SCOTTISH HYDRO ELECTRIC POWER DISTRIBUTION PLC.

Pentland Firth

Navigational Risk Assessment

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GLOSSARY

AIS
Automatic Identification System

ALARP
As Low As Reasonably Practicable

BP
Best Practice

CD
Chart Datum

CLV
Cable Lay Vessel

COLREGs
Collision Regulations

COMP
Compliance

DP
Dynamic Positioning

FLMAP
Fishing Liaison Mitigation Action Plan

FLO
Fishing Liaison Officer

KP
Kilometre Point

MAIB
Marine Accident Investigation Branch

MCA
Maritime and Coastguard Agency

MSI
Maritime Safety Information

NM
Nautical Miles

NTM
Notice To Mariners

NRA
Navigational Risk Assessment

OOS
Out of Service

PLGR
Pre-Lay Grapnel Runs

RLNI
Royal Lifeboat National Institution

RYA
Royal Yachting Association

SSEN
Scottish and Southern Electricity Networks

SHEPD
Scottish Hydro Electric Power Distribution plc

SOLAS
Safety Of Life At Sea

UKHO
United Kingdom Hydrographic Office

VMS
Vessel Monitoring System

vhpm
Vessel Hours Per Month

1. SHIPPING AND NAVIGATION

1.1 Introduction

1.1.1 Aim of this Section

This section identifies the potential risk to shipping and navigation arising from cable activities associated with installation of the replacement cable, decommissioning of the offshore (where required) and nearshore sections of the existing cable and the presence of the replacement cable during its operational lifespan.

Where relevant, any limitations related to the baseline conditions, data sources or scientific understanding / interpretation within the process of assessing the effects have been highlighted.

1.1.2 Data sources

Automatic Identification System (AIS) data from EMODnet covering 2021 have been used in this section. 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, 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; all passenger vessels irrespective of size and fishing vessels greater than 15 m. In recent years, AIS has increasingly been installed by other maritime users on smaller craft, including yachts, fishing vessels, and pleasure craft, making it a robust and reliable indicator of marine traffic.

Baseline conditions for shipping and navigation have been established by undertaking a desktop review of published information and available reports for the project in relation to shipping, fishing and navigation. The data sources used to inform the baseline description and assessment include the following:

- AIS data. EMODNET (2021);
- Admiralty charts, http://wmsgateway.findmaps. co.uk/wms/IntertecMetocCharts? (internally held Web Map Service connection);
- Royal Yachting Association (RYA) Data for 2020;
- Marine Mammal Observation (MMO) fishing data, 2019;
- Marine Traffic, www.marinetraffic.com;
- Royal National Lifeboat Institution incidents 2008 to 2022. https://data-rnli.opendata.arcgis.com/datasets/rnli-returns-of-service?geometry=-46.917%2C50.370%2C36.711%2C59.196;
- Marine Accident Investigation Branch (MAIB) annual reports 2017 to 2021. https://www.gov.uk/governmentcollections/maib-annual-reports.

Additional review of the following reports has also informed this NRA:

- AECOM Pentland Firth East Submarine Cable Replacement: Navigational Risk Assessment Report Kirkwall (60591722-REP-03), 2019;
- Cathie Pentland Firth East (2) Cable Replacement CBRA (C1172R01, issue 03), 2020.

1.1.3 Summary of Stakeholder Consultation

The project has been discussed in general terms at recent meetings with the following navigation related stakeholders:

- Orkney Harbours (Orkney Islands Council);
- MCA;
- Scottish Fishermen's Federation;
- Orkney Fishermen's Association; and
- Northern Lighthouse Board.

On 19th February 2019, there was a Navigation Risk Assessment workshop facilitated by AECOM as part of the AECOM NRA report (2019) where 23 hazards were identified and discussed. This was attended by Orkney Fisheries, Orkney Council, Orkney Ferries, Northlink Ferries and SSE.

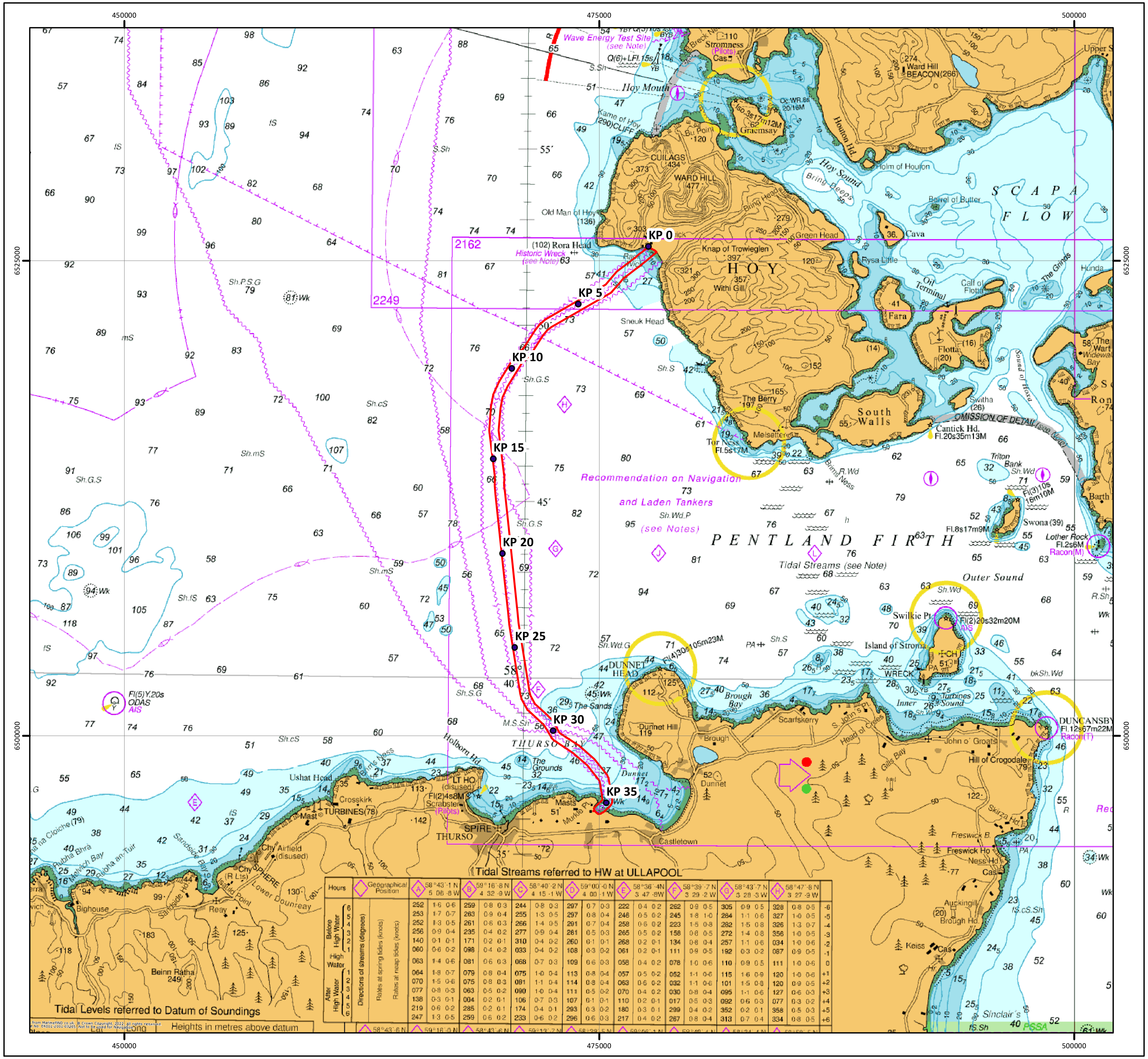
There have been no specific mitigation measures discussed, although the licence application for the new route will be the same corridor as the previously installed cable.

1.1.4 Study Area

This section covers the marine components of the cable installation works through the Pentland Firth Strait. The study area has been defined as 10 km either side of the proposed Application Corridor.

Kilometre points (KPs) have been assigned to the route using the Rackwick Bay landfall on Hoy as KP0, up to the Murkle Bay landfall on Scottish mainland as KP35 and are shown in Figure 1-1 (Ref: P2577-LOC-004).

All AIS data and navigational features dataset presented in this report are limited to the area of the assessment, hereby known as the Study Area.



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PENTLAND FIRTH EAST (3) CABLE REPLACEMENT

LOCATION OVERVIEW
Cable Route Corridor

Drawing No: P2577-LOC-004 | **A**

Legend

- KP
- Installation Corridor

NOTE: Not to be used for Navigation

Date	18 November 2022
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineFind; ESRI; SSE
File Reference	J:\P2577\MXD_QGZ\01_LOC\ P2577-LOC-004.mxd
Created By	Alice Gymer
Reviewed By	Irinios Yiannoukos
Approved By	Andrew Page

0 3 6 9 12 km

1.2 Guidance Methodology

The Navigation Risk Assessment (NRA) methodology used in this section differs slightly from a significance assessment and 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

Whilst not necessarily directly applicable to marine cable projects, consideration to linear cables in relation to offshore renewable structures has been considered using:

- Maritime and Coastguard Agency (MCA) MGN 543 (Merchant and Fishing) Safety of Navigation Offshore Renewable Energy Installations (OREIs) – Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA 2016) and industry best-practice;
- Marine Guidance Note "Offshore Renewable Energy Installations (OREIs) - Guidance to Mariners operating in the vicinity of UK OREIs"; and
- Methodology for Assessing the Marine Navigational Safety Risks & Emergency Response of Offshore Renewable Energy Installations.

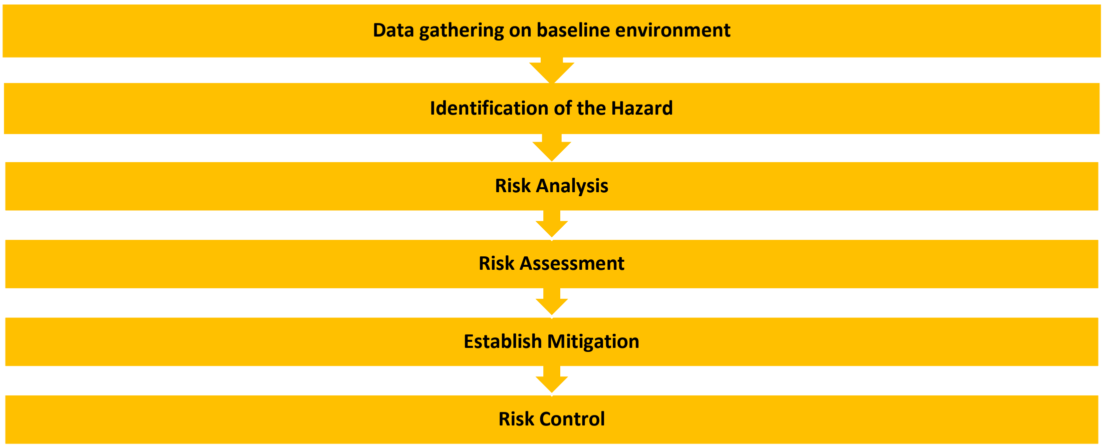
Where applicable, further consideration has been given to:

- Port Marine Safety Code (PMSC) (Dept. for Transport & Maritime and Coastguard Agency Nov 2016); and
- Guide to Good Practice on Port Marine Operations (GtGP) (Dept. for Transport & Maritime and Coastguard Agency Feb 2018).

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).

The assessment process involves the following main steps presented in Figure 1-2.

Figure 1-2 Assessment Steps



For the purposes of this document the definition of "Hazard", "Risk" and "Maximum Displacement" are detailed below.

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

- **Maximum Displacement** – defined as the maximum number of vessels affected and duration of displacement during the installation operations, as a result of the installation operations.

The steps presented in Figure 1-2 are described in more detail below.

1.2.2 Data gathering on baseline environment

To assess the potential effects resulting from the operation, it is necessary to establish the current shipping conditions and features that exist along and near the Proposed Development. A 10 km buffer has been applied around the Project to ensure that all shipping patterns and navigational features are captured.

The analysis has included:

- Potential accidents resulting from navigation activities – Marine Accident Investigation Branch (MIAB) & Royal Lifeboat National Institution (RLNI);
- Navigation activities affected by the Proposed Development;
- Project structures that could affect navigation activities, such as external protection installed on the seabed;
- Project phases that could affect navigation activities;
- Other structures and features that could affect navigation activities;
- Vessel types involved in navigation activities;
- Conditions affecting navigation activities;
- Human actions related to navigation activities for use in hazard identification (if possible).

1.2.3 EMODnet dataset grouping

The EMODnet vessel density maps have been created from Automatic Identification System (AIS) data, collected by coastal stations and satellites. They provide the total ship presence time for 14 individual ship categories (as given in Table 1-1) for every month of 2021 on a 1 km grid that follows the EEA / Inspire standards.

Table 1-1 EMODnet Ship Category Descriptions

EMODnet Ship Category	AIS Ship Type Description
Other	Wing in ground (WIG), Other, Spare, Diving Ops, Reserved
Fishing	Fishing
Service	Pilot vessel, Search and Rescue vessel, Port Tender, Anti-pollution equipment, Medical Transport
Dredging or underwater operations	Dredging or underwater ops
Sailing	Sailing
Pleasure craft	Pleasure craft Category A to B
High-speed craft	High-speed craft
Tug and towing	Towing, Tug
Passenger	Passenger Category A to B
Cargo	Cargo Category A to B
Tanker	Tanker Category A to B
Military and law enforcement	Military ops, Law Enforcement
Unknown	Unknown

Source: EMODnet (2021)

The ship category 'unknown' does not have relevant details in the raw AIS data and, therefore, cannot be assigned to a relevant category.

1.2.4 RNLI dataset grouping

RNLI incident callout data documents marine incidents between 2008 and 2020. For this assessment, the assigned classifications have been further grouped so the data can be visualised and assessed clearly. Table 1-2 details the applied grouping.

Table 1-2 Applied Grouping of RNLI Data

RNLI Data Classification	Intertek Grouping for Assessment
Vessel abandoned derelict or adrift	Abandoned Vessel
Vessel abandoned, derelict or adrift	
Capsize	Capsize
Collision	Collision
Collision with object on surface	
Collision with other craft	
Collision with rocks	
Collision with submerged object	
Criminal activity	
Hit by craft	
Equipment failure	Equipment failure
Fire	Fire on board vessel
Fire / Explosion	
Fouled propeller / impeller	Fouled Propeller

RNLI Data Classification	Intertek Grouping for Assessment
Leaks / Swamping	Leak & Swamping
Machinery failure	Machinery failure
Man overboard	Man overboard
Adverse conditions	MetOcean Conditions
Blown / Swept out to sea	
Currents	
Cut off by tide	
Flooding	
High winds	
In danger of being carried away by tide	
In danger of drowning	
Overcome by crashing waves	
Rip current	
Stranded	
Stranding / Grounding	
Stranding or grounding	
Stuck in mud	
Sudden wave	
Swamping	
Aircraft crashed	Other
Aircraft thought to be in trouble	
Ambulance or doctor call	
Animal in trouble	
Attempting recovery of item	
Attempting rescue of a casualty	
Attempting rescue of an animal	
Attempting to evade police	
Cause (other)	
Marine Debris or Object	
Medical condition	
Missing or overdue	
Motor vehicle in the sea	
No service	
Open channel VHF	
Other	
Risk taking behaviour	
Safety Cover	
Signal blocking VHF channel	
Slippery or uneven surface	

RNLI Data Classification	Intertek Grouping for Assessment
Sporting injury	
Stepped to edge e.g. to take photo or look at the scene	
Thought to be in trouble	
Trapped in motor vehicle	
Unexploded bomb / mine	
Unknown	
Unsure of position (lost)	
Cliff collapsed	Personal Incident
Dementia senility or other similar condition	
Disability	
Exhaustion / fatigue / cold	
Fear of drowning	
Fell from height on craft (e.g. rigging or mast)	
Footing gave way	
Human error	
Ill crewman on vessel	
Illness	
Injured	
Person ill	
Person in distress	
Person Injured	
Person missing	
Person on shoreline in difficulty	
Person recovery	
Person to be taken ashore	
Person to be taken ashore from a vessel	
Fishing gear snagged on underwater obstruction	Snagging
Steering failure	Steering Failure
Cargo shifted	Vessel Distress
Gas leak	
Out of fuel	
Sail failure / dismasting	
Vessel overdue	
Vessel thought to be in trouble	
Vessel unsure of position	
Vessel dragging anchor	Vessel Dragging Anchor
Sinking / Sunk	Vessel Sinking or Sunk
Darkness or poor visibility	Visibility

1.2.5 Identification of the hazard

The hazard identification phase seeks to build on the work of the data gathering and identify known hazards expected to be encountered as a result of the marine operations and presence of project vessels.

The hazards have been identified in relation to where the Project may make it more likely that existing vessels will deviate from the Collision Regulations (COLREGs), either as an intended or unintended action.

This may include any effects which the Project might have on existing vessels such as vessels giving appropriate clearance to cable operations when undertaking cable installation and obstruction to the light and sound signals made by vessels and navigational aids in particular circumstances.

The approach used for hazard identification comprises a combination of both creative and analytical techniques, the aim being to identify all relevant hazards. Where relevant, consultation has been undertaken with stakeholders to help to identify hazards. The creative element is to ensure that the process is proactive and not confined only to hazards that have materialized in the past.

1.2.6 Risk analysis

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 assesses their impact on navigational safety.

Risk is the combination of frequency and consequence which are defined in Table 1-3 and Table 1-4. The definitions below have been developed using the IMO guidelines which includes effects on human safety and ships, however, this assessment also focuses on displacement of existing vessels and this is the most likely consequence of the proposed development.

Table 1-3 Frequency of a hazard

Value	Description	Definition
1	Extremely Remote	Likely to occur once in the lifetime of the project (25 years)
2	Remote	Likely to occur once per year
3	Probable	Likely to occur once per month
4	Very Probable	Likely to occur once per week
5	Frequent	Likely to occur once per day

Table 1-4 Consequence of a hazard

Value	Description	Definition		
		Effects on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
1	Minor	Single or minor injuries	Single local equipment damage	Temporal displacement of vessel (hours)
2	Significant	Multiple minor injuries	Multiple local equipment damage	Temporal displacement of vessel (days)
3	Severe	Multiple or severe injuries	Non-severe ship and equipment damage	Temporal displacement of vessel (weeks)
4	Serious	Single fatality or multiple severe injuries	Severe damage to ship and equipment	Temporal displacement of vessel (months)
5	Catastrophic	Multiple fatalities	Total loss of ship and equipment	Permanent displacement of vessels

Risk prioritisation is an important part of the process, the greater the potential of a hazard, the greater the need to ensure that there are mitigation measures in place to control the risk.

1.2.7 Risk assessment

IMO Guidelines above 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 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.

Having established the frequency and consequence of the hazard, a risk assessment has been carried out using a risk matrix, adapted from the guidance above, presented in Table 1-5.

Table 1-5 Risk Matrix

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

At the low end of the scale, frequency is extremely remote and consequence minor; risk can be said to be negligible. At the high end, where hazards are defined as frequent and the consequence catastrophic, then risk is intolerable.

The result of using this matrix approach is to ensure that the level of risk is reduced to ALARP for the effects that the Project has on the baseline shipping environment. This is undertaken prior to any mitigation. Best Practice and Project Specific Mitigation will then be applied to generally reduces the effects to ALARP.

Definitions of the risk levels are provided in Table 1-6 below.

Table 1-6 Definitions of risk levels with respect to vessel displacement

Score	Classification	Definition
1-2	Negligible	A hazard which causes noticeable changes in the navigation environment but without effecting its sensitivities. Generally considered as insignificant.
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.
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 As Low As Reasonably Practicable (ALARP) and that no further measures are feasible.
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.
15-25	Intolerable	Regarded as unacceptable prior to any mitigation measures being considered.

1.2.8 Establish mitigation

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

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 will allow recommendations to be made to enhance safety.

Mitigation measures are the actions or systems proposed to manage or reduce the potential negative 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.

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 routing 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.

- Offset: If the hazard can neither be avoided nor reduced, mitigation should seek to offset the hazard through the implementation of compensatory mitigation.

Mitigation measures fall into two categories: mitigation which forms part of the Project design which are referred to as Best Practice (BP) Mitigation; and mitigation which is part of the construction of the Proposed Development, which is referred to as Project Specific Mitigation.

1.2.9 Risk control

The aim of assessing the Project operations on the existing shipping baseline is to reduce risk As Low As Reasonably Practicable (ALARP).

The risk assessment is repeated taking into consideration the application of Best Practice and Project Specific Mitigation. 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.

Risks that have been assessed as **Major** or above after considering mitigation will 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.

1.3 Marine Campaign Works

The Project Description is provided in Appendix A of the Environmental Supporting Information and provides details of the proposed route and operational aspects of the marine campaign works such as cable installation, site preparation and cable protection methods. A schedule is also included estimating the timeframe for the various marine activities.

The operation will be performed on a 24-hour basis. Durations presented are exclusive of weather downtime above vessel working limits and any third-party influences that may increase the duration or interrupt operations.

Existing vessels will be requested to remain at least 500 m from project vessels whilst they are engaged in cable installation activities, resulting in a width of 1 km. This is due to the cable lay vessel's limited ability to manoeuvre whilst undertaking operations.

Unless otherwise directed by Notice to Mariners (NtMs), the entire cable route corridor will require to be kept clear of all fishing gear (mobile and static) until the end of the works, including the post lay survey period.

Pertinent Information from the project description that is directly relevant to the marine activities for the NRA is outlined below.

Pre-Lay Survey
A detailed geophysical pre-lay survey will be undertaken across the entire cable route. Typically, vessels survey at approximately **800 m/hr** and is estimated to take approximately **9.1 days (assuming 5 survey lines and excluding weather)**.

Therefore, as a worst case the maximum area for disruption would be 1 km wide by 19.2 km long per 24-hour period.

Pre-Lay Grapnel Run (PLGR)
It is anticipated for the PLGR to take up to **6 days**. This usually clears the route of any debris such as OOS cables and fishing gear etc.

Therefore, as a worst case the maximum area for disruption during a PLGR would be 1 km wide by 6.0 km long per 24-hour period.

Boulder clearance

Large boulders that cannot be avoided during the route engineering process will need to be cleared on a case-by-case basis. The progress rate for this operation is currently unknown as it depends on the extent of boulders found that require clearance, but boulder removal is estimated to take up to **4 days**. Boulder removal would be undertaken by a hydraulic operated 'Orange Peel' grab.

Therefore, as a worst case the maximum area for disruption during boulder clearance would be 1 km wide by 9.0 km long per 24-hour period.

Cable Shore End Pull-In Operations

The first cable pull in operations are expected to take approximately **1 day** to complete and the Cable Lay Vessel (CLV) will be stationed around the 13 m water depth contour.

Once the cable is laid across the seabed, the cable lay vessel will remain on station at the 13 m water depth contour at the other shore end. The cable will then float off the vessel to shore to complete the second cable pull in operation taking another **1 day.**

Cable Lay Operations

Once the cable is successfully pulled (first cable pull-in) to its required position onshore, the buoyancy units will be removed and the CLV will commence laying operations until the second cable pull in. The CLV is a DP2 (Dynamic Positioning) class vessel and the expected cable laying speed will be between **200 m/hr** and **450 m/hr**, therefore it is expected to take **11 days** to complete cable lay operations.

Therefore, as a worst case the maximum area for disruption would be 1 km wide by 4.8 km long per 24-hour period.

Post-Lay Trenching

Once the cable has been laid on the seabed the cable is then buried using a trenching tool. Typical burial speeds are expected to be approximately **200 m/h** and is estimated to take **12 days.**

Therefore, as a worst case the maximum area for disruption would be 1 km wide by 4.8 km long per 24-hour period.

Articulated Pipe Installation

The cable protection strategy may include the installation of Articulated Pipe in very shallow water. Generally, this is installed following the cable pull-in operations by divers or from the CLV, or by a combination of both methods where areas require articulating piping. Typical speeds for installing articulated piping are expected to be approximately **0.6 m/hr**, and durations are estimated at **15.0 days for Murkle Bay** and **7.5 days for Rackwick Bay.**

Rock bags for cable stabilisation

Rock bags are anticipated to be used as a means of stabilising the cable where deemed necessary by the On Bottom Stability Analysis. It is expected that the quantity of rock bags will be similar to the previously installed figure (378) and the estimated duration would be **28 days**.

Mattress Installation

Two fibre optic cable crossings will be required along the proposed route. In order to cross the fibre optic cable, concrete mattresses are proposed to protect both the existing cable and the proposed cable. There are likely to be three pre lay concrete mattresses (6 m long, 3 m wide) and one post lay mattress per crossing.

The existing crossing points will most likely be re-utilised but there is still potential for new ones to be required.

Typical mattress installation speeds are around **1 mattress every 4 hrs** and, with eight mattresses anticipated in total, would consequently take approximately **16 hrs per crossing.**

Decommissioning of Out of Service cable
The Out of Service Pentland Firth East (2) cable will be removed to facilitate the installation of Pentland Firth East (3) according to the decommissioning plan (Appendix F of Environmental Supporting Information). Clump weights will be installed to secure any cut cable ends.

Similar vessels as used in installation will be involved but the expected rate for decommissioning the will be similar to that of the cable laying operations. There may be some de-burial operations to excavate the cable in areas of deep cable burial which will have similar rates to post lay trenching operations.

Operational Phase
Routine inspections to examine the subsea infrastructure would take place periodically every 5-8 years after installation during the lifetime of the cable. This would involve a 500 m radius around the survey vessel moving at 150 m/hr.

Therefore, as a worst case the maximum area for disruption would be 1 km wide by 3.6 km long per 24-hour period.

1.4 Existing Baseline Assessment

1.4.1 Shipping Overview

12 months of AIS data from Jan to December 2021 were analysed within 10 km of the cable corridor to examine the types and patterns of shipping activity occurring near the Application Corridor. The total average monthly vessel density can be observed in Figure 1-5 (P2577-AIS-001).

A total vessel density of over 31,000 vessel hours were recorded across the Study Area in 2021. The distribution of the vessel categories are presented in Figure 1-3. It can be seen that many cargo (25.6%) and fishing (22.1%) vessels make up the AIS dataset, whilst passenger vessels constitute 15.6% and dredging/underwater operations make up 14.5%.

In 2021, dredging vessels were present near Scrabster Harbour to facilitate the St. Ola Pier refurbishment. This resulted in moderate AIS intensity (26 vessel hours per km^2) 200 m to the South-West of KP30, but this operation was completed December 2021.

Figure 1-3 Vessel Distribution Across the Pentland Firth East Route

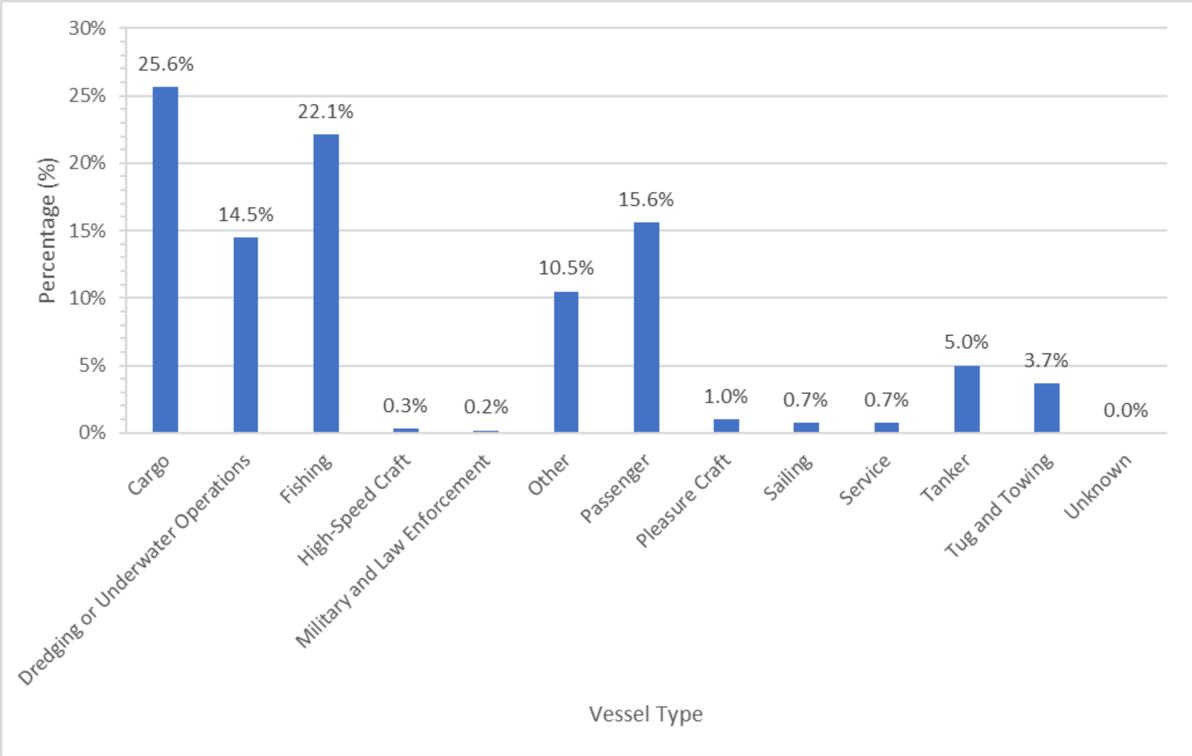


Figure 1-4 highlights the seasonal changes in vessel distribution.

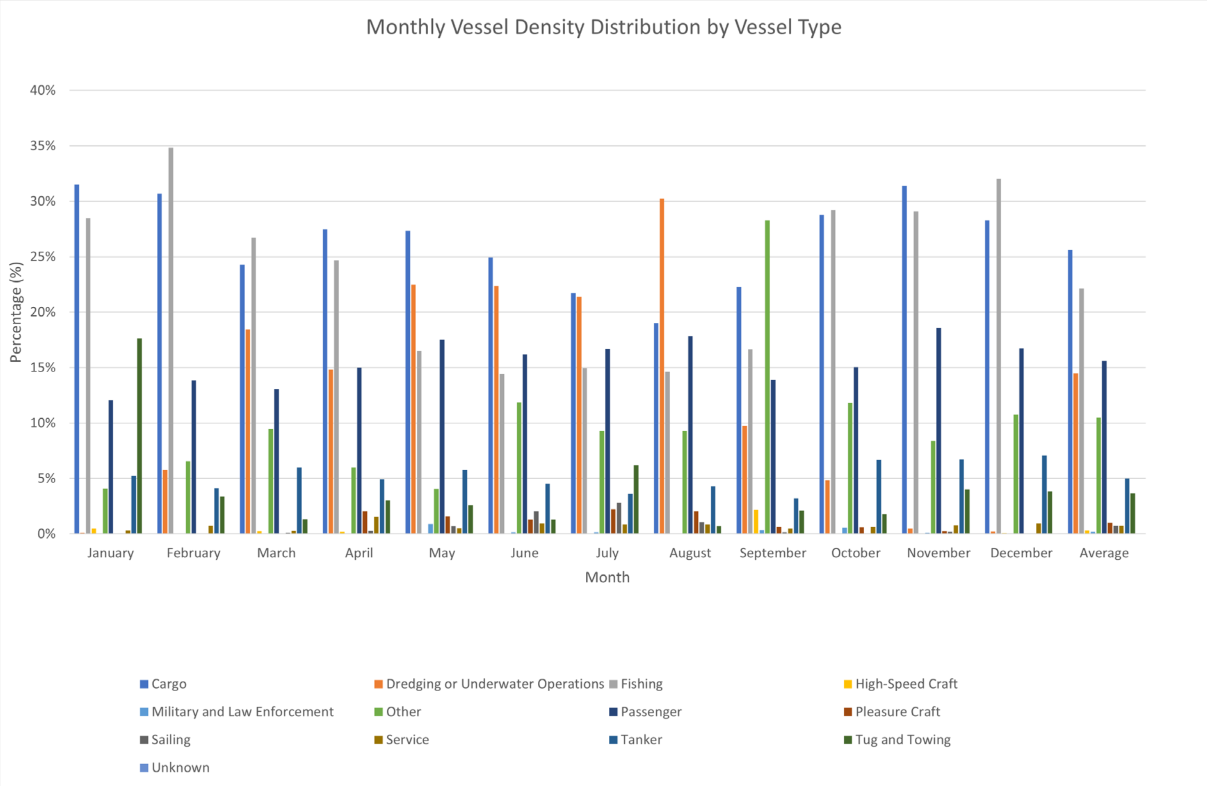
Dredging/underwater operations are very seasonally dependent with higher proportions of vessels between March (18.4%) and August (30.2%) compared to November (0.5%) to January (0.1%).

In addition, the percentage of fishing vessels halves in summer months (May – September) at 14.4% - 16.6% in comparison to the rest of the year (October – April) ranging from 22.1% - 34.8%. It is important to note that less fishing vessels will be present during installation operations as these activities generally take place in more favourable weather windows (summer months).

There was a spike in January 2021 where Tug and Towing vessels made up 17.6% of the vessel density, which is a significant increase from low levels throughout the other months (average was 3.6%).

Furthermore, cargo vessels were consistently present in relatively high proportions throughout 2021, ranging from 19.0% in August and 31.5% in January, with an average of 25.6%.

Figure 1-4 Seasonality Changes in Vessel Traffic Across the Pentland Firth East Route



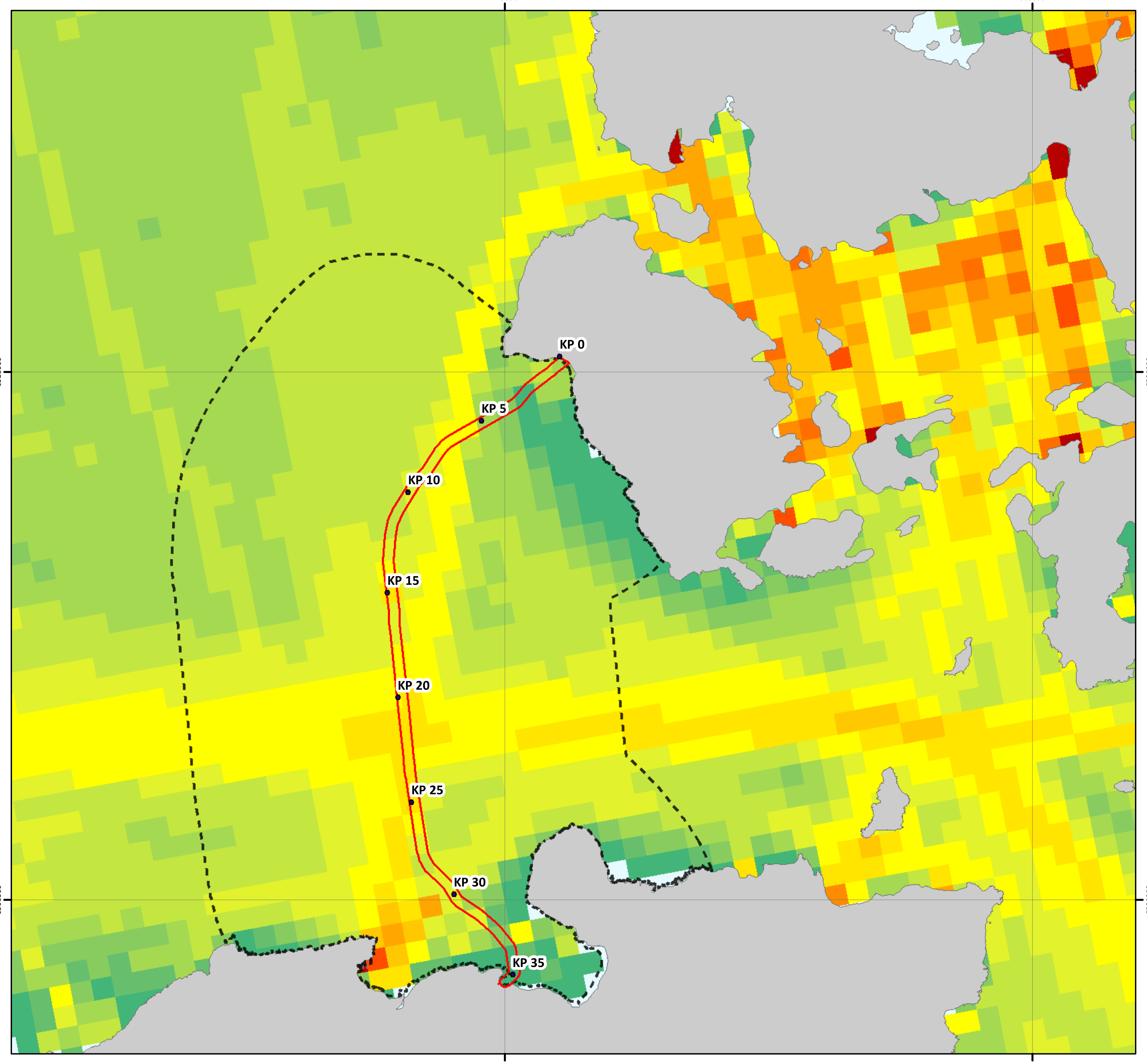
The vessel density across the Study Area is generally relatively low with a mean of 1.2 vessel hours per km^2.

The cable corridor itself is within slightly higher vessel densities which tend to range from 2-5 vessel hours per km^2 with a maximum of 8 near KP21 where a horizontal pattern of traffic can be seen across the Pentland Firth. This pattern can be attributed to cargo vessels which tend to travel between KP18 and KP23, perpendicular to the cable corridor. Tanker vessels additionally travel along the same route at lower densities between KP20 and KP23.

A near vertical pattern of moderate vessel density (~3 vessel hours per km^2) can be seen stretching up from Thurso past the West coast of the Isle of Hoy. This pattern is due to the regular passenger ferry line between Thurso and Stromness, which travels 2-3 times each day. The cable corridor mostly follows this pattern for 9.8 km from KP20 to KP28 and crosses the corridor for 2.3 km from KP5 to KP8.

Low vessel densities are present directly near the two landfall sites – Rackwick Bay has an average of 0.3 vessel hours per km^2 and Murkle Bay ranges from 0.05 to 3.4 vessel hours per km^2. However, the highest vessel traffic can be observed at Scrabster (West of Murkle Bay and 22.5 km SW of KP 30), where vessel density reaches 280 vessel hours per km^2, due to Scrabster Harbour (facilitating cargo, tanker, dredging, tug/towing, service vessels and pleasure craft) and the ferry terminal.

The latest Marine Traffic data from 2021 has been investigated and the average of all vessels are displayed in Figure 1-6. The Study Area is shown in a black outline and cable corridor displayed in red. At the Rackwick Bay landfall, there is a slightly higher intensity area within the bay, which can be attributed to High Speed Craft (0.4 vessel hours per km^2).



PENTLAND FIRTH EAST (3) CABLE REPLACEMENT

AIS VESSEL DENSITY

Average Monthly Vessel Density - All Vessels

Drawing No: P2577-AIS-001 | **A**

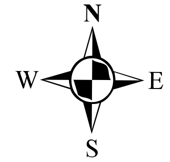
Legend

- KP
- Installation Corridor
- 10 km Buffer

All Vessels - Average

Vessel hours per km²

- 0
- < 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- > 500



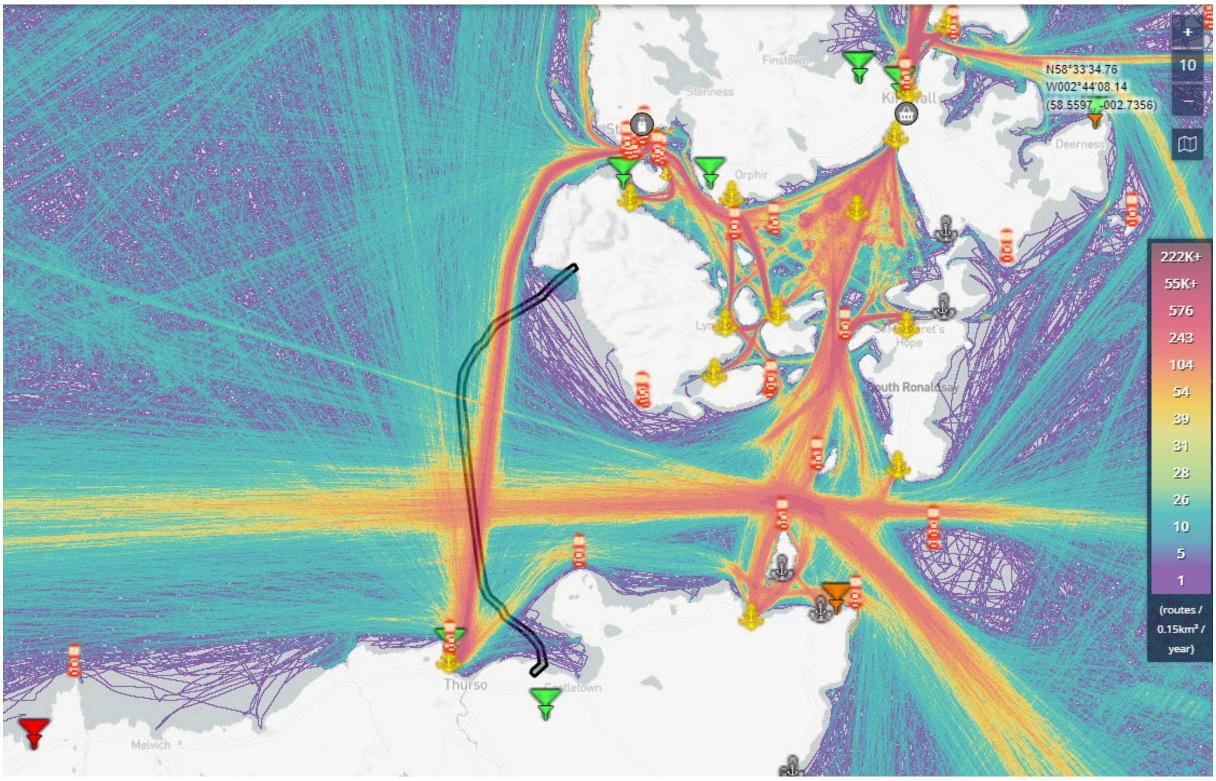
NOTE: Not to be used for Navigation

Date	22 September 2022
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	OSOD; EMODnet; SSE
File Reference	J:\P2577\MXD_QGZ\02_AIS\ P2577-AIS-001.mxd
Created By	Alice Gymer
Reviewed By	Irinios Yiannoukos
Approved By	Andrew Page

sse intertek

0 2.5 5 7.5 10 km

Figure 1-6 Vessel Activity in the Pentland Firth



Marine Traffic

The average number of vessels transiting the Pentland Firth each day remains fairly consistent across the year, with offshore and passenger vessels seeing increases of five and ten vessels per day during the summer respectively. Passenger vessels account for a high number of average vessels per day, with the Pentland Firth being used regularly by Serco NorthLink's ferry which operates between Scrabster and Stromness, and Pentland Ferries' ferry which operates between Gills Bay and St. Margaret's Hope. The cable corridor is located approximately 19 km from the Gills Bay – St Margaret's Hope route, therefore project vessels are too far a way to interfere. The cable corridor intersects the Scrabster - Stromness ferry route at three points, for approximately 0.7 km between KP8.9 and KP 9.5, approximately 2.9 km between KP22.9 and KP25.8, and perpendicularly crosses the cable at KP30 for 500 m.

1.4.2 Navigational Features and Anchorages

There is an International Marine Organisation Area to be Avoided traffic routing scheme around the West, North and East of the Orkney Islands, where vessels of more than 5,000 gross tonnage that carry oil or other hazardous material should avoid. This covers the West of Hoy and Stromness, intersecting with the cable corridor from KP0 to approximately KP8, however it will not interfere with the vessels used during this operation. Admiralty chart notes advise that laden tankers not bound to or from Flotta and Scapa Flow should not use the Pentland Firth in restricted visibility or adverse weather (AECOM NRA, 2019).

On the Scottish mainland north coast, there are four ports: two larger ports at Scrabster and Thurso; a small private port at Castlehill (near Castletown) and a small municipal port at Dwarwick (near Dunnet), where recreational diving takes place. A private slipway is also present in Brough Bay (East of the Easter headland). The Pentland Firth cables fall within the Scrabster Harbour Authority boundary, which stretches from Scrabster to Castletown. In addition, berthing and overnighting of survey vessels may occur within harbour limits.

There are no navigational buoys within the study area.

1.4.3 Royal Yachting Association (RYA)

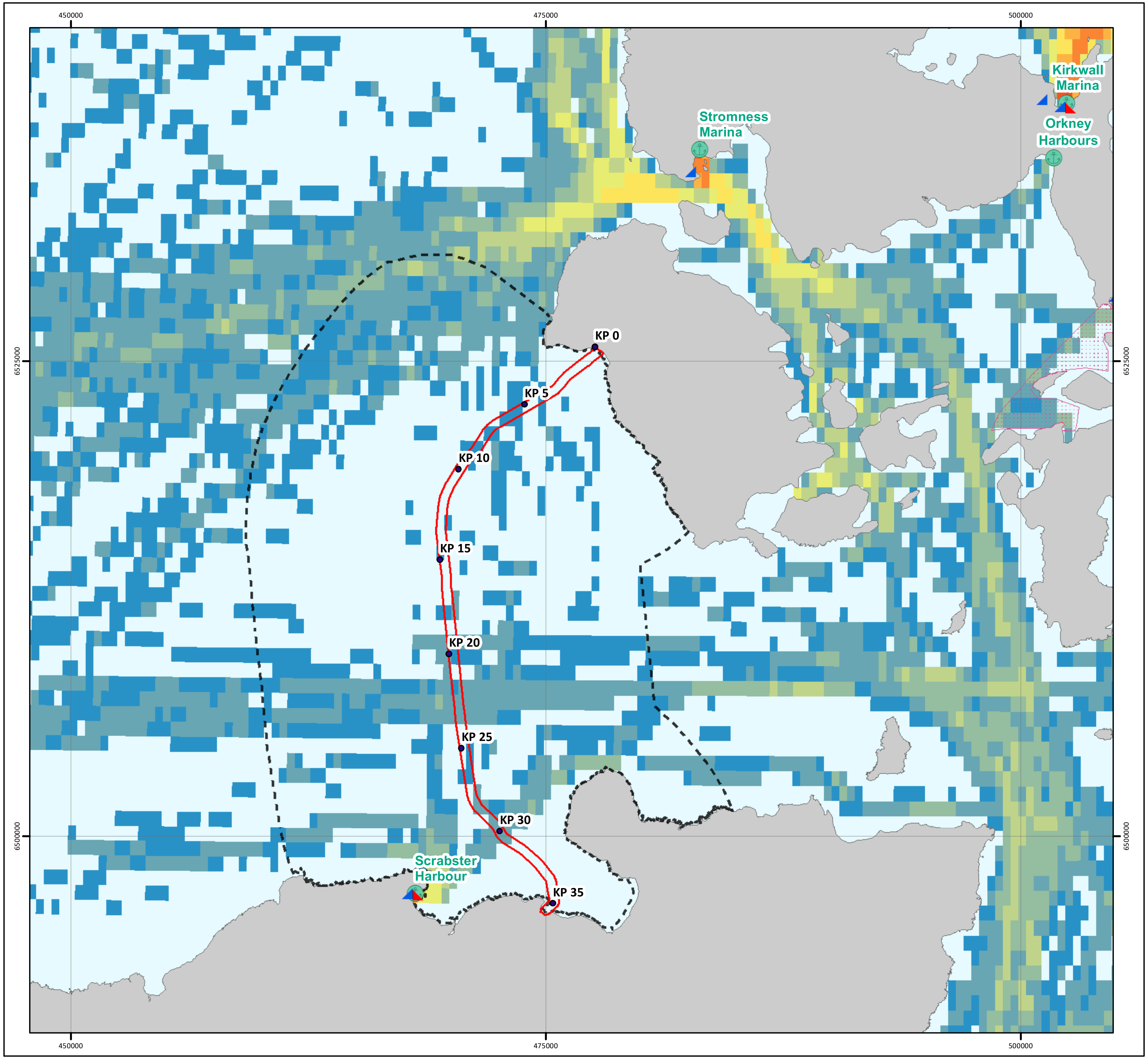
RYA clubs, training centres, marinas as well as the RYA AIS data within the Study Area are illustrated in Figure 1-7 (P2577-RYA-001-A). The figure also presents a heat map of AIS data of the recreation boating activity across study area.

RYA AIS intensity data is limited in the study area, resulting in significant patches of no data especially between KP5 and KP20, however the available data indicates low to negligible AIS intensity (0.3 - 0.8) throughout the study area. However, there is moderate AIS intensity (1.8) in close vicinity of Scrabster Harbour.

The Pentland Firth Yacht Club (blue triangle) and one training centre (red triangle) are located in Scrabster Harbour 7 km to the West of the Murkle Bay landfall and the closest distance from the cable corridor is 5 km South-West of KP30. Sailing from RYA tends to occur within Thurso Bay itself, resulting in moderate AIS intensity (1.8) in close vicinity of Scrabster Harbour. Recreational activity is therefore unlikely to be affected during the cable operation.

There are no general boating areas within the study area.

The North Caithness Coast and Orkney waters are used by small numbers of sailing vessels each year, with the summer months seeing significantly higher numbers than in the winter. Vessels typically visit the main ports and marinas of the region including Westray, Kirkwall, Stromness and Scrabster.



PENTLAND FIRTH EAST (3) CABLE REPLACEMENT

ROYAL YACHTING ASSOCIATION
RYA UK Coastal Atlas of Recreational Boating

Drawing No: P2577-RYA-001 | **A**

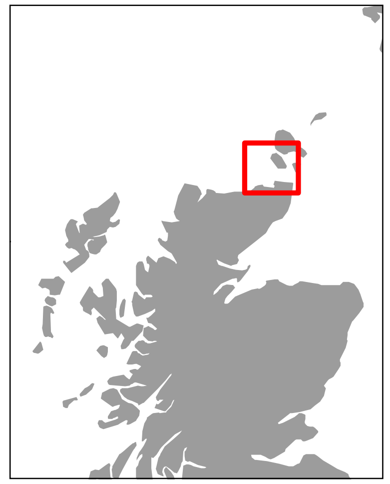
Legend

- KP
- RYA Club
- RYA Training Centre
- Marina
- Installation Corridor
- 10 km Buffer
- General Boating Area

AIS Intensity (Recreational Yachting)

Intensity

- Low
- High



NOTE: Not to be used for Navigation

Date	22 September 2022
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	OSOD; RYA; SSE
File Reference	J:\P2577\MXD_QGZ\05_RYA\ P2577-RYA-001.mxd
Created By	Alice Gymer
Reviewed By	Irinios Yiannoukos
Approved By	Andrew Page

0 3 6 9 12 km

1.4.4 Fishing Overview

The Commercial Fishing section provides a detailed assessment of the effects that the installation/operation of the replacement cable and decommissioning of the nearshore ends of the existing cable could have on fishing within the Study Area.

Many different fishing gears and fishing methods are used by commercial fisheries. Each gear type is used for specific activities and different gears can have very different impacts on the marine environment and cable security. Furthermore, it is possible for smaller fishing vessels to bottom out if they become snagged on subsea cables.

This section has used information provided in the Fishing Liaison Mitigation Action Plan (FLMAP), the PFE (2) CBRA (2020) and Vessel Monitoring System (VMS)/vessel traffic data to identify the main areas of fishing in relation to the Project which may be disrupted during the offshore marine campaigns.

Fishing from VMS data appears to be fairly consistent across the route with a vertical pattern to the West of Hoy, adjacent to Melvich where fishing activity is relatively more intense. There are additionally areas of no data to the South of Hoy, as shown in Figure 1-8 (Ref: P2557-FISH-001).

Within the Pentland Firth and Orkney Waters, creeling is the most popular method of fishing. Within ICES rectangle 46E6, creeling accounts for three-quarters of fishing effort, with the top species targeted being crab, lobster and haddock (see Section 7 of the FLMAP). Bottom (demersal) trawling, such as otter trawling, and scallop dredging, are also common fishing activities within the Pentland Firth, but low levels occur within the Study Area itself. Demersal gear types pose a significant risk to the cable as they are towed along the seafloor and can snag and damage subsea cables. The depth of penetration indicates the risk to the cable from fishing gear, however, fishermen do reduce penetration where possible to decrease risk of losing equipment and consume less fuel. Depending on the substrate, scallop dredging can result in a penetration up to 35 cm deep.

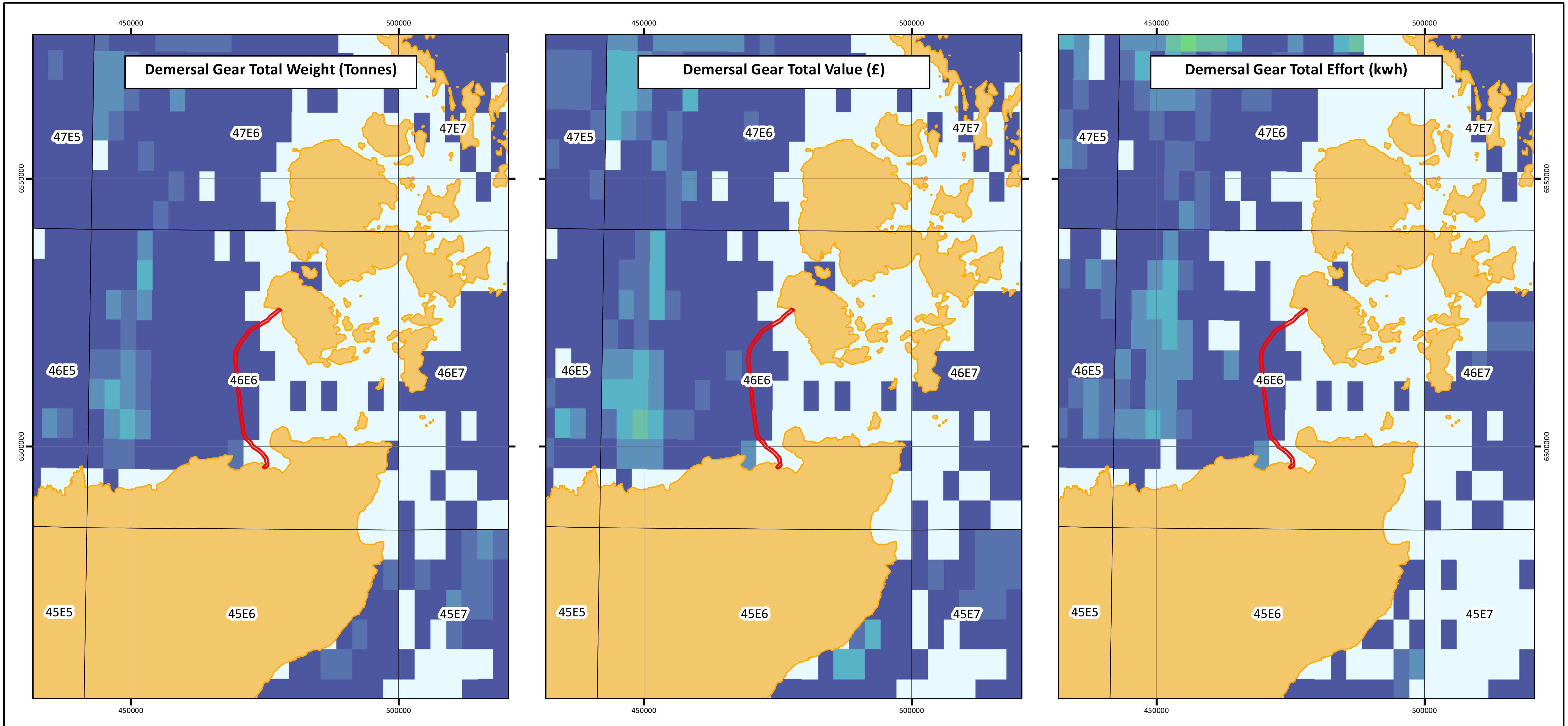
The size (6 m to 19 m) of static gear vessels vary, however smaller fishing vessels may not be recorded by AIS/VMS. Creeling conducted by vessels under the length of 10 m, working nearshore between the Orkney islands will most likely be the primary source of conflict during any cable works as creeling activity by this size of vessel is typically confined to the nearshore area.

Static gear fishing vessels mainly use the port of Stromness for operations. Demersal trawling is more prevalent in close proximity to Rackwick Bay. Mobile/active fishing gear is seasonally restricted along the West coast of Hoy (The Berry to Costa Head). Scallop dredging is prohibited from the headland North of Scrabster Harbour to Dunnet Head (including Thurso Bay, Murkle Bay and Dunnet Bay)[1].

Fishing effort in the region follows a seasonal pattern with activity varying to shelter from adverse weather conditions, reacting to seasonal changes and exploiting target species[2].

[1] Marine Scotland (2022). National Marine Plan Interactive (NMPi). Accessible here: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=311 [accessed November 2022]

[2] Coleman M T., & Rodrigues E. (2016). Orkney Shellfish Project End of Year Report: January – December 2015. Orkney Sustainable Fisheries Ltd. No.13, pp. 86



PENTLAND FIRTH EAST (3) REPLACEMENT

FISH AND FISHING - Fishing Activity for ≥ 15m UK Vessels 2019 by ICES Sub Rectangle (Demersal Gears)

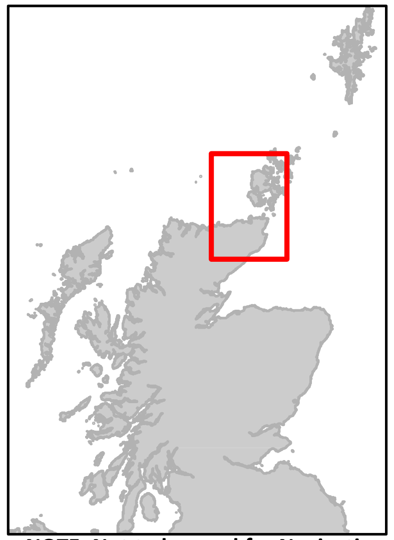
Drawing No: P2577-FISH-001 | A

Legend

- EEZ Boundary
- Installation Corridor
- ICES Rectangle

Total Weight (Tonnes)	Total Value (£ Sterling)	Total Fishing Effort (kilowatt/hours)
> 0 - 10 (Tonnes)	> £0 - £10,000	> 0 - 2,500 (kilowatt/hours)
> 10 - 20	> £10,000 - £20,000	> 2,500 - 5,000
> 20 - 40	> £20,000 - £40,000	> 5,000 - 10,000
> 40 - 80	> £40,000 - £80,000	> 10,000 - 20,000
> 80 - 160	> £80,000 - £160,000	> 20,000 - 40,000
> 160 - 320	> £160,000 - £320,000	> 40,000 - 80,000
> 320 - 640	> £320,000 - £640,000	> 80,000 - 160,000
> 640 - 1,280	> £640,000 - £1.28 million	> 160,000 - 320,000
> 1,280 - 2,560	> £1.28 - £2.56 million	> 320,000 - 640,000
> 2,560 (Tonnes)	> £2.56 million	> 640,000 (kilowatt/hours)

N E S W



NOTE: Not to be used for Navigation

Date	22 September 2022
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; MMO; OSOD; ICES; ESRI; SSE
File Reference	J:\P2577\MXD_QGZ\04_FISH\P2577-FISH-001.mxd
Created By	Alice Gymer
Reviewed By	Irinios Yiannoukos
Approved By	Andrew Page

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0 10 20 30 40 km

Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Exclusive Economic Zone (EEZ), version 11. Available online at http://www.marineregions.org/. https://doi.org/10.14284/386; Contains public sector information, licensed under the Open Government Licence v2.0, from the UKHO, 2018.; Open Government Licence reproduced with permission of the Marine Management Organisation.; Contains Ordnance Survey data © Crown copyright and database right 2013; ©ICES; ©Esri

1.4.5 Marine Accident Data

This section reviews maritime incidents that have occurred within 10 km of the cable routes across the Pentland Firth. The analysis is intended to provide a general indication as to whether the area of the Project 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.

The most recently available 12 years of data from RNLI and the last 5 MIAB annual reports have been analysed. It is noted that the same incident data could have been recorded by both sources.

1.4.5.1 RNLI

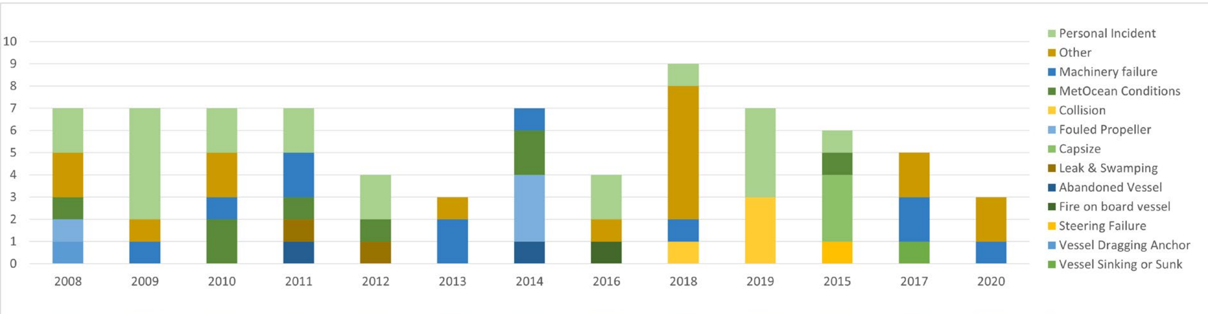
The most recent twelve-year period available of RNLI data (collected between 2008 and 2020) has been plotted spatially and analysed across the study area.

The dataset is a condensed Return of Service data from RNLI callouts across the United Kingdom. It is worth noting that there are records present that have not been spatially adjusted to their exact locations but does give an indication of the number of marine incidences in the area.

A total of 76 launches across the study area (all to unique incidents) were recorded by the RNLI (excluding hoaxes and false alarms) over the last 12 years. This corresponds to an average of around 6 incidents per year indicating that the number of incidents in the Pentland Firth is very low.

Incident type and corresponding years for across the study area are presented in Figure 1-9. RNLI categories that are not relevant to this assessment have assigned to the category 'Other'.

Figure 1-9 RNLI Yearly Callouts



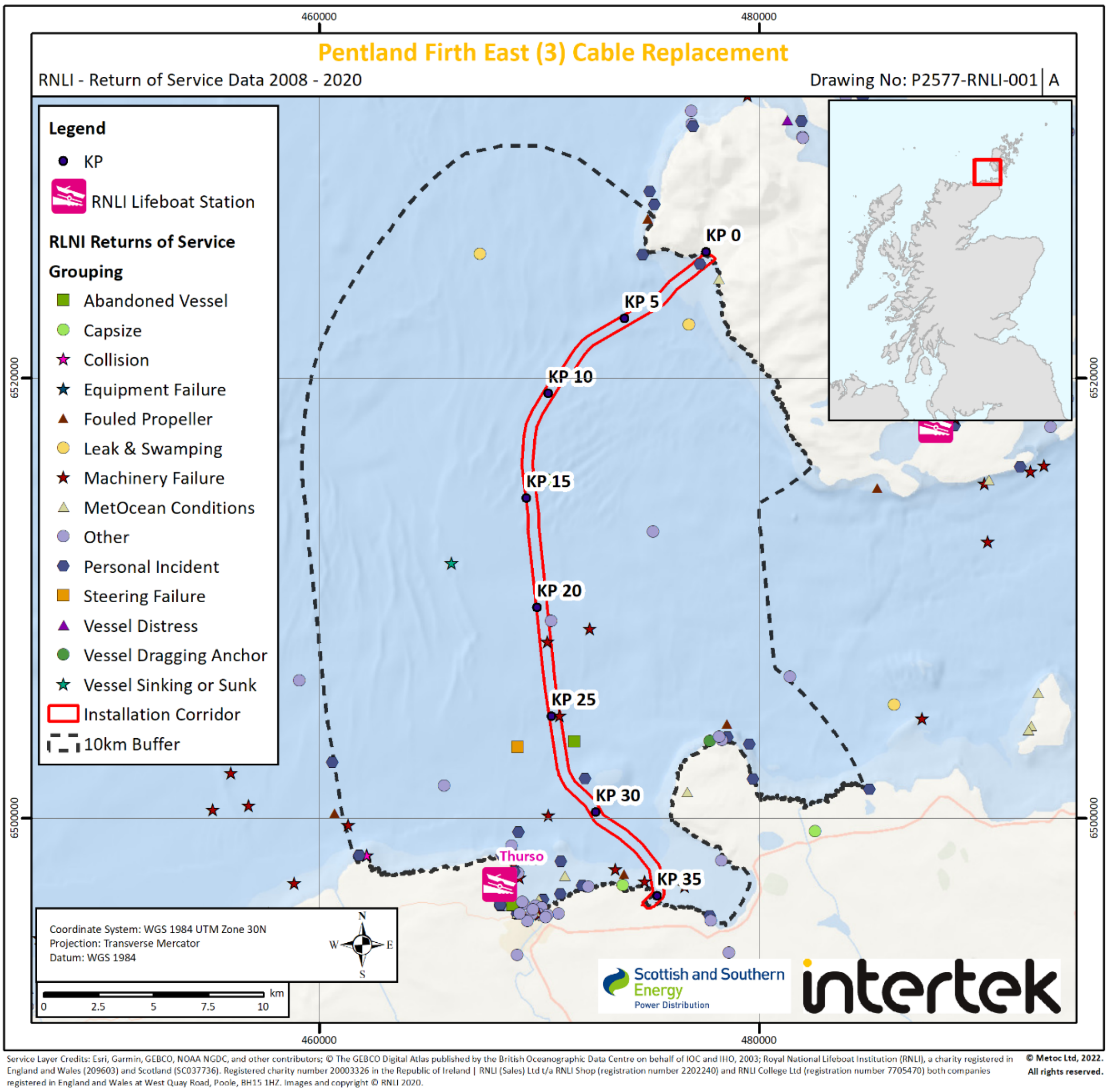
With the exception of 'Other' (17 incidents), which, as mentioned above is not relevant to this assessment, it can be seen that for 'Personal Incidents' (21 incidents), 'Machinery Failure (11 incidents) and 'MetOcean Conditions' (8 incidents, e.g. due to strong tidal currents and wave bores that can overpower vessels) account for a large portion of the dataset. Similarly, there have been a relatively low number of recorded collisions (4 incidents) over the last 12 years.

The highest proportion of call outs were to commercial vessels (36%) and people (30%). This indicates that fishing and cargo vessel incidents are more likely within the study area, in addition to a number of personal incidents especially nearshore Thurso.

As a result of the temporal effects of the offshore marine campaign works, and that incidences are largely as a result of Personal Incidences (e.g. person in distress, missing person, person in water) and machinery breakdowns and vessels being caught out in the commonly severe MetOcean conditions occurring in the Pentland Firth, it is not thought that the presence of project vessels will increase the risks to the existing baseline of marine safety.

Figure 1-10 (Ref: P2577-RNLI-001) presents the locations of incidences recorded by the RNLI.

Figure 1-10 Recorded Incidents between 2008 and 2020 (P2577-RNLI-001)



1.4.5.2 MAIB

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 nautical miles (NM) and carrying passengers to or from a UK port. However, the MAIB will always record details of significant accidents of which they are notified by bodies such as the Coastguard. The Maritime and Coastguard Agency, harbour authorities and inland waterway authorities also have a duty to report accidents to the MAIB.

The last 5 years of annual MAIB reports from 2017 to 2021 have been analysed to determine if any accidents have occurred within or nearby the Pentland Firth. The findings have been summarised below as:

- **2021**: No incidents or accidents relating to vessels at sea within the vicinity of the study area.
- **2020**: 31st October - Loss overboard of 33 ISO containers from the container vessel Francisca (9113214) near Duncansby Head, Scotland (20 km East of the study area).

- **2019**: No incidents or accidents relating to vessels at sea within the vicinity of the study area.
- **2018**: 18th July - Grounding of the Netherlands registered general cargo vessel Priscilla in the Pentland Firth, Scotland.
- **2017**: No incidents or accidents relating to vessels at sea within the vicinity of the study area.

A total of two marine incidents were reported across or near the study area, corresponding to an average of 0.4 incidences a year. One of those incidents in 2020 took place near Ducansby Head, which is 20 km East of the cable route. It can be seen that in 2021, 2019 and 2017, there were no incidents or accidents reported by MAIB.

It is worth noting that none of the incidents relate to a collision with other vessels so this area of the sea can be deemed relatively incident free.

Furthermore, a recent incident also took place in July 2022 within the Pentland Firth by Swona on the Gills Bay-St Margaret's Hope ferry line, which is currently under investigation by the MAIB:

- **2022** (up to September): 5th July - Grounding of a UK registered ro-ro passenger ferry (MV Alfred) on Swona Island, Scotland.

1.5 Hazard Identification

Marine operations and their associated hazards have been identified and listed in Table 1-7. A hazard has been assigned to each aspect of the marine operation including the zone of influence, resulting in a worst-case assessment. The zones of influence are also presented in the table below.

Table 1-7 Marine Operations and Identified Hazards – Shipping and Navigation

<table>
<tr><th>Project Phase</th><th>Operation</th><th>Hazard Identified</th><th>Receptor</th><th>Zone of Influence</th></tr>
<tr><td rowspan="3">Pre-Lay</td><td>Pre-Lay Survey</td><td rowspan="10">Displacement of vessels due to avoidance of project vessels
Vessel Collision
Project vessels blocking navigational features
Fishing interaction with Surface laid cable
Accidental anchoring on surface laid cable
Extreme weather conditions
Displacement of vessels due to avoidance of project vessels</td><td rowspan="10">Project vessels; Commercial shipping; Recreational, boating and fishing vessels</td><td>1km wide x 19.2km along centreline (in any 24-hour period)</td></tr>
<tr><td>Pre-Lay Grapnel Run</td><td>1km wide x 6.0km along centreline (in any 24-hour period)</td></tr>
<tr><td>Boulder Clearance</td><td>1km wide x 9.0km along centreline (in any 24-hour period)</td></tr>
<tr><td rowspan="6">Installation</td><td>Shore End Operations (cable pull in)</td><td>1km wide x 7.2km along centreline (in any 24-hour period)</td></tr>
<tr><td>Cable Lay</td><td>1km wide x 4.8km along centreline (in any 24-hour period)</td></tr>
<tr><td>Offshore installation, post-lay trenching</td><td>1km wide x 2km at crossing and burial locations (in any 24-hour period)</td></tr>
<tr><td>Mattress Installation</td><td>1km wide x 4.8km along centreline (in any 24-hour period)</td></tr>
<tr><td>Articulated Pipe Installation</td><td>1km wide x 1km along centreline (in any 24-hour period)</td></tr>
<tr><td>Rock Bag Installation</td><td>1km wide x 1km along centreline (in any 24-hour period)</td></tr>
<tr><td>Operation and maintenance</td><td>Routine Inspection</td><td>1km wide x 3.6km along centreline (in any 24-hour period)</td></tr>
</table>

1.6 Risk Control

1.6.1.1 Compliance Mitigation

The Compliance measures included in Table 1-8 are required to be undertaken to meet environmental and health and safety legislation.

Table 1-8 Compliance Mitigation

ID	Embedded mitigation
COMP 1	Project vessels will 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.
COMP 2	'As-laid' co-ordinates of the cable route will be recorded and circulated to the UK Hydrographic Office (UKHO), KIS-ORCA service and any other relevant authorities. Cables will be marked on Admiralty Charts and KIS-ORCA charts (paper and electronic format). An update will be distributed to stakeholders following the completion of installation.
COMP 3	Where weather reduces visibility then vessel masters shall adhere to MGN guidelines and COLREGS to prevent collisions at sea.

1.6.1.2 Best Practice Mitigation

The Best Practice project mitigation relevant to shipping is provided in Table 1-9. When undertaking the assessment, it is assumed that these measures will be complied with - either as a matter of best practice or to ensure compliance with statute.

Table 1-9 Best Practice Mitigation

ID	Embedded mitigation
BP1	Early consultation with relevant contacts to notify of impending activity.
BP2	Notice to Mariners will be published to inform sea users via Notices to Mariners, Kingfisher Bulletins and Maritime and Coastguard Agency (MCA) and UK Hydrographic Office (UKHO). Vessels will be requested to remain at least 500 m away from cable vessels during installation operations.
BP3	A guard vessel may be used during the installation campaign where a potential risk to the asset or danger to navigation has been identified.
BP4	Appropriate cable protection to be installed as applicable along the cable route including over shallow burial areas if required.
BP5	An onshore Fishing Liaison Officer (FLO) will be provided for the project. The FLO will follow the Fishing Liaison Mitigation Action Plan (FLMAP) and ensure the entire corridor is kept clear of fishing gear until all operation have been completed.
BP6	The UKHO will be informed of installation activities in order to issue Maritime Safety Information (MSI) broadcasts as appropriate.
BP7	Marine Guidance Notice (MGN) provided by the UKHO, IHO and International Convention for the Safety of Life at Sea (SOLAS) recommend that fishing vessels should avoid trawling over installed seabed infrastructure (MCA, 2021)[3]. Vessels are advised in the Mariners Handbook not to anchor or fish (trawl) within 500 m of the cable
BP8	If cables are buoyed off whilst the vessel departs the area, buoy positions will be notified to the Notice to Mariners (NTM) distribution list including Kingfisher and 500 m clearance will be requested.

`

[3] Marine & Coastguard Agency. (MCA; 2021). MGN 661 (M+F) Navigation – safe and responsible anchoring and fishing practices. [online]. Available at: https://www.gov.uk/government/publications/mgn-661-mf-navigation-safe-and-responsible-anchoring-and-fishing-practices/mgn-661-mf-navigation-safe-and-responsible-anchoring-and-fishing-practices

2. RISK ANALYSIS

The descriptions and definitions in the below risk analysis takes into consideration the applied mitigation needed to reduce the hazards to ALARP, resulting in the **residual risk ratings**.

2.1 Displacement of vessels due to the avoidance of project vessels

Existing vessels may have to re-route around or reduce speed on approach to the project vessels which may causing a disturbance in the existing shipping patterns.

The presence of the project vessels will add an additional hazard for mariners to be aware of, which will potentially make them more vigilant when navigating through the area. In most cases, there is ample 'sea room' for existing shipping to manoeuvre around the project vessels. However, in extreme cases, existing shipping may need to give way to project vessels temporarily due to the geography of Inter-Island landmasses and relatively short routes.

Since the project vessels will be moving along at the rate of the PLGR/Cable Installation operations (speed is dependent on installation method used), any disruption will be temporary and short term in any one location. As shipping will have to make minor diversions to avoid the project vessels, their frequency has been assessed as **Remote**. For slower operations (cable protection installation), disruption due to the presence of project vessels would be **Probable**.

The consequence has been assessed as **Minor** because it will be very short-term, temporary, and acceptable alternatives for route planning are available for shipping traffic to easily manoeuvre around project vessels.

2.2 Collision Risk

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 landfall areas.

Vessels will be operating in compliance with international shipping standards, therefore, vessel masters will be competent and adept at navigating in unfamiliar waters.

The probability of a vessel-to-vessel collision is **Extremely Remote,** but the consequence could be **Catastrophic.**

2.3 Accidental anchoring on surface laid cable

Vessel anchors will have the potential to interact with the Cable Corridor if anchors are deployed where the cable is surface laid, or burial is not achieved to below the anchor penetration depths. If the cable is damaged, then existing shipping may be slightly disrupted when carrying out cable repair operations.

However, it is very unlikely that an anchor will be deployed offshore in deeper waters and away from anchorage areas. The probability of an anchor deployment on a surface laid cable has been determined to be very unlikely but may occur in the event of an emergency, extreme weather conditions or accidental deployment of an anchor.

The probability of a ships anchor interacting with the cables are **Extremely Remote,** but the consequence on the ship itself and human safety could be **Significant.**

2.4 Accidental snagging of fishing gear on unburied cable

Fishing vessel gear will have the potential to interact with the Cable Corridor where the cable is surface laid, or burial is not achieved to below the fishing trawl board depths or scallop/clam dredging.

Once established, appropriate mitigation is needed to ensure the cable is suitably protected against the type of fishing (i.e. scallop and clam dredging) and anchoring in the area. While it is advised by the MCA and 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.

During the installation phase, there will be a designated FLO. With these services in place, there will be a FLO monitoring body present during the installation process. The project FLO can disseminate information to the project vessels regarding seasonal variations in fishing patterns and identifying fishing gear/pots.

Complete fishing clearance from the installation corridor will be maintained until the post-lay surveys have been completed. This will be co-ordinated via the FLO.

Where the cable is not surface laid, the recommended cable burial ranges between 0.4 m and 0.6 m below the seabed (Cathie CBRA, 2020). Once installation is complete, an assessment of the potential hazards the installed cable poses to other marine users will be submitted to Marine Scotland.

The probability of a fishing gear interacting with the cables is **Extremely Remote**, but the consequence of snagging could be **Catastrophic** since it could cause smaller fishing vessels to bottom out.

2.5 Project vessels blocking navigational features

Project vessels have the potential to block key navigational features such as anchorages or approaches to ports.

While the corridor does not intersect any anchorage areas there are designated anchorages to the East of Pentland Firth (Gills Bay, Stroma Harbour). Some displacement of vessels may occur and consideration to existing vessels anchoring may need to be carried out for the pull in operations.

However, these effects are temporary, and the cable corridors do not enter any port authority areas, so the probability is expected to be **Remote** and consequence **Minor**.

Cable protection installation operations have longer durations and therefore frequency of blocking navigational features during these operations have been assessed as **Probable**.

2.6 Extreme weather conditions

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, the project vessels may need to shelter in port if weather exceeds working limitations. This would mean seeking shelter before the weather reaches the limitations of the vessel and its crew, reducing the residual frequency. However, during the cable lay process this could mean cutting and buoying the cable in a situation that is too dangerous to continue working.

The probability of project vessels encountering extreme weather is **Extremely Remote** to **Remote**, and the consequence is likely to be **Significant**. In the risk assessment, the residual frequency is represented by Remote; although vessels should always shelter before reaching working limits, the weather can change unpredictably, and adverse weather could be encountered multiple times in winter months in the high-energy waters of Pentland Firth.

2.7 Reduced visibility

Navigating a ship in reduced visibility because of fog or heavy rain presents a set of challenges where vessel masters should follow the relevant MGN guidelines for preventing collisions at sea.

When the ship's officer gets information regarding such upcoming weather condition, they should take the necessary precautions to ensure that the ship sails through reduced visibility area without confronting any kind of collision or grounding accident. Some precautions are as follows:

- Keep the Fog Horn Ready: Ensure that the fog horn is working properly for the restricted area. If the horn is air operated, drain the line prior to opening the air to the horn.
- Reduce Speed: Reduce the speed of the ship depending on the visibility level. If the visibility is less, bring down the ship to manoeuvring RPM.
- Ensure Navigation Equipment and Light Are Working Properly: Ensure that all important navigating equipment and navigation lights are working properly during restricted visibility. The officer on watch must ensure that the navigation charts are properly checked for correct routeing.

Vessel masters shall be aware of their radar settings and use known objects such a channel buoys to confirm correct calibration to ensure vessels without AIS transponders are located on radar in reduced visibility which may lead to a collision of grounding.

The probability of project vessels encountering weather that caused reduced visibility (excluding night-time hours) is **Extremely Remote to Remote,** but the consequence is likely to be **Significant**. The residual risk for reduced visibility is represented as Remote in the risk assessment table.

2.8 Change in water depth – affecting safe navigation

In the event rock bags are used for the purposes of additional external cable protection, they will generally be up to 0.7 m high. The UK Maritime and Coastguard Agency (MCA) require that any contingency cable protection works must ensure existing and future safe navigation is not compromised. Generally, they are prepared to accept a maximum of 5% reduction in surrounding depth referenced to chart datum (CD) if the depth reductions do not compromise safe navigation.

However, the presence of the rock bags in water depths less than 20 m has the potential to change the chart datum by more than 5%. Consequently, concrete mattresses (0.3 m high) will be used where required in shallow water areas due to the lower profile of the structure.

There are two planned cable crossings, Northern Lights and Farice telecom cables. The existing crossings are likely to be re-used, however if new crossings are required, then concrete mattresses will be placed in approximately 55 m and 60 m water depths. Assuming a height of 0.3 m, maximum of 2 m height for each crossing, this does not exceed the 5% depth MCA requirement.

No other external cable protection is expected.

3. RISK ASSESSMENT

3.1 Assessment

In this risk assessment the hazard has been ranked by expected risk, based on the estimated frequency and consequence with no mitigation measures applied creating a 'Inherent Risk' to the project. The exercise was repeated with compliance mitigation (Table 1-8) and industry best practice (Table 1-9) measures which results in a residual risk allowing the hazards to be reduced to ALARP. No hazards more than a moderate risk (see Table 1-6) are present as identified in the risk assessment.

Table 3-1 presents the risk assessment conducted on the marine operations and associated hazards. All hazards have reached a risk level tolerable to the project through the ALARP process.

Risk Assessment: Operation	Hazard	Inherent Risk							Risk Mitigation	Residual Risk							Comments
			Consequence			Risk Rating					Consequence			Risk Rating			
		Frequency	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)		Frequency	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	
Route Clearance (PLGR & Boulder)	Presence of project vessels	3	1	1	1	3	3	3	COMP1 COMP2 COMP3 BP1, BP2 BP3, BP5, BP6 BP7, BP8	2	1	1	1	2	2	2	
	Vessel collision	2	5	5	N/A	10	10	N/A		1	5	5	N/A	5	5	N/A	Cannot assess vessel displacement if collision has occurred
	Project vessels blocking navigational features	3	1	1	2	3	3	6		2	1	1	1	2	2	2	
	Extreme weather conditions	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
	Reduced visibility	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
Shore end Operations (Cable Pull in)	Presence of project vessels	3	1	1	1	3	3	3	COMP1 COMP2 COMP3 BP1, BP2 BP3, BP4 BP5, BP6 BP7, BP8	2	1	1	1	2	2	2	
	Vessel collision	2	5	5	N/A	10	10	N/A		1	5	5	N/A	5	5	N/A	Cannot assess vessel displacement if collision has occurred
	Project vessels blocking navigational features	4	1	1	2	4	4	8		2	1	1	2	2	2	4	Existing vessel anchorage must be considered
	Accidental anchoring on unburied cable	2	2	2	2	4	4	4		1	2	2	1	2	2	1	
	Accidental snagging of fishing gear on unburied cable	3	5	5	1	15	15	3		1	5	5	2	5	5	2	Maintain fishing clearance until after post-lay surveys (co-ordinated via FLO)
	Water depth reduction	2	1	1	1	2	2	2		1	1	1	1	1	1	1	Water depth assessed as navigable at all crossing locations
	Extreme weather conditions	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
	Reduced visibility	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
Cable Lay Operations	Presence of project vessels	3	1	1	2	3	3	6	COMP1 COMP2 COMP3 BP1, BP2 BP3, BP4 BP5, BP6 BP7, BP8	2	1	1	1	2	2	2	
	Vessel collision	2	5	5	N/A	10	10	N/A		1	5	5	N/A	5	5	N/A	Cannot assess vessel displacement if collision has occurred
	Project vessels blocking navigational features	4	1	1	2	4	4	8		2	1	1	1	2	2	2	
	Accidental anchoring on unburied cable	2	2	2	2	4	4	4		1	2	2	1	2	2	1	
	Accidental snagging of fishing gear on unburied cable	3	5	5	1	15	15	3		1	5	5	2	5	5	2	Maintain fishing clearance until after post-lay surveys (co-ordinated via FLO)
	Extreme weather conditions	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
	Reduced visibility	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
Post Lay Trenching	Presence of project vessels	3	1	1	1	3	3	3	COMP1 COMP2 COMP3 BP1, BP2 BP3, BP4 BP5, BP6 BP7, BP8	2	1	1	1	2	2	2	
	Vessel collision	2	5	5	N/A	10	10	N/A		1	5	5	N/A	5	5	N/A	Cannot assess vessel displacement if collision has occurred
	Project vessels blocking navigational features	4	1	1	2	4	4	8		2	1	1	1	2	2	2	
	Extreme weather conditions	2	2	2	2	4	4	4		1	2	2	2	2	2	2	
	Reduced visibility	2	2	2	2	4	4	4		2	2	2	2	4	4	4	
Articulated Pipe Installation	Presence of project vessels	4	1	1	1	4	4	4	COMP1 COMP2 COMP3 BP1, BP2 BP3, BP5, BP6 BP7, BP8	3	1	1	1	3	3	3	Longer operations so increased frequency
	Vessel collision	2	5	5	N/A	10	10	N/A		1	5	5	N/A	5	5	N/A	Cannot assess vessel displacement if collision has occurred
	Project vessels blocking navigational features	4	1	1	2	4	4	8		3	1	1	1	3	3	3	Longer operations so increased frequency
	Extreme weather conditions	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)
	Reduced visibility	2	2	2	2	4	4	4		2	2	2	2	4	4	4	Worst case frequency assumed (Remote)

3.2 Conclusions

The overall vessel density across the Application Corridor is generally consistent across the Pentland Firth and observed to be fairly low over the cable corridor itself (~1.2 vessel hours per km^2). There are horizontal and vertical patterns of more intense vessel density related to unofficial shipping lanes, used by cargo, tanker and fishing vessels leaving and entering ports. The East-West route is mainly traversed by cargo vessels, whilst the North-South routes are regularly used by passenger vessels.

From available RYA data, the intensity of recreational boating appears low across the study area, though the dataset is limited particularly between KP5 and KP20, with the most activity in close vicinity to Scrabster Harbour. The operation is not impacted by the Orkney Islands Area to Avoid.

Fishing activity is fairly consistent within the study area, with some greater activity present in a vertical pattern perpendicular to the coast at Melvich (to the West of the study area). Moreover, creeling, otter trawling and demersal gear are particularly common in the inshore areas where the cable is more at risk of being impacted and snagging.

The new cable is being laid in between two existing cables which were both surface laid and have been charted for many years. The cable corridor is therefore not getting any wider as a result of the replacement PFE (3) cable.

The risk assessment has identified that all identified hazards have been reduced to ALARP and, with the relevant best practice measures applied, no hazards exist that are above a moderate risk level. The greatest risk to the existing baseline has been assessed as vessel collision, either by project vessels interacting with the existing shipping or vice versa, however due to all vessels operating in compliance with COLREGs the frequency has been assessed as extremely remote, lowering the overall risk rating.