BRITISH TELECOMMUNICATIONS PLC

R100 Inner Hebrides Telecommunication Cables

Technical Appendix D - Navigation Risk Assessment

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Technical Appendix D - Navigation Risk Assessment

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SUMMARY

Digital Connectivity plays a vital role in supporting telecommunications across the UK, as has been demonstrated during the continuing Covid-19 pandemic.

The R100 Project will enhance the existing infrastructure and extend superfast broadband coverage across Shetland, Orkney and the Inner Hebrides as part of the Scottish Government's 'Reaching 100%' (R100) programme (30Mbps).

This project has been contracted to BT, who have sub-contracted Global Marine Ltd (GM) to supply and install the marine elements, comprising new submarine cables between Orkney, Shetland and the Inner Hebrides.

Intertek Energy & Water (Intertek) have been commissioned by Global Marine Systems Ltd (GM) to conduct Navigation Risk Assessments (NRAs) for the installation and operation of 16 fibre optic cables in three geographical regions which are Orkney, Shetlands and the Inner Hebrides.

The scope of work of this NRA is to identify and assess potential risks to shipping and navigation arising from the installation and associated activities of the fibre optic cables in the Inner Hebrides.

A review of data including anonymised Automatic Identification System (AIS) data, incident data, vessel density grids, existing infrastructure, navigational features, and anchoring (identified by stationary AIS signals and on admiralty charts) along the corridors have been carried out to define the existing shipping and navigation baseline. In summary:

- The highest number of vessels operating across the corridors have been identified as operational ferries along defined ferry routes.
- Fishing is generally consistent all year round, however peak seasons vary between November to December and June to July across the corridors.
- The cable corridor do not cross any Traffic Separation Schemes (TSS).
- Marine Accidents (including false alarms, hoaxes and personal injury) are around less than 1 per year. Machinery failure and collisions are negligible, and it is not expected that the presence of project vessels will increase the risks to the existing baseline of marine safety.

Hazards to shipping and navigation during the marine campaign works (cable installation) have been identified across the corridors and risk control measures such as best practice and compliance mitigation have been proposed to reduce the hazards to As Low As Reasonably Practicable (ALARP).

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ABBREVIATIONS

AIS
Automatic Identification System

ALAPR
As Low As Reasonably Practicable

BMH
Beach Manhole

BT
British Telecommunication Plc

BU
Branching Unit

EEZ
Exclusive Economic Zone

EMODnet
European Marine Observation and Data Network

HM
Her Majesty

GM
Global Marine

IRL
Ireland

IoM
Isle of Man

km
Kilometre

NRA
Navigation Risk Assessment

nm
Nautical Mile

MAIB
Marine Accident Investigation Branch

MCA
Maritime and Coastguard Agency

MHWS
Mean High Water Springs

mm
Millimetre

MMO
Marine Management Organisation

MLV
Main Lay Vessel

MSLOT
Marine Scotland Licensing Operations Team

OREI
Offshore Renewable Energy Installations

PLIB
Post Lay Inspection Burial

PLN
Port Letter Number

PLGR
Pre Lay Grapnel Run

RC
Route Clearance

ROV
Remotely Operated Vehicle

RNLI
Royal National Lifeboat Institution

RYA
Royal Yachting Association

SOLAS
Safety of Life at Sea

UK
United Kingdom

UKHO
United Kingdom Hydrographic Office

VHPM
Vessel Hours Per Month

1. INTRODUCTION

1.1 Project overview

BT is proposing to install 16 submarine fibre optic cables in three geographical regions: Orkney, Shetland and the Inner Hebrides. This report forms 3 of 3 reports and focuses on **Inner Hebrides**, covering 4 cable corridors as follows:

- Orkney – Seven corridor [ref P2308 R5391]
- Shetland – Five corridors and a Branching Unit [ref P2308 R5367]
- **Inner Hebrides – Four corridors [ref P2308 R5368]**

These new cables will form part of the 'Reaching 100%' (R100) BT programme.

A full project description for installation of the R100 cable corridors is provided in Appendix A

1.2 Scope and Objectives

The purpose of this NRA is to identify potential risk to shipping and navigation arising from the installation of the fibre optic cables and associated activities. The study will examine potential effects on existing shipping activities including fishing and recreational activities, or navigational features.

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.

This NRA covers marine operations that are being carried out during cable installation only.

1.3 Inner Hebrides Geographical Area

There are four cable corridors connecting various islands and/or the mainland in the Inner Hebrides highlighted in **Figure 1-1** (P2308-LOC-001_IH). Details of cable corridor landing points and positions are described in **Table 1-1**.

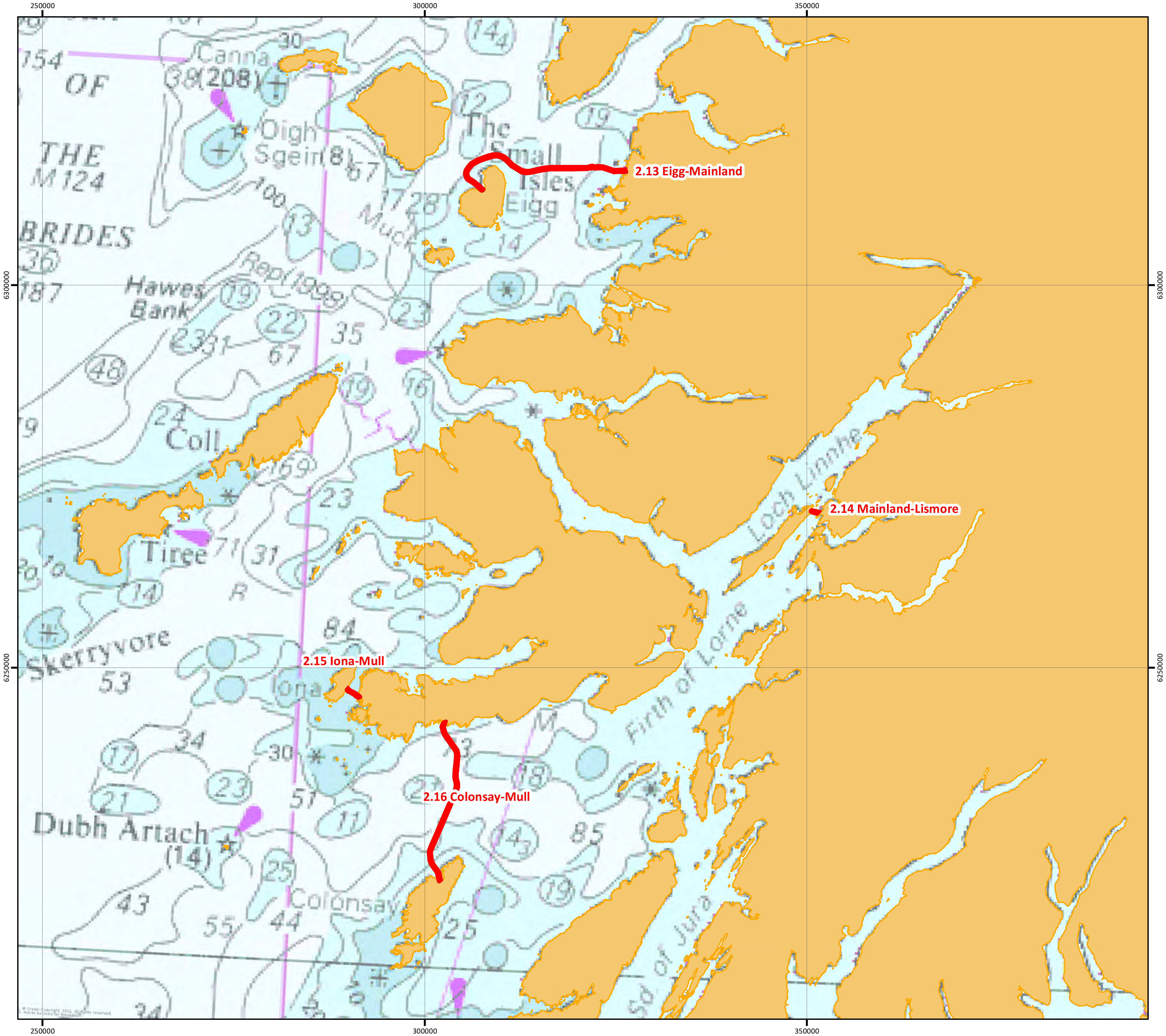
SCOTTISH ISLES
FIBRE OPTIC CABLE PROJECT

LOCATION OVERVIEW
Cable Route Application Corridors - Inner Hebrides

Drawing No: P2308-LOC-001_IH	D

Legend

Cable Route Application Corridor



NOTE: Not to be used for Navigation

Date	18 October 2021
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	ONS; MarineFind; ESRI;
File Reference	J:\P2308\Mxd\01_LOC\ P2308-LOC-001_IH.mxd
Created By	Chris Dawe
Reviewed By	Abigale Nelson
Approved By	Paula Daglish

0 5 10 15 20 km

Table 1-1 Estimated BMH Positions

Cable Segment	Landing Point	Estimated BMH Latitude	Estimated BMH Longitude
2.13	Eigg	56° 54.867' N	6° 09.564' W
	Mainland	56° 56.737' N	5° 51.298' W
2.14	Mainland	56° 33.126' N	5° 24.892' W
	Lismore	56° 33.249' N	5° 26.048' W
2.15	Iona	56° 18.790' N	6° 21.977' W
	Mull	56° 19.484' N	6° 23.904' W
2.16	Colonsay	56° 06.019' N	6° 10.737' W
	Mull	56° 17.568' N	6° 11.270' W

**Larger search area used to account for updated route to Scoor landfall*

1.4 Data sources

Baseline conditions for this NRA 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:

- EMODnet vessel density maps of European waters, 2019 (Ref 1);
- Admiralty charts (FindMaps 2018) (Ref 2)
- Royal Yachting Association (RYA), 2019 (Ref 3)
- MMO Fishing Data, 2016 (Ref 4)
- Marine Traffic (Ref 5)
- RNLI Incident Data (ref 6)
- Marine Accident Investigation Branch (MAIB) (ref 7)

1.4.1 AIS 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 and merchant shipping regulations, 2011, a class A Automatic Identification System (AIS) (regulation 8A) 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 15m. 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.

1.4.2 EMODnet data

The EMODnet (ref 1) 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 1-2**) for every month of 2019 on a 1km grid that follows the EEA / Inspire standards.

Table 1-2 EMODnet Ship Category Descriptions

EMODnet Ship Category	AIS Ship Type Description
Other	Wing in ground (WIG), Diving ops, 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 (2019)

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

For the RYA dataset, AIS data from recreational vessels was used to determine the density per unit area of boating in UK coastal waters, to give a picture of the most utilised routes and areas by leisure boaters. The AIS data covers the UK coastal region, including the Channel, and the Irish Sea, currently utilising data from May to September of 2014 and 2017 (ref 2).

Intertek has analysed the 2019 EMODnet dataset that was recently released (March 2020) has been processed using the following stages:

- Collation of AIS data.
- Extraction of all recreational vessels identifying themselves as Sailing or Pleasure Craft.
- Verification of any vessel over 24 m in length using external databases, while those under 24 m were assumed to be recreational.
- Removal of vessels with a Port Letter Number (PLN), as these were assumed to be fishing vessels.
- Removal of vessels with the strings 'survey', 'fish'.

All charted data is presented in Vessel Hours Per Month (vhpm). For this report, the intensity is defined as per the classifications (defined by Intertek) in **Table 1-3** below.

Table 1-3 VHPM Intensity Classification

VHPM range	Intensity Classification
200 - <500	Very High
100 - 200	High
20 - 100	Medium to High
10- 20	Medium
5-10	Low
0-5	Very Low

1.4.3 RNLI data

RNLI incident callout data (ref 6) documents marine incidents between 2008 and 2019. For this assessment, the assigned classifications have been further grouped to so the data can be visualised and assessed clearly. **Table 1-4** below details the applied grouping.

Table 1-4 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
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	

RNLI Data Classification	Intertek Grouping for Assessment
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	
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	

RNLI Data Classification	Intertek Grouping for Assessment
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

1.4.4 RYA Data

AIS data from recreational vessels are used to determine the density per unit area of boating in UK coastal waters, to give a picture of the most utilised routes and areas by leisure boaters.

The AIS data covers the UK coastal region, including the Channel, and the Irish Sea, currently utilising data from the summers of 2014 and 2017.

Data processing for the 2019 update includes:

- Collation of AIS data for May to September of 2014 and 2017.
- Extraction of all recreational vessels identifying themselves as Sailing or Pleasure Craft.

- Verification of any vessel over 24 m in length using external databases, while those under 24 m were assumed to be recreational.
- Removal of vessels with a Port Letter Number (PLN), as these were assumed to be fishing vessels.
- Removal of vessels with the strings ‘survey’, ‘fish’, ‘wind’, ‘farm’, or ‘prawns’ in their destinations.
- Verification with external databases of any vessels with irregular tracks.
- Use of ArcGIS toolkit to calculate the number of AIS tracks within 0.25 km x 0.25 km cells to obtain a relative density for each cell and produce a mean value across the two summers.

1.4.5 Cable route desktop study

The cable route desktop study (ref 8) was used to inform this assessment which included (among other things) a review of the risk identification and assessment of anthropogenic hazards to the cable such as fishing and ship’s anchors.

1.5 Study area

This NRA covers the Marine components of the fibre optic cables highlighted in **Figure 1-1** (P2308-LOC-001_IH).

The study area for each cable route have been defined using a minimum distance of 2km (5km for route 2.3) either side of the cable routes (500m), resulting in a minimum corridor of 4.5km taking into consideration the full navigable area extents, to ensure that sufficient baseline shipping information is captured for each cable. The corridor has then been edited on a case-by-case basis to be clipped to the Mean High Water (MHW) and adjusted for headlands/peninsulas so vessel traffic that will never cross the cable route is discounted. The search area has been based on client input and guidance from the section 4 of IMOs Formal Safety Assessment which states that the baseline needs to be established before an assessment can be carried out.

Table 1-5 below summarises the search areas used for the analysis of baseline shipping.

Table 1-5 Search Radius Across the R100 Cable Corridors in Inner Hebrides

ID	Segment	Area	Search Radius applied to Cable corridor
2.13	Eigg-Mainland	Inner Hebrides	2000m
2.14	Mainland-Lismore	Inner Hebrides	2000m
2.15	Iona-Mull	Inner Hebrides	2000m
2.16	Colonsay-Mull	Inner Hebrides	5000m*

**Larger search area used to account for updated route to Scoor landfall*

All AIS data and navigational features dataset presented in this report are limited to the search area relative to each cable.

The defined study area shall be known as the **Cable Corridor** or **Geographical Area**.

1.6 Consultation

Table 1-6 summarises the relevant aspects of the consultation responses, specific to shipping and fishing navigation for the R100 Corridors in Inner Hebrides.

Table 1-6 Consultation responses

Stakeholder	Comment	How this has been addressed
Maritime and Coastguard Agency (MCA)	We would expect the NRA to detail the impact on navigation for commercial, fishing and recreational craft; including identifying traffic levels, collision risk, emergency response, lighting and marking, and mitigation measure to reduce risks to ALARP, with a detailed methodology. Particular attention should also be paid to cabling routes and burial depth for which a Burial Protection Index study should be completed and subject to the traffic volumes, an anchor penetration study may be necessary. Cable protection works must ensure existing and future safe navigation is not compromised, accepting a maximum of 5% reduction in surrounding depth referenced to Chart Datum	Addressed within the NRA Burial protection Index not yet defined. Planned to bury the cable to 1m where possible
Northern Lighthouse Board (NLB)	Northern Lighthouse Board are content with the proposed EIA study and will respond in full to the Marine Licence application. We also request the following: Northern Lighthouse Board should be included in the Navigation Risk Assessment consultation by contacting them navigation@nlb.org.uk. Northern Lighthouse Board are invited to the on-line Pre-Application Consultation events for each of the areas.	NRA has been produced for the Inner Hebrides Geographical Area. A copy of the NRA shall be made available to the Northern Lighthouse Board if necessary
Scottish Creel Fishermen's Federation	Initial FLO consultation and fisheries workshops. Pre-application consultation event. Opportunity to comment on FLMAP – see FLMAP for further details	Fisheries Liaison Mitigation Action Plan has been developed in consultation with fishing interests in the Inner Hebrides Geographical Area. Any mitigation proposed in the FLMAP has been used where appropriate in the NRA. The FLO team will work collaboratively throughout each project phase to ensure that stakeholder relationships are built around efficient and transparent communication pathways. In doing so, the Project team aims to minimise and largely mitigate impacts on others in the industry.
Scottish Fishermen's Federation		
Mallaig Fishery Office		
Oban Fishery Office		
Portree Fishery Office		
Scottish Fishermen's Organisation		
Inshore Fisheries Alliance		
Scottish White Fish Producers Association (SWFPA)		
Regional Inshore Fisheries Group (RIFG)		
Scottish Salmon Producers Organisation (SSPO)		
Scottish Sea Farms Ltd		
Mallaig & North-West Fishermen's Association (MNWFA)		

Stakeholder	Comment	How this has been addressed
Ross, Sutherland, Skye & Lochalsh Fishermen's Association (RSSLA)		
Mowi Scotland		
West of Scotland Fish Producers Organisation (WSFPO)		
Mallaig Harbour Master		
Clyde Fishermen's Association (CFA)		
Western Isles Fishermen's Association		
Oban Harbour Authority		

1.7 Guidance and methodology

This report has been prepared in accordance with current 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 telecommunications cables, consideration to linear cables in relation to offshore renewable structures has been considered using:

- Maritime and Coastguard Agency (MCA) MGN 654 (Merchant + Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response (April 2021)
- Marine Guidance Note 372 "Offshore Renewable Energy Installations (OREIs) - Guidance to Mariners operating in the vicinity of UK OREIs"
- Methodology for Assessing the Marine Navigational Safety Risks & Emergency Response of Offshore Renewable Energy Installations

Where applicable, further consideration has been given to:

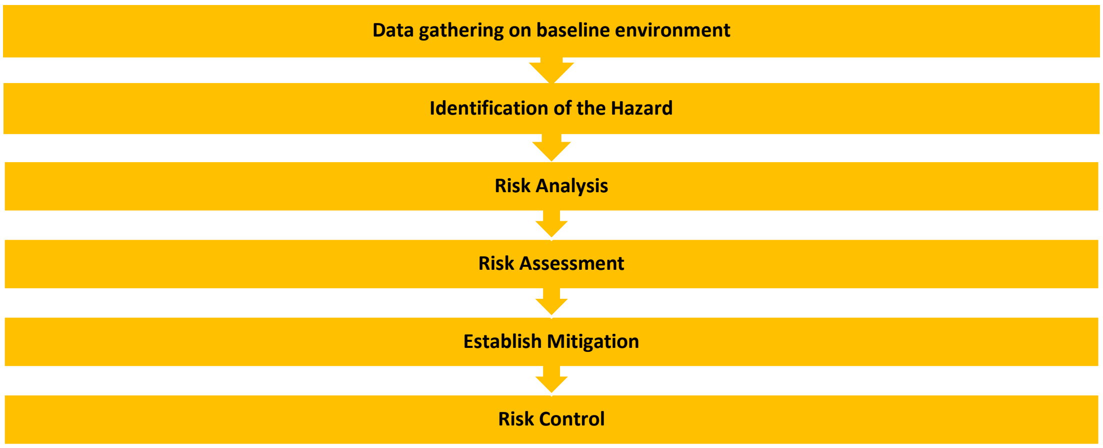
- Port Marine Safety Code (PMSC) (Dept. for Transport & Maritime and Coastguard Agency Nov 2016)
- Guide to Good Practice on Port Marine Operations (GtGP) (Dept. for Transport & Maritime and Coastguard Agency Feb 2018)

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**. In carrying out these assessments, Intertek has addressed, as far as reasonably possible, the following phases of the Proposed Development:

- Pre-Installation works
- Cable Installation
- Post Installation works

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.

1.7.2 Data gathering on baseline environment

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

1.7.3 Data Analysis on Baseline Data

The analysis includes:

- Potential accidents resulting from navigation activities (MIAB & RLNI)
- Navigation activities affected by the Proposed Development
- Proposed Development structures that could affect navigation activities, such as external protection installed on the seabed
- Proposed Development 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)

1.7.4 Identification of the hazard

The hazard identification phase seeks to build on the work of the data gathering and identify 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 Proposed Development may make it more likely that existing vessels will deviate from the COLREGS, either as an intended or unintended action.

This may include any effects which the Proposed Development might have on existing vessels such as vessels giving appropriate clearance to cable installation operations and potential obstruction to the light and sound signals made by vessels and navigational aids.

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.

1.7.5 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 assess their impact on navigational safety

Risk is the combination of frequency and consequence which are defined in **Table 1-7** and **1-8** below. 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 1-7 Frequency of a hazard

Value	Description	Definition
1	Extremely Remote	Very Unlikely to occur during marine operation
2	Remote	Unlikely to occur during marine operation
3	Probable	Likely to occur during marine operation
4	Very Probable	Very Likely to occur during marine operation
5	Frequent	Certain to occur during marine operation

Table 1-8 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.

1.7.6 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 can be carried out using a risk matrix, adapted from the guidance above, presented in **Table 1-9**

Table 1-9 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 Proposed Development has on the baseline shipping environment. This is undertaken prior to any mitigation. Compliance and Best Practice Mitigation will then be applied to reduce the effects to ALARP.

Definitions of the risk levels are provided in **Table 1-10** below.

Table 1-10 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.

1.7.7 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 Proposed Development design which are referred to as **Best Practice Mitigation**; and mitigation which is part of the construction of the Proposed Development, which is referred to as **Compliance Mitigation**.

1.7.8 Risk control

The aim of assessing the Proposed Development 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 Compliance 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.

2. PROJECT DESCRIPTION

2.1 Installation overview

This chapter presents information on the planned installation of the marine components of the R100 cable system.

The key activities to be undertaken during installation are:

- Route preparation: pre-lay grapnel run (PLGR) and route clearance (RC);
- Cable installation (plough burial, surface lay);
- Shore end installation; and
- Post lay inspection and burial (PLIB).

All products, equipment and/or vessel specifications detailed in this section are indicative. In the event that the Project does not/cannot use the specified equipment similar products will be selected.

2.1.1 Summary of Operations

Table 2-1 below summarises the estimated cable installation operations including duration and location of activities.

The following assumptions have been made. Note that progress rates may change depending on as found conditions:

- Pre-Lay Grapnel Run (PLGR) and Route Clearance (RC) progress rates of **1500m/hour**
- Cable Lay (Includes Plough Burial and Surface Lay)
  - Plough Burial based at **600m/hour**
  - Surface lay based on **2000m/hour**
  - Includes Uraduct at crossings
  - Includes vessel time for shore end landing
- Post Lay Inspection and Burial (PLIB)
  - PLB (Post Lay Burial) progress rate - **200m/hr**
  - PLI (Post Lay Inspection) progress rate - **400m/hr**
- Diver/ROV pre-install survey at shore ends progress rates of **1 day assumed for survey at each landing (where standard MLV installation), 5 days for nonstandard MLV installation**
- Diver/ROV post install survey and Shore End Burial. **7 days for each landing estimated including survey, set up for burial and burial, additional time for non MLV installation**
- Contingency: Rock bags, mattressing, rock placement for areas where cable burial is not possible due to seabed conditions, remedial protection may be required to help protect both the cable and other seabed users. **2 days included but contingency requirements unknown so may not require anything or may require more. Some contingency operations may be needed preinstall and some post install.**

Contingencies will be carefully engineered in water depths less than 10m and therefore will not reduce the depth by more than 5%

Where cable installation from main lay vessel is not required a multicat or subaqueous solution is provided.

Table 2-1 Summary of works (estimated days)

Installation activity	2.13 Eigg - Mainland	2.14 Mainland - Lismore	2.15 Iona - Mull	2.16 Colonsay - Mull
Pre-installation works Route clearance and PLGR	3	Included in Diver/ROV pre install survey at Shore ends (if required)	Included in Diver/ROV pre install survey at Shore ends (if required)	2
Installation: Cable Lay, Burial and Surface Lay	2.5	Included in NO MLV solution	Included in NO MLV solution	3
Installation: Post-lay inspection and burial (PLIB)	2	Included in Diver/ROV post install survey and Shore End Burial	Included in Diver/ROV post install survey and Shore End Burial	2
Diver/ROV pre installation survey at Shore ends	2	10	10	2
Diver/ROV post installation survey and Shore End Burial	14	16	16	14
Contingency: Boulder Relocation, Rock bags, Concrete mattressing, Rock placement	2	2	2	2
No MLV installation - Multicat or subaqueus solution	N/A	2.5	2.5	N/A
Total days of Installation Activity	25.5	30.5	30.5	25

2.2 Subsea route development

The marine cable route and project design are developed and refined through two main stages:

- Marine cable route study (ref 8) – detailed review of all factors affecting the routing of the cable, including physical, environmental, socioeconomic, and regulatory aspects; and
- Marine cable route survey – surveys of the inshore and offshore sections of the route.

A cable route study was produced to inform pre-survey route planning and marine cable route survey. It provides comprehensive and accurate information for cable engineering, system installation and identification of constraints during the 25-year design life of the R100 Cable Routes.

Global Marine achieve this using customised GIS technology known as GeoCable™. The combination of all information sources into one system provides a clear picture of the locations and combinations of risks to the cable and the options available to avoid or mitigate the risk. Alternatively, routing of cables into areas likely to maximise protection through burial can also be considered. Final planning using MakaiPlanTM allows accurate infill slack values to be inserted into the Route Position List (RPL), based on the expected morphology of the seabed to improve cable lay planning (ref 8).

The primary rationale for cable route engineering is to avoid areas likely to pose a threat to system security. Shipping and fishing density are considered when determining the threats to system security, and high-density areas such as shipping lanes have been avoided. Sometimes risks cannot be avoided due to the additional cable length required resulting in excessive cost, or other constraints present which take priority. In these cases, the route normally seeks areas conducive to burial as the primary protection measure or an increase in armouring protection is specified if within deployment depth limitations. Where neither is possible the route usually tries to limit the length of cable over which the risk is present (ref 8).

Existing beach manholes (BMHs) which service the R100 cable route have been a key factor in selecting the final landing points from the sites located during the site visit, to minimize the terrestrial works. There is a suite of secondary ducts on both existing cables to the beach and from the BMH to the terminal station (ref 8).

Survey data is being acquired (between May to September 2021) across a 500m wide survey corridor and extended in some areas to accommodate additional landfall options. The marine cable route has been engineered where appropriate to avoid potential hazards, reduce impact to sensitive seabed habitats and users such as disruption to marine resources and operations, and secure long-term protection of the cable.

2.1 Project schedule

Cable installation/route preparation for the relevant routes are scheduled to commence in the 2nd/3rd quarter 2022 and be complete by the end of the year. Following installation, the cables are expected to be in service and operational for at least 25-years.

The marine campaign work could be delayed due to permit conditions or operational and planning reasons therefore the project installation over a 12-month period has been assessed.

2.2 Marine Campaign Works

This section summarise the offshore Marine Campaign works that are being carried for the installation, of the R100 cable corridors. Further details of the marine campaign works are provided in **Appendix A.** Additional marine operations/vessels have been included in the project description for contingency.

2.2.1 Request for Clearance for Safe Working

The cable ship shall request a safe working distance to existing vessels when carrying out works and follow COLREG guidelines. In open waters this might be as much as 1nm, however this is not practical with the geography of inter-island and shall be reduced where necessary.

3. EXISTING BASELINE DESCRIPTION

3.1 Shipping Overview

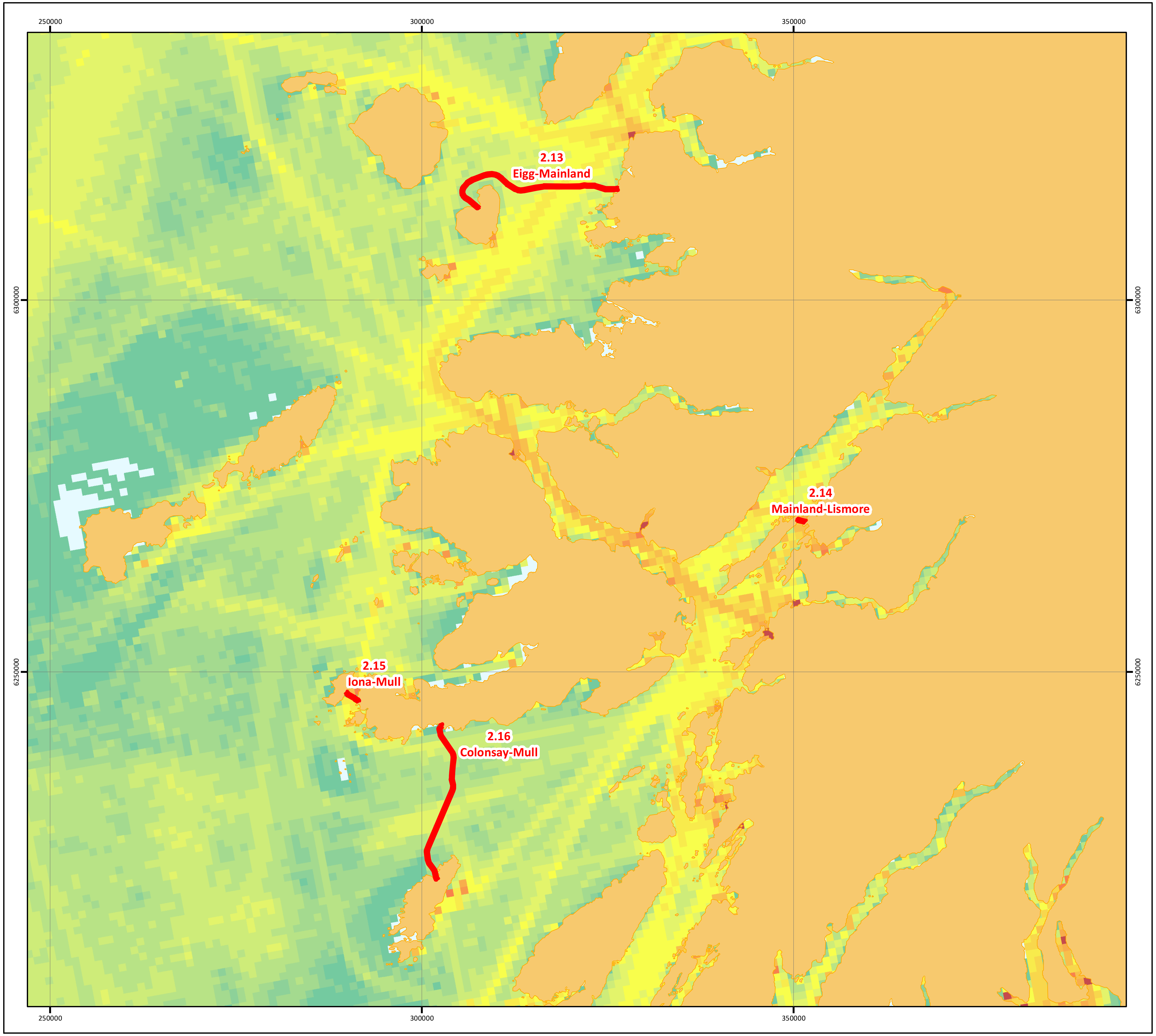
12 months of AIS data from Jan to December 2019 (ref. 1) were analysed within a 4.5km/10.5km search area across each cable route in the Inner Hebrides This will enable examination of the types of shipping occurring near the cable corridors including typical patterns of vessel activity.

It is noted that only a small portion of the recreational craft are likely to be equipped with AIS transponders and the reliance on utilising this data for recreational craft alone is not advised. Recreational vessels with a smaller draft may also cross areas shallower than those shown spatially within the AIS data. Using Coastal Atlas of Recreational Boating data in conjunction with AIS data has been carried out for each cable corridor to understand recreational areas in more detail.

It should be noted that within the month of August in the EMODNet dataset used for this analysis there is an abundance of 'Other' vessels while the previous month, July, has none. This may indicate an anomaly in the AIS data sourced publicly from EMODnet. No other anomalies have been observed in this data.

Additional features of key navigation influences such as buoys, ports and anchorages have also been identified as well as ferry routes operated by Caledonian MacBrayne.

Average monthly vessel density across the region of the Inner Hebrides can be found in **Figure 3-1** (P2308-SHIP-014_IH).



SCOTTISH ISLES FIBRE OPTIC CABLE PROJECT

AIS VESSEL DENSITY
Average Monthly Vessel Density
All Vessels - Inner Hebrides

Drawing No: P2308-SHIP-014_IH	B

Legend

Cable Route Application Corridor

2019 Vessel Density

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	18 October 2021
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	EMODnet; GEBCO; ESRI;
File Reference	J:\P2308\Mxd\04_SHIP\ P2308-SHIP-014_IH.mxd
Created By	Chris Dawe
Reviewed By	Abigale Nelson
Approved By	Paula Daglish

0 5 10 15 20 km

Information contained here has been derived from data that is made available under the European Marine Observation Data Network (EMODnet) Human Activites project (https://www.emodnet-humanactivities.eu/about.php), financed by the European Union under Regulation (EU) No 508/2014 of the European Parliament and of the Council of 15 May 2014 on the European Maritime and Fisheries Fund.; © The GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003; ©Esri;

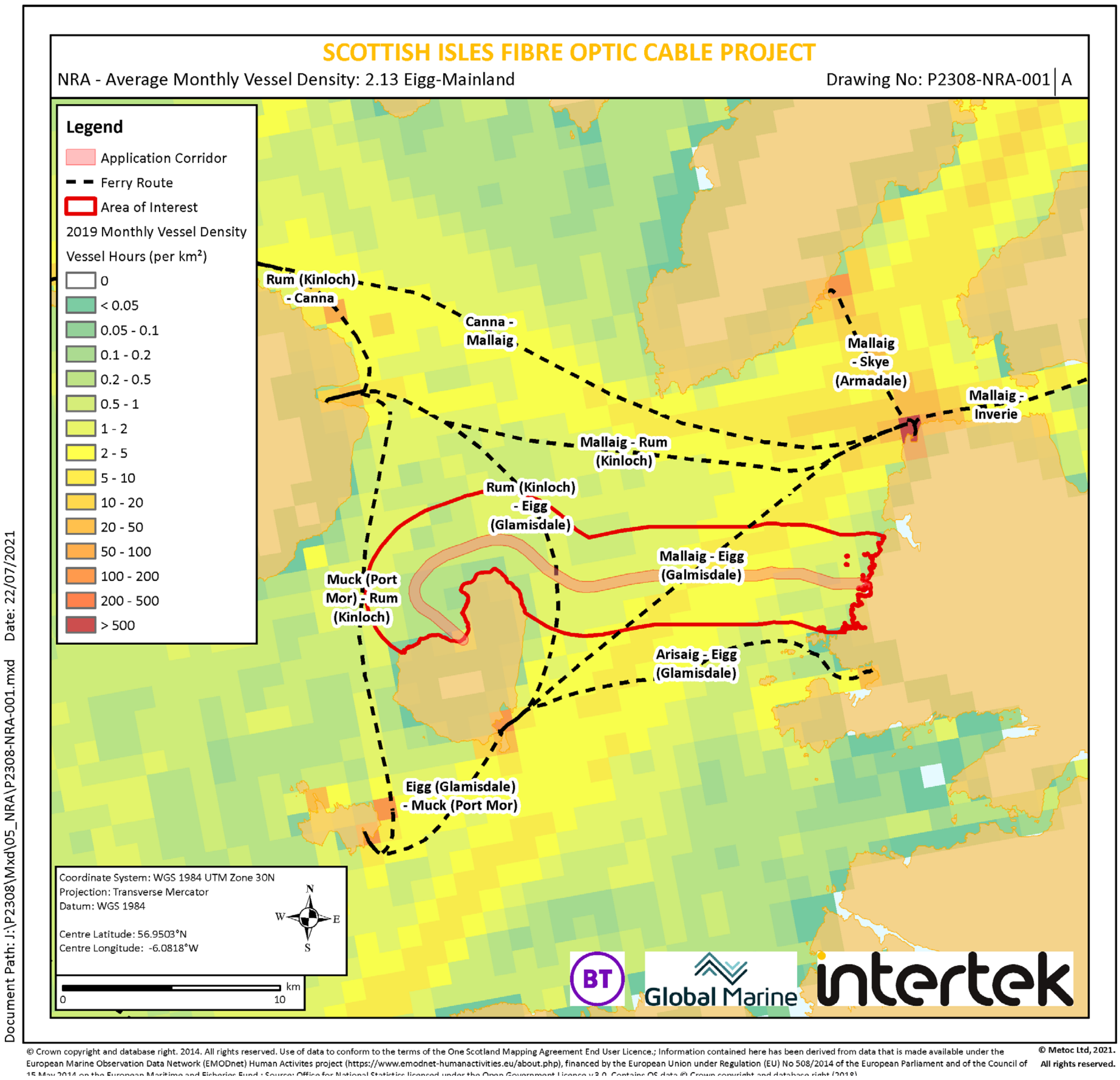
3.1.2 2.13 Eigg – Mainland

Cable Corridor 2.13 extends from Eigg to Mainland Scotland and is approximately 25.6 km in length.

The vessel density across the study area is generally low, between 5 and 10 vhpm. Correlating with ferry routes and shipping lanes transecting the cable corridor.

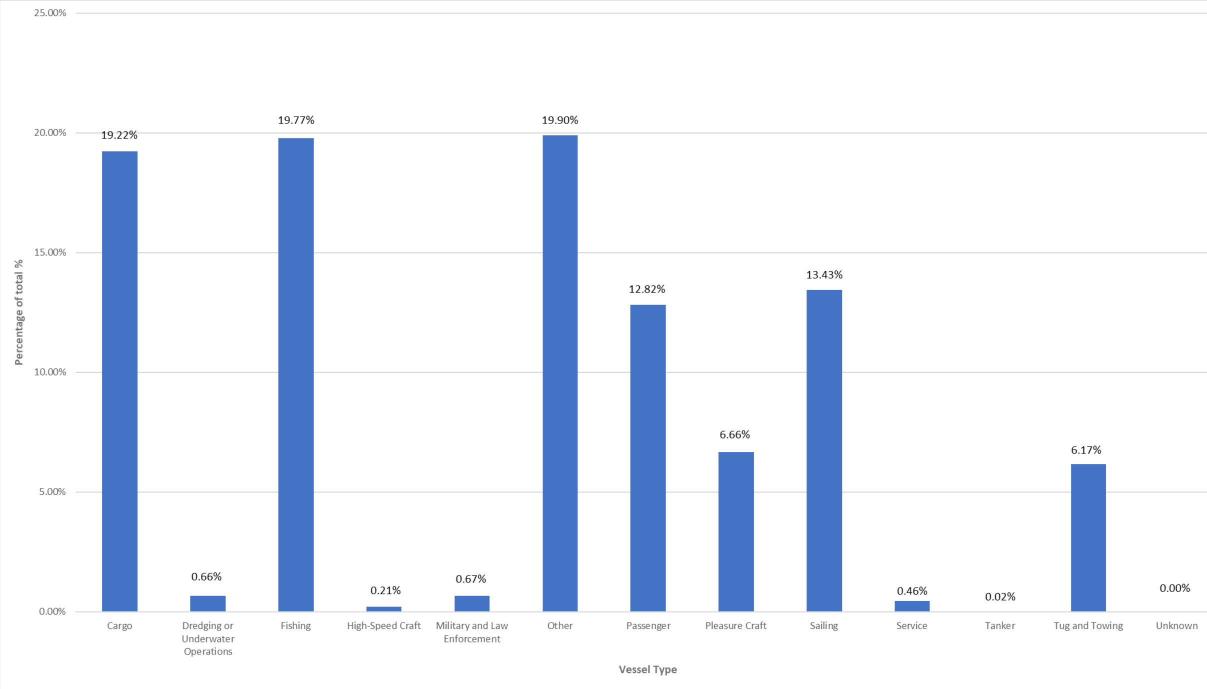
Figure 3-2 highlights the shipping patterns (monthly) and ferry routes across the study area.

Figure 3-2 AIS Intensity and Study Area for 2.13 Eigg - Mainland



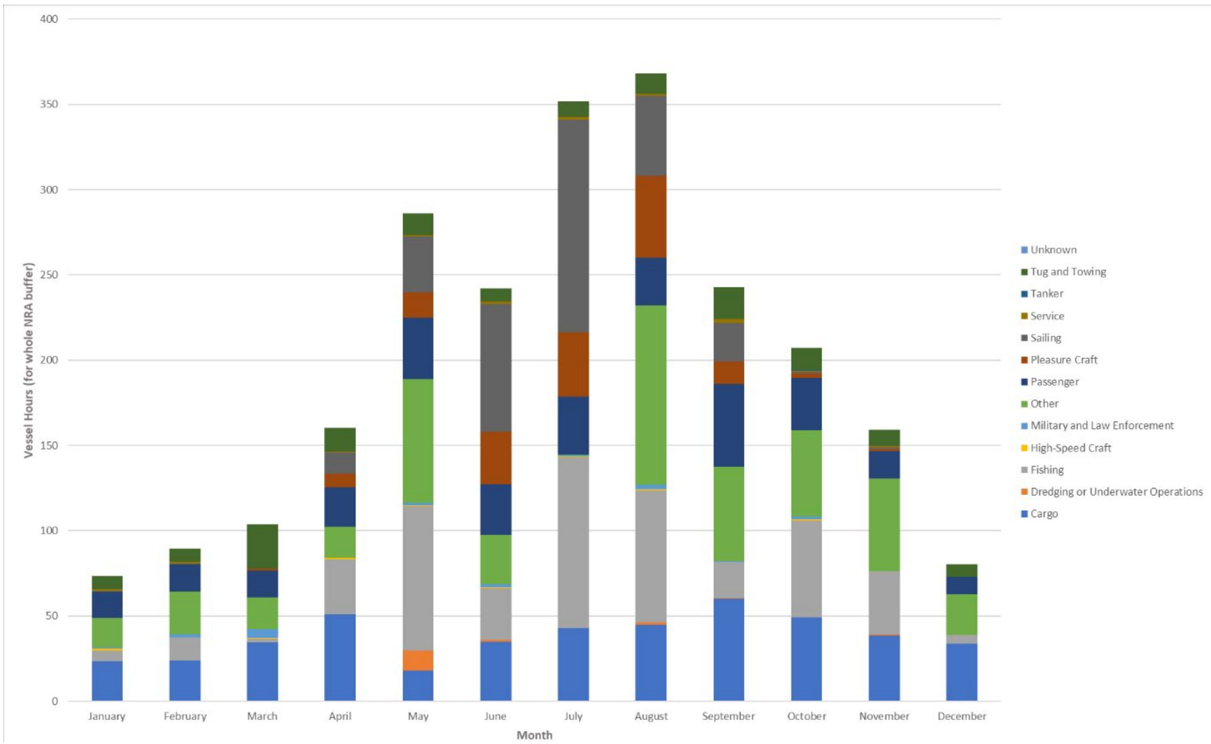
A total vessel density of 2364 hours per month were recorded across the study area in 2019. The percentages of the vessel categories are presented in **Figure 3-3.** There is a fairly even distribution of vessel types across the study area with Cargo, Fishing, Other, Passenger and Sailing making up the majority of the data.

Figure 3-3 Vessel Distribution Across the 2.13 Eigg – Mainland Study Area



Seasonal distribution of the vessel traffic has been analysed across the study area and the busiest months are observed to between May and August. **Figure 3-4** highlights the seasonal changes.

Figure 3-4 Seasonality Changes in Vessel Traffic Across the 2.13 Eigg – Mainland Study Area



Galimsdale Port and Mallaig Harbour are located outside the study area but traffic crossing the routes are associated with vessels moving between these areas.

There are only two ferry routes which transect the cable corridor and may be impacted by the marine campaign works. These are as follows:

- Rum to Eigg
- Mallaig to Eigg

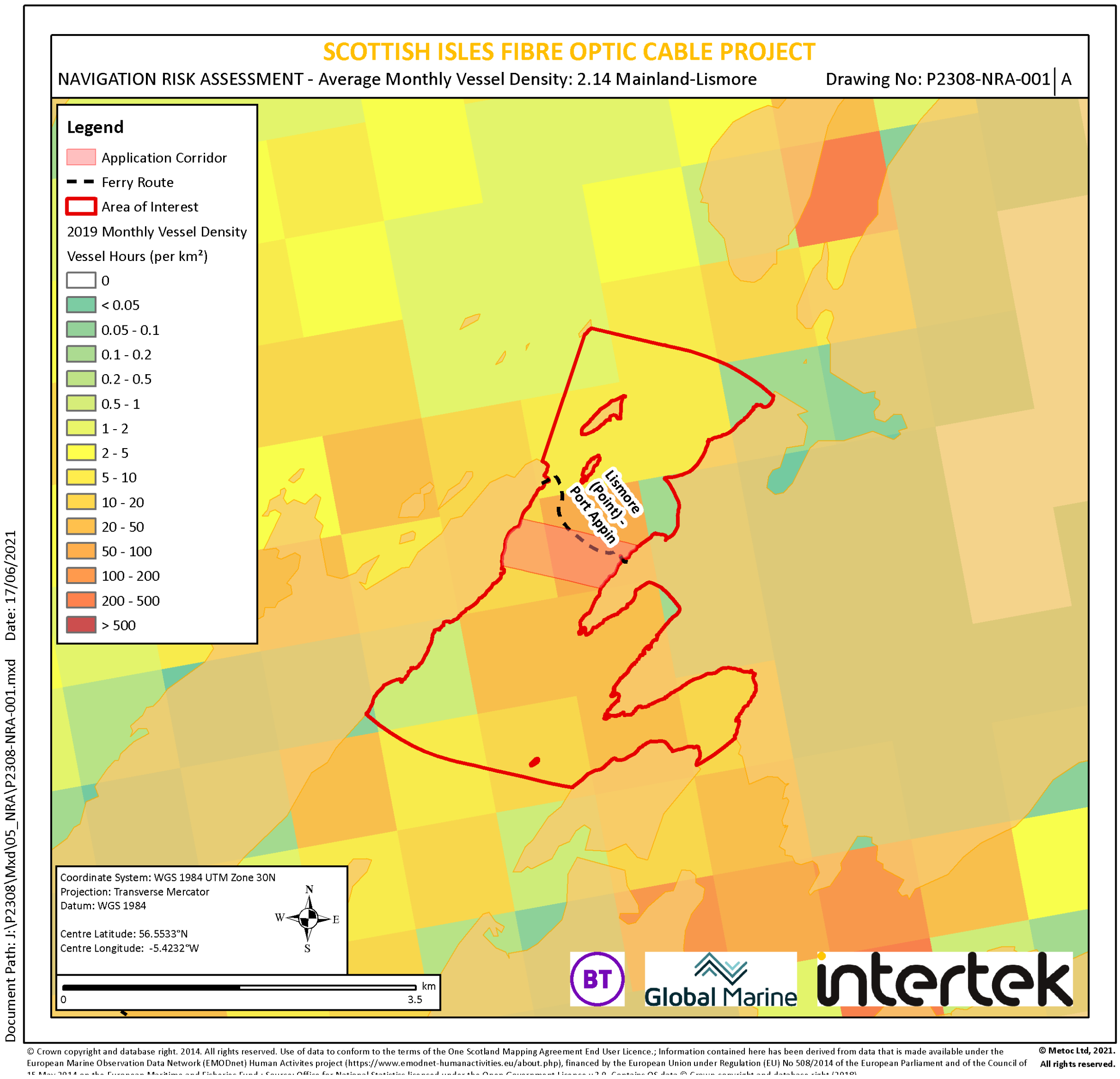
3.1.3 2.14 Mainland – Lismore

Cable Corridor 2.14 extends from Mainland Scotland to Lismore and is approximately 1.18 km in length.

The vessel density across the study area is generally Medium to High (20 – 50 vhpm) with the highest densities associated with a ferry route transecting the cable corridor.

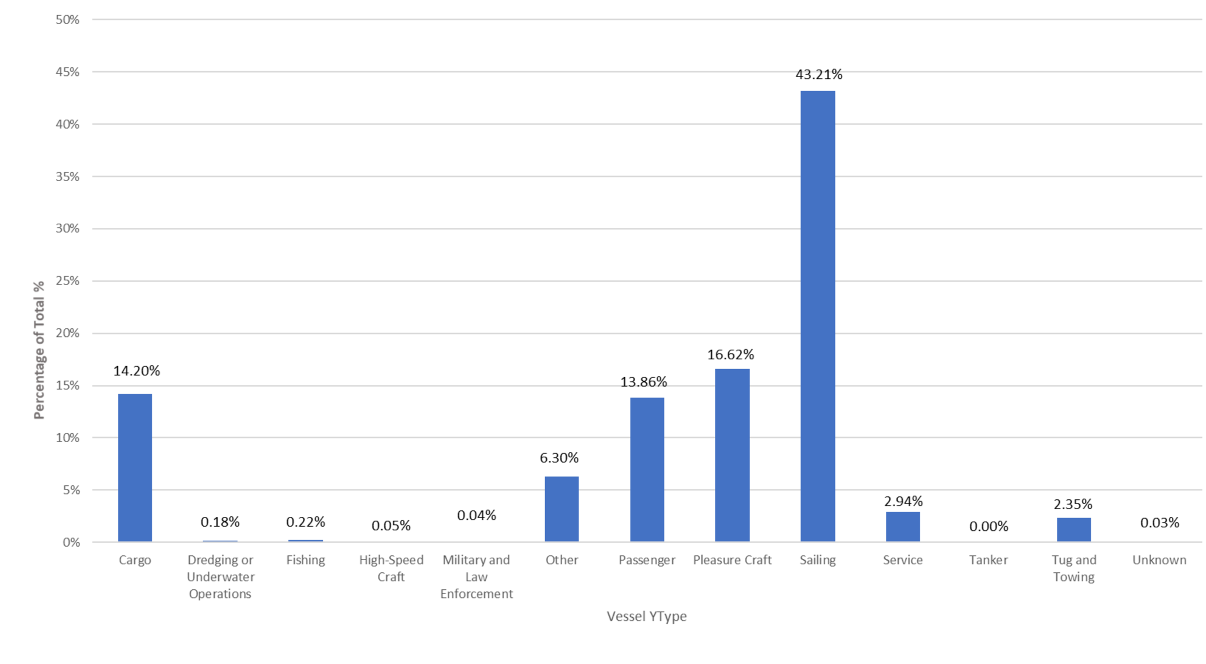
Figure 3-5 highlights the shipping patterns (monthly) and ferry routes across the study area.

Figure 3-5 AIS Intensity and Study Area for 2.14 Mainland – Lismore



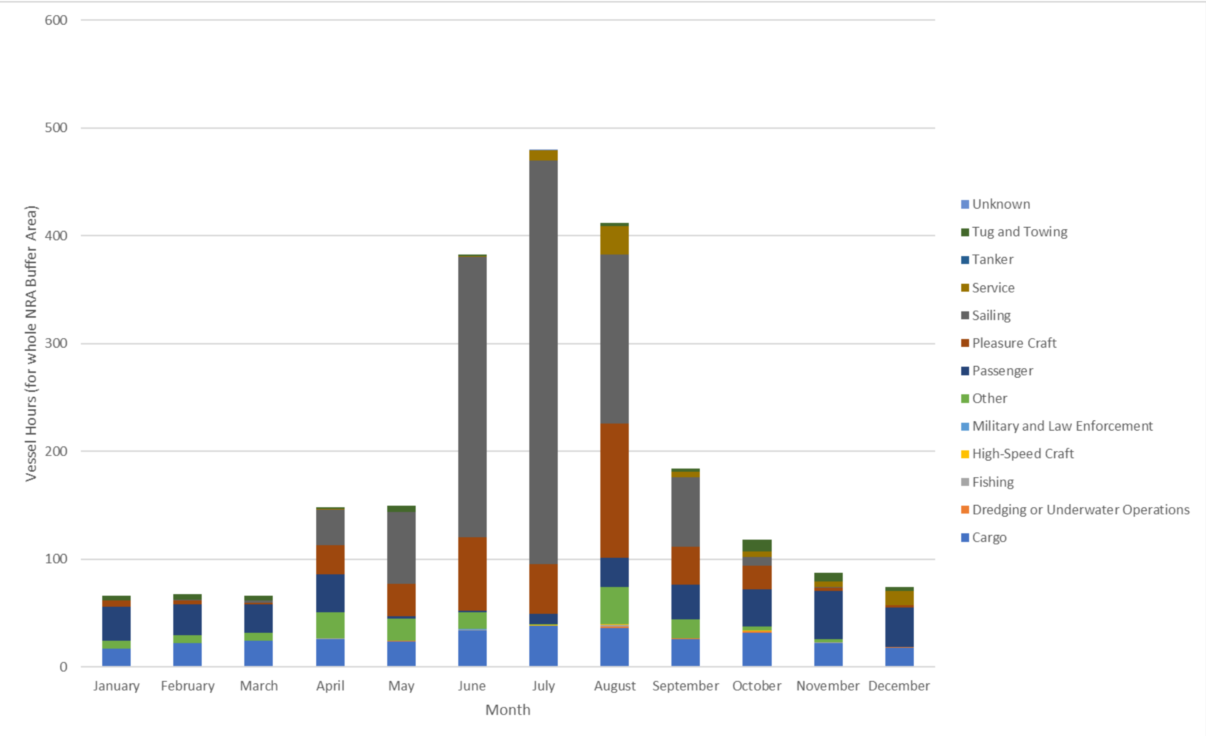
A total vessel density of 2235 hours per month were recorded across the study area in 2019. The percentages of the vessel categories are presented in **Figure 3-6.** The data is generally dominated by sailing vessels (43%).

Figure 3-6 Vessel Distribution Across the 2.14 Mainland – Lismore Study Area



Seasonal distribution of the vessel traffic has been analysed across the cable corridor and is highlighted in **Figure 3-7**. The busiest months are observed to be June, July and August.

Figure 3-7 Seasonality Changes in Vessel Traffic Across the 2.14 Mainland – Lismore Study Area



Port Appin is located within the study area and cable corridor, primarily associated with a passenger vessel arriving and departing the port.

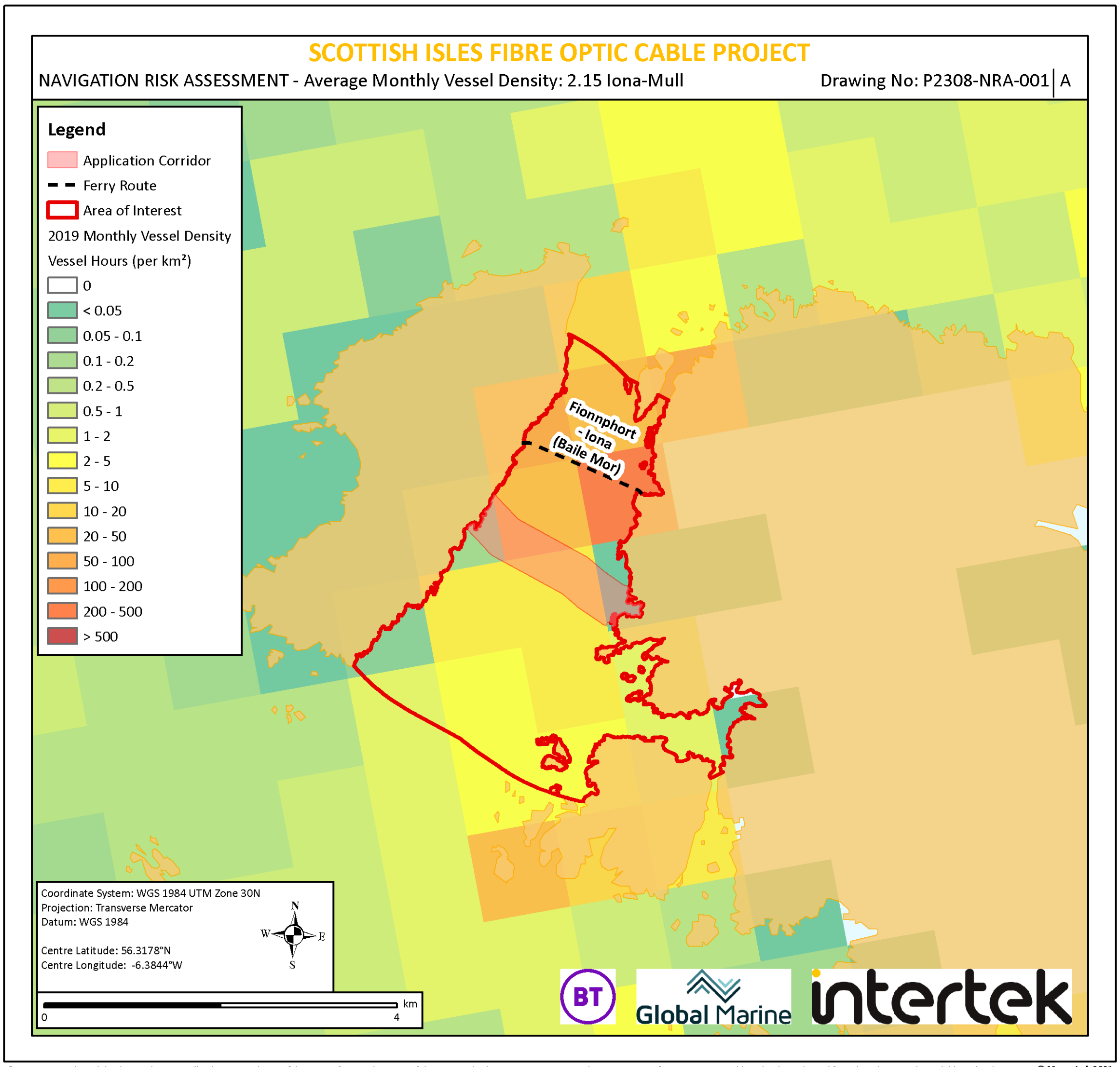
3.1.4 2.15 Iona – Mull

Cable Corridor 2.15 extends from Iona to Mull and is approximately 2.35 km in length traversing the sound of Iona

The vessel density across the study area is generally low (5 – 10 vhpm). And can be correlated with shipping patterns and ferry routes across the study area. Medium intensities are also observed within the study area and can be correlated with vessels using the Fionnphort to Iona ferry to the north of the cable corridor.

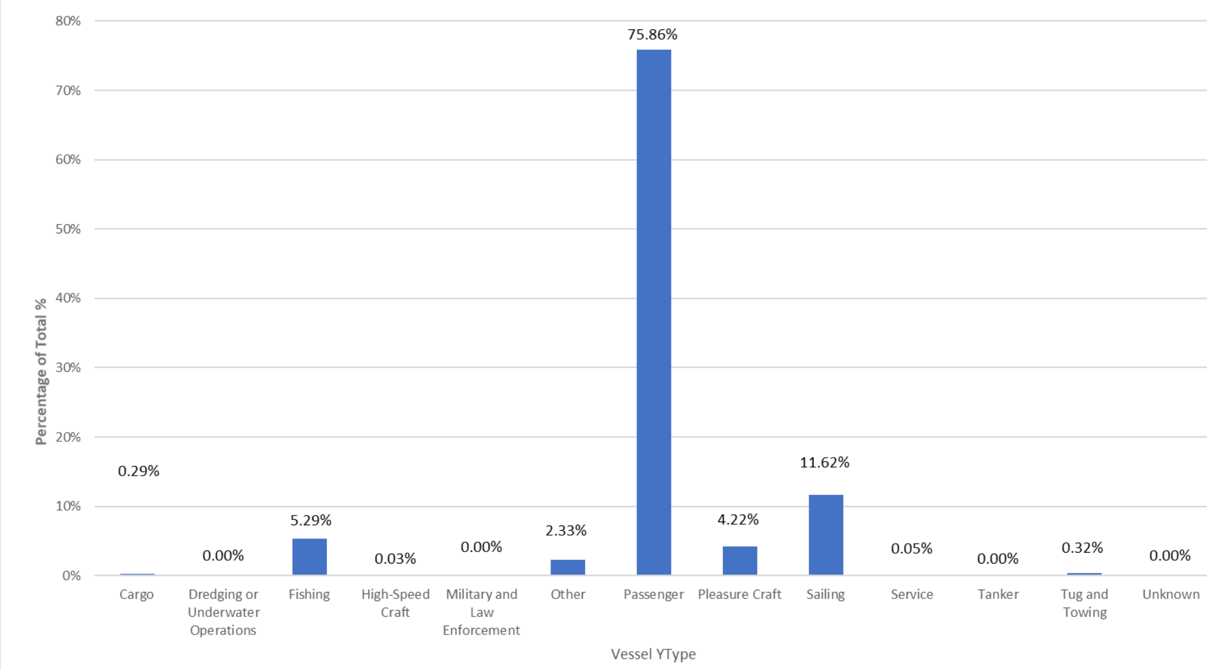
Figure 3-8 highlights the shipping patterns (monthly) and ferry routes across the study area.

Figure 3-8 AIS Intensity and Study Area for 2.15 Iona – Mull



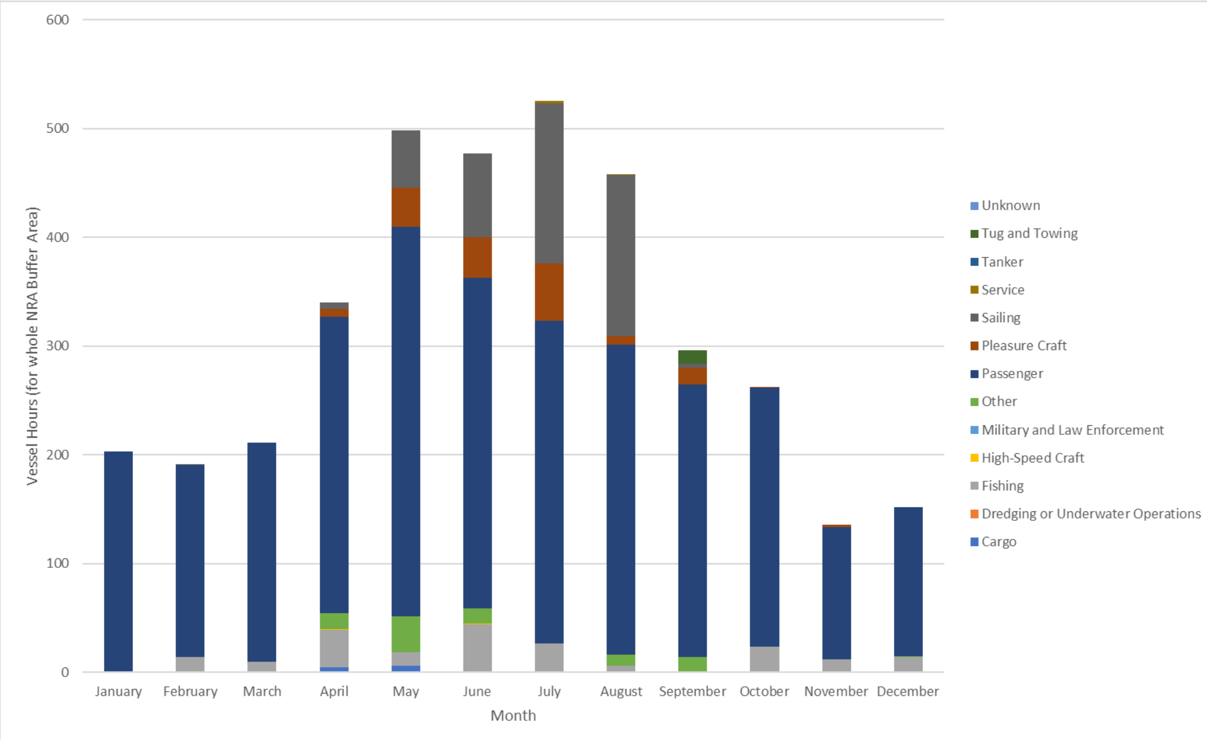
A total vessel density of 3750 hours per month were recorded across the study area in 2019. The percentages of the vessel categories are presented in **Figure 3-9** and can be seen that passenger vessels make up the majority of the data (75%).

Figure 3-9 Vessel Distribution Across the 2.15 Iona – Mull Study Area



Seasonal distribution of the vessel traffic has been analysed across the cable corridor and the busiest months are observed from May to August. **Figure 3-10** highlights the seasonal changes. Note that the passenger vessel is working a similar amount all year round.

Figure 3-10 Seasonality Changes in Vessel Traffic Across the 2.15 Iona – Mull Study Area



There are two ferry terminals within the study area for the Fionnphort to Iona ferry connecting Iona to Mull and is not thought to be impacted by the marine campaign.

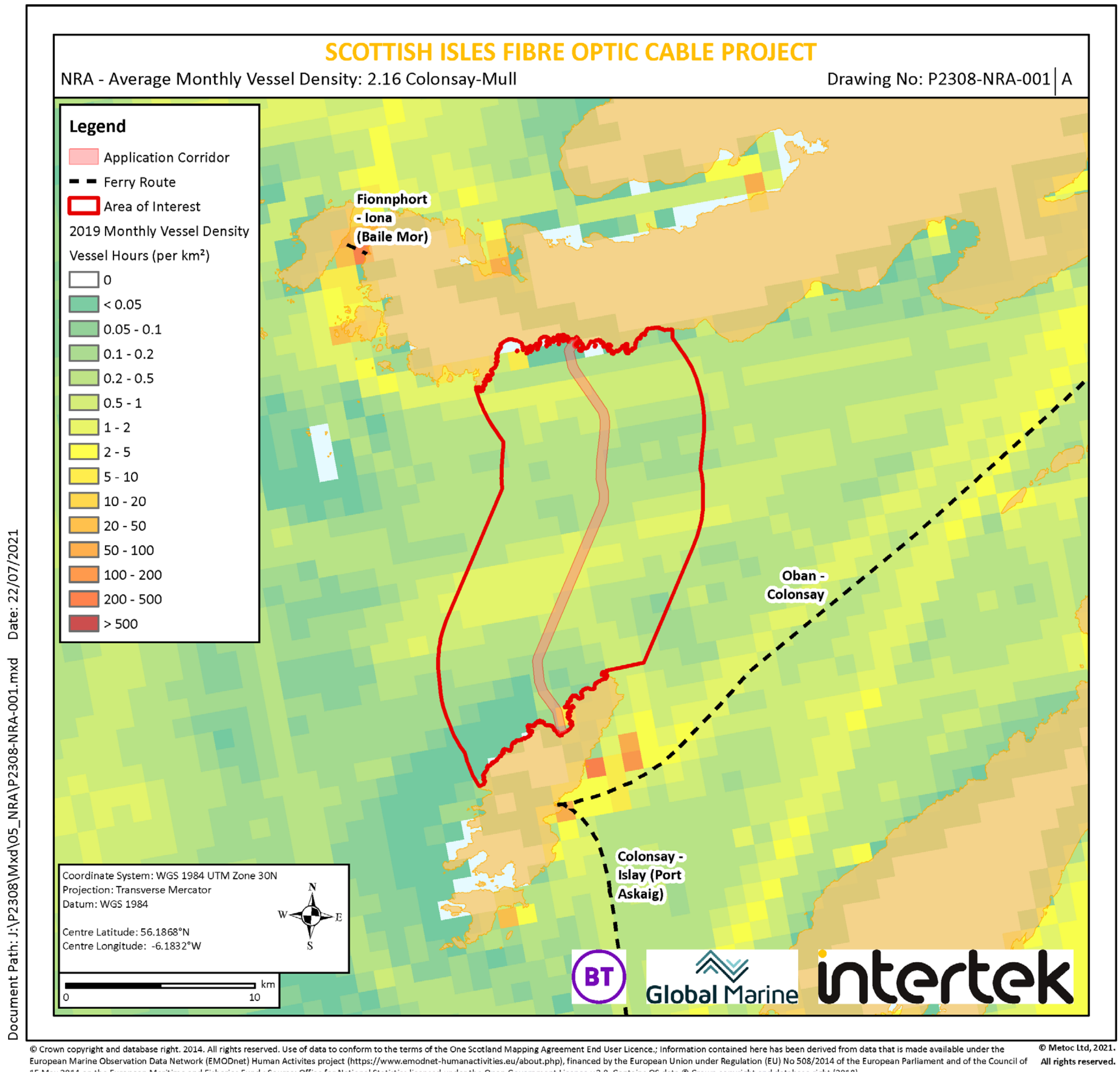
3.1.5 2.16 Colonsay – Mull

Cable Corridor 2.16 extends from Colonsay to Mull and is approximately 22.43 km in length.

The vessel density across the study area is generally very low (0 – 5 vhpm) with little/no correlation to ferry routes and/or shipping lanes.

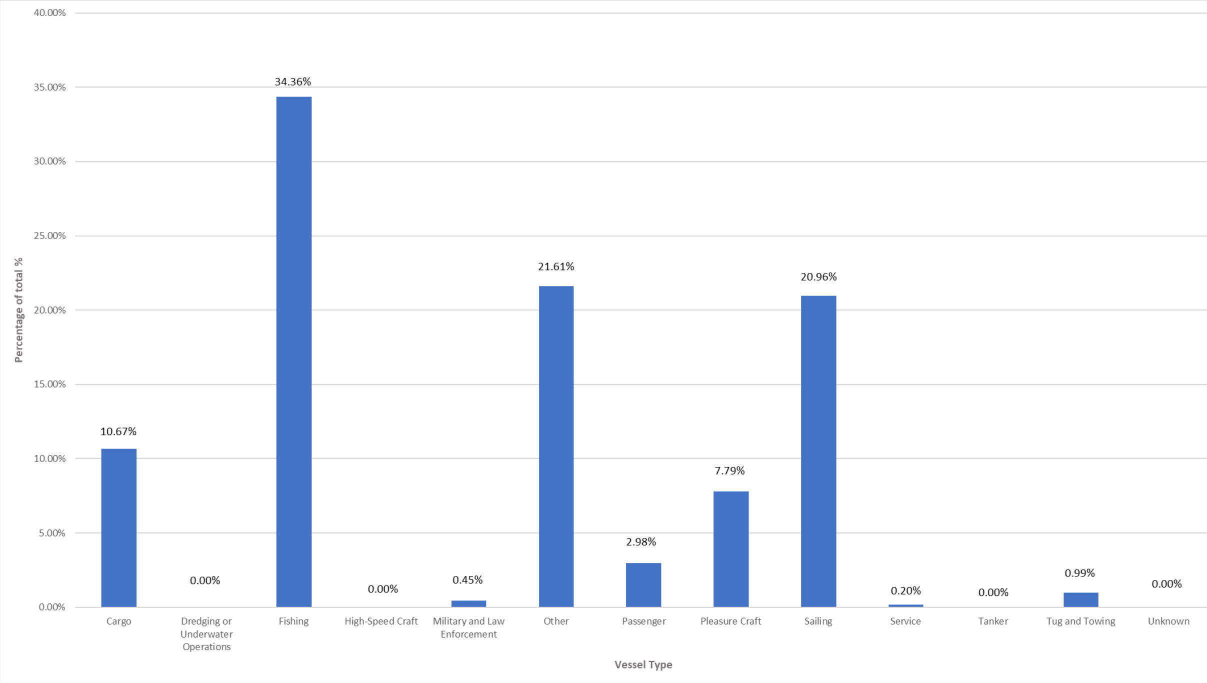
Figure 3-11 highlights the shipping patterns (monthly) and ferry routes across the study area.

Figure 3-11 AIS Intensity and Study Area for 2.16 Colonsay – Mull



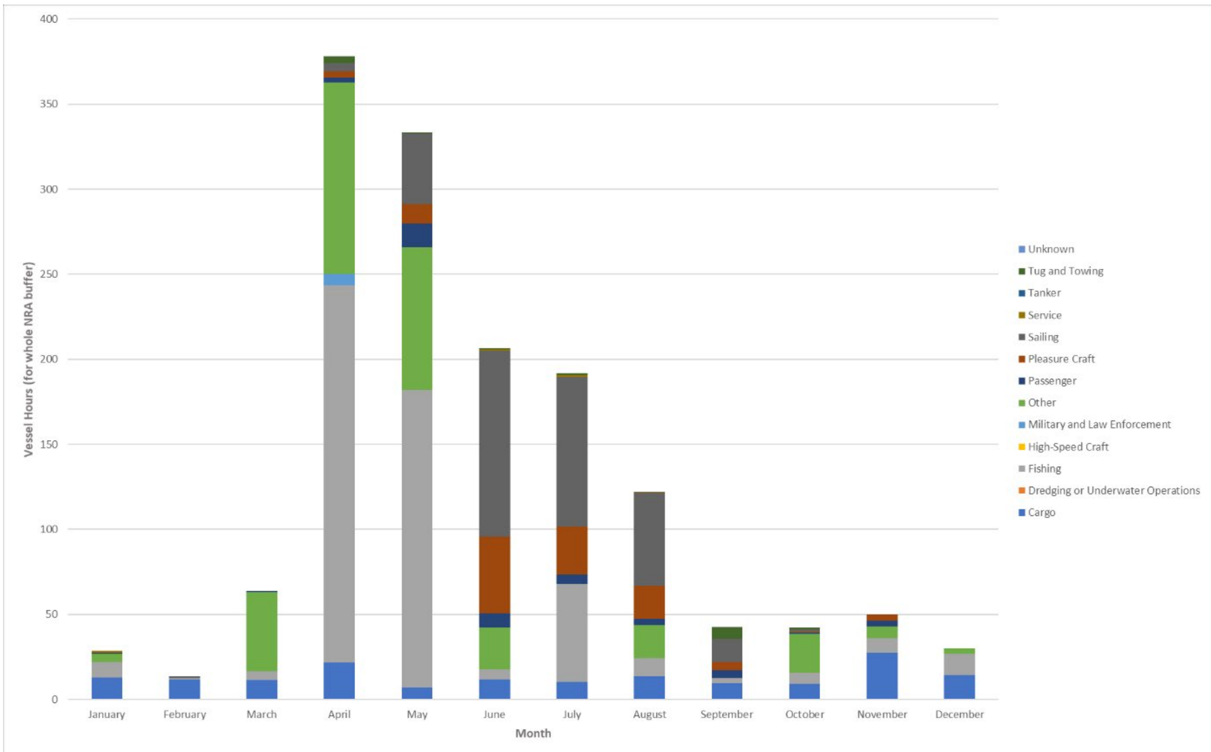
A total vessel density of 1503 hours per month were recorded across the study area in 2019. The percentages of the vessel categories are presented in **Figure 3-12.** The majority of the data is predominantly made up of fishing (34%), Other (21%) Sailing (20%) and Cargo 10%).

Figure 3-12 Vessel Distribution Across the 2.16 Colonsay – Mull Area



Seasonal distribution of the vessel traffic has been analysed in across the cable corridor and the busiest months are observed in April and May, noting the increase of fishing activity for these months. **Figure 3-13** highlights the seasonal changes.

Figure 3-13 Seasonality Changes in Vessel Traffic Across the 2.16 Colonsay – Mull Study Area



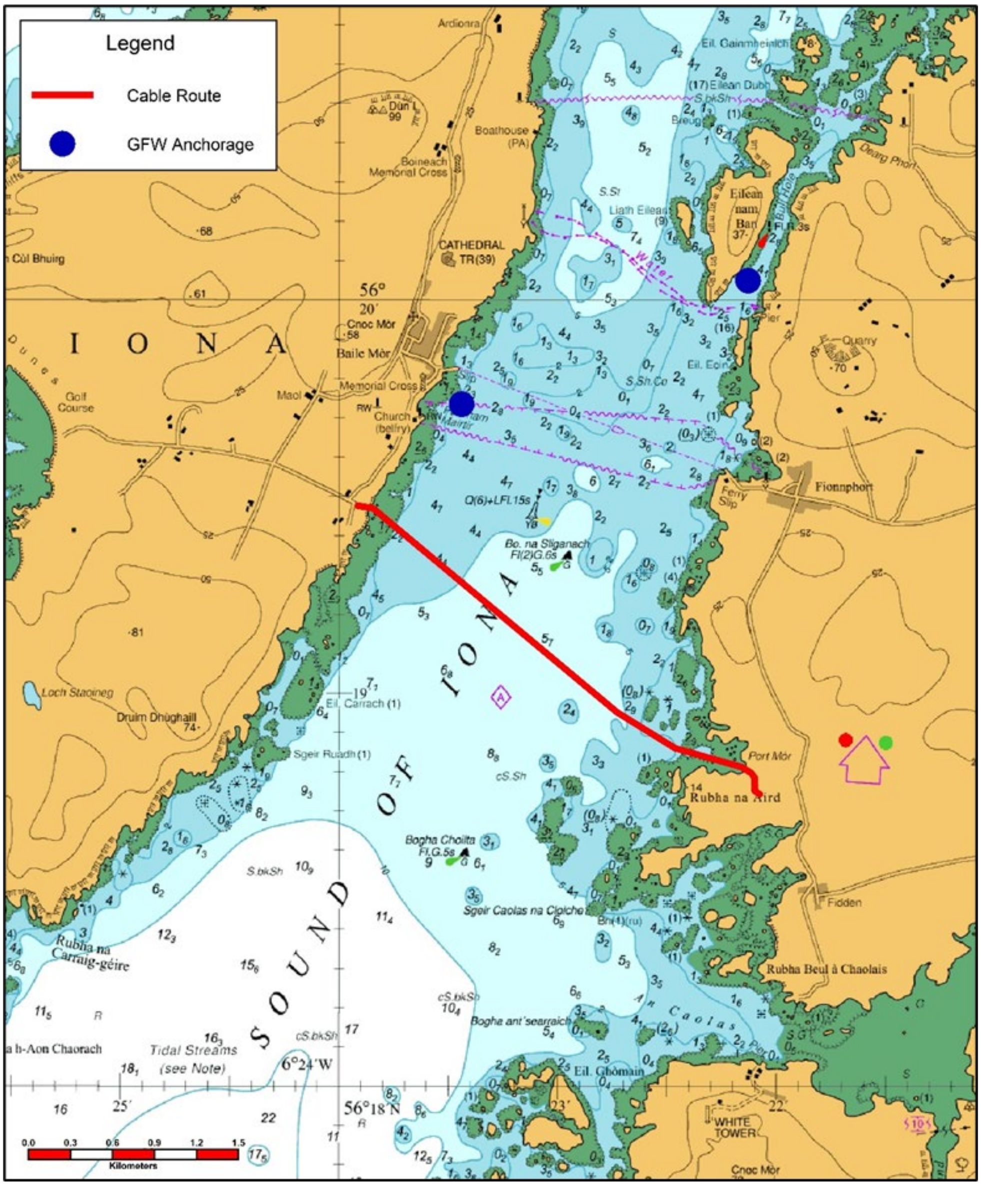
3.1.6 Navigational Features and Anchorages

Navigational features and anchorages have been identified across the R100 corridors, however as stated in the cable route DTS (ref 8), many vessels still anchor in undesignated areas. When planning cable routes, it is hard to avoid these areas as they are unknown and therefore cannot be mapped easily. Anchorages were therefore located using a database from Global Fishing Watch, who use an algorithm that detects vessels which have remained stationary (defined as moving less than 0.5km in 12hrs) and presumes their locations to be anchorages. This highlights designated anchorages as well as areas where vessels may anchor frequently, but which are undesignated.

The following anchorages and navigational features have been identified in Inner Hebrides:

2.15 Iona - Mull
An undesignated anchorage exists approximately 500m north of the cable route at Iona **(Figure 3-14)**. This coincides with a vessel density hotspot observed from AIS data and is assumed to be related to the passenger ferry service operating between Fionnphort and Iona. AIS data show that small vessels also anchor in the southern Sound of Iona and may be a risk to the cable (ref 8).

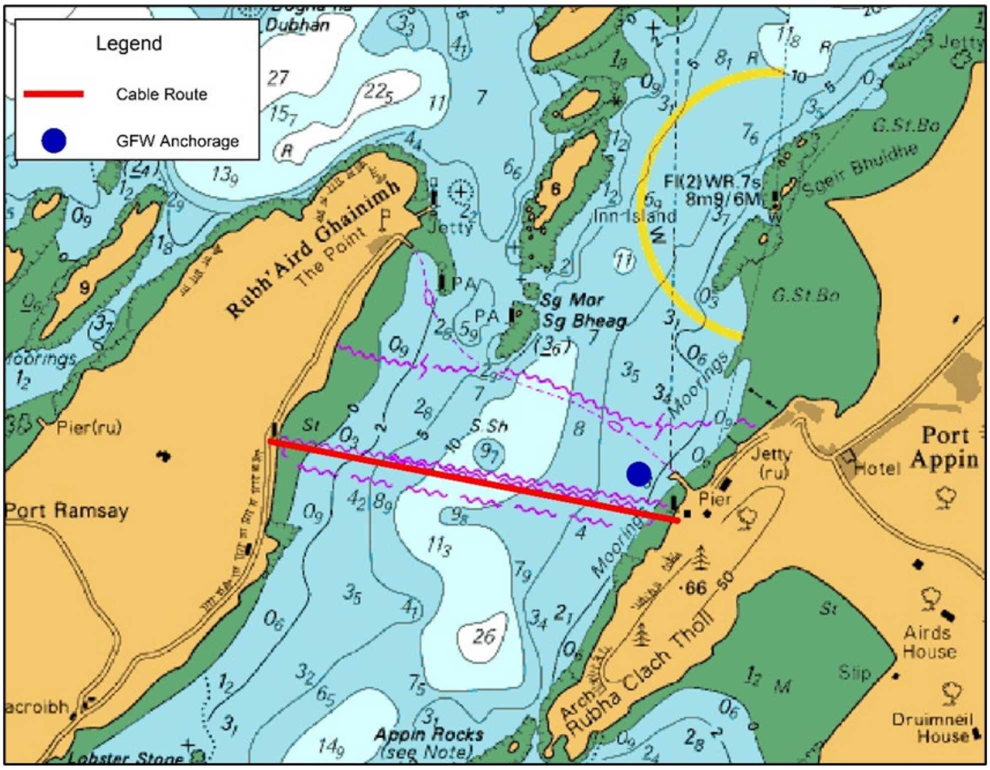
Figure 3-14 undesignated Anchorage near cable route 2.15 Iona – Mull (ref 8)



2.14 Mainland – Lismore

An undesignated anchorage is present just off the cable route at Port Appin, west of the pier, which is also at the centre of a vessel density hotspot **(Figure 3-15)**. Similarly, to the Iona-Mull cable it is assumed this anchorage is used by the passenger ferry service operating between Port Appin and Point (Lismore), as seen on UKHO navigation charts. Google Earth satellite imagery and Street View reveal a vessel moored at this location, which suggests the anchorage is used. There are numerous further moorings off the Port Appin ferry terminal and the AIS data filtered for stationary vessels confirms that these moorings are also used regularly

Figure 3-15 Undesignated Anchorage near cable route 2.14 Mainland – Lismore (ref 8)



No other navigational features have been identified on the admiralty charts within the study area.

Aggregate extraction sites and dumping grounds have been avoided in the during the route selection process.

3.1.7 Summary

Table 3-1 summarises the sensitivity of existing baseline for the corridors in the Inner Hebrides

Table 3-1 Search Radius Across the Cable Corridors in Inner Hebrides

ID	Segment	Cable length (km)	General AIS Intensity (vhpy)	No of Ferry Routes intersected	No of Ports within vicinity of Study Area
2.13	Eigg - Mainland	25.6	Low (5-10)	2	2
2.14	Mainland – Lismore	1.18	Med to High (20-50)	1	1
2.15	Iona - Mull	2.35	Low (5-10)	1	No ports but x2 ferry terminals
2.16	Colonsay - Mull	22.43	Very Low (0-5)	0	0

3.2 Recreational Boating Areas

As mentioned in **Section 1.4**, the regulation requires AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size. It is therefore assumed that a large portion of recreational vessels are not included within the AIS dataset.

The Coastal Atlas of Recreational Boating is a vital tool to aid in representing recreational boating interests around coastal and offshore developments and generally captures where vessels that do not transmit AIS sail. This is important as smaller vessels generally have a smaller draft and can likely traverse shallower waters than those vessels with AIS which will not show up in the purchased AIS track lines or statistics.

The RYA dataset has extracted all recreational vessels identifying themselves as Sailing or Pleasure Craft and included in the heat maps.

It is recognised this still means that vessels which are not required to transmit a AIS signal by law may not be included within this dataset and therefore reliance on general boating area polygons, provided by the coastal atlas will provide a good location for recreational boating.

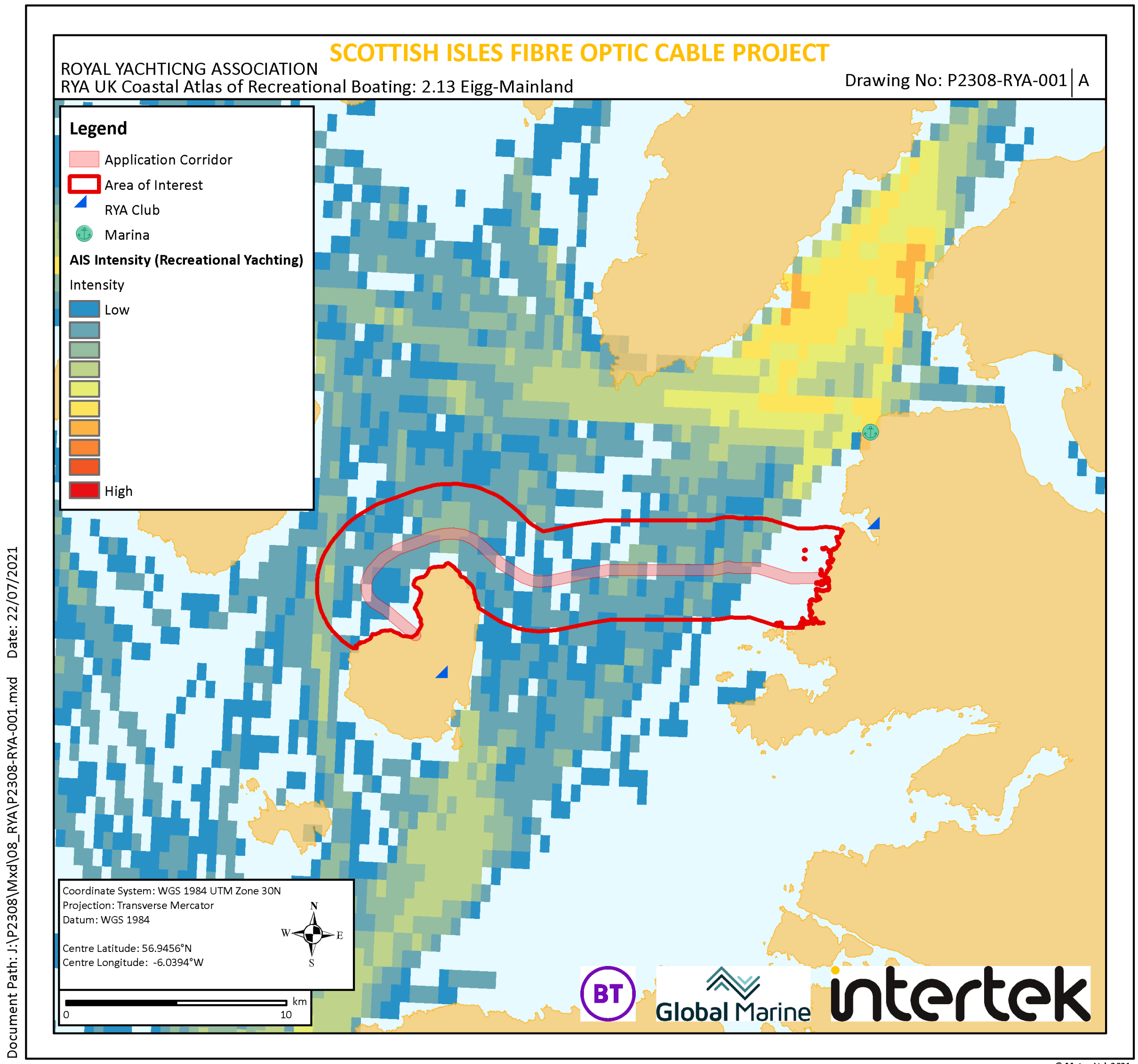
RYA clubs, training centres, marinas as well as the RYA AIS data are highlighted in the following sections.

3.2.1 2.13 Eigg – Mainland

The recreational vessel density across the study area is generally Low with no general boating areas, clubs, or mariners present within the study area which may indicate that smaller recreational vessels that do not transmit AIS are low in number.

Figure 3-16 highlights the recreational patterns across the study area.

Figure 3-16 RYA Data Across the 2.13 Eigg – Mainland Study Area

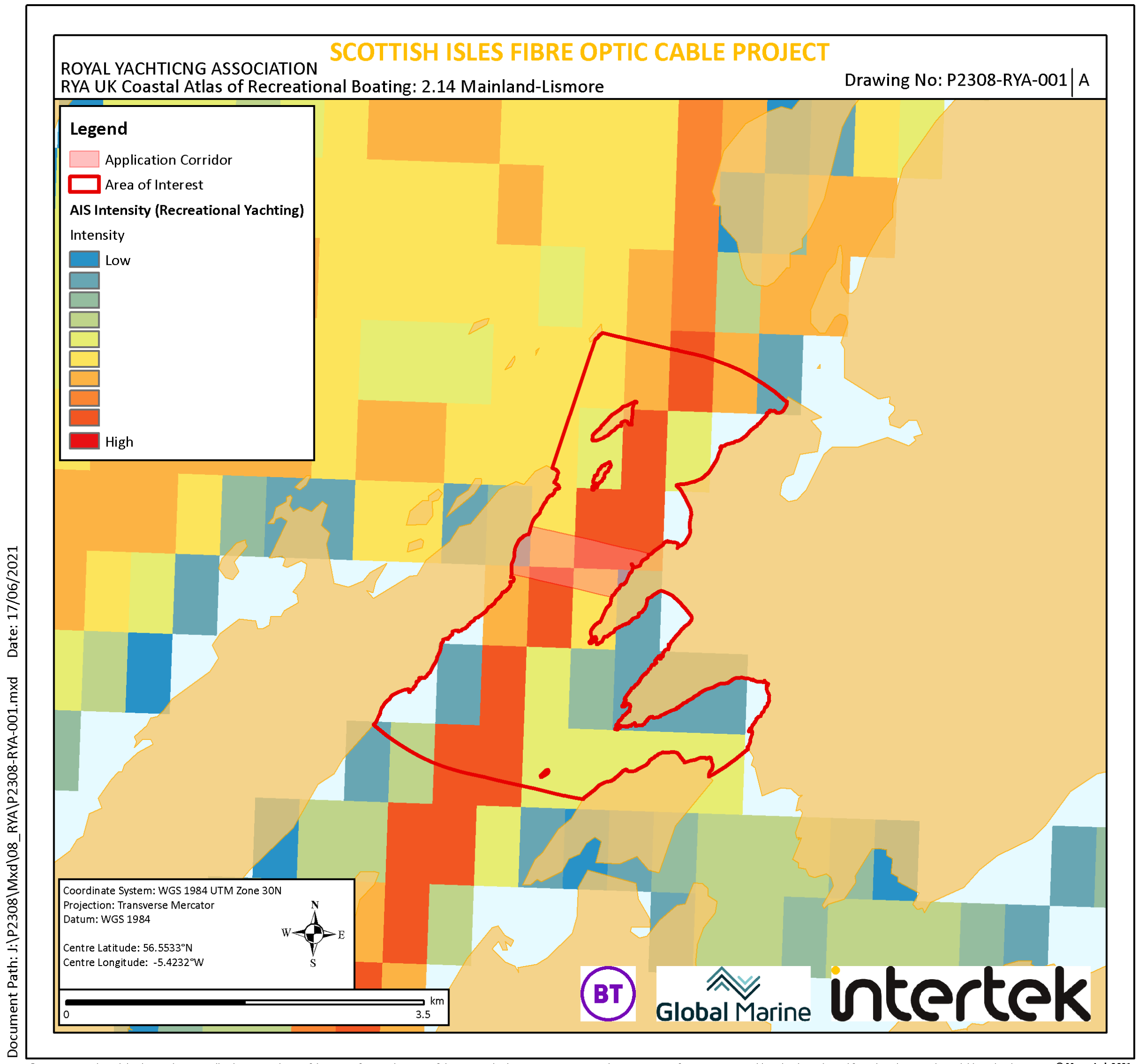


3.2.2 2.14 Mainland – Lismore

The recreational vessel density across the study area is generally very high. While there are no general boating areas, clubs or mariners in the area, there appears to be a high level of recreational vessels using the channel between mainland Scotland and Lismore (as identified in **section 3.13**). Smaller recreational vessels that do not transmit AIS could also be present.

Figure 3-17 highlights the recreational patterns across the study area.

Figure 3-17 RYA Data Across the 2.14 Mainland – Lismore Study Area

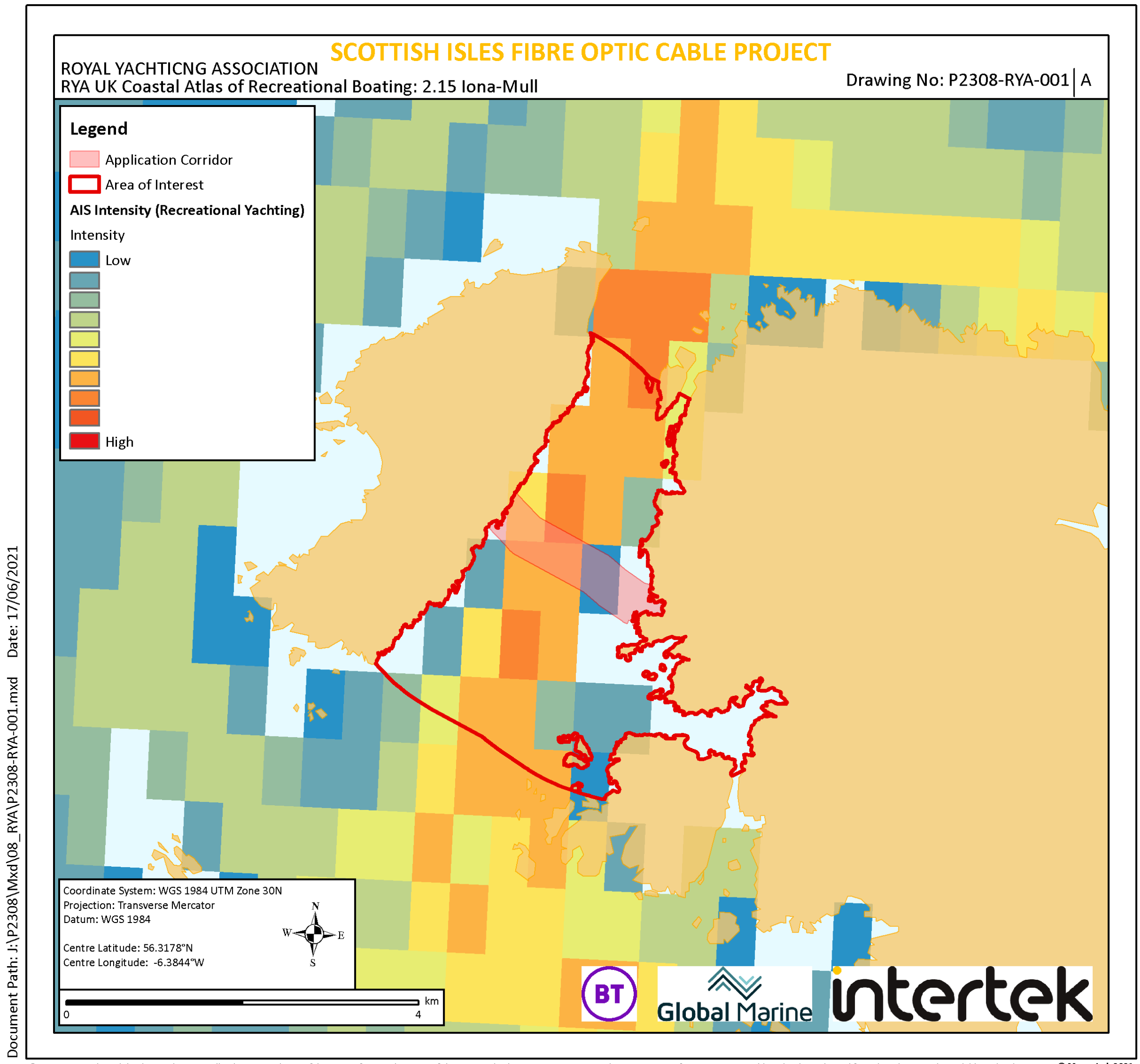


3.2.3 2.15 Iona – Mull

The recreational vessel density across the study area is generally medium to high. While there are no general boating areas, clubs or mariners in the area, there appears to be a high level of recreational vessels using the channel between mainland Iona and Mull. Smaller recreational vessels that do not transmit AIS could also be present.

Figure 3-18 highlights the recreational patterns across the study area.

Figure 3-18 RYA Data Across the 2.15 Iona – Mull Study Area

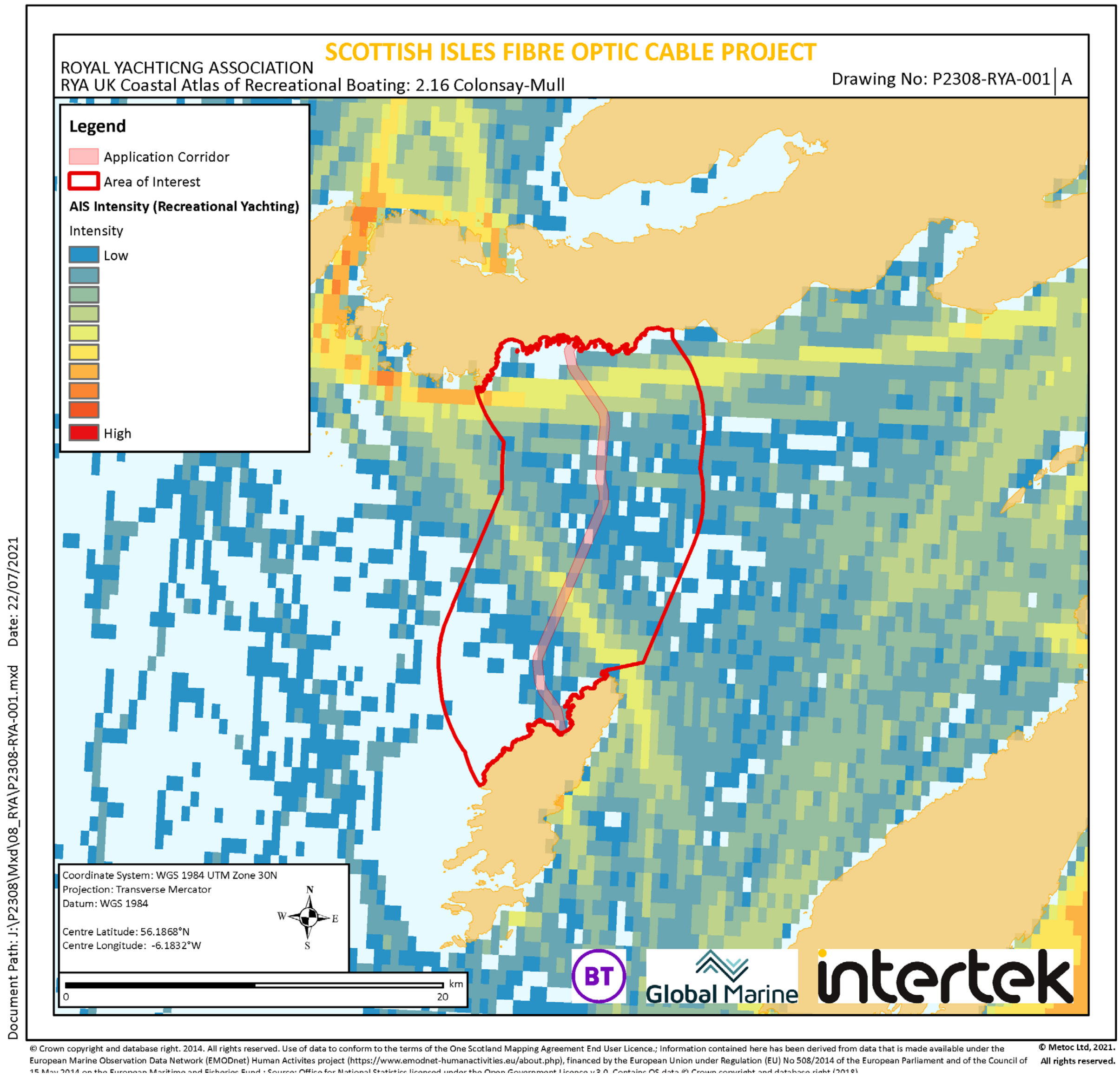


3.2.4 2.16 Colonsay – Mull

The recreational vessel density across the study area is generally low with two areas of medium density transecting the study area (north, near Mull coast and south around the headland of Colonsay). There are no general boating areas, clubs or mariners and in the study area which may indicate that smaller recreational vessels that do not transmit AIS are low in number.

Figure 3-19 highlights the recreational patterns across the study area.

Figure 3-19 RYA Data Across the 2.16 Colonsay - Mull Study Area



3.2.5 Summary

In summary, there are two cables corridor which may encounter a high level of recreational activity during the installation campaign. Based on the high AIS intensity and general boating areas these cable corridors are as follows:

- 2.14 Mainland – Lismore
- 2.15 Iona Mull

3.3 Fishing Overview

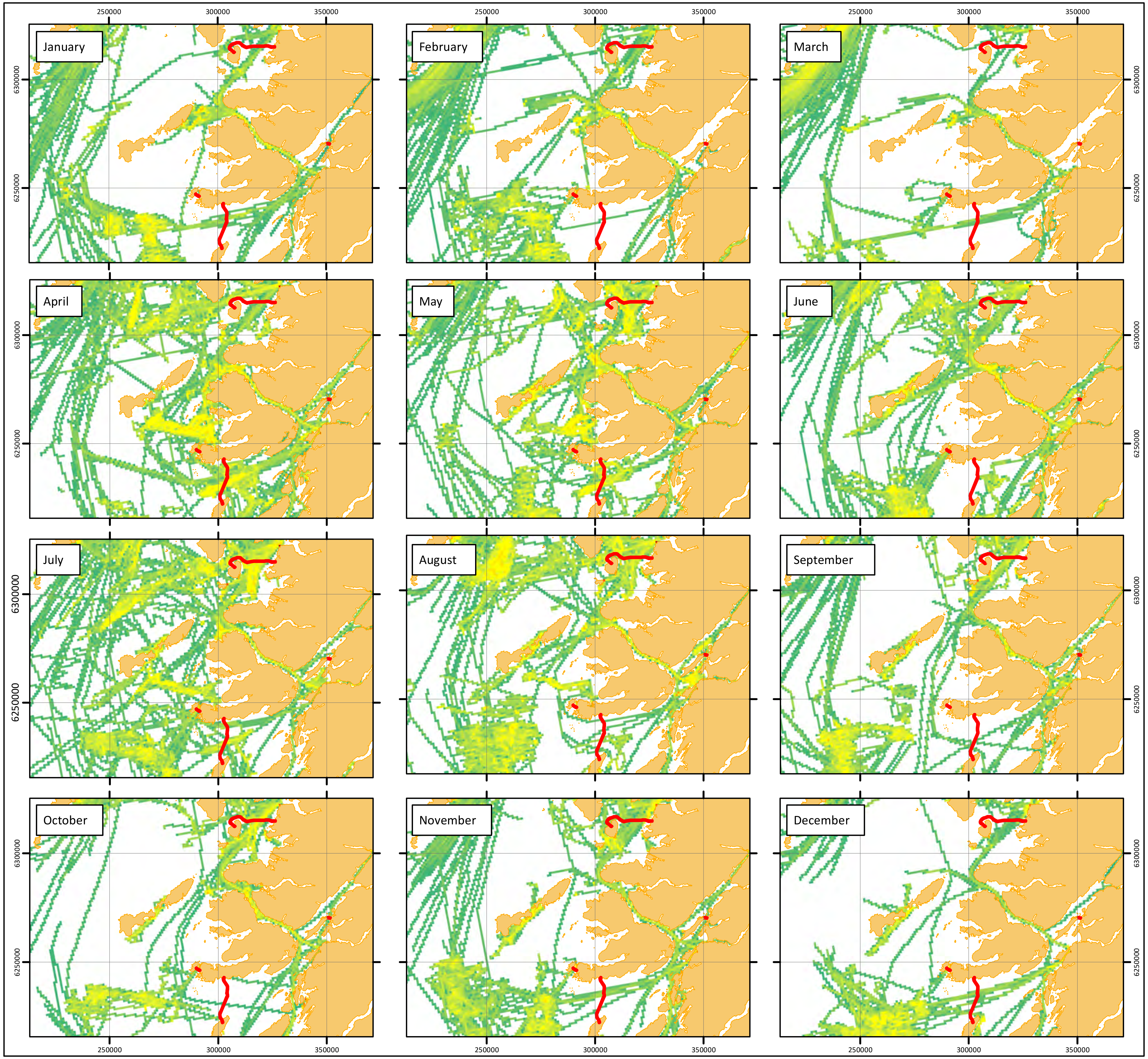
Many different fishing gears and fishing methods are used by commercial fisheries. Each gear type is used for specific activities and different gears can have very different impacts on the marine environment and cable security. A fishing study (P2308_R5310_Rev0) has identified the areas of fishing in relation to the Inner Hebrides R100 s routes which may be disrupted during the offshore marine campaigns.

Seasonal fishing intensity can be found in **Figure 3-20** (P2302-SHIP-001_IH) demonstrating that generally the total fishing effort is consistently present across all R100 routes around the Inner Hebrides. Monthly AIS vessel density is low all year round with the exception of Cable Corridor 2.13 during the summer months and Cable Corridor 2.16 for the period April – May which are low - moderate (EMODnet 2020 and Marine Scotland 2016).

The fishing study reviewed publicly available fisheries data and identified the fishing activity across the Inner Hebrides geographical area by reviewing fishing methods, spatial patterns, landings data and seasonal trends. The findings have been summarised for each cable corridor within the Inner Hebrides in **Table 3-2**:

Table 3-2 Summary of fisheries activity by cable corridor

Cable Corridor	ICES rectangle	Target Species	Dominant Fishing type	Peak season
2.13 Eigg-Mainland	42E3	Crab, haddock, lobster, nephrops, scallop, lobster,	Shellfish	June, July and November
	42E4	Nephrops, scallop, crabs, lobster, razor clam	Shellfish	November
2.14 Mainland - Lismore	42E4	Nephrops, scallop, crabs, lobster, razor clam	Shellfish	November
2.15 Iona - Mull	41E3	Crabs, haddock, lobster, nephrops, monks or anglers	Shellfish	November – December
2.16 Colonsay - Mull	41E3	Crabs, haddock, lobster, nephrops, monks or anglers	Shellfish	November – December



SCOTTISH ISLES FIBRE OPTIC CABLE PROJECT

AIS VESSEL DENSITY
Monthly Vessel Density
Fishing Vessels - Inner Hebrides

Drawing No: P2308-SHIP-001_IH	B

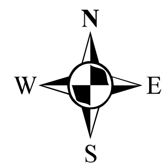
Legend

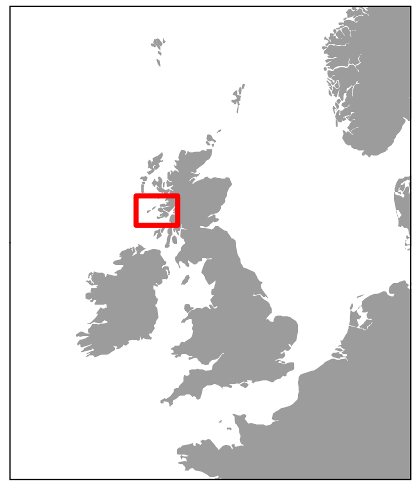
- Cable Route Application Corridor

2019 Vessel Density

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	18 October 2021
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	EMODnet; GEBCO; ESRI; MarineFind
File Reference	J:\P2308\Mxd\04_SHIP\ P2308-SHIP-001_IH.mxd
Created By	Chris Dawe
Reviewed By	Abigale Nelson
Approved By	Paula Daglish

BT Global Marine intertek

km 0 25 50 75 100

Information contained here has been derived from data that is made available under the European Marine Observation Data Network (EMODnet) Human Activites project (https://www.emodnet-humanactivities.eu/about.php), financed by the European Union under Regulation (EU) No 508/2014 of the European Parliament and of the Council of 15 May 2014 on the European Maritime and Fisheries Fund.; © The GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003; Charts from MarineFIND.co.uk © British Crown and OceanWise, 2020. All rights reserved. License No. EK001-FN1001-03265 Not to be used for Navigation; ©Esri

3.4 Marine Accident data

This section reviews maritime incidents that have occurred in within the relevant study areas of the cable corridorss across the Inner Hebrides. The analysis is intended to provide a general indication as to whether the area of the proposed development 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 10 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.

3.4.1 RNLI

The most recent ten-year period available of RNLI data (collected between 2009 and 2020) has been plotted spatially and analysed across the R100 Cable Corridors.

The dataset is a condensed Return of Service data from RNLI callouts across the United Kingdom and the Republic of Ireland. 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 (ref 6).

A total of 32 launches across the Inner Hebrides Cable Corridors, all to unique incidents, were recorded by the RNLI (excluding hoaxes and false alarms) which corresponds to an average of between 5 to 6 incidents per year.

Incident type and number for the routes are presented in **Figure 3-21** and **Table 3-3**. RNLI categories that are not relevant to this assessment have assigned to the category 'other'.

No callouts from the result of collisions or vessel groundings were also recorded.

Figure 3-21 RNLI Yearly Callouts – Inner Hebrides

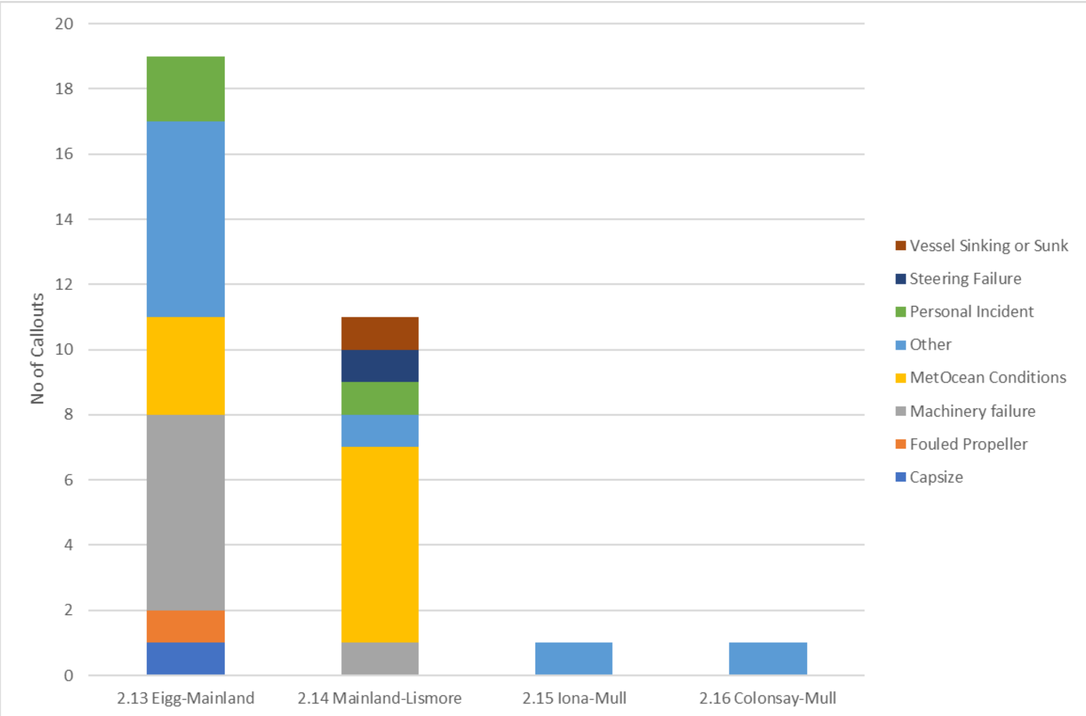
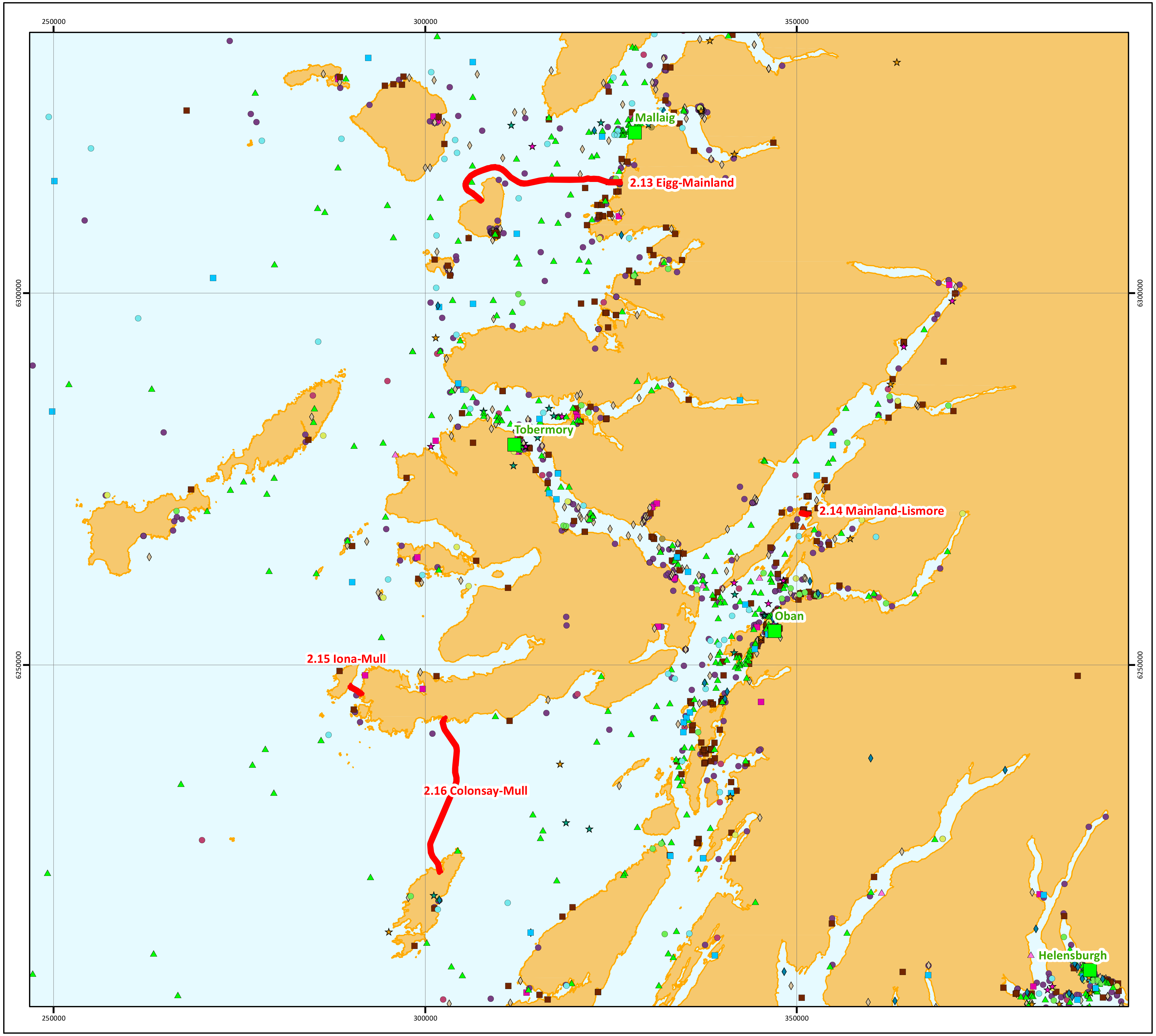


Table 3-3 RNLI Incident data across the Inner Hebrides Cable Corridor Study Areas

Cable Corridor	Capsize	Fouled Propeller	Machinery failure	MetOcean Conditions	Other	Personal Incident	Steering Failure	Vessel Sinking or Sunk	Grand Total
2.13 Eigg-Mainland	1	1	6	3	6	2			**19**
2.14 Mainland-Lismore			1	6	1	1	1	1	**11**
2.15 Iona-Mull					1				**1**
2.16 Colonsay-Mull					1				**1**
Grand Total	1	1	7	9	9	3	1	1	**32**

With the exception of ‘other’, which as mentioned above is not relevant to this assessment, it can be seen that due to the low number of callouts across the Inner Hebrides it is not expected that the presence of project vessels will increase the risks to the existing baseline of marine safety.

Figure 3-22 (P2308-RNLI-001_IH) presents the locations of incidences recorded by the RNLI.



SCOTTISH ISLES
FIBRE OPTIC CABLE PROJECT

ROYAL NATIONAL LIFEBOAT INSTITUTION
RNLI Retruns of Service 2008 - 2020
Inner Hebrides

Drawing No: P2308-RNLI-001_IH	**B**

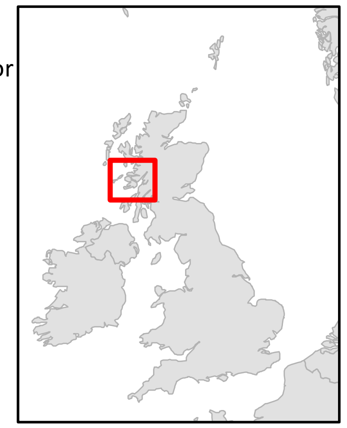
Legend

- Cable Route Application Corridor
- RNLI Lifeboat Station

RNLI Return of Service 2008 to 2020

Reason for Callout

- Abandoned Vessel
- Capsize
- Collision
- Equipment failure
- Fire on board vessel
- Fouled Propeller
- Leak & Swamping
- Machinery failure
- Man overboard
- MetOcean Conditions
- Other
- Personal Incident
- Snagging
- Steering Failure
- Vessel Distress
- Vessel Dragging Anchor
- Vessel Sinking or Sunk
- Visibility



NOTE: Not to be used for Navigation

Date	18 October 2021
Coordinate System	WGS 1984 UTM Zone 30N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	ONS; RNLI; ESRI;
File Reference	J:\P2308\Mxd\07_RNLI\ P2308-RNLI-001_IH.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Paula Daglish

0 5 10 15 20 km

Source: Office for National Statistics licensed under the Open Government Licence v.3.0, Contains OS data © Crown copyright and database right (2018);Contains Open Data licensed under the GIS Open Data Licence© RNLI 2020. https://data-rnli.opendata.arcgis.com/datasets/rnli-returns-of-service?geometry=-46.917%2C50.370%2C36.711%2C59.196; ©Esri

3.4.2 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 12nm 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 (ref 7).

The last 5 years of annual MAIB reports from 2016 to 2020 have been analysed to determine if any accidents have occurred within the seas surrounding the Inner Hebrides. The findings have been summarised below as:

- **2020**: No incidents or accidents relating to vessels at sea within the vicinity of the cable corridors
- **2019**: 3rd February - Capsize and sinking of the UK registered fishing vessel Investor while east of Ardnamurchan Point, Scotland
- **2018**: No incidents or accidents relating to vessels at sea within the vicinity of the cable corridors
- **2017**: No incidents or accidents relating to vessels at sea within the vicinity of the cable corridors
- **2016**: No incidents or accidents relating to vessels at sea within the vicinity of the cable corridors

A total of one marine incident was reported within the Inner Hebrides over a total of 5 years. In terms of yearly variations, this corresponds to less than one incidence per year and it can be seen that in for four of the years there were no incidents or accidents reported by MAIB.

It is worth mentioning that the incident does not relate to vessel-to-vessel collisions or grounding.

4. HAZARD IDENTIFICATION

Marine operations and their associated hazards have been identified and listed in **Table 4-1**. 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 and calculated using the estimated installation rates defined in Section 2.

Table 4-1 Marine Operations and Identified Hazards – Shipping and Navigation

Project Phase	Operation	Hazard Identified	Receptor	Zone of Influence
Pre-installation	Pre-Lay Grapnel Run	▪ Displacement of vessels due to the avoidance of Project vessels ▪ Collision risk ▪ Accidental anchoring on unburied cable ▪ Accidental snagging of fishing gear on unburied cable ▪ Project Vessels blocking navigational features and anchorages ▪ Change in water depth - affecting safe navigation ▪ Extreme weather conditions ▪ Reduced visibility	Commercial shipping, recreational boating and fishing vessels	Requested Safe working distance and up to 18km in any 12-hour period
	Route clearance			
Installation	Cable lay and burial			Requested Safe working distance and up to 7.2km in any 12-hour period
	Surface Laid cable			Requested Safe working distance and up to 24km in any 12-hour period
	Post-lay inspection and burial (PLIB)			Requested Safe working distance and to 2.4km in any 12-hour period
	Diver/ROV pre installation survey at Shore ends			Requested Safe working distance at shore end survey operations (1 day per landing)
	Diver/ROV post installation survey and Shore End Burial			Requested Safe working distance at shore end burial operations (7 days per landing)
Contingency/ Change in water depth*	Boulder relocation			Requested Safe working distance for vessels carrying out contingency operations (if required)
	Concrete Mattressing			
	Rock Bags			
	Rock Placement			
No MLV installation - Multicat or subaqueous solution	Cable lay and burial including surface lay			Requested Safe working distance for vessels carrying out contingency operations (if required)

*Contingencies will be carefully engineered in water depths less than 10m and therefore will not reduce the depth by more than 5%

5. RISK ANALYSIS

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

5.1 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**.

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.

5.2 Collision Risk

Existing vessels may have to re-route around project vessels which may create pinch points and alter the potential 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.**

5.3 Accidental anchoring on surface laid cable

Vessel anchors will have the potential to interact with the R100 cables 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 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 remote but may occur in the event of an emergency or accidental deployment of an anchor.

The probability of a ships anchor interacting with the cables are **Extremely Remote,** but the consequence could be **Minor.**

5.4 Accidental snagging of fishing gear on unburied cable

Fishing vessel gear will have the potential to interact with the R100 cables 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.

It is noted that a burial assessment is usually carried out and submitted to the MCA prior to installation, as full details of the cable route and additional protection measures are not normally finalised at the time of the NRA, however the cable will be buried to a target depth of 1m were possible.

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.

The probability of a fishing gear interacting with the cables is **Remote,** but the consequence could be **Significant.**

5.5 Project vessels blocking navigational features

Project vessels have the potential to block key navigational features such as anchorages or leading lights for vessels on approach to ports.

While the routes do not intersect any anchorage areas there are undesignated anchorages within two cable corridors. Some displacement of vessels may occur and consideration to existing vessels anchoring may need to be carried out particularly 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**.

5.6 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, 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,** and the consequence is likely to be **Significant.**

5.7 Reduced Visibility

Navigating a ship in reduced visibility because of fog, heavy rain or dust storm 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,** but the consequence is likely to be **Significant.**

6. RISK 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 6-1**) and industry best practice (**Table 6-2**) measures which results in a residual risk allowing the hazards to be reduced to ALARP. No hazards more than a moderate risk are present as identified in the risk assessment.

6.1 Risk Control

6.1.1 Compliance Mitigation

The Compliance measures included in **Table 6-1** below are required to be undertaken to meet environmental and health and safety legislation.

Table 6-1 Compliance Mitigation

ID	Compliance 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	The dropped object procedure will be followed, and any unrecovered dropped objects must be reported to the relevant authority (MS LOT) using their dropped object procedure, within 24 hours of the project becoming aware of an incident.
COMP 3	'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).
COMP 4	Where weather reduces visibility then vessel masters shall adhere to MGN guidelines and COLREGS to prevent collisions at sea.
COMP 8	Should the project create potential hazards to shipping (such as cables temporarily buoyed off or reduction in water depth) along the cable routes, stakeholders will be informed immediately via a NtM distribution list including Kingfisher to ensure safety is upheld.

6.1.2 Best Practice Mitigation

The Best Practice project mitigation relevant to shipping is provided in **Table 6-2** below. 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 6-2 Best Practice Mitigation

ID	Best Practice 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 MCA and UKHO. Vessels will be requested to remain at least 1NM away from cable vessels during installation operations.
BP3	An onshore Fishing Liaison Officer (FLO) will be provided for the project. The FLO will follow the Fishing Liaison Mitigation Action Plan (FLMAP). The FLO will continue in this role during installation process.
BP4	The UKHO will be informed of installation activities in order to issue navigational warnings via NAVTEX/VHF/MF as appropriate.
BP5	Guidance provided by the UKHO and International Convention for the Safety of Life at Sea (SOLAS) recommend that fishing vessels should avoid trawling over installed seabed infrastructure (UKHO 2020). Vessels are advised in the Mariners Handbook not to anchor or fish (trawl) within 0.25NM of cables.

ID	Best Practice Mitigation
BP6	If cables are buoyed off whilst the vessel departs the area, buoy positions will be notified to the NTM distribution list including Kingfisher and 0.25NM clearance will be requested.
BP7	Coordination with local ferry Service and Coastguard Operations to provide 24-hour radio and radar coastal vessel traffic information which helps vessels navigate safely to help prevent collisions at sea.
BP 8	Rock bags/contingency protection measures will only be deployed where adequate burial cannot be achieved or as required by crossing agreements. The footprint of the deposits will be the minimum required to ensure cable safety stability.

6.2 Risk Assessment

It has been deemed that the risk to existing shipping is similar across all the cable corridors therefore one assessment has been carried out and taken into consideration a worst-case scenario.

The following tables 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.

6.2.1 Risk Assessment Table

P2308 Navigation Risk Assessment

Cable Route: 2.13 Eigg – Mainland, 2.14 Mainland – Lismore, 2.15 Iona – Mull, 2.16 Colonsay – Mull

It has been deemed that the risk to existing shipping is similar across all the cable routes therefore one assessment has been carried out and taken into consideration a worst-case scenario

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	Presence of project vessels	2	1	1	1	2	2	2	COMP1 COMP3 COMP4 BP1, BP2 BP3, BP4 BP5, BP6 BP7	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		1	2	2	2	2	2	2	
	Reduced Visibility	2	2	2	2	4	4	4		1	2	2	2	2	2	2	
Installation: Surface Lay Cable Lay and Burial	Presence of project vessels	2	1	1	1	2	2	2	COMP1 COMP3 COMP4 BP1, BP2 BP3, BP4 BP5, BP6 BP7	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	
	Accidental anchoring on unburied cable	2	2	2	1	4	4	2		1	2	2	1	2	2	1	
	Accidental snagging of fishing gear on unburied cable	3	2	2	1	6	6	3		2	2	2	2	4	4	4	Fishing vessels often work behind cable lay vessels after cable hase been installed
	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		1	2	2	2	2	2	2	
Installation: Post Lay Inspection and Post Lay Burial	Presence of project vessels	2	1	1	1	2	2	2	COMP1 COMP3 COMP4 BP1, BP2 BP3, BP4 BP5, BP6 BP7	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	
	Accidental anchoring on unburied cable	2	2	2	1	4	4	2		1	2	2	1	2	2	1	
	Accidental snagging of fishing gear on unburied cable	3	2	2	1	6	6	3		2	2	2	2	4	4	4	Fishing vessels often work behind cable lay vessels after cable hase been installed
	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		1	2	2	2	2	2	2	
Survey: Diver/ROV pre installation survey at Shore ends	Presence of project vessels	2	1	1	1	2	2	2	COMP1 COMP3 COMP4 BP1, BP2 BP3, BP4 BP5, BP6 BP7	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	2	2	2	4	
	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		1	2	2	2	2	2	2	
Survey: Diver/ROV post installation survey and Shore End Burial	Presence of project vessels	4	1	1	1	4	4	4	COMP1 COMP3 COMP4 BP1, BP2 BP3, BP4 BP5, BP6 BP7	2	1	1	1	2	2	2	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	2	3	3	6	Longer operations so increased frequency
	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		1	2	2	2	2	2	2	

7. CONCLUSIONS

AIS data from marine traffic and EMODnet has shown that AIS intensity and thus vessel densities across the R100 Cable Corridors in Inner Hebrides are generally quite low. The areas of high AIS intensity are almost always correlated to either a ferry route and/or a designated ports or harbours where shipping patterns are predictable, and thus the mitigation can be employed to ensure the least amount of disruption to the existing baseline.

The only anchorages present are in the Sound of Iona, south of Cable Corridor 2.15 and near Port Appin, north of Cable Corridor 2.14. Both anchorage areas are undesignated and in less than 10m of water. They are far enough away from the cable routes to not have a risk of vessel overspill from the anchorages onto the cable route.

Analysis of incident data over the past 5 to 10 years has indicated that the level of baseline collision risk is very low/negligible, and it is therefore assessed that project vessels will not add to the existing maritime safety risks in the area.

To conclude, the risk assessment has shown that with the identified best practice and compliance mitigation measures applied all identified hazards have been reduced to ALARP and 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 with Best Practice and Compliance mitigation (i.e. COLREGs) the frequency has been assessed as extremely remote, lowering the overall risk rating.

REFERENCES

1 AIS data. EMODNET (2017, 2018 & 2019)

2 Admiralty charts, http://wmsgateway.findmaps.co.uk/wms/IntertecMetocCharts?

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6 Marine Accident Investigation Branch (MAIB) annual reports 2011 to 2019. https://www.gov.uk/

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8 Marine Scotland (2016). Vessel Monitoring System Intensity layers. Available at: http://marine.gov.scot/information/average-intensity-hours-fishing-using-ices-vms-data-sets [Accessed September 2021]

9 Marine Traffic, www.marinetraffic.com

10 Royal National Lifeboat Institution incidents 2010 to 2019. https://data-rnli.opendata.arcgis.com/datasets/rnli-returns-of-service?geometry=-46.917%2C50.370%2C36.711%2C59.196

11 Royal Yachting Association (RYA) Data for 2019 government collections/maib-annual-reports

APPENDIX A

R100 Project Description

2. PROJECT DESCRIPTION

2.1 Section Overview

This chapter presents information on the planned installation of the marine components of the R100 cable system.

The key activities to be undertaken during installation are:

- Route preparation: pre-lay grapnel run (PLGR) and route clearance (RC);
- Cable installation (plough burial, surface lay);
- Cable landing; and
- Post lay inspection and burial (PLIB).

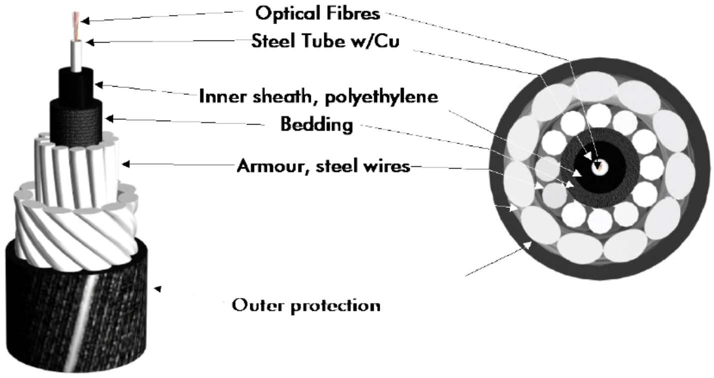
All products, equipment and/or vessel specifications detailed in this section are indicative. In the event that the Project does not/cannot use the specified equipment similar products will be selected.

2.2 Submarine Cable Description

Burial of the cable is required (where sediments allow) to protect the optical fibre transmission path over the entire service life of the system and prevent interaction with the seabed and other sea users.

The cable types to be used for the R100 project are armoured fibre optic cables, which are a resilient cable type suitable for installation within Scottish waters (Figure 2-1). The cable system will be unrepeatered (an 'unrepeatered system' is a cable system without optical amplifiers due to the short overall length). There will be no EMF emissions from the operating cable. The cable itself is between 25mm (single armour) and up to 46mm (rock armour) in diameter, depending on the level of cable armouring required. The optical fibres are contained within a gel filled stainless steel tube. This is surrounded by a polyethylene insulation layer. The construction of this core provides protection against water penetration and hydrogen. The core is further protected by layers of steel wire and an outer polypropylene yarn.

Figure 2-1 Cross section of URC-1 fibre optic cable (rock armour variant)



Source: Nexans (2008)

2.3 Landing Point

The R100 installations are additional cable connections where new BMH will be constructed for all landing points. Details of the landing points in the Inner Hebrides are provided in Table 2-1.

Table 2-1 Inner Hebrides marine licence application landfall sites (estimated BMH position)

Cable Corridor	Landing Point	Estimated BMH Latitude	Estimated BMH Longitude	Cable lengths (km)
2.13	Eigg	56° 54.867' N	6° 09.564' W	26.6km
	Mainland	56° 56.737' N	5° 51.298' W	
2.14	Mainland	56° 33.126' N	5° 24.892' W	1.4km
	Lismore	56° 33.249' N	5° 26.048' W	
2.15	Iona	56° 18.790' N	6° 21.977' W	2.6km
	Mull	56° 19.484' N	6° 23.904' W	
2.16	Colonsay	56° 06.019' N	6° 10.737' W	23.6km
	Mull	56° 17.568' N	6° 11.270' W	

Targeted burial depth between the BMH to Low Water Mark (LWM) is 2m. Offshore the target burial depth will be to 1m below the seabed. Depths are subject to survey and other potential constraints.

2.4 Route Preparation Works

The objective of route preparation (route clearance and PLGR) is to ensure that the route is, as far as reasonably possible, clear and free from debris in order that the installation is not hindered.

At the conclusion of these activities, the route shall be as far as reasonably possible:

- Clear of UXO. A UXO desk study has been carried out by Ordtek.
- Clear of any crossed out-of-service (OOS) submarine cable systems or as otherwise agreed with the system owners.
- Clear of any nearby chains, wires, ropes, warps, abandoned fishing equipment and other items of equipment located on the seabed.

2.4.1 Route clearance

2.4.1.1 Out of Service Cable

The presence of OOS cables have been identified during the DTS of the proposed cable routes, and subsequently verified during survey operations. These will be cleared and made safe in accordance with International Cable Protection Committee (ICPC) recommendation No.1 or managed as otherwise agreed with the systems owners. Prior to cable installation activities commencing, the vessel will move to the known position of each OOS cable, deploy the grapnel and start clearance activities.

Route clearance operations will include cutting the existing OOS cable, recovering the parted cable ends to deck, streaming each parted end back along the original OOS cable and then lowering each OOS cable end to the seabed using a slip line. This procedure for clearing the OOS cable is intended to ensure a clear passage for the burial operation and to minimise the likelihood of the OOS cable being fouled or hooked by other seabed users. Chain or clump weights will be used as cable end anchors to secure the cable ends in place and minimise the risk of fastening to fishing gear, in accordance with ICPC recommendations.

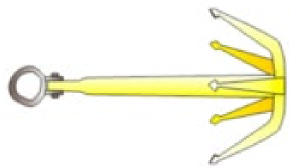
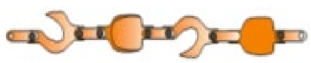
A range of cable recovery tools will be available for use, typically a ‘Flatfish’ cutting grapnel, de-trenching grapnel, and ‘Rennie and Gifford’ grapnel (see Figure 2-2), together with the necessary rigging equipment. In summary, route clearance operations shall include:

- Cutting the existing OOS cable at the cable route intersection;
- Recovering each end of the cut cable;
- Weighting the cable ends with clump weights or chain; and
- Lowering the weighted end to the seabed on slip ropes and laying each end back on the original OOS cable route.

2.4.2 Pre-lay grapnel run

PLGR will be conducted following route clearance works. Typical tools are shown in Figure 2-2 below, which will generally penetrate 0.4m - 1m into the seabed under suitable conditions. The specific grapnel rigging may vary depending on the seabed conditions identified on site.

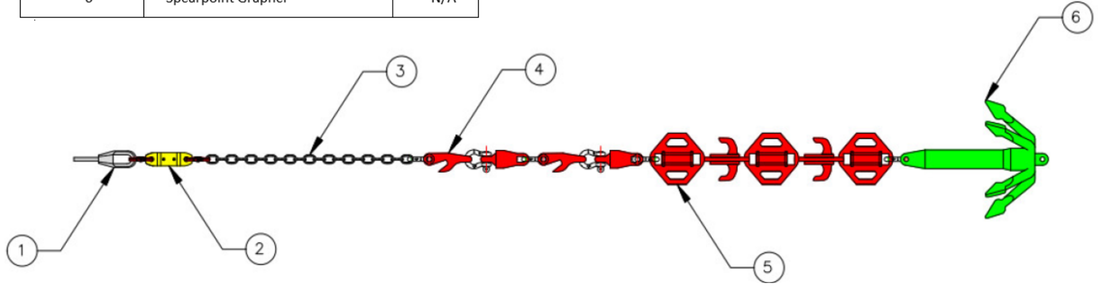
Figure 2-2 Typical PLGR Equipment

Spearpoint Grapnel	
Rennie Grapnel	
Gifford Grapnel	
Flatfish Grapnel (cutting and non-cutting variants used)	
De-trenching Grapnel	

A PLGR ‘Grapnel Train’ (Figure 2-3) will be deployed from the vessel to the seabed and the vessel will manoeuvre along the planned cable route paying out grappling rope/winch wire. The amount of grappling rope/winch wire to be paid out will be dependent on the depth of water. Once the grapnel train has been deployed the vessel will move along the planned cable route.

Figure 2-3 Typical PLGR Chain

Item No.	Description	SWL (Te)
1	48mm Winch Wire	100
2	Swivel	15
3	32mm chain, 20m	31.5
4	Gifford Assembly	13
5	Rennie Assembly	13
6	Spearpoint Grapnel	N/A



2.5 Cable installation

This section details the specific installation activities associated with the installation of the R100 project and follows the typical installation sequencing.

2.5.1 Installation vessels

The cable lay will be performed on a 24-hour basis to ensure minimal duration of navigational impact on other users and to maximise efficient use of suitable weather conditions and vessel and equipment time. The progress speed for plough installation is approximately 600m/hour with speed depending on seabed sediment conditions, achieving target burial depth and weather conditions. Cable may be surface laid in areas of hard ground or at cable crossing locations. Where the cable is surface laid, cable lay vessel speeds may increase up to 2km/hr.

In addition to the installation vessel, additional vessels may be involved with the operation if required by weather conditions, safety and best practice, although exact details may change, it is likely that the vessels to be used will consist of those outlined below. All vessels will comply with shipping requirements as set out in the Navigation Risk Assessment (Appendix E).

2.5.1.1 Main lay vessel (MLV)

The MLV is a specialist ship equipped with dynamic positioning systems, designed specifically to carry and handle long lengths of armoured fibre-optic cable (Figure 2-4). A plough and ROV will be mobilised to the vessel for cable laying activities. Following mobilisation, the cable will be loaded onto the ship at the cable factory and then transit to the worksite.

Figure 2-4 Typical MLV

2.5.1.2 Ancillary support vessel

In addition to the MLV, a dedicated ancillary vessel may be used for all ancillary operations, including Route Clearance, PLGR, Pre-Lay Inspection and PLIB operations. The ancillary support vessel will be equipped with a remotely operated vehicle (ROV).

2.5.1.3 Tug(s)

A tug may be required to support the MLV and/or the Ancillary support vessel due to the high currents that may be experienced across the work site.

Figure 2-5 Typical shallow water vessel

2.5.1.4 Multicat (or similar)

A multicat (Figure 2-6) can be mobilised to support either cable installation or cable burial operations in shallow water areas where the main lay vessel cannot access. The vessel would be mobilised with a small deck spread to support cable storage and installation equipment as cable engine and cable chute, along with a burial tool and support equipment.

Figure 2-6 Typical multicat

2.5.1.5 Barges

A self-propelled barge can be mobilised to support either cable installation or cable burial operations in shallow water areas where the main lay vessels or multicats cannot access. The vessel would be mobilised with a small deck spread to support cable storage and installation equipment as cable engine and cable chute, along with a burial tool and support equipment. Anchor/clump weights will be deployed from a support vessel or from the barge in advance of the works.

Figure 2-7 Barge

2.5.1.6 Shore end/ shallow water vessels

For all shore end and shallow water operations, multiple small inshore vessels (such as RIBs) will be used to support the cable pull in, the lowering of the cable onto the seabed and any burial of the cable in waters depths less than 15m (Figure 2-5).

2.5.1.7 Rock-placement vessel

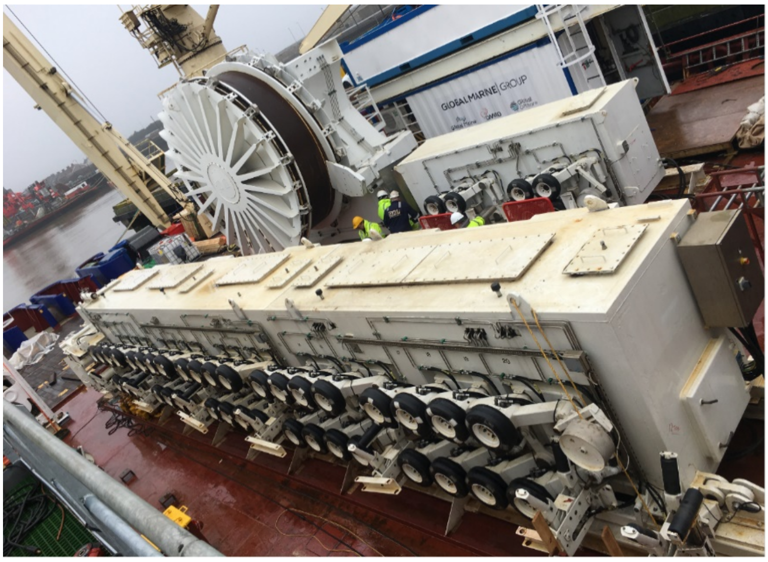
Additional rock may be required as a contingency measure to protect or stabilise the cable. Therefore, a rock placement vessel is included as a potential contingency for crossing agreements, stability or additional protection as required. The rock placement vessel will be equipped to carry sufficient rock material to provide the necessary protection. The vessel will utilise a fall pipe to accurately deposit rock from the vessel to the seabed in a controlled manner.

2.5.2 Cable lay and burial

Once the MLV arrives on site within the Inner Hebrides geographical area, the first shore end will be landed. At the time of writing it is not known which cable within Inner Hebrides will be installed first.

The MLV installs the cable by passing it through the on-board cable engine (Figure 2-8) which assists in moving the cable to the stern sheaves where the cable is over boarded and deployed to the seabed.

Figure 2-8 Typical Cable Engine



The MLV will lay away from the first shore end and bury the cable via the plough as described in Section 2.5.2.2 below. There will be certain sections (such as in areas of hard ground and at crossings (if any)) where the cable will be laid on the surface of the seabed and will not be ploughed (Section 2.5.3).

The MLV will continue plough burial to the second shore end position. After the second shore end has been landed PLIB will be conducted with an ROV to bury sections of the cable which have been surface laid, for planned post lay burial, or in sections of the seabed which were unsuitable for plough burial (Section 2.5.3). This process will then be repeated for the next cable.

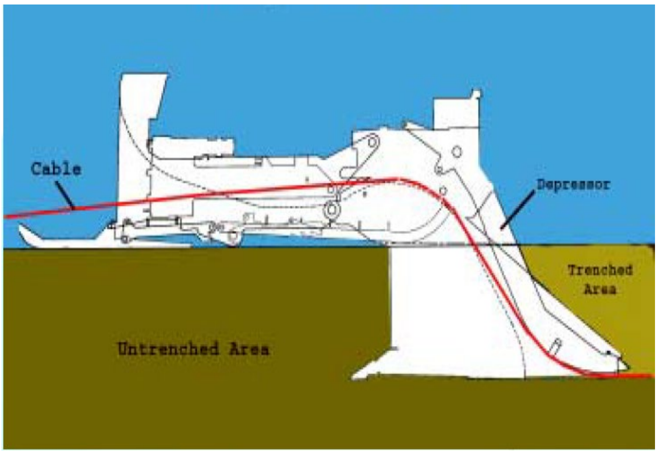
The key steps associated with the cable lay and burial are outlined below.

2.5.2.2 Plough installation

Simultaneous cable installation with plough burial is the planned method of installation where possible on the offshore routes. Once the shore end has been landed, the MLV will lay away from the shore end position and tow the plough behind the vessel. The cable feeds into a bell-mouth at the front of the plough and is guided down through the plough share to emerge in the trench (Figure 2-9).

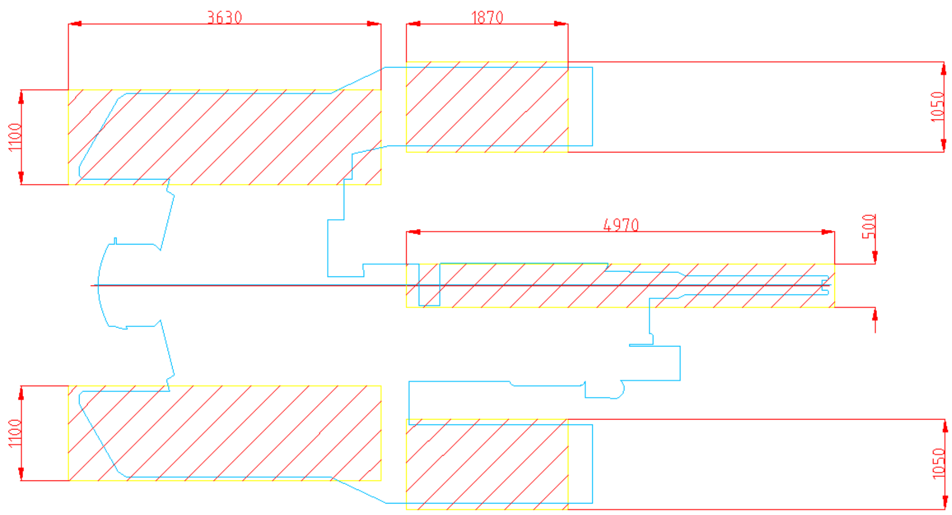
Hydraulically adjustable skids are used to provide steering on the plough and the share is used to vary the burial depth. On-board sensors ensure the cable passes through the plough in a safe manner before being buried. The sensors also record the burial depth achieved, for this Project the target burial depth is 1m subject to seabed conditions. The approximate speed of plough installation is 600m p/h which is approximately 0.3 knots.

Figure 2-9 Plough schematic



The skids have an approximate footprint of 7m^{2}per skid, and the share footprint is approximately 2.45m^2. The plough share width is approximately 0.5m. The sections of the plough in contact with the seabed is outlined in Figure 2-10 and demonstrated by the hatched areas. The plough dimensions are indicative of the size of equipment to be used. Burial by plough will be carried out at a rate of approximately 600m/ hour (depending on sediment type).

Figure 2-10 Plough footprint



Note: measurements are in millimetres (mm)

2.5.3 Surface lay

Where conditions are unsuitable for plough burial, the cable will be surface laid. This could be in areas of hard seabed, where burial is not achievable, or at cable crossings.

Prior to the start of operations seabed topography will have been reviewed and the amount of slack required in the cable will have been determined. The cable will be installed using cable lay software to ensure that the lay angle, pay out speed, slack and tension fall within the design limits of the cable and to also ensure (where possible) that the cable naturally confirms to the seabed topography. The approximate speed of surface lay installation is 2000m p/h which is approximately 1 knot.

2.6 Cable Landing

2.6.1 Shore end installation

The two typical types of shore end landings that would be conducted for the R100 project include a Direct Shore End (DSE) or Pre-Lay Shore End (PLSE). The following standard practice will be undertaken for each shore end albeit with a slight variation in the sequence of events.

A beach and dive team, along with the necessary equipment and vessels to carry out the cable landings, will be mobilised to each site prior to the arrival of the MLV or ancillary support vessel.

A pre-lay diver swim survey of each route will be carried out prior to the arrival of the MLV/PLSE vessel, from the LWM to the agreed plough down point /proposed position of the MLV/PLSE vessel. Key positions, such as, alter courses, holding anchors, other in service and out of service cables, will be marked with temporary buoys or similar.

Beach inspections/walk overs will be undertaken prior to any operations taking place and photographic and video records taken.

The beach team will then prepare the landfall and position the equipment for cable pull in operations (position the quadrant and excavator) with due care and consideration for the environment and general public.

Once preparations have been completed and the MLV/PLSE vessel has arrived at the planned support vessel will transfer a messenger line will be transferred to the ancillary support vessel to take ashore. A diver will swim ashore through the surf zone with the messenger line and hand it to the beach team. The beach team will then pass the messenger line around a cable pull-in quadrant (if required), to assist the cable to be pulled in (a quadrant is used when no direct pull in from the vessel to the BMH is possible).

A hauling line will then be attached to the messenger line which will then be transferred back to the MLV/PLSE vessel for the cable to be attached for hauling ashore.

Under the control of the Beach Master, the second excavator will commence the pull in of the cable ashore which will be supported in the water by buoys attached to the cable on the MLV/PLSE as it is paid out (Figure 2-11). The excavator will slowly move along the beach while monitoring the cable tension under the control of the Beach Master.

Once the cable is ashore and confirmed to be in position over the planned Route Position List (RPL), divers in small support craft will commence the removal of the buoys allowing the cable to lay onto the seabed. During this process, the dive team will check that the cable is lying satisfactorily on the seabed.

The dive team will return the swivel and buoys back to the MLV/PLSE vessel.

Depending on if the shore end landing is a first or second end the MLV/PLSE will commence cable installation or move clear of the area.

Figure 2-11 Typical DSE landing from MLV

2.6.2 Beach Works

The seaward duct which provides access for the telecommunication cable in the intertidal area to the BMH will be exposed using an excavator. The beach team will then remove any duct cover and attach the pre-installed rope to the end of the cable on the beach and pull into the BMH and secure using an armour wire anchor clamp (AWAC) fitted to the wall of the BMH.

Generally, a trench of 2m depth will then be excavated (subject to beach/ soil conditions) using an excavator/breaker down the beach to the LWM and the cable/AP lowered into the bottom of the trench and the burial depth measured and recorded. After depth verification the trench will be backfilled.

On completion of the cable burial the beach profile will be restored, and all machinery, equipment and personnel removed from site.

2.6.3 Rock cutting

In the event that there is little sediment or rock outcropping between the proposed BMH location to LWM, limited and targeted rock cutting may be conducted if no other practical technique exists to provide acceptable cable protection. Rock cutting is not currently planned however may be a requirement for a short section (75m) for-Route 2.13 Mainland landing point and Route 2.14 Mainland landing point (15m) within the Inner Hebrides geographical area.

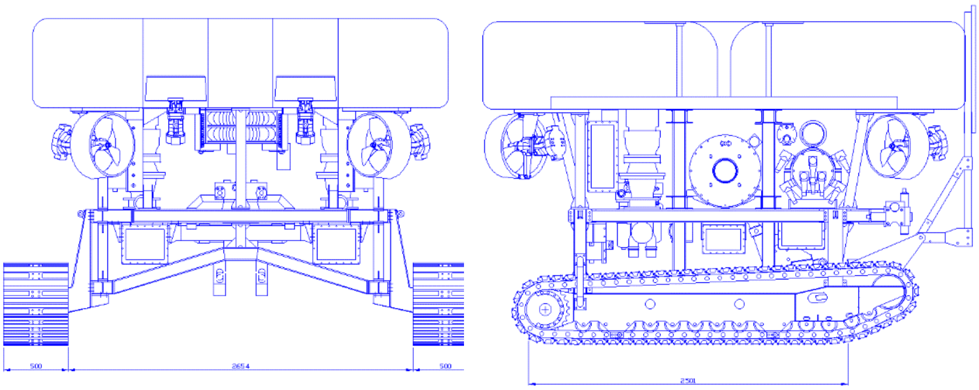
If required, any surface ground material will be excavated using an excavator bucket to create a spoil mound adjacent to and clear of the working area. The bucket will then be removed from the excavator and a rock breaker attached. The outcropping rock will then be broken using the rock breaker within the designated work area/ trench. The broken rock/ stones will then be removed from the trench using the excavator bucket to form a trench. The width of the rock cut trench is dependent on the cutting tool used but is likely to be approximately 0.3m wide and 0.5m deep. This process is then repeated until the trench has been excavated to the required specification. Post installation, the trench will then be backfilled with excavated material. In some instances, it may be necessary for the trench to be backfilled with a marine grade concrete (bentonite) or a mix of concrete or locally excavated material. Excavated rock material would then be relocated over the trench.

2.7 Post Lay Inspection and Burial

On completion of cable laying and plough burial operations there will be areas along the route where it has not been possible to utilise the plough such as In-Service cable crossings where the cable has been surface laid over the third-party cable. These areas of cable will be buried by means of a jetting ROV (Figure 2-12). This operation is referred to as PLIB. The jetting ROV is tracked to allow it to sit on the seabed and follow the cable whilst employing water pumps to inject seawater either side of the cable. This fluidises the seabed and allows the cable to sink below the surface. A typical jetting trencher ROV is shown in Figure 2-12 and Figure 2-13 with two 500mm wide tracks each with a seabed contact length of 2,500mm; the target burial depth is 1m. It should be noted that the seabed will naturally reinstate to its original profile shortly after completion of the works.

Figure 2-12 Typical ROV jetting trencher

Figure 2-13 Typical ROV Schematic



2.7.2 Inshore/ Shallow Water Post Lay Burial (PLB)

Inshore burial from the Low Water Mark (LWM) out to the position where depths are suitable for plough burial to commence often uses a diver assisted jet burial tool fitted with suitable burial jet legs for the target burial depth (Figure 2-14). The PLB equipment will be mobilised onto an ancillary support vessel which will undertake these operations separately to the MLV.

Figure 2-14 Typical diver assisted jet burial tool

An ancillary support vessel will set up close to the landfall and the burial tool will be deployed to the beach where the cable will be loaded into the tool. Having run up the water pump, the jet legs will then be lowered to the required PLB depth as it is slowly commencing burial. This operation will continue until the burial tool approaches the plough down position, when it will be recovered to the ancillary support vessel, and divers will post-lay bury the final section of cable using surface fed burial lances. PLB of the inshore section could also take place from the plough down position towards the beach.

2.7.3 Diver swim survey/ Mini ROV survey

Once burial operations have been completed a final diver or mini ROV swim survey pass will be conducted. This will provide a video survey of the trenched cable.

2.7.4 Cable jointing

The operations are planned for the MLV to install all cables without the requirement for jointing onboard. There are certain circumstances however where it may be necessary for the vessel to conduct jointing operations (adverse weather, emergency, unexpected high traffic levels). If jointing is required, joints will be constructed on board the vessel before the cable laying operation continues.

Where cable joints are required, the MLV may remain stationary for a number of up to several days to create one joint. If joints are required, sensitive areas, e.g., shipping channels, anchoring grounds, will be avoided as far as reasonably practicable.

2.8 Cable crossings

There is one known cable crossing required within the cable corridors within the Inner Hebrides geographical area. The cable crossing is on Route 2.14 Mainland – Lismore where the proposed cable will cross a BT telecommunication cable. An engineered cable crossing including rock protection, is only required for crossings with power cables or pipelines. Crossings with telecom cables only require protection against the cables touching, therefore Uraduct is applied to these crossings (see section 2.9.1 below) and no rock protection is required.

It is possible that some out of service (OOS) cables are within the Inner Hebrides cable corridors, however these will be removed prior to installation where possible (during route preparation works described in Section 2.4).

2.9 Proposed integral cable protection

2.9.1 High Density Polyethylene (HDPE) Protection (Uraduct ®)

High Density Polyethylene (HDPE) Protection, Uraduct ® (or similar), is currently the only planned cable protection method for all of R100 cable crossings (Figure 2-15). Uraduct® (or similar) is a well-established anti- abrasive method of cable protection which may be applied 50m either side of the cable crossing (100m in total per crossing). This will provide separation between the installed cable and existing asset. Once installed the Uraduct ® (or similar) is approximately 94mm in diameter. Post lay burial (Section 2.7) will be undertaken to bury the cable to a target depth of 1m if possible following surface lay, subject to the burial status of the crossed assets.

Figure 2-15 Typical High-Density Polyethylene Protection (HDPE) cable protection

2.9.2 Articulated pipe

For this Project, articulated pipe (AP) is planned to be fitted from the end of the BMH duct to the LWM or approx. 10m water depth contour subject to burial conditions (Figure 2-16). The maximum external diameter will be approximately 150mm. It may be that the length of AP installed may extend beyond the 10m contour in the event that seabed conditions prevent/ limit burial or where the cable is at risk of exposure and damage from external forces. The AP will also provide additional protection and stability to the cable in areas where it may move during storm conditions.

In some cases, the AP may require clamping and pinning to the seabed to ensure tidal conditions do not cause abrasion damage to the AP and cable. The clamping and pinning operations will be conducted by divers.

Figure 2-16 Articulated pipe

The approximate lengths of AP that may be included in the marine licence applications are provided in Table 2-2.

Table 2-2 Indicative articulated pipe lengths required for each landfall within the Inner Hebrides Geographical Area

Cable Route	Landfall	Length of Articulated Pipe (BMH to 10m depth contour)*
2.13	Eigg	780m
	Mainland	1850m
2.14	Mainland	610m
	Lismore	680m
1.15	Iona	2486m
	Mull	
2.16	Colonsay	890m
	Mull	1150m

*AP lengths may vary according to ground conditions at the time of installation.

2.9.3 Cable Stabilisation in High Currents

In some limited areas of exceptionally high current (and or where it is subject to storm surges) where cable protection by burial may not be fully achieved due to lack of sediments, additional mass may be added to the cable to assist in maintaining the cable in a stable position on the seabed. This would take the form of additional lengths of similar type submarine cable or inert metallic chain being bound to the R100 cable using a bundling machine and intermittent titanium straps or similar. This additional cable mass would be installed as an integral part of the cable during the main lay process, and burial by plough would not be attempted in these areas due to the high risk of damage to the seabed and subsea equipment. The bundled cable would be approximately 15cm in overall diameter.

2.10 Contingency measures

The proposed installation measures are detailed in the above project description. However, a number of contingency measures are included to allow a level of flexibility during the installation to allow decisions to be made during operations to ensure stability of the cable, and to ensure that the cable can be protected in unforeseen circumstances.

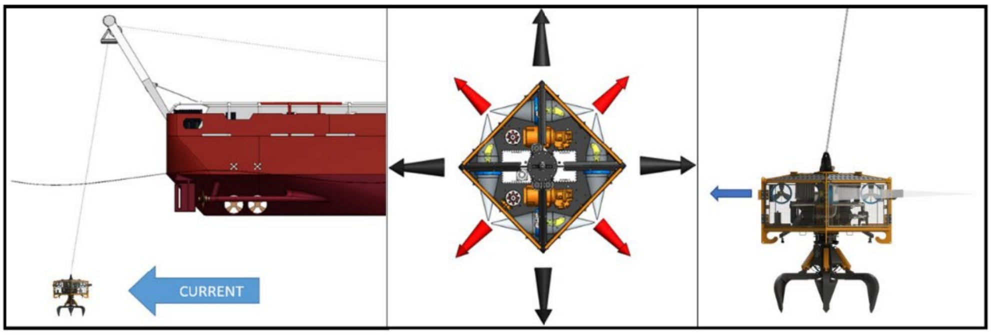
Conservation bodies on past projects have also noted that any additional or external protection should be included in any initial application to avoid subsequent applications being made post-installation. Therefore, whilst additional external protection such as rock bags are not expected or planned, a number have been included as a contingency.

In areas where cable burial is not possible due to seabed conditions, a number of contingency measures could be implemented to ensure safety of the cable and other sea users. This section details the contingencies included in this application.

2.10.1 Boulder relocation

There is currently no plan for any boulder removal activity on any of the R100 cable routes however, it may be necessary a limited number of targeted boulders from the cable route to allow adequate burial to be achieved during cable installation. If required, this will be undertaken using a crane on the MLV or ancillary support vessel to lift and relocate a boulder to a new position – and will simply be a minor relocation to move the obstruction from the line of the cable route and boulders will not be removed from the seabed. Boulder picking is typically conducted via a grab and can operate in currents up to 3knots (Figure 2-17).

Figure 2-17 Equipment used for boulder picking



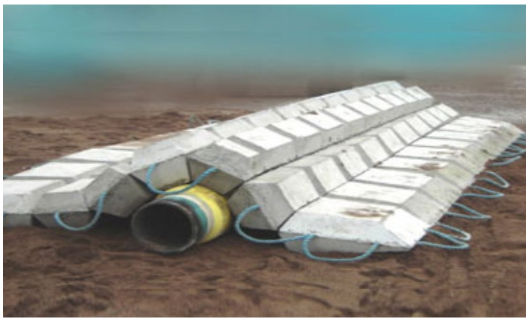
2.10.2 Concrete mattressing

Concrete mattresses (Figure 2-18) are matrices of interlinked concrete blocks which form a close-fitting layer over the cable to provide a strong protective cover to prevent potential impact and snagging by fishing gear or anchors. Typically, concrete mattresses are 6m long by 3m wide by 0.3m high.

The mattresses are usually installed via a crane from the MLV, multicat or ancillary support vessel; which lowers them one at a time or in batches using a purpose designed frame.

Mattresses are typically used in combination with rock protection e.g., at third-party asset crossings, or in areas where the main risk to cables is from fishing activities. Concrete mattresses have been included as a contingency measure and the worst-case number for each cable corridor is given in Table 2-4 below.

Figure 2-18 Concrete mattress



2.10.3 Rock bags

Rock bags are typically installed on top of the cable and are sized to suit each scenario dependant on current speeds and environmental conditions (Figure 2-19). The size and weight of the rock bags to be used will ultimately be dependent on the findings of the Cable Burial Assessment (CBA) and post installation survey results. The exact number will not be known until after the cable has been installed. A contingency number of rock bags has been provided per cable route (see Table 2-3 below). Typical dimensions of the rock bags likely to be used for R100 are shown in Table 2-3 below.

Table 2-3 Typical rock bag dimensions

Type	Mesh Size	Stuffing Stones *1 particle diameter	Weight of empty filter unit	Dimensions in meters, filter unit installed			Current velocity Ms^{-1}	
				Diameter	Height	Volume	Unit	Grouped
2 T Model	25mm	50*200mm	6kg	1.9m	0.4m	$1.24m^3$	$3.1ms^{-1}$	$4.6\ ms^{-1}$
4 T Model	25mm	50*200mm	13kg	2.4m	0.6m	$2.5m^3$	$3.4ms^{-1}$	$5.2\ ms^{-1}$
8 T Model	50mm	75*200mm	48kg	3.0m	0.7m	$5.0m^3$	$3.9ms^{-1}$	$5.8\ ms^{-1}$

Figure 2-19 Rock bag deployment

2.10.4 Rock placement

No engineered cable crossings are proposed for cable installation within the Inner hebrides Geographical Area.

In the event of cable suspensions occurring along the route, rock may be placed instead of or in addition to rock bags to help mitigate these suspensions. The requirement for such mitigation will only be in sections of the route where the cable is surface laid / or burial cannot be achieved. The locations of such areas will not be known until after cable installation. The size of the berm will depend on the location, the site-specific anchor and fishing risks and the prevailing metocean conditions. The worst-case quantity of rock if required for this application has been included in the contingency measures per cable corridor.

2.11 Summary of Cable installation per cable corridor

2.11.1 Installation footprint

The R100 project within the Inner Hebrides geographical area consists of four cable installations each with a separate marine licence application to Marine Scotland Licensing Operations Team (MS LOT). The licensable activities occurring within each cable corridor and approximate footprints are provided in Table 2-4. Table 2-4 also provides the approximate footprints for worst case contingency external cable protection measures. The use of contingency external cable protection is not currently proposed but may be used at the time of installation if required.

Table 2-4 Summary of installation methods and footprints per licence application

Cable Route	PLGR / RC Note 1	Installation method Note 2 Approximate footprint of installation (width of tool x length of installation)					Contingency measures (worst case deposits)			
		Surface lay*	Plough Note 3 2.6m wide x length of cable corridor (worst case)	Trenching 2m deep x width of excavator bucket (assumed to be 2m)	Rock cutting Note 4 (Length x 0.5 burial x 0.3 width)	ROV Note 5	Boulder relocation Note 6	No. Rock Bags Note 7 3m diameter = 7m² per rock bag (8T bag)	No. Concrete Mattress Note 8 6m x 3m = 18m² per mattress	Bentonite Cement (m³) Note 9 (0.3m x 0.5m) x length of rock
Cable 2.13 Eigg - Mainland	✓		0.069km²	✓	✓ 11.25m³	✓		10 bags 70m²	3 mattress 54 m²	✓ 11.25m³
Cable 2.14 Mainland - Lismore	✓		0.004km²	✓	✓ 2.25m³	✓		10 bags 70m²	3 mattress 54 m²	✓ 2.25m³
Cable 2.15 Iona - Mull	✓		0.007km²	✓		✓		20 bags 140m²	3 mattress 54 m²	
Cable 2.16 Colonsay - Mull	✓		0.062km2	✓		✓	✓	10 bags 70m²	3 mattress 54 m²	

Note 1: PLGR is within the installation footprint of the plough and therefore is not an additional footprint.

Note 2: Cable corridor lengths are given in Table 2-1.

Note 3: Based on approximate measurements of an indicative plough to be used for the installation (Figure 2-10). This is subject to change depending on the availability and suitability of equipment at the time of installation.

Note 4: Rock cutting dimensions are for a wheel attachment to an excavator (Section 2.9.3) – applicable to Route 2.13 and 2.14 only.

Note 5: ROV dimensions are indicative of typical equipment used by Global Marine during cable installation for all sections of the route.

Note 6: Boulder relocation is not planned and will only be used, if necessary, as outlined in Section 2.3.1.

Note 7: As a contingency, rock installation has been included in the marine licence.

Note 8: To allow flexibility within the installation process the applicant has included a contingency deposit of concrete mattressing per cable corridor.

Note 9: A marine grade cement such as Bentonite or similar will be used to backfill any areas where rock cutting has taken place.

* Although the base case is for no surface lay in the Inner Hebrides geographical area, should cable burial not be achievable in any sections of the cable routes, surface lay may be required.

2.12 Indicative Programme

Following approval of the Marine Licence applications, cable installation is currently scheduled to commence in the Q2 2022 and be complete by the end of the 2023. Timings may vary due to weather and/or other operational reasons such as conditions found during survey. Indicative durations for the licensable activities are outlined in Table 2-5 below. Cable installation for the routes within the Inner Hebrides Application Area will take between 25 and 31 days per route with the longer durations for Routes 2.14 and 2.15 due to longer installation using a Multicat or similar. This is not the timescale for an installation vessel to be on site within the corridor but are worst case timings for each activity. Activities within the same cable corridor can occur simultaneously and all offshore works are likely to be completed within <>5-14 operational days per cable corridor.

Table 2-5 Worst case indicative timing of works

Activity (No of Days)	PLGR	Cable lay (Including cable landing)	PLIB	Diver / ROV Pre installation survey	Diver / ROW post install survey and shore end burial	Contingency (Rock bags/ Mattressing / rock placement)	No MLV installation (Multicat or similar)
Cable 2.13 Eigg - Mainland	3	3	2	2	14	2	N/A
Cable 2.14 Mainland - Lismore	Included in Diver/ROV post install survey and Shore End Burial	Included in NO MLV solution	Included in Shore End Burial	10	16	2	2.5
Cable 2.15 Iona - Mull	Included in Diver/ROV preinstall survey at Shore ends (if required)	Included in NO MLV solution	Included in Diver/ROV post install survey and Shore End Burial	10	16	2	2.5
Cable 2.16 Colonsay - Mull	2	3	2	2	14	2	N/A

* Contingencies will be carefully engineered in water depths less than 10m and therefore will not reduce the depth more than 5%

Notifications of works will be issued at an agreed schedule prior to operations closer to the project commencement. Following installation, the cables are expected to be in service and operational for at least 25-years.

The exact timing of the landfall works will be dependent upon the offshore works, marine licensing and onshore permits and conditions.

2.13 Mitigation

The R100 Project has been developed through an iterative process which involved seeking to avoid or reduce potential environmental effects through careful consideration of the routing of the marine cable. This was the first Project specific step in mitigating potential effects by seeking to avoid or reduce environmental disturbance as far as practicable.

The R100 Project within the Inner Hebrides geographical area includes a range of primary mitigation measures that have been 'designed' into the development proposals to demonstrate that the applicant will comply with national and international statute and best practice guidance as determined by the cable industry as a basic standard for how to proceed on a project. These design measures will help to reduce the effects of cable installation.

The design measures are detailed within each Section of the MEA (where relevant) and gathered in Table 2-6 below. For clarity, each design measure has been given an identification number for the source of the mitigation. Should project specific mitigation measures be required to further reduce the effects of cable installation, the mitigation measures have been proposed from within the MEA Report and supporting documents and are provided in Section 8 of this MEA.

Table 2-6 Project design measures

ID	Aspect	Design Measure	Source
COMP 1	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	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.	International Maritime Organisation
COMP 2	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	The dropped object procedure will be followed, and any unrecovered dropped objects must be reported to the relevant authority (MS LOT) using their dropped object procedure, within 24 hours of the project becoming aware of an incident.	MS-LOT
COMP 3	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	'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).	Maritime and Coastguard Agency
COMP 4	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	Where weather reduces visibility then vessel masters shall adhere to MGN guidelines and COLREGS to prevent collisions at sea.	International Maritime Organisation
COMP 5	Biological Section: Benthic and Intertidal Ecology	Ballast water discharges from Project vessels will be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard.	International Maritime Organisation
COMP 6	Biological Section: Benthic and Intertidal Ecology	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	International Maritime Organisation
COMP 7	Biological Section: Benthic and Intertidal Ecology	Control measures and shipboard oil pollution emergency plans (SOPEPs) will be in place and adhered to under MARPOL Annex I requirements for all project vessels.	International Maritime Organisation
COMP 8	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	Should the project create potential hazards to shipping (such as cables temporarily buoyed off or reduction in water depth) along the cable routes, stakeholders will be informed immediately via a NtM distribution list including Kingfisher to ensure safety is upheld.	Maritime and Coastguard Agency
COMP 9	Human Environment - Archaeology	The Crown Estate's 'Protocol for Archaeological Discoveries' (The Crown Estate, 2014) will be implemented during installation works.	The Crown Estate
COMP 10	Human Environment - Archaeology	The locations of any wrecks or features of archaeological significance discovered during the project will be provided to Historic Environment Scotland and the UK Hydrographic Office (UKHO).	UKHO
BP 1	Human Environment: Commercial Fishing;	Early consultation with relevant contacts to notify of impending activity.	Global Marine

ID	Aspect	Design Measure	Source
	Shipping and Navigation; Other sea users		
BP2	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	Notice to Mariners will be published to inform sea users via Notices to Mariners, Kingfisher Bulletins and MCA and UKHO. Vessels will be requested to remain at least 1NM away from cable vessels during installation operations.	Maritime and Coastguard Agency
BP3	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	An onshore Fishing Liaison Officer (FLO) will be provided for the project. The FLO will follow the Fishing Liaison Mitigation Action Plan (FLMAP). The FLO will continue in this role during installation process.	Maritime and Coastguard Agency and Global Marine installation requirement
BP4	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	The UKHO will be informed of installation activities in order to issue navigational warnings via NAVTEX/VHF/MF as appropriate.	Maritime and Coastguard Agency
BP5	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	Guidance provided by the UKHO and International Convention for the Safety of Life at Sea (SOLAS) recommend that fishing vessels should avoid trawling over installed seabed infrastructure (UKHO 2020). Vessels are advised in the Mariners Handbook not to anchor or fish (trawl) within 0.25NM of cables.	Maritime and Coastguard Agency and Mariners Handbook
BP6	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	If cables are buoyed off whilst the vessel departs the area, buoy positions will be notified to the NTM distribution list including Kingfisher and 0.25NM clearance will be requested.	Maritime and Coastguard Agency
BP7	Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	Coordination with local ferry Service and Coastguard Operations to provide 24-hour radio and radar coastal vessel traffic information which helps vessels navigate safely to help prevent collisions at sea.	Maritime and Coastguard Agency
BP8	Physical, Biological, Human Environment: Commercial Fishing; Shipping and Navigation; Other sea users	Rock , bags/contingency protection measures will only be deployed where adequate burial cannot be achieved or as required by crossing agreements. The footprint of the deposits will be the minimum required to ensure cable safety stability.	Crossing Agreements; Existing Asset Owner (BT
BP9	Human Environment: Archaeology	The geophysical survey data will be reviewed by an appropriately qualified archaeologist. Appropriate archaeological exclusion zones (AEZs) will be assigned to anomalies identified with archaeological potential. These will be avoided. If it is not possible to avoid the AEZ completely, alternative mitigation will be proposed.	The Crown Estate 2021
BP10	Biological Environment Marine Birds; Marine mammals; Fish and shellfish; Protected sites	The installation vessels will be moving at a speeds less than 6 knots during installation activities. Typical installation speeds are likely to be 1knot for surface lay and 0.3 knots for plough installation.	Global Marine installation requirement
BP11	Human Environment: Commercial Fishing	Disruption claims will be handled in accordance with ESCA standard operating practices.	ESCA Guidance (No13, issue 11)

ID	Aspect	Design Measure	Source
BP12	Biological Environment: Benthic and Intertidal Ecology	Route development and micro-routing has been used where possible to avoid or minimise the footprint of the application corridor routes through potentially sensitive habitats.	Global Marine installation requirement
BP13	Biological Environment: Benthic & Intertidal Ecology	Construction vehicle movement will be minimised as far as practical to minimise effects to compacting the beach; beach profile will be restored following cable installation.	Global Marine installation requirement
BP14	Biological Environment	The 'Guide to Best Practice for Watching Marine Wildlife' guidance will be followed where practicable.	Global marine installation requirement