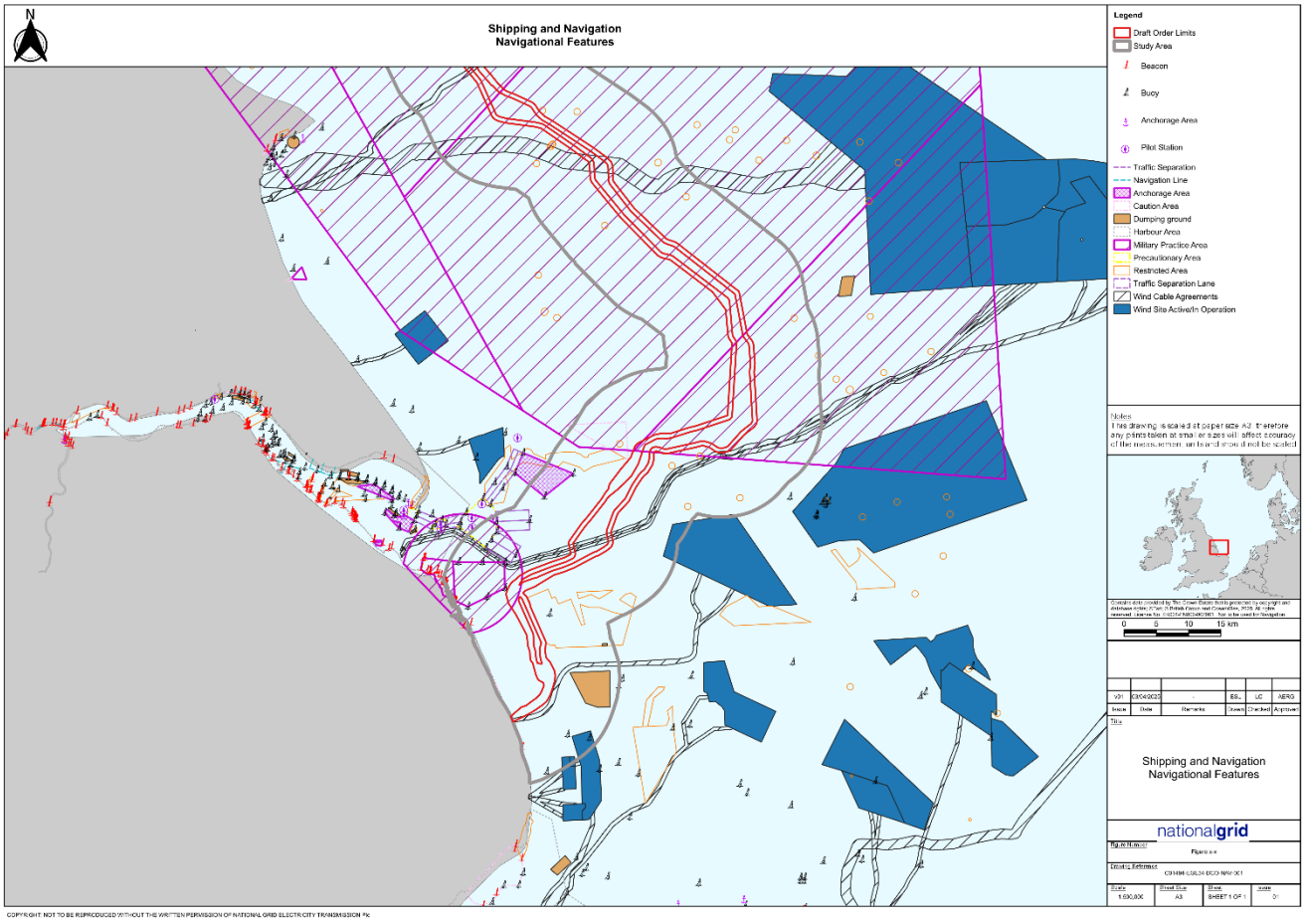
3.23.A.9.1 The key navigational features found in this area are:

- Humber Vessel Traffic Services;
- Humber deep water anchorage;
- OWFs (Triton Knoll, Lincs, Inner Dowsing, Humber Gateway);
- Donna Nook Military Area;

- Military Practice Areas (Staxton, Druridge Bay) and Areas of Intense Aerial Activity; and
- 18 navigational buoys and 3 beacons in the Lincolnshire nearshore, mostly concentrated on approach to the Humber estuary (including one TSS marker).

3.23.A.9.2 **Plate 3.23.A-6** illustrates the key navigational features in the Lincolnshire nearshore area.

Plate 3.23.A-6: Lincolnshire key navigational features



3.23.A.10 Consultation and stakeholder engagement

3.23.A.10.1 A summary of the relevant responses received in the Scoping Opinion in relation to shipping and navigation, including confirmation of how these have been considered (for example as mitigation) within the assessment can be found in **Volume 1, Part 3, Chapter 23: Shipping and Navigation**. Key extracts related to shipping and navigation have been summarised below:

- Clear, effective and frequent project communication;
- Use of RYA coastal atlas to supplement assessments for recreational vessels; and
- Advisory safety zones to include sufficient turning space for vessels.

3.23.A.10.2 Shipping and navigation hazard identification (HAZID) workshops took place on 13/11/2024, where focus groups for English waters and Scottish waters were formed. In these workshops, the NRA methodology was presented, and the risk matrix was introduced to the shipping and navigation stakeholders.

3.23.A.10.3 The shipping and navigation risk matrix was sent for comment to stakeholders. The risk matrix underwent development based on the feedback received. Key changes as a result are as follows:

- Updated the frequency categorisations to have 'once a week or more' as the most frequent definition instead of 'likely to occur once per day', which brings the frequency ratings more in line with the definition of frequency in standard guidelines and NRA methodologies. The frequency categories are based on the Formal Safety Assessment guidelines and are determined as a suitable resolution for the durations of the marine campaigns.
- Added environmental impact definition and risk ratings.
- Added Business/Reputational Impacts definition and risk ratings.
- New hazard definition of: 'Reduced visibility / adverse weather conditions' as a more appropriate hazard.
- Added snagging of static fishing gear by seabed preparation & route clearance activities as a risk.

3.23.A.11 Cumulative effects

3.23.A.11.1 Cumulative effects have been evaluated at a high-level in this NRA as a qualitative assessment and considered in the risk ratings in the shipping and navigation risk matrix. Further details of cumulative effects can be found in **Volume 1, Part 4, Chapter 28: Cumulative Effects Assessment.**

3.23.A.11.2 With the North Sea seabed becoming increasingly congested, the cumulative presence of multiple OREIs within the area can lead to the restriction of shipping and navigation users. Particularly affected are vessels visiting the Humber, where the EGL 3 Project and EGL 4 Project have been routed to cross multiple vessel track lines from the Humber at a perpendicular angle to minimise potential anthropogenic interactions. To avoid potential future seabed developments in the area, vessel patterns may deviate from current levels, which could increase the risk of anchor drag over the EGL 3 Project and EGL 4 Project.

3.23.A.11.3 In addition, sufficient sea room to accommodate vessel manoeuvres may become spatially restricted by multiple offshore activities occurring at the same time. This would particularly affect the construction phase where the promulgation of notices, effective communication and SIMOPs between different parties would be essential for efficient and safe vessel movements.

3.23.A.11.4 The EGL 3 Project and EGL 4 Project share a co-located landfall at Anderby Creek (Lincolnshire) and follow an almost parallel route northwards along the coast of England for approximately 300 km until offshore Northumberland, where the EGL 3 Project and EGL 4 Project split before entering Scottish waters. The frequency of vessels increases with proximity to the Anderby Creek Landfall and therefore the risk of anchor drag is also increased with the cables converging approximately 5 km from the shore. Vessels in the nearshore area mostly comprise of smaller vessels which would have shallower anchor penetration and therefore would not impact both

the EGL 3 and EGL 4 Project cables within the same incident. The Applicant is aware that other projects are also exploring landfall options along the Lincolnshire coastline for power cables. Multiple projects being constructed at the same time has the potential to increase risks. The Applicant is seeking to co-ordinate with other developers as appropriate to manage risks and reduce impacts.

3.23.A.11.5 The ports used for the construction phase of the Projects are to be confirmed at a later stage in the Project development. However, it is noted that the vessel movements for various offshore activities must be co-ordinated to lower the risk of possible vessel incidents.

3.23.A.12 Anticipated marine activities

3.23.A.12.1 **Volume 1, Part 1, Chapter 4: Description of the Projects** provides details of the English Offshore Scheme and operational aspects of the marine campaign works such as cable installation, site preparation and cable protection methods; a schedule is also included to estimate the timeframe for the various marine activities. Anticipated marine campaign works have been based on the Project description activities.

3.23.A.12.2 Flexibility would be required in the construction programme in order to accommodate a range of uncertainties. This would include the time taken to undertake procurement activities, variable lead times for components and equipment, and variable task durations dependent on the suppliers, technologies and methodologies selected. This may be affected by factors such as supply chain bottlenecks as well as implementation of any required mitigation measures for environmental sensitivities or sensitive receptors.

3.23.A.12.3 Furthermore, realistic but worse-case assumptions have been utilised in the Project description and determination of the risk ratings in this NRA, such as using the lower end of progress rates. A factor of safety (FoS) has also been added to the zones of influences (ZOIs) in order to add contingency. This approach has added a layer of conservatism to account for uncertainties.

3.23.A.12.4 Pertinent information based on the Project description activities is outlined below in **Table 3.23.A-8** (EGL 3 Project) and **Table 3.23.A-9** (EGL 4 Project) in order to identify the zones of influence for shipping and navigation. The following assumptions have been made to guide the zones of influence:

- Existing vessels would be requested to remain at least 500 m from project vessels whilst they are engaged in cable installation activities. This is due to limited ability for construction vessels to manoeuvre whilst undertaking operations.
- Unless otherwise specifically directed by Notice to Mariners (NtMs), sections of the English Offshore Scheme would require to be kept clear of all fishing gear (mobile and static) until the end of the works, including the post-lay survey period.
- The operation is assumed to be performed on a 24-hour basis unless otherwise described. Durations presented are exclusive of any third-party influences that may increase the duration or interrupt operations.

3.23.A.12.5 As the English Offshore Scheme covers both the EGL 3 Project and the EGL 4 Project, the worse-case option between the EGL 3 Project and EGL 4 Project has been chosen for consideration to determine the NRA risk ratings.

3.23.A.12.6 Further information regarding the marine campaign activities is available in the following sections as indicative estimations.

Table 3.23.A-8 - EGL 3 campaign worse-case indicative estimations for the English Offshore Scheme

Marine Campaign		Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 3 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
UXO survey		2,000	8 lines	435,000	1740	1.5	73	110	72.0	Assuming entire route of UXO survey 100 m corridor. UXO ID & Disposal not assessed - Optional dependent on UXO survey campaign. Assumes lower end of progress rate.
Route Clearance	Pre and Post Lay Survey	3,000	2 lines	435,000	290	1.2	13	16	86.4	Assuming single line x2 pre and post lay with ROV.
	PLGR	1500	1 line	435,000	290	1.2	13	16	43.2	From PD, assume 100% route length to require PLGR.
	Boulder clearance	200	1 line	235,000	1175	1.2	49	59	5.8	From PD
	Sandwave pre-sweeping	200	1 line	11350	57	1.2	3	4	5.8	From PD

Marine Campaign		Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 3 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
	OOS cable removal	1 asset per day	2 OOS cables	200 m of OOS cable removed	48	1.2	2	3	0.5	OOS assets identified across the route in third-party crossings list for English waters only. These would be de-buried and but with ROV manipulator arm
Cable Lay and Burial	Cable Lay	200	1 line	435,000	2175	1.2	91	110	5.8	Assumes lower end of progress rates to account for weather
	Cable Burial	150	1 line	435,000	2900	1.2	121	146	4.3	Assumes lower end of progress rates to account for potential challenging geology
Cable Jointing		10	9 expected cable joints	N/A	2160	1	90	90	0.2	From PD. Assumes up to 9 cable joints from recent EPC tender returns. FoS not required either as operations are robust enough to not be affected by weather or a weather window

Marine Campaign		Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 3 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
										would be targeted for operations
HDD punch out and Cable Pull in		6 days per pull in	1 pull in	N/A	6 days per landing	1.5	6	9	0.5	Shallow water barge potentially at Lincolnshire, includes preparation work
External Protection Operations	External Protection for IS cables & pipeline crossings	1 crossing per day	46 crossings	200 m per crossing	1104	1.2	46	56	0.5	From active, IS and proposed assets in the third-party crossings list. Include pre-lay mattressing. No external protection has been accounted for remedial rock for shallow burial. Abandoned pipelines have been treated as IS crossings
	Remedial Rock Placement	200	905,000 m^3	91,000	4525	1.5	189	284	7.2	Due to shallow bedrock preventing burial being achieved. Assumes lower end of progress rates. Factor of safety

Marine Campaign	Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 3 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
									increased to account for Contractor's tools to potentially not be able to reach lowering depth due to poor tool performance. From EGL 3 Preliminary Rock Protection memo (Intertek Metoc, 2025).
Operation & Maintenance Survey	1,000	1 line	435,000	435	1.5	19	29	36.0	Assuming single line with ROV. Assumes lower end of progress rate

Table 3.23.A-9 - EGL 4 campaign worse-case indicative estimations for the English Offshore Scheme

Marine Campaign		Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 4 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
UXO survey		2,000	8 lines	420,000	1680	1.5	70	105	72.0	Assuming entire route of UXO survey 100 m corridor. UXO ID & Disposal not assessed - Optional dependent on UXO survey campaign. Assumes lower end of progress rate.
Route Clearance	Pre and Post Lay Survey	3,000	2 lines	420,000	280	1.2	12	15	86.4	Assuming single line x2 pre and post lay with ROV.
	PLGR	1500	1 line	420,000	280	1.2	12	15	43.2	From PD, assume 100% route length to require PLGR.
	Boulder clearance	200	1 line	125,000	625	1.2	27	33	5.8	From PD
	Sandwave pre-sweeping	200	1 line	8280	41	1.2	2	3	5.8	From PD

Marine Campaign		Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 4 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
	OOS cable removal	1 asset per day	1 OOS cable	200 m of OOS cable removed	24	1.2	1	2	0.5	OOS assets identified across the route in third-party crossings list for English waters only. These would be de-buried with an ROV manipulator arm
Cable Lay and Burial	Cable Lay	200	1 line	420,000	2100	1.2	88	106	5.8	Assumes lower end of progress rates to account for weather
	Cable Burial	150	1 line	420,000	2800	1.2	117	141	4.3	Assumes lower end of progress rates to account for potential challenging geology
Cable Jointing		10	7 expected cable joints	N/A	1680	1	70	70	0.2	From PD. Assumes up to 7 cable joints from recent EPC tender returns. FoS not required either as operations are robust enough to not be affected by

Marine Campaign		Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 4 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
										weather or a weather window would be targeted for operations
HDD punch out and Cable Pull in		6 days per pull in	1 pull in	N/A	6 days per landing	1.5	6	9	0.5	Shallow water barge potentially at Lincolnshire, includes preparation work
External Protection Operations	External Protection for IS cables & pipeline crossings	1 crossing per day	67 crossings	200 m per crossing	1608	1.2	67	81	0.5	From active, IS and proposed assets in the third-party crossings list. Include pre-lay mattressing. No external protection has been accounted for remedial rock for shallow burial. Abandoned pipelines have been treated as IS crossings
	Remedial Rock Placement	200	1,120,000 m^3	115,000	5,600	1.5	234	351	7.2	Due to shallow bedrock preventing burial being achieved.

Marine Campaign	Rate of progress (m/hr unless otherwise stated)	Operational quantities	Operational length - EGL 4 (m)	Duration hours	Factor of Safety	Duration (days) without FoS	Duration (days) with FoS	Zone of Influence (km) in 24 hour period	Assumptions/ Comments
									Assumes lower end of progress rates. Factor of safety increased to account for Contractor's tools to potentially not be able to reach lowering depth due to poor tool performance
Operation & Maintenance Survey	1,000	1 line	420,000	420	1.5	18	27	48.0	Assuming single line with ROV. Assumes lower end of progress rate

3.23.A.13 Pre-installation works

Unexploded Ordnance (UXO) survey

3.23.A.13.1 There is a risk that UXO may be encountered during cable installation and cable repair activities. UXO can present a high risk to vessels and personnel if encountered and specifically within the footprint of the installation equipment.

3.23.A.13.2 An offshore geophysical, geotechnical and environmental survey has been completed across a 500 m survey corridor for each of the EGL 3 Project and the EGL 4 Project. The survey was designed to detect any significant seabed features and obstacles within the English Offshore Scheme. A more detailed UXO specific pre-construction survey using a magnetometer array would be undertaken prior to installation along a detailed route position engineered within the Order Limits.

3.23.A.13.3 The extent of the UXO survey would be nominally 50 m either side of the detailed route position. With a reasonable FoS added onto this for safety of marine users, a 500 m width for the ZOI has been assigned.

3.23.A.14 Route preparation

3.23.A.14.1 It is essential to ensure the English Offshore Scheme is clear of obstructions that may hinder the installation works. Types of seabed preparation that may be required in certain areas are boulder clearance, sandwave pre-sweeping and a pre-lay grapnel run (PLGR).

Boulder clearance

3.23.A.14.2 A review of geophysical survey data indicates that a considerable length of the EGL 3 Project and EGL 4 Project would require boulder clearance (up to 54% of EGL 3's route in English waters; 30% for EGL 4 in English waters).

Sandwave pre-sweeping

3.23.A.14.3 Sandwave clearance would be necessitated where bedforms with wave heights above 1.5 m are present as they present technical challenges for burial equipment. These sandwaves would be cleared to ensure sufficient tool reach and safe operation by removing steep slopes.

3.23.A.14.4 Sandwaves are particularly apparent north of the Holderness Offshore Marine Conservation Zone (MCZ), where there are dense sandwave fields.

3.23.A.14.5 The methodology for pre-sweeping is yet to be determined. It is noted that the installation contractor may prepare individual method statements and specific risk assessments for the different methodologies, which must be read in conjunction with this NRA if available.

Pre-Lay Grapnel Run

3.23.A.14.6 A PLGR would involve towing a pre-lay grapnel along the route position engineered within the Order Limits to clear any seabed debris (e.g. ghost fishing gear) that may present snagging risks and to prepare the route position for cable installation. This is usually undertaken a few days before cable installation. A large vessel is required for this due to the tension generated by the pre-lay grapnel as it is towed along the seabed.

Pre-lay geophysical survey

3.23.A.14.7 The installation contractor may conduct further surveys prior to the commencement of cable installation.

3.23.A.14.8 The objectives of these surveys would be to:

- confirm that no new obstructions have appeared on the seabed since the original marine surveys were undertaken;
- to confirm the seabed level pre- and post-installation to demonstrate that the required burial depth for the cables has been reached; and
- micro-route the engineered route position around any mobile bedforms or sensitive habitats within the Order Limits.

3.23.A.14.9 The geophysical survey is typically split into two elements: nearshore (<10 m of water) and offshore (>10 m of water). Each element requires a survey vessel that is catered for the appropriate water depths. The offshore vessel is generally much larger and can conduct 24-hour operations. The nearshore vessel is generally smaller but due to its reduction in size can reach shallower water depths.

3.23.A.14.10 Operations are usually kept to 12 hours (or daylight hours) for nearshore operations. The survey would involve a range of standard geophysical survey techniques such as multi-beam echosounder, side scan sonar, sub-bottom profiler and magnetometer. Visual inspection of seabed features may be carried out with a ROV. This may require the survey vessel to hold position at a specific location.

3.23.A.15 Cable Installation

Installation Vessels

3.23.A.15.1 The cable lay operation would be performed on a 24-hour basis. It is anticipated that the following vessel types would be required for cable installation:

- Cable-lay vessel would undertake cable lay and burial in water depths greater than 10 m.
- Post lay burial vessel would undertake cable lowering below seabed to a required depth.
- Guard vessel(s) would be used to protect areas of exposed cable prior to external protection being applied and would be used in support of the cable-lay vessel which would have limited manoeuvrability. Guard vessels are small to increase manoeuvrability around the larger vessels during sensitive operations. Suitably experienced fishing vessels (locally based or sourced through the National Federation of Fishermen's Organisations (NFFO)) can be used in this role.

- Construction support vessels would likely include crew transfer vessels, dive support vessels (DSV), general construction support vessels and rock placement vessels. DSVs and construction support vessels come in a variety of sizes to fit the working conditions and activity and can be adapted to undertake several different roles e.g. archaeological or UXO inspections; PLGR; and deposition of concrete mattresses at crossing locations. Rock-placement vessels are specialised vessels that feature a large hopper to transport the rock, and a mechanism for deployment of the rock on site. It is likely that a fall pipe vessel would be used for rock placement.

3.23.A.15.2 It is noted that survey/installation contractor may prepare individual method statements and specific risk assessments for each of the operations.

3.23.A.16 Cable Laying

Cable Lay Techniques

3.23.A.16.1 Post lay burial is being considered for the English Offshore Scheme. In this operation the cable lay vessel would lay the cables on the seabed and a post-lay burial vessel would follow to bury the cables. The post-lay burial vessel may be some distance, or some days, behind the lay vessel so there are two discrete operations separated physically and in time. Both vessels utilise high redundancy dynamic positioning (DP2) which would enable cable laying at a reasonable speed without reducing laying accuracy.

3.23.A.16.2 The sea surface footprint of a cable installation spread would depend on the technique that is used. It would incorporate that of the vessel, or vessels if working in together, and the surrounding area commensurate with being a “vessel restricted in its ability to manoeuvre”. Typically, a large cable lay vessel would be up to 150 m in length and other vessels would be requested to remain a safe distance from the operation. This is typically a 500 m radius or potentially up to 1200 m radius if the cable lay vessel has anchors.

3.23.A.16.3 Cable lay operations would be performed on a 24-hour basis to maximise suitable weather conditions, vessel and equipment time and to minimise the presence of the cable lay spread in navigation channels or other sensitive areas such as harbour authorities.

Cable Lay Progress Rates

3.23.A.16.4 The effect of the cable lay operations would depend on the slowest moving element which is usually the cable lay burial spread. Indicative progress rates for a laying of a straight line bundled cable with no allowances for operational delays or stoppages are expected to be:

- Surface cable lay between 130 – 320 m/hr [assuming 200 m/hr].
- Cable burial first pass between 110 – 260 m/hr [assuming 150 m/hr].

3.23.A.16.5 These progress rates may be reduced in practice once operational constraints are factored in for lay initiation, cable end lay down, weather delays, tidal current delays, alter courses, cable crossings, micro-routeing around obstructions and unplanned maintenance.

3.23.A.16.6 The vessel speed of a DP2 vessel would remain constant throughout operations including when in proximity to physical obstructions such as navigation marks. Manoeuvring on anchors however would result in significantly reduced vessel speeds and therefore progress rates.

Burial Depths

3.23.A.16.7 The recommended and target burial depths along the cable length have been determined using cable burial risk assessment (CBRA) methodology to be between 0.6 m to 3 m typically, with a maximum of 6 m due to extremely low strength clays in sections of the EGL 4 Project. The burial depths consider cable design, seabed geology and morphodynamics, sediment mobility, and potential for damage from external sources, e.g. fishing gear and vessel anchors.

Infrastructure Crossings

3.23.A.16.8 A number of third-party crossings have been identified across the English Offshore Scheme consisting of active and inactive pipeline and cables and proposed infrastructure (assumed to be installed before the English Offshore Scheme). It is estimated that 57 in-service third party crossings would be constructed for EGL 3 in English waters and 58 in-service crossings for EGL 4 in English waters; where third-party assets are in proximity to one another, a longer rock berm would be considered which covers multiple crossings. Out of service cables would be removed during the route clearance campaign.

3.23.A.16.9 During typical infrastructure crossing operations, support vessel would place pre-lay mattresses on the crossed infrastructure to prepare for the cable to be laid across it. The cable is laid across the mattresses and trenched into the seabed either side of the crossing up to an agreed exclusion zone between the two crossing parties, leaving up to 100 m of exposed cable on the seabed. Post-lay rock is then placed onto the exposed cable to protect the asset against external aggressors.

Cable Jointing

3.23.A.16.10 Due to the significant length of the cable in English waters (EGL 3 Project length of 436 km and EGL 4 route length of 425 km, totalling 861 km), several jointing operations are expected to take place. Exact positions and number of joints are not finalised, however for the purpose of the NRA nine joints shall be assumed as a worst case (based route lengths of both EGL 3 and EGL 4). The lay down area and jointing operations would be designed to minimise existing shipping and target areas of lower AIS traffic.

Cable Pull-in

3.23.A.16.11 During the cable pull in operations in Lincolnshire, the cable lay vessel (CLV) would be stationed around the 10 m water depth contour.

3.23.A.16.12 Once the first cable has been floated from the CLV to the HDD exit and pulled in from the CLV through the first landfall HDD duct and to shore, the same procedure would be repeated for the second landfall HDD duct.

3.23.A.16.13 If the water is too shallow for CLV to carry out operations, then a shallow water anchored barge would likely be used until water depths are great enough for the CLV to continue laying the cable.

3.23.A.16.14 The cable would then float off the vessel to shore to complete the second cable pull in operation. The total cable pull in operation is estimated to take 6 days.

Remedial Rock

3.23.A.16.15 Remedial rock across the English Offshore Scheme may be required where the cable cannot reach the target depth of lowering. If burying the cable is not viable due to seabed geology, then other means of protection with equivalent safety should be applied. There would be locations along the Order Limits where rock placement around the cable is required.

3.23.A.16.16 Technical memorandums have been undertaken for EGL 3 and EGL 4 to provide preliminary estimations of rock volumes using a 1.2 x factor of safety. Within the draft Order Limits, there are 115 crossings in total (across both EGL 3 and EGL 4) which are assumed to require rock berms, in addition to areas of challenging geology that may prevent sufficient burial. A large proportion of the areas requiring rock protection are situated within English waters (approximately 94%), with the majority of potential rock protection attributed to subcropping and outcropping hard layers.

Post-Lay Inspection Survey

3.23.A.16.17 A post-lay geophysical inspection survey would be undertaken once the installation of the cable has been completed. This survey would be completed using standard geophysical survey equipment and survey techniques used would be similar to the pre-installation surveys. This would include visual inspection by ROV, multi-beam echosounder, side scan sonar and magnetometer. In addition, shallow sub-bottom profiling and cable tracking may be used.

3.23.A.17 In-Service Cable Operation

3.23.A.17.1 Routine maintenance work to the cable is not anticipated. Some work may be required to maintain the burial of the cable to protect it from adverse interactions with other sea users and marine processes which might damage it. The cable and its installation would be designed to minimise any maintenance requirements.

3.23.A.17.2 The likelihood of a fault occurring is very low based on the burial specification of the cable and therefore the frequency of the residual risk has been assessed as Extremely Remote. The consequence of the impact would have been assessed as minor as any repair works are site specific and short term, and acceptable alternatives would be available for vessels to re-route around the Project vessels.

Electromagnetic Fields (EMFs)

3.23.A.17.3 Submarine HVDC cables generate magnetic fields due to the current flowing along the cables. The magnitude of the magnetic fields produced is directly dependent upon the amount of current flowing through the cables. The cable sheathing is used to prevent the propagation of electric fields into the surrounding environment. The movement of sea water or marine organisms through the static magnetic fields would create small, localised induced electric fields.

3.23.A.17.4 EGL 3 and EGL 4 would be formed of a pair of bundled HVDC armoured cables operating at zero Hertz. Bundled and armoured cable design reduces the EMF generated during operation. In addition, cable burial also increases the distance between the EMF source and potential receptors.

3.23.A.17.5 The EMF assessment indicates that over 99.5% of the English Offshore Scheme resulted in compass deviations of less than 3 degrees; small sections exceeding this are located in shallow waters, where water depth is below 3 m. 99.7% of the English Offshore Scheme are within the threshold for less than 5 degree compass deviation. Subsequently, very low compass deviation occurs over the cables.

3.23.A.17.6 MCA guidance for compass deviation is that there must be no more than a 3 degree electromagnetic variation for 95% of the cable route and for the remaining 5% of the cable route there must be no more than a 5 degree electromagnetic variation in water depths of 5 m and deeper. The calculations provided indicate that this guidance is met.

3.23.A.17.7 Post-installation compass deviation surveys would be undertaken if required to confirm compass deviation levels and the results forwarded to the UKHO and MCA.

Maintenance and Repair

3.23.A.17.8 The requirement for repair operations during the lifetime of the cable would depend on the number of faults, location of the faults, and the burial or protection methods used for the original installation.

3.23.A.17.9 The estimate of the number of repair operations is:

- One operational cable fault over the operational lifetime of the cable (40 years);
- Two third party interactions with the cable over the operational lifetime of the cable (40 years), based on calculation formulas provided by Ofgem, ENTSO-E and CIGRE 3791. All repair activities would be undertaken within the draft Order Limits and the effects of each cable repair is assumed to be the following:
  - Repair to 500 m length of each cable (i.e. two power cables and the fibre optic cable);
  - Cables would be re-buried; and
  - Cable removal and re-burial footprints would not overlap (as a worst case, as in reality they may occur within overlapping areas).

3.23.A.18 Risk Assessment

3.23.A.18.1 A risk matrix approach has been used to undertake the risk assessment. This has been adapted from the guidance, which examined the frequency and consequence of a hazard to determine the combined inherent risk. Risk ratings have been calculated using **Table 3.23.A-5**, which can be interpreted using **Table 3.23.A-6**. The exercise has been repeated with compliance mitigation and industry best practice measures which result in a residual risk enabling the hazards to be reduced to ALARP. No hazards more than a major risk are present as identified in the risk assessment post-mitigation.

Vessel Collisions

3.23.A.18.2 Existing vessels may have to re-route around project vessels which may create pinch points and alter the rate of encounters. Therefore, there is the potential for vessel-to-vessel collisions to occur as a result from existing shipping avoiding the marine operations, particularly across shipping lanes, near fishing grounds and at the Anderby Creek Landfall.

3.23.A.18.3 Vessels would be operating in compliance with international shipping standards; therefore, vessel master's would be competent and adept at navigating in unfamiliar waters.

3.23.A.18.4 The likelihood of a vessel to vessel collision is remote, but the consequence could be Catastrophic, with a resultant Major risk level.

3.23.A.18.5 The likely frequency of vessel collisions increases to Probable for Jointing Operations due to higher likelihood of vessels being stationary in one location for several days at a time, leading to an Intolerable inherent risk rating prior to mitigation.

Reduced Visibility / Adverse Weather Conditions

3.23.A.18.6 A long-range weather forecast is usually monitored hourly when conducting marine operations which mitigates the risk of encountering any adverse or extreme weather conditions. However, reduced visibility may occur in the event of extreme weather conditions, which can be unpredictable in the North Sea. This could mean that project vessels may need to shelter in port or in designated adverse weather shelters if weather exceeds working limitations. However, during the cable lay process, this could mean cutting and buoying the cable in a situation that is too dangerous to continue working.

3.23.A.18.7 The probability of project vessels encountering extreme weather is Very Probable, but the consequence is likely to be Significant, with a resultant Moderate risk level.

Project Vessels Blocking Navigational Features

3.23.A.18.8 The probability of project vessels blocking navigational features, such as anchorages or approaches to ports, is expected to be Very Probable, and the consequence could be Significant for vessel displacement for most operations, with a resultant Moderate risk level.

3.23.A.18.9 There is a high risk of project vessels blocking navigational features during construction nearshore, causing the potential displacement of vessels. The English Offshore Scheme intercepts with areas of high shipping activity, as well as anchorage points, which further increases the likelihood in Lincolnshire. Therefore, the frequency has been determined as Frequent during construction.

3.23.A.18.10 Furthermore, for Cable Lay & Burial, the temporal displacement of vessels rises to Severe due to close proximity to multiple shipping lanes nearshore, leading to a Major risk rating as a worse case.

3.23.A.18.11 During jointing operations, it has been considered that joints would be located offshore and therefore are less likely to block navigational features. This has led to a frequency of Probable being determined for jointing.

Disturbance to Existing Shipping and Fishing Patterns

3.23.A.18.12 During construction, the risk of disturbance to existing shipping and fishing patterns is the highest. As a result of project vessel presence, other vessels may have to re-route around or reduce speed on approach to the Project vessels, having the potential for temporary disturbance.

3.23.A.18.13 Considering this, the probability is expected to be Frequent, with a consequence that could be Severe for Cable Lay & Burial and External Protection due to close proximity to multiple shipping lanes nearshore, with a resultant Intolerable inherent risk level.

Accidental Anchor Strike or Drag

3.23.A.18.14 Risk of anchor strike is lowest in the construction phase of the Project, however, there is a small risk of emergency anchoring of project vessels, which has been determined to be Remote for Cable Lay and Burial.

3.23.A.18.15 The risk of accidental anchor strike or drag over surface-laid/exposed cable is highest in the operational phase, as cable exposures may have occurred due to mobile sediment/scour. In addition, vessel anchors would have the potential to interact with the English Offshore Scheme if deployed where the cable is surface laid. However, it is very unlikely that an anchor would be deployed offshore in deeper waters and away from designated anchorage areas. The probability of an anchor deployment on a surface laid cable has been determined to be Probable but remains a low probability in the event of an emergency or accidental deployment of an anchor.

3.23.A.18.16 Furthermore, the risk of anchor strike/drag on the cable is relatively low throughout the majority of the Project, considering that the Project would enter into crossing agreements and/or proximity agreements with third-party asset owners.

3.23.A.18.17 As a result, the probability of a ships anchor interacting with the operational cables are Probable, but the consequence could be Severe, with a resultant Moderate risk level.

Accidental Fishing Gear Snagging

3.23.A.18.18 Fishing vessel gear would have the potential to interact with the English Offshore Scheme for brief periods during construction before protection is installed or when the cable is surface laid prior to burial. Once established, appropriate mitigation is needed to ensure the cable is suitably protected against fishing and anchoring in the area. While it is advised in The Mariners Handbook and as per European Subsea Cables Association (ESCA) standard industry guidelines that fishing should be avoided across subsea cables, it is assumed that fishing may occur across the cable once installed.

3.23.A.18.19 During the installation phase, there would be a designated Fisheries Liaison Officer (FLO). With these services in place, there would be a FLO monitoring body present during the installation process. The Project FLO can disseminate information to the guard vessels (if employed) regarding seasonal variations in fishing patterns. This leads to a frequency of Remote for Cable Lay and Burial.

3.23.A.18.20 The probability of a fishing gear interacting with the operational cables is Probable, but the consequence could be Serious, with a resultant Moderate risk level.

Reduction in Under-keel Clearance

3.23.A.18.21 The risk of reduction in under-keel clearance is highest during the operational phase due to the presence of cable protection measures that reduce the navigable water depth for vessels. However, the operational cables are predominantly located in waters deep enough for this not to be in effect.

3.23.A.18.22 The shallowest section where cable protection measures would be deployed is in the nearshore area on approach to the Anderby Creek Landfall. The proposed crossings rock berm height would be a maximum of 1.5 m above the seabed, and there are at least 28 crossings located in less than 30 m water depth which could therefore lead to a water depth reduction of more than 5% (compared to chart datum). The shallowest crossing is located at 8.6 m water depth (Viking Link). This would lead to a reduction in water depth of 17.4%, which is considered by the MCA to have the potential to impact navigation. The MCA recommend that any reduction in water depth greater than 5% of chart datum has the potential to impact navigation.

3.23.A.18.23 The vessels operating in the shallowest area are typically restricted to high-speed craft (recreational vessels), which have a small draft as standard due to the smaller vessel size and are therefore unlikely to be impacted by any reductions in water depth at the crossing locations. There is an area of peak tanker activity in the nearshore area, with vessel hours peaking at a level between 75-100 hours per year within the draft Order Limits boundary. The closest crossing to the area of increased activity is located approximately 650 m away from the edge of the activity area. The nearshore crossing locations are planned directly west of an area to be avoided (which contains multiple wrecks), and so therefore it is considered unlikely that any large vessels would be transiting close to the western half of the English Offshore Scheme. However, the eastern side of the English Offshore Scheme may be impacted by the reduction in vessel clearance due to the level of tanker activity in the region – the larger drafts of these vessels could prevent them from transiting over the crossings based on the rock berm design.

3.23.A.18.24 The probability of a reduction in under-keel clearance affecting shipping and navigation over the operational cable is Very Probable, and the consequence could be Severe with a resultant Moderate risk.

Interference with Marine Navigation Equipment

3.23.A.18.25 Emissions of EMF have the potential to cause deviations of magnetic compasses and interference with inertial navigation. Considering inertial navigation, craft using international navigations systems (INS) and global positioning systems (GPS) are not expected to be greatly affected by EMF emanating from the operational cable, since these systems have negligible sensitivity to EMF. This is owing to marine gyrocompasses (used in INS) remaining unaffected by external magnetic fields as modern INS equipment generally uses laser technology and resonating quartz devices which are self-contained. Affected INS equipment is more likely to be present on older recreational and leisure vessels.

3.23.A.18.26 However, the EMFs that would be generated from the English Offshore Scheme may have a small, localised effect that could cause compass deviations in vessels using magnetic compasses. The degree of deviation can depend on multiple factors, such as the proximity of marine cables to each other, and water depth. However, any compass deviation as a result of EMF emanation from the English Offshore Scheme is expected to have minor consequences.

3.23.A.18.27 The EMF study (**Volume 2, Part 1, Appendix 1.4.A EMF Assessment)** indicates that over 99.5% of the English Offshore Scheme resulted in compass deviations of less than 3 degrees; small sections exceeding this are located in shallow waters, where water depth is below 3 m. 99.7% of the English Offshore Scheme are within the threshold for less than 5 degree compass deviation. Subsequently, very low compass deviation is expected to occur over the cables. 0.5% of the route outside the deviation threshold has been used as the basis of the frequency of the compass deviation risk rating. This leads to a negligible risk classification for compass deviation.

3.23.A.18.28 MCA guidance for compass deviation is that there must be no more than a 3 degree electromagnetic variation for 95% of the cable route and for the remaining 5% of the cable route there must be no more than a 5 degree electromagnetic variation in water depths of 5 m and deeper. The calculations provided indicate that this guidance is met.

3.23.A.19 Risk control to ALARP

3.23.A.19.1 Risks that have been assessed as Major or above after considering mitigation would normally require additional analysis and consultation to discuss and possibly further mitigate hazards where possible. Where further mitigation is not possible a residual hazard may remain.

3.23.A.19.2 Short-hand identifiers have been assigned to each mitigation and referred to in the shipping and navigation risk matrix.

Environmental measures

3.23.A.19.3 **Table 3.23.A-10** contains a list of the identified environmental mitigations relating to shipping & navigation, which have been established to improve identified impacts in the PEIR. Environmental mitigations have been applied to reduce the risks to ALARP to determine residual risk ratings post-mitigation.

3.23.A.19.4 Several management plans would be provided as Outline Management Plans with the DCO application to support the Deemed Marine Licences. These would include an Outline Construction Fisheries Liaison and Coexistence Plan (FLCP), an Outline Construction Environmental Management Plan (CEMP) and Outline Marine Pollution Contingency Plan (MPCP). These documents would outline measures to be implemented to comply with legislation (e.g., in relation to the prevention of oil and chemical spills) during all phases of the English Offshore Scheme. These management plans would also include details of notices to be sent to other marine users (including fishers) prior to activities being undertaken. Final management plans would be submitted in accordance with the deemed Marine Licenses (dMLs) to discharge the licence conditions. The environmental measures listed below would be secured and circulated to the Contractors through these management plans.

Table 3.23.A-10 - Environmental measures list

Reference	Short-hand	Environmental Measures (EM)
CF01	FLO	A Fisheries Liaison Officer (FLO) and fisheries working group(s) would be maintained throughout installation to ensure project information is effectively disseminated, dialogue is maintained with the commercial fishing industry and access to home ports is maintained during the main fishing season. Details of the FLO would the included in the Construction Fisheries Liaison and Coexistence Plan
CF04	Fishers Coexistence	A procedure for the claim of loss of/or damage to fishing gear would be developed and details included in the Construction Fisheries Liaison and Coexistence Plan
OMT03	Burial	The intention is to bury the cables in the seabed, except in areas where trenching is not possible e.g. where ground conditions do not allow burial or at infrastructure crossings.
OMT04	Cable Protected as Needed	Cable protection would only be installed where considered necessary for the safe operation of the English Offshore Scheme. This includes the repair of cables due to accidental damage, where depth of lowering is not achieved and at infrastructure crossings.
OMT06	Bundling	HVDC poles would be bundled to minimise the effects of EMF.
OMT07	As-laid Co-ordinates	As-built locations of cable and external protection would be supplied to UKHO (Admiralty), The Crown Estate and Kingfisher (KIS-ORCA)
OMT08	Pollution Plans	An offshore Construction Environmental Management Plan (CEMP) including an Emergency Spill Response Plan and Waste Management Plan, Marine Pollution Contingency Plan (MPCP), Shipboard Oil Pollution Emergency Plan (SOPEP) and a dropped objects procedure would be produced prior to installation.
OMT09	Pollution Regs	All project vessels must comply with the International Regulations for Preventing Collisions at Sea (1972), regulations relating to International Convention for the Prevention of Pollution from Ships (the MARPOL Convention 73/78) with the aim of preventing and minimising pollution from ships and the International Convention for the Safety of Life at Sea (SOLAS, 1974).
OMT12	Designated Anchoring	Designated (and as minimal as possible) anchoring areas and protocols shall be employed during marine operations to minimise physical disturbance of the seabed
OSU01	Contractor Procedures	Procedures would be in place to minimise disruption near high density shipping areas. e.g. avoidance of anchoring near busy areas, passage planning of installation vessels, emergency response plan etc.
OSU02	Effective Communication	Channels of communication would be established and maintained between the English Offshore Scheme, commercial fishing interests and relevant Port Authorities.

Reference	Short-hand	Environmental Measures (EM)
OSU05	SIMOPs	Coordination of SIMOPs with other developers and marine activities to be undertaken prior to commencement.
OSU06	COLREGs	Project vessels would comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) as amended, particularly with respect to the display of lights, shapes and signals. The masters of other vessels are expected to be familiar with and comply with the COLREGs.
OSU07	Pilotage	Pilotage within Port Authority Limits as required by the Port Authority
OSU09	Joints	Cable jointing operations to be planned away from high shipping activity where possible
OSU11	Charts	Cables would be marked on Admiralty Charts and fisherman's awareness charts (paper and electronic format).
OSU13	Early Consultation	Timely and efficient communication would be given to sea users in the area via Notices to Mariners (NtM), Kingfisher Bulletins, Radio Navigation Warnings Navigational Telex (NAVTEX and Navigational Areas (NAVAREA) warnings and /or broadcast warnings.
OSU14	Visibility	All Project vessels would display appropriate marks and lights and would always broadcast their status on AIS if appropriate.
OSU16	Guard Vessels	Guard vessel(s), using RADAR with Automatic RADAR Plotting Aid (ARPA) to monitor vessel activity and predict possible interactions, would be employed to work alongside the installation vessel(s) during cable installation works and to protect any temporary cable exposures during installation.
OSU10	CBRA	Cable Burial Risk Assessment (CBRA) to be undertaken to identify appropriate target depth of burial based on geology, water depths and AIS data. This would reduce the chance of interaction with other marine users, and as per the CBRA recommendations deeper burial or cover would be implemented in areas of high shipping activity to further reduce this risk.
OSU17	Advisory Safety Zone	For safety purposes, all vessels would be requested to maintain a minimum distance from construction vessels to prevent interactions.
OSU15	Aids	If required, temporary aids to navigation would be used to guide vessels around areas of installation activity.
OSU12	Crossing Agreements	Crossing and/or proximity agreements would be agreed with aggregate extraction, cable and pipeline owners. The crossing agreement describes the rights and responsibilities of the parties and also the design of the crossing. Crossing design would be in line with industry standards, using procedures and techniques agreed with the cable and pipeline owners.
OSU18	Crossing Compliance	Client Representation onboard Project vessels ensuring compliance with crossing design and communications with Asset Owners.

Reference	Short-hand	Environmental Measures (EM)
OSU03	Humber 7DLA	7 day look-ahead (7DLA) for ABP Humber to inform the port of planned project vessel movements

Project-specific measures

3.23.A.19.5 Based on stakeholder consultation and Project discussions, the following project-specific measures have been established in **Table 3.23.A-11.**

Table 3.23.A-11 - Project-specific measures list

Short-hand	Project-specific (PS) measures:
Weather Shelter	Designated adverse weather shelter areas (would recommend to be further than 500 m from installation) - to be determined with the Contractor.

Residual risk

3.23.A.19.6 Where further mitigation is not possible, a residual hazard may remain. However, all impacts were assessed to be no more than a moderate risk. Following the implementation of environmental measures, any residual impacts can be considered as ALARP. **Therefore, no intolerable residual risks for navigation and shipping remain.**

3.23.A.19.7 It is noted that the risk to under-keel clearance is Moderate and there is the potential for additional mitigation to be applied to minimise the reduction of under-keel clearance, such as a study regarding vessel usage over each crossing location once exact final rock berms have been finalised for each crossing.

3.23.A.19.8 As the EGL 3 Project and EGL 4 Project are still in development, it is necessary that flexibility in the NRA is retained and that this would be developed as the Projects progress. Updates based on further stakeholder consultation and the latest reports and technical memos (e.g. rock protection, EMF effects) would be reflected in the NRA where appropriate. The risk ratings and mitigation measures would be re-assessed upon availability of this information.

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Annex A Risk rating matrix

Risk Assessment: Operation	Hazard	Inherent Risk											Mitigation	Residual Risk											Comments
		Frequency	Consequence					Risk Rating						Frequency	Consequence					Risk Rating					
			Effect on Human Safety	Effect on Vessel(s) / Property	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects	Effect on Human Safety	Effect on Vessel(s)	Displacement of Vessel(s)	Business/ Reputational Impacts	Environmental Impacts			Effect on Human Safety	Effect on Vessel(s)	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects	Effect on Human Safety	Effect on Vessel(s)	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects	
UXO Survey (Target Investigation)	Disturbance to existing shipping patterns & fishing	5	1	1	2	3	1	5	5	10	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter	3	1	1	2	3	1	3	3	6	9	3	
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	5	1	1	2	3	1	5	5	10	15	5		4	1	1	2	3	1	4	4	8	12	4	
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
Pre- and Post-Lay Survey	Disturbance to existing shipping patterns & fishing	5	1	1	2	3	1	5	5	10	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter	3	1	1	2	3	1	3	3	6	9	3	
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	4	1	1	2	3	1	4	4	8	12	4		3	1	1	2	3	1	3	3	6	9	3	
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
Route Clearance & Preparation of third-party asset crossings (PLGR, Boulder Clearance, Sandwave Pre-Sweeping, OOS removal)	Disturbance to existing shipping patterns & fishing	5	1	1	2	3	1	5	5	10	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter, Burial, Cable Protected As Needed	4	1	1	2	3	1	4	4	8	12	4	
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	5	1	1	2	3	1	5	5	10	15	5		4	1	1	2	3	1	4	4	8	12	4	
	Snagging of static fishing gear on seabed	4	2	2	4	3	2	8	8	16	12	8		3	2	2	4	2	2	6	6	12	6	6	
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
Cable Lay and Burial	Disturbance to existing shipping patterns & fishing	5	1	1	3	3	1	5	5	15	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter	4	1	1	3	3	1	4	4	12	12	4	
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	5	1	1	3	3	1	5	5	15	15	5		4	1	1	3	3	1	4	4	12	12	4	
	Accidental anchor strike or drag on cable	1	3	3	2	4	1	3	3	2	4	1		1	3	3	2	4	1	3	3	2	4	1	Small risk of emergency anchoring of project vessels
	Accidental snagging of fishing gear on cable	2	4	4	2	4	1	8	8	4	8	2		1	4	4	2	4	1	4	4	2	4	1	Maintain fishing clearance until after post-lay surveys (co-ordinated via FLO). Guard vessels assumed to be present
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
HDD punch out and Cable Pull (Trenchless Construction)	Disturbance to existing shipping patterns & fishing	5	1	1	2	3	1	5	5	10	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter	4	1	1	3	3	1	4	4	12	12	4	
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	5	1	1	2	3	1	5	5	10	15	5		4	1	1	3	3	1	4	4	12	12	4	
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	

Risk Assessment: Operation	Hazard	Inherent Risk											Mitigation	Residual Risk											Comments
		Frequency	Consequence					Risk Rating						Frequency	Consequence					Risk Rating					
			Effect on Human Safety	Effect on Vessel(s) / Property	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects	Effect on Human Safety	Effect on Vessel(s)	Displacement of Vessel(s)	Business/ Reputational Impacts	Environmental Impacts			Effect on Human Safety	Effect on Vessel(s)	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects	Effect on Human Safety	Effect on Vessel(s)	Displacement of Vessel(s)	Business/ Reputational Effects	Environmental Effects	
Jointing Operations	Disturbance to existing shipping patterns & fishing	5	1	1	2	3	1	5	5	10	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter, Jointing	4	1	1	2	3	1	4	4	8	12	4	Joints will be located away from high shipping traffic, which decreases the likelihood.
	Vessel collision	3	5	5	N/A	5	5	15	15	N/A	15	15		1	5	5	N/A	5	5	5	5	N/A	5	5	Vessel collision could be higher as stationary in one location for several days but with the correct mitigation has been assessed as low. Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	3	1	1	2	3	1	3	3	6	9	3		2	1	1	3	3	1	2	2	6	6	2	Vessels will be mainly offshore and therefore not blocking navigation features.
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
External Protection (third-party crossings & remedial rock) Operations	Disturbance to existing shipping patterns & fishing	5	1	1	3	3	1	5	5	15	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter, Burial, Cable Protected As Needed, Crossing Agreements, Crossing Compliance	4	1	1	3	3	1	4	4	12	12	4	
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	4	1	1	2	3	1	4	4	8	12	4		3	1	1	3	3	1	3	3	9	9	3	
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
Operation & Maintenance Surveys	Disturbance to existing shipping patterns & fishing	5	1	1	2	3	1	5	5	10	15	5	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter	3	1	1	2	3	1	3	3	6	9	3	Periodic inspections every 5-8 years.
	Vessel collision	2	5	5	N/A	5	5	10	10	N/A	10	10		1	5	5	N/A	5	5	5	5	N/A	5	5	Cannot assess vessel displacement if collision has occurred. Cannot quantify costs of vessel collisions for each vessel type.
	Project vessels blocking navigational features	4	1	1	2	3	1	4	4	8	12	4		3	1	1	2	3	1	3	3	6	9	3	
	Reduced visibility / Adverse weather conditions	4	2	2	2	2	1	8	8	8	8	4		3	2	2	2	2	1	6	6	6	6	3	
In-Service Cable	Accidental snagging of fishing gear on cable	3	4	4	2	5	1	12	12	6	15	3	FLO, Fishers Coexistance, As-laid Co-ordinates, Pollution Plans, Pollution Regs, Designated Anchoring, Contractor Procedures, Effective Communication, SIMOPs, COLREGs, Pilotage, Charts, Early Consultation, Visibility, Advisory Safety Zone, Aids, Humber 7DLA, Weather Shelter, Burial, Cable Protected As Needed, Crossing Agreements, Crossing Compliance, CBRA, Bundling	1	4	4	2	5	1	4	4	2	5	1	Maintain fishing clearance until after post-lay surveys (co-ordinated via FLO). Guard vessels assumed to be present
	Accidental anchor strike or drag on cable	3	3	3	2	5	1	9	9	6	15	3		1	3	3	2	5	1	3	3	2	5	1	
	Reduction in under-keel clearance	4	1	1	1	2	1	4	4	4	8	4		3	1	1	1	2	1	3	3	3	6	3	Water depth assessed as navigable at all crossings. Concrete mattressing used if 5% depth change caused by rock bags and assessed once positions are known. Frequency has been increased due to rock protection being required in nearshore area.
	Interference with Marine Navigational Equipment	2	1	1	1	1	1	2	2	2	2	2		2	1	1	1	1	1	2	2	2	2	2	Frequency based on 0.5% of the routes being affected by <3º compass deviation and recreational & leisure vessel tracklines in nearshore area. No additional mitigation measures suggested.

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