Scottish Hydro Electric Power Distribution plc

Mossbank - Yell Emergency Cable Replacement

High-Level Navigation Risk Assessment (HLNRA)

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ACRONYMS AND ABBREVIATIONS

ABBREVIATION	DEFINITION
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AtoN	Aid to Navigation
BT	British Telecoms
CEMP	Construction Environmental Management Plan
CSV	Comma-Separated Values
DC	Direct Current
DWT	Deadweight Tonnage
EMF	Electromagnetic Fields
EU	European Union
FLMAP	Fisheries Liaison Mitigation Action Plan
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
HES	Historic Environment Scotland
HLNRA	High Level Navigational Risk Assessment
Hz	Herz
IMO	International Maritime Organisation
IRPCS	International Regulations for the Prevention of Collision at Sea
KIS - ORCA	Kingfisher Information Service- – Offshore Renewable and Cable Awareness
km	Kilometres
km^2	Square kilometres
m	Metres
MCA	Maritime and Coastguard Agency
MEA	Marine Environmental Appraisal
MGN	Marine Guidance Note
MHWS	Mean High Water Springs

ABBREVIATION	DEFINITION
MLWS	Mean Low Water Springs
MMSI	Maritime Mobile Service Identity
MTS	Marine Traffic Survey
NM	Nautical Mile
NtMs	Notice to Mariners
OIMD	·Operation, Inspection, Maintenance and Decommissioning Strategy
OoS	Out of Service
OREI	Offshore Renewable Energy Installation
RCZ	Recommended Clearance Zone
RP	Reference Point
SAR	Search and Rescue
SFA	Shetland Fishermen's Association
SIC	Shetland Islands Council
SHEPD	Scottish Hydro Electric Power Distribution
SOLAS	Safety of Life at Sea
SSMO	Shellfish Management Organisation
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UTC	Universal Time Coordinated
VTS	Vessel Traffic Service
µT	microtesla

1 INTRODUCTION

This High-Level Navigational Risk Assessment (HLNRA) provides an appraisal of navigational risk associated with the proposed Mossbank to Yell Emergency Cable Replacement (the Project). The replacement cable will be constructed between the landfalls at Mossbank (Mainland Shetland) and Hoga (Yell) connecting to existing distribution networks. The replacement cable will be approximately 4 kilometres (km) in length.

A targeted Marine Traffic Survey (MTS) has been undertaken to describe the relevant shipping and navigation and marine traffic baseline, as understood through desk-based review, and is presented in Section 3. This is followed by the HLNRA, which uses a Formal Safety Assessment (FSA) approach to identify and assess the risks to shipping and navigation presented by the project activities.

The HLNRA should be read in conjunction with the following Mossbank to Yell Emergency Cable Replacement documents:

- Project Description;
- Marine Environmental Appraisal (MEA);
- Marine Construction Environmental Management Plan (CEMP);
- Shetland Regional Fisheries Liaison Mitigation Action Plan (FLMAP);
- How SHEPD Co-Exists with Other Marine Users; and
- Operation, Inspection, Maintenance and Decommissioning Strategy (OIMD).

1.1 Project overview

Scottish Hydro Electric Power Distribution plc (SHEPD) holds a licence under the Electricity Act 1989 for the distribution of electricity in the north of Scotland including the Islands. It has a statutory duty to provide an economic and efficient system for the distribution of electricity and to ensure that its assets are maintained to provide a safe, secure and reliable supply to customers.

In May 2024, SHEPD identified that one of the subsea cables connecting Mainland Shetland (Mossbank) to Yell had faulted. The cable was installed in 2009 (Mossbank – Yell North 1), as shown in Figure 1-1. In this location there is also a currently active subsea cable that was replaced in 2019 (Mossbank – Yell South 2). An option evaluation process recommended complete replacement of the 2009 faulted cable.

The proposed cable replacement will involve the installation of a new 33 kilovolt (kV) subsea cable and associated cable stabilisation and protection, together with the removal of sections of the existing faulted and Out of Service (OoS) cables, where required. Installation of this cable is required to replace the existing faulted cable and restore connection to the power distribution network providing supply to the communities on Yell, Unst and Fetlar. The cable installation is currently planned to be undertaken in summer 2025, i.e., ahead of winter and anticipated deterioration in weather conditions.

The proposed replacement will be constructed between the landfalls at Mossbank (Mainland Shetland) and Hoga, (Yell) to tie into existing distribution networks (Figure 1-2). The final cable route has not yet been determined. As such, to provide flexibility for final route engineering, this HLNRA considers a 1.7 km^2 proposed cable corridor, within which the Mossbank to Yell replacement cable will be located. The final route selection will be based on further detailed route engineering and design parameters, while taking environmental and other constraints into account.

Figure 1-1 Existing subsea cable locations and fault and damage locations

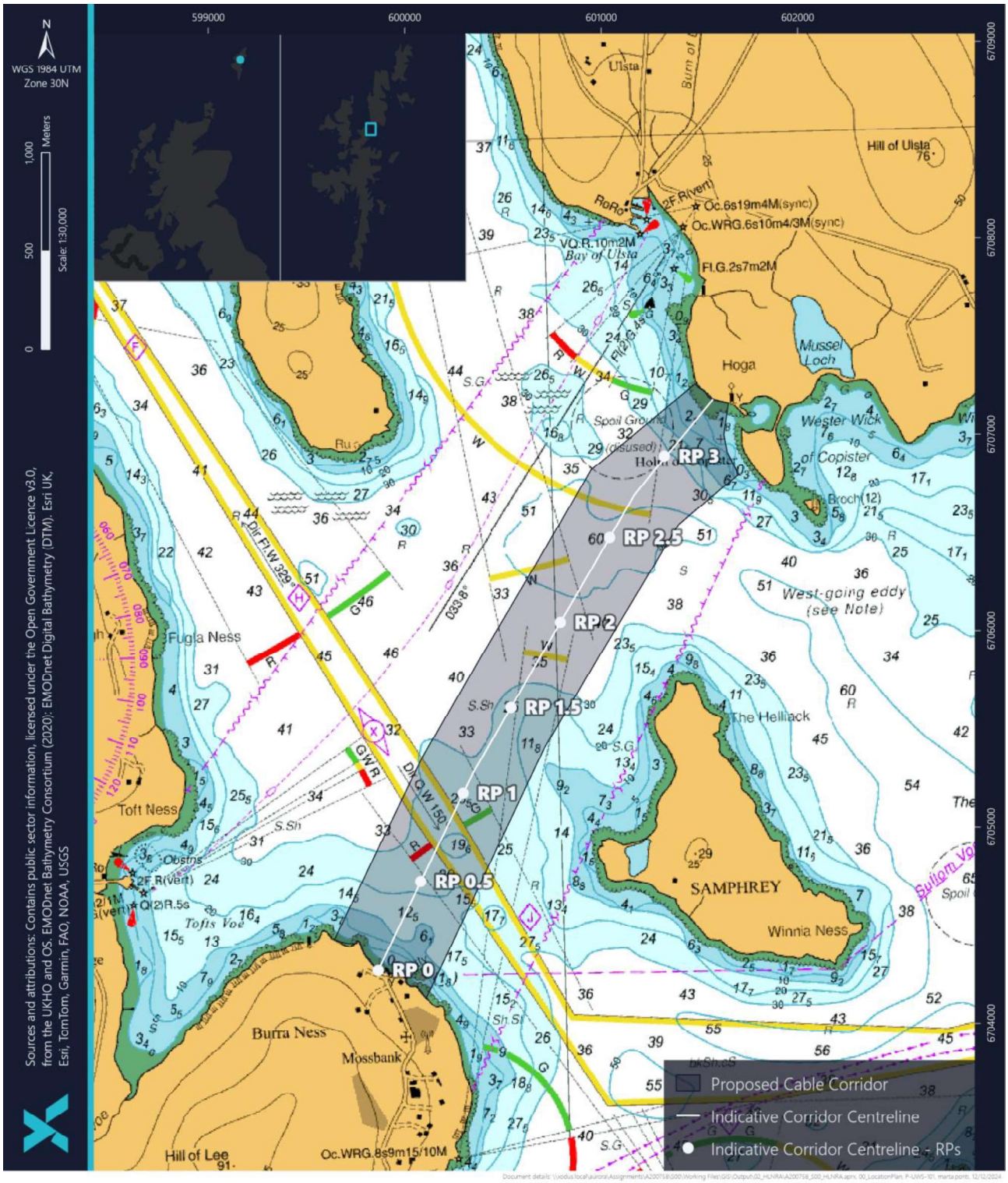


Figure 1-2 The Mainland Shetland (Mossbank) – Yell (Hoga) Proposed Cable Corridor (Note: indicative corridor centreline does not depict proposed cable route but is provided for spatial referencing within the proposed cable corridor, in combination with the Reference Points (RPs)).

1.2 Embedded Mitigation

Certain risk control or mitigation measures are embedded in the Project design as adherence from all operators to standard industry best practices, which is fundamental to how the Project will be executed. Details of the embedded mitigation which SHEPD are committed to implementing, and hence has been considered by this HLNRA, are presented in Table 1-1. All embedded mitigation will be included within the outline CEMP.

During the HLNRA, all proposed mitigation is considered when assessing the significance of risks.

Table 1-1 Embedded Mitigation and Principal Industry Best Practices Relevant to the Proposed Activities.

MEASURE	DETAILS
Avoidance of Trawling and Anchoring	In line with guidance provided by the UKHO, the International Maritime Organisation (IMO) and the Maritime and Coastguard Agency (MCA) within the Mariner's Handbook (NP100), and Marine Guidance Note (MGN) 661, SHEPD recommend that vessels should avoid demersal fishing and anchoring in proximity to subsea cables.
A Fisheries Liaison Officer (FLO) will be employed to manage interactions between cable installation vessels, personnel, equipment and fishing activity. This will be managed through the Fisheries Liaison Mitigation Action Plan.	Employment of a FLO will ensure all commercial fisheries operators in the vicinity of the Project will be proactively and appropriately communicated with in terms of proposed Project operations.
Notice to Mariners (NtMs), local notifications to marine users, Kingfisher bulletins, Radio Navigational Warnings, and/or broadcast warnings will be promulgated in advance of any proposed works. The notices will include the time and location of any work being carried out, and emergency event procedures	Ensure navigational safety and minimise the risk of equipment snagging. The NtMs will be distributed via the Sullom Voe Harbour Authority. Notices will also be issued if any large boulders are relocated within the licenced installation corridor.
Compliance with International Regulations for the Prevention of Collision at Sea (IRPCS) (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS).	IRPCS are the international standards designed to ensure safe navigation of vessels at sea. All installation vessels will adhere to these rules, including displaying appropriate lights and shapes. SOLAS is an international maritime treaty which sets minimum safety standards in the construction, equipment and operation of merchant ships. The convention requires signatory flag states to ensure that ships flagged by them comply with at least these standards. In relation to the Project its compliance will ensure navigational safety.

MEASURE	DETAILS
Guard Vessels and Recommended Clearance Zone (RCZ)	A guard vessel or small support vessel, marshalling a 500 m RCZ may be used during the installation campaign where a potential risk to the asset or danger to navigation has been identified. The requirement for a guard vessel will be considered through consultation with the Sullom Voe Harbour Authority and Installation Contractor. The RCZ may be reduced to 250 m (or other agreed distance) for the Yell Ferries and vessels carrying Sullom Voe Harbour Authority pilots. This will be implemented through ongoing communications and agreements between the Sullom Voe Harbour Master, the Yell ferry operator, SHEPD and the cable installation contractor.
As built survey data will be provided to the UKHO and Kingfisher for inclusion on Admiralty Charts and the Kingfisher Information Service – Offshore Renewable and Cable Awareness (KIS-ORCA) charts.	Ensure navigational safety and minimise the risk and equipment snagging.
Aids to Navigation: cable marker beacons	In consultation with the Northern Lighthouse Board (NLB) and subject to their Statutory Sanction, it will be determined whether any additional marker beacons (4 m poles with 2.5 m tall yellow flash mark diamonds) are required for established landfalls. These markers will be inspected and maintained for the life of the cable.
Engagement with navigational consultees	Ongoing consultations with Shetland Islands Council (SIC) ports and harbour authority ensure continued awareness and communication of installation and harbour specific details relevant to minimising disruption. Ongoing consultation with Shetland Shellfish Management Organisation (SSMO) and Shetland Fishermen's Association (SFA) to discuss the potential impacts as a result of the installation activities. Engagement with ferry operators and regular runners ensures awareness of the installation details which minimises disruption. Installation maintenance and decommissioning schedules arranged to minimise impact on ferry schedules. This may extend to working in night-time hours where practicable.

2 METHODOLOGY

2.1 Consultation

A consultation meeting was held with SIC harbour masters and ferry operators on the 19th November 2024 to discuss the Project to further aid understanding of any navigational concerns associated with the cable replacement works. The outputs from the consultation meeting have been used to supplement this HLNRA.

2.2 Marine Traffic Study

Relevant baseline marine traffic conditions have been established by undertaking a review of historic Automatic Identification System (AIS) data for a 5 nautical mile (NM) corridor around the proposed cable corridor (the study area). The IMO requires that all ships of ≥ 300 gross tonnage engaged on international voyages, cargo vessels of ≥ 500 gross tonnage not engaged on international voyages, and all passenger ships regardless of size built on or after 1st July 2002, are fitted with an AIS. All European Union (EU) registered fishing vessels of length 15 m and above are required to carry AIS equipment by EU directive. Smaller fishing vessels (below 15 m) as well as recreational craft are not required to carry AIS, although a proportion does so voluntarily. As such smaller vessels are likely to be underrepresented in the AIS data.

AIS data was used to assess the patterns and intensity of shipping activity in the vicinity of the marine installation corridor. AIS records were acquired for a full year between the dates 01-09-2023 00:00 and 31-08-2024 23:59 Universal Time Coordinated (UTC), and supplied by Kpler (industry standard commercial AIS data supplier) with all standard parameters (longitude, latitude, vessel Maritime Mobile Service Identity (MMSI) number, status, speed, course, heading and timestamp) and the following additional parameters:

- Deadweight tonnage (DWT);
- Vessel length;
- Vessel draught;
- Vessel type;
- Vessel name;
- Previous port; and
- Next port.

AIS data was received in a raw, point-based table format in multiple comma-separated values (CSV) files and quality checked. The entire point-based dataset was subsequently converted to vessel tracks using in-house developed Python tools that use the unique MMSI, journey information (previous port and next port) and the timestamp associated with each individual AIS record. Vessel tracks were created where each AIS record was 'connected' by a line to another that shares the same MMSI and vessel type and that falls under a specified time and distance threshold. In this case, sequential AIS point records were connected where the intervening time or distance did not exceed 60 minutes or 10 miles, respectively. These thresholds were set to strike a balance between ensuring the connectivity of valid points across the assessment area so that a singular journey is not broken into multiple lines and therefore misrepresenting the volume of transits or trajectories, and accurately reflecting the direction or route of a transect. Vessel density grids for the wider area were produced by overlaying a 0.1 square kilometres (km^2) hexagonal grid

and determining the density of tracks within each cell. The tracks are subsequently 'reattached' to the ship-specific attribute data base to enable further analysis. Each track line or trajectory will have a start and end time and date taken from the minimum and maximum timestamp value for the range of AIS points associated with that track line, allowing for temporal analysis of vessel distributions. Vessels were determined to be transiting during the day where the journey end time was between 06:00 (06:00 AM) and 18:00 (06:00 PM) and during the night where the journey end time was between 18:00 (06:00 PM) and 06:00 (06:00 AM).

2.3 HLNRA Methodology

HLNRA uses the baseline shipping data from the MTS to inform a high-level desk-top FSA process which identifies and assesses hazards to all relevant navigation or shipping activities, from the Project. The process provides a hazard log which ultimately demonstrates that suitable risk management measures have been applied to the development and that risks are both reduced to as low as reasonably practicable (ALARP) and trackable.

2.3.1 Formal Safety Assessment Approach

The FSA process provides a structured and systematic method for evaluating and controlling risk within a defined framework. The process is implemented using a classic risk matrix approach broadly in line with the IMO FSA Guidelines (IMO, 2018) and the MCA Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI).

This approach is qualitative and comprises the following principal elements:

- Hazard / impact identification;
- Identification of existing risk control measures;
- Risk assessment;
- Identification of additional risk control measures; and
- Cost benefit considerations.

The outcome of these elements is the formulation of recommendations to inform decision-making for all relevant parties. Further detail on each element is provided below.

2.3.2 Hazard/Impact Identification

Taking into account the Project components and activities, baseline information provided in the MTS, expert judgement/industry experience, a list of all relevant hazards, as well as their worst potential outcomes is compiled. The hazards are categorised according to Project phase with the operational phase referring to the condition where the cable is installed, and sea surface activities have ceased. Installation, maintenance, and decommissioning phases translate to the presence of vessels limited in their manoeuvrability across the installation corridor for the duration of the operations.

2.3.3 Identification of Existing Risk Control Measures

All existing risk control measures are identified such that they can be incorporated into the risk assessment process. These include mandatory requirements and good industry practice as well as Project specific measures that are prescribed / predefined as forming part of the Project design.

2.3.4 Risk Assessment

Each impact is individually evaluated against specific criteria and assigned categories for severity of the hazardous outcome consequences and likelihood or frequency of the occurrence. The definitions used in the FSA to evaluate the consequence and frequency of impacts are shown below in Table 2-1 and Table 2-2. Note that there is no established consensus for risk matrix category definitions within the IMO, MCA or across wider industry. The categories applied here are considered appropriate for this HLNRA.

Table 2-1 Severity of Consequence of Hazard / Impact Criteria.

SEVERITY / MAGNITUDE	CRITERIA DESCRIPTION
High	Loss of a crew member, or multiple serious injuries / Major/Severe damage to infrastructure or vessel / Operations / activities halted indefinitely
Medium	Serious injury to person / Notable damage to infrastructure or vessel / Protracted operational delays
Low	Minor injury(s) to person / Minor/Local damage to equipment or vessel / Minor operational delays
Negligible	No significant operational impacts

Table 2-2 Likelihood Criteria.

LIKELIHOOD	CRITERIA DESCRIPTION
Remote	Never occurred during Company's activities but has been known to occur in the wider industry.
Unlikely	Has occurred in Company's activities in the past but as an isolated incident under exceptional circumstance.
Occasional	Has occurred on more than one occasion during Company's activities in the past.
Likely	Occurs regularly during Company's activities.

The likelihood and consequence categories are combined for each hazard/impact using the risk matrix shown in Table 2-3, which is used to derive a risk tolerability level of either Unacceptable, Tolerable or Broadly Acceptable, with unacceptable or tolerable risks being considered to be significant in Environmental Appraisal terms. Definitions of each risk tolerability level are provided in Table 2-4.

Table 2-3 Risk Matrix.

FREQUENCY/ LIKELIHOOD					
	Likely	Broadly Acceptable	Tolerable	Unacceptable	Unacceptable
	Occasional	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
	Unlikely	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
	Remote	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
	-	Negligible	Low	Medium	High
SEVERITY OF CONSEQUENCE / MAGNITUDE					

Table 2-4 Tolerability Definitions.

TOLERABILITY	DEFINITION
Broadly Acceptable (Low Risk - not significant)	Generally regarded as acceptable and adequately controlled. At these risk levels the opportunity for further reduction is limited.
Tolerable if ALARP (Moderate Risk - significant)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate mitigation measures are in place, residual risks are as low as reasonably practicable (ALARP) and that risks are periodically reviewed to monitor if further controls are appropriate.
Unacceptable (High Risk - significant)	Generally regarded as unacceptable whatever the level of benefit associated with the activity. Significant risk mitigation or design modification required to reduce to tolerable (ALARP).

2.3.5 Identification of Additional Mitigation Measures

Where risks are assessed as being unacceptable or tolerable after factoring in the embedded mitigation measures already identified, further additional risk mitigation measures are considered and identified where necessary and practicable.

2.3.6 Cost-Benefit Considerations

To formulate recommendations for decision-making, any additional risk mitigation measures identified are subjected to a qualitative cost-benefit comparison in order to justify the measure and establish a residual risk categorisation and basic ALARP position.

2.3.7 Risk Assessment Table/Hazard Log

The HLNRA output has been presented in a table, such that the hazards for each of the development scheme phases and their associated mitigation measures (embedded and additional) are captured to provide a single auditable hazards and effects log. The output of the assessment can be seen in Table 4-1.

3 MARINE TRAFFIC STUDY

This section covers the relevant shipping and navigation baseline within the study area, providing a summary of key navigational features and shipping activity as determined from analysis of AIS data. Analysis of shipping and navigation is important, due to potential interactions between existing vessel traffic and the proposed cable, particularly during the installation phase.

3.1 Key Navigational Features

An overview of all relevant key navigational features is provided in the following sections and presented on Figure 3-1.

3.1.1 Ports and Ferry Routes

Sullom Voe Harbour, located on the northern coast of Mainland Shetland in the Shetland Islands, Scotland, is one of the UK's largest deep-water harbours. It primarily supports the Sullom Voe Oil Terminal, a key facility in the North Sea oil and gas industry since its establishment in the 1970s. Operated by SIC, the harbour can accommodate large vessels, including tankers up to 365 meters in length. Its infrastructure also allows handling of other cargo types, including quarried rock and containerised goods[1]. Sullom Voe Harbour Authority operate a Vessel Traffic Service (VTS) for vessels transiting through Yell Sound, whereby vessels are provided information on vessel movements and other activities to facilitate onboard decision making and passage planning.

The proposed cable replacement and all associated works, including the study area extent, are fully contained within the Sullom Voe Harbour limits, situated between Mossbank and Yell. The Project is located at the easternmost border of the harbour area.

The Yell Ro-Ro ferry route (between Toft and Ulsta), is situated approximately 280 m west of the proposed cable corridor at the closest point. The ferry route runs broadly parallel to the proposed cable corridor (Figure 3-1). As a result, vessel traffic within the 5 NM study area primarily consists of passenger vessels operating this service. It comprises 58% of the track lines in the AIS data (see Section 3.2). The ferry service currently operates the Daggri (MMSI: 235014768) and Dagalien (MMSI: 235014766) vessels during the week and a single vessel during the weekend, with the last ferry departing from Toft at 23:30 and from Ulsta at 22:30 (winter schedule).

[1] https://www.shetland.gov.uk/sullom-voe/sullom-voe-port-information

3.1.2 Cables and Navigational Aids

As shown in Figure 1-1, several submarine cables run within and near the proposed cable corridor, connecting Mossbank to Yell. Among them is the SHEPD 2009 faulted cable (Mossbank–Yell North 1), the subject of these replacement works. Additionally, there is also the active SHEPD subsea cable installed in 2019 (Mossbank–Yell South 2). The active British Telecoms (BT) 100 telecommunications cable also very partially overlaps the proposed cable corridor on approach to the Mossbank landfall. Furthermore, a number of pipelines are in proximity to the proposed cable corridor, the closest being the TAQA Cormorant A to Sullom Voe active pipeline, located 1.2 km southeast of the proposed cable corridor.

In terms of aids to navigation (AtoN), the beacons near the proposed cable corridor are registered as 'beacon – special purpose/general' and mark the start and endpoints of the existing cables. Two beacons are located at the Mossbank landfall, and one is positioned near the Yell landfall.

No charted anchorage areas are located within, or in the immediate vicinity of the proposed cable corridor.

3.1.3 Wrecks and Obstructions

Wreck locations were identified using Marine Themes Vector data layers from OceanWise and the National Record of the Historic Environment (Canmore) – Maritime records of wrecks, losses, and obstructions. The Marine Themes Vector data indicate an obstruction (an underwater rock of unknown depth) adjacent to the Yell landfall (Figure 3-1). While the Historic Environment Scotland (HES) (Canmore) dataset records an unverified wreck (possibly a craft) located within the proposed cable corridor, 230 m north from the Mossbank landfall (Figure 3-1). No other wrecks or obstructions are present within the proposed cable corridor.

It should be noted that the open Ulsta dredge spoil site partially overlaps the western edge of the proposed cable corridor near the Yell landfall and covers an area of approximately 1.6 km^2, this is considered further within the MEA (Document Number: A-200758-S00-A-REPT-002).

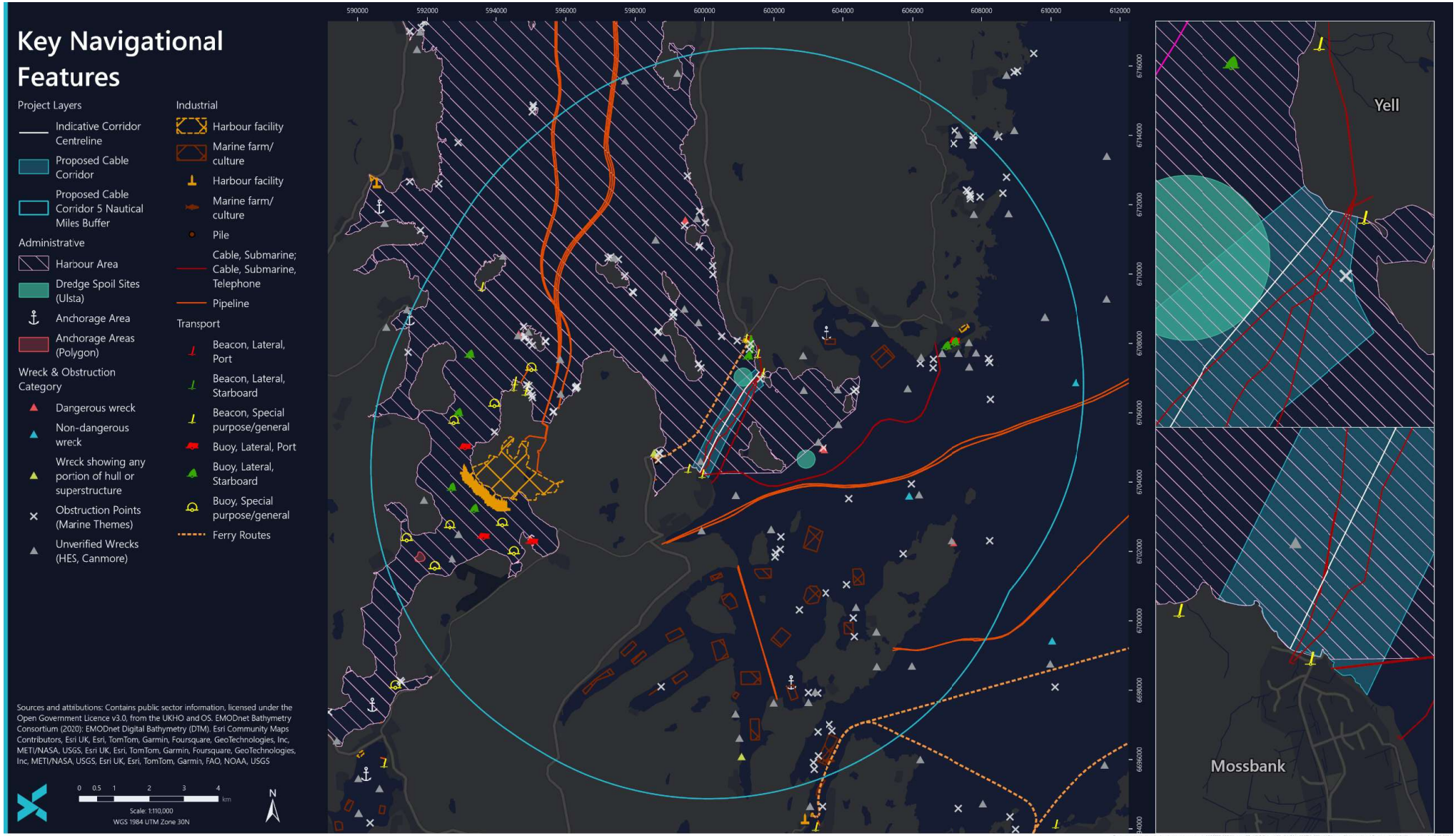


Figure 3-1 Key Navigational Features.

3.2 Baseline Shipping Activity

3.2.1 Overview and Temporal Changes

A total of 14,180 and 2,626 vessel tracks were recorded within the 5 NM study area and the proposed cable corridor between the dates 01-09-2023 and 31-08-2024, respectively (Table 3-1). These tracks were associated to 309 unique vessels, and 350 unique routes, based on previous and next port information captured in the AIS data. The busiest routes were associated with the ferry service operated by the passenger vessels Daggri and Dagalien: Ulsta (Yell)–Toft with 2,176 vessel tracks, and Toft–Ulsta (Yell) with 3,415 tracks, as clearly visible in Figure 3-5.

Some seasonal variation is observed, with autumn and winter recording slightly higher track line counts within both the 5 NM study area and the proposed cable corridor, when compared to spring and summer. Within the 5 NM study area, vessel activity recorded an average of 1,182 tracks per month, with May and June being the quietest months. In the proposed cable corridor, vessel activity averaged 219 tracks per month, with March and May being the quietest months.

3,693 tracks within the 5 NM study area were observed during winter months, accounting for 26% of total track line counts across the study year. Within the proposed cable corridor specifically, 736 tracks were recorded during the same period accounting for 28% of total track line counts across the study year. Spring and summer observed a slight decrease in the number of vessels, with summer accounting for 23% (3,268 tracks) and 22.3% (585 track) of the total number of tracks within the 5 NM study area and the proposed cable corridor, respectively. The difference in track count between day (06:00 – 18:00) and night (18:00 – 06:00) is illustrated in Figure 3-2 and Table 3-1.

In terms of vessel types, passenger vessels were the most frequent within both the 5 NM study area and the proposed cable corridor. Passenger vessels were particularly dominant during the winter season, accounting for 64.7% of vessel activity within the 5 NM study area (Figure 3-3) and 68.8% of the tracks within the proposed cable corridor (Figure 3-4) during this period.

February was the busiest month both for the 5 NM study area (1,324 tracks) and the proposed cable corridor (274 tracks). The day with the highest vessel activity within the 5 NM study area was March 18, 2024, when 69 vessel tracks were recorded. While the busiest day for the proposed cable corridor was November 15, 2023, with 11 tracks recorded. In contrast, the quietest day for the 5 NM study area was December 31, 2023, with only 1 track recorded, while the proposed cable corridor experienced 70 days within the study period with no recorded tracks.

Table 3-1 Vessel Tracks Per Season and Day/Night.

SEASON	TRACK LINE COUNTS					
	5NM Study Area			Proposed Cable Corridor		
	Day	Night	Total	Day	Night	Total
Autumn	2,669	967	3,636	599	139	738
Winter	2,759	934	3,693	586	150	736
Spring	2,650	933	3,583	421	146	567
Summer	2,570	698	3,268	505	80	585
Grand Total	**10,648**	**3,532**	**14,180**	**2,111**	**515**	**2,626**

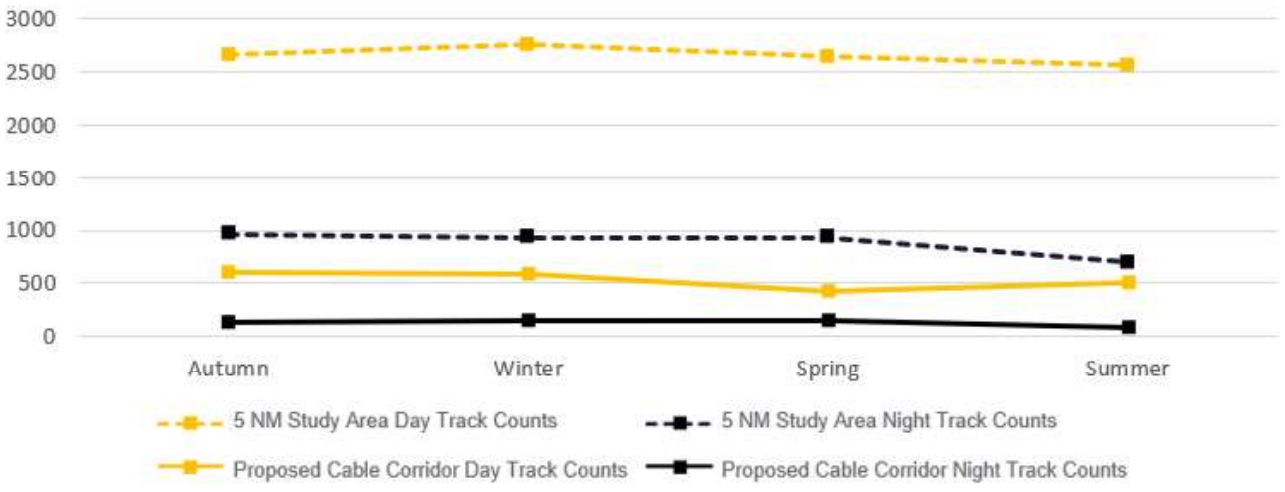
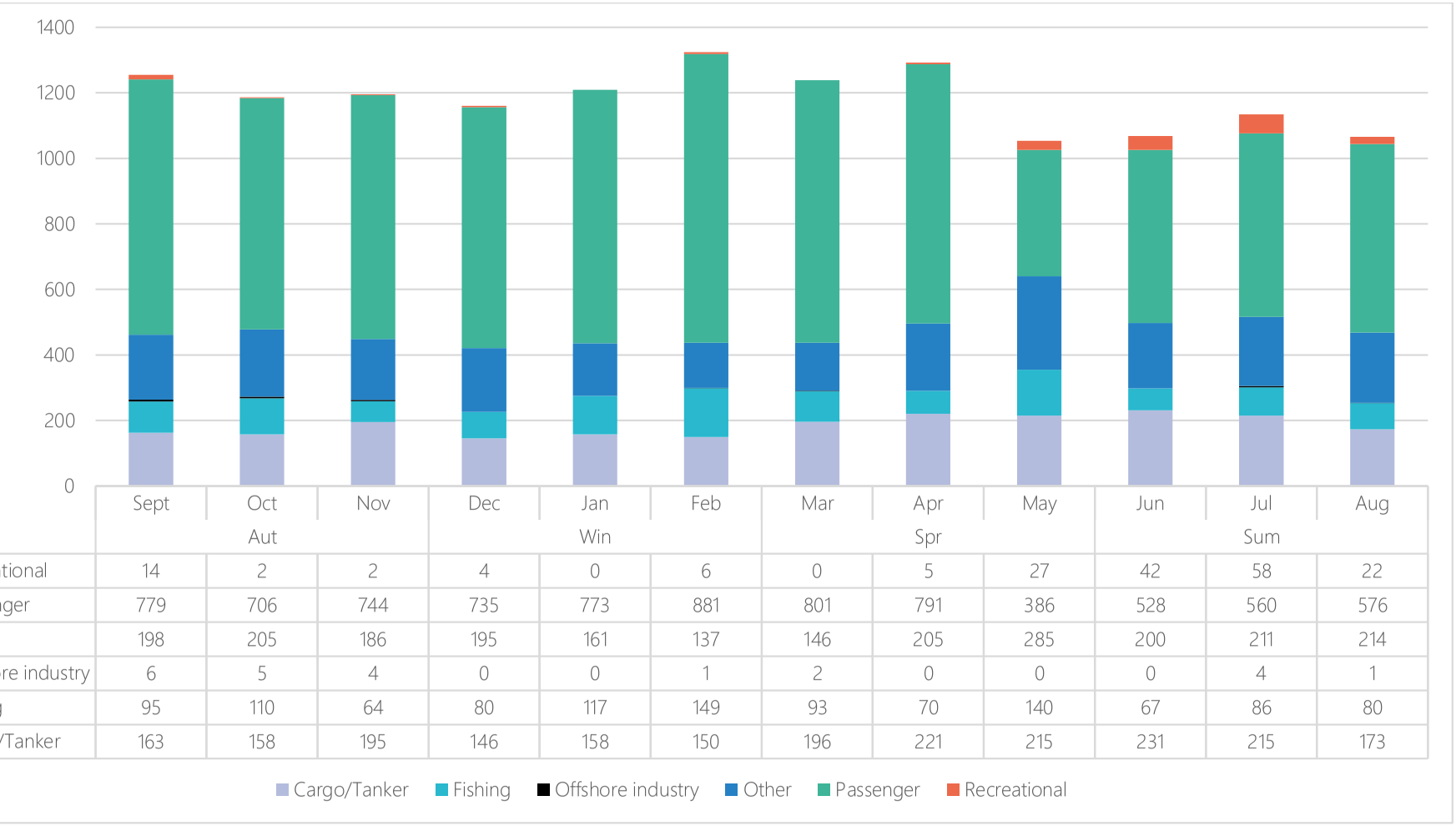


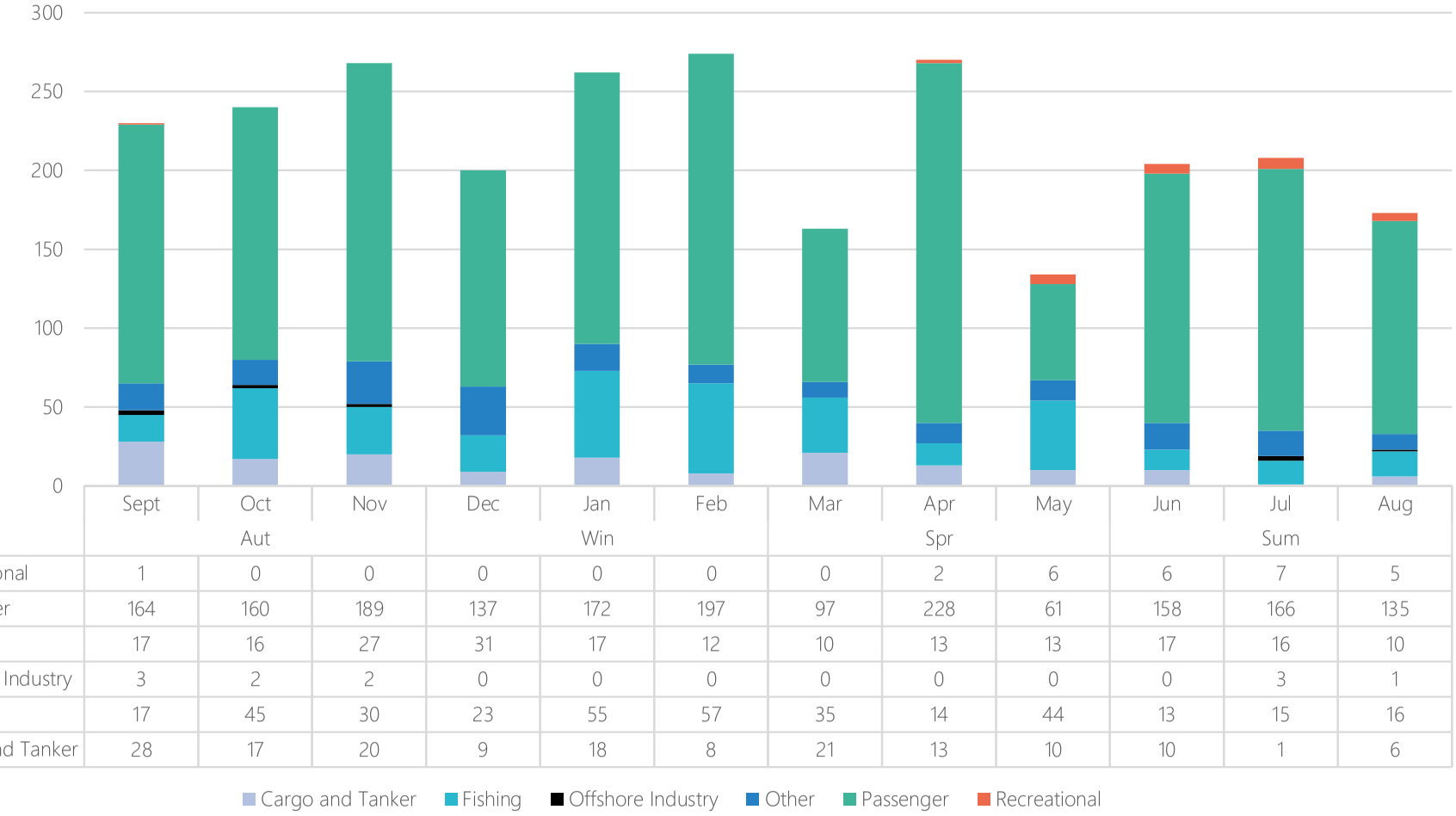
Figure 3-2 Vessel Tracks Per Season and Day/Night.

In total, fewer vessels are observed during the night (18:00 – 06:00), accounting for 25% and 20% of the total number of tracks within the 5 NM study area and proposed cable corridor, respectively. Overall, this represents a 50% reduction in vessels traffic during the night within the 5 NM study area and a 61% reduction within the proposed cable corridor (Figure 3-5). All vessel types observed a reduction in tracks during the night, with passenger vessels decreasing from a total of 7,955 during the day to 2,169 during the night.



	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
		Aut			Win			Spr			Sum	
Recreational	14	2	2	4	0	6	0	5	27	42	58	22
Passenger	779	706	744	735	773	881	801	791	386	528	560	576
Other	198	205	186	195	161	137	146	205	285	200	211	214
Offshore industry	6	5	4	0	0	1	2	0	0	0	4	1
Fishing	95	110	64	80	117	149	93	70	140	67	86	80
Cargo/Tanker	163	158	195	146	158	150	196	221	215	231	215	173

Figure 3-3 Seasonal and Monthly Summary of Vessel Types Within the 5 NM Study Area.



	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
		Aut			Win			Spr			Sum	
Recreational	1	0	0	0	0	0	0	2	6	6	7	5
Passenger	164	160	189	137	172	197	97	228	61	158	166	135
Other	17	16	27	31	17	12	10	13	13	17	16	10
Offshore Industry	3	2	2	0	0	0	0	0	0	0	3	1
Fishing	17	45	30	23	55	57	35	14	44	13	15	16
Cargo and Tanker	28	17	20	9	18	8	21	13	10	10	1	6

Figure 3-4 Seasonal and Monthly Summary of Vessel Types Within the proposed cable corridor.

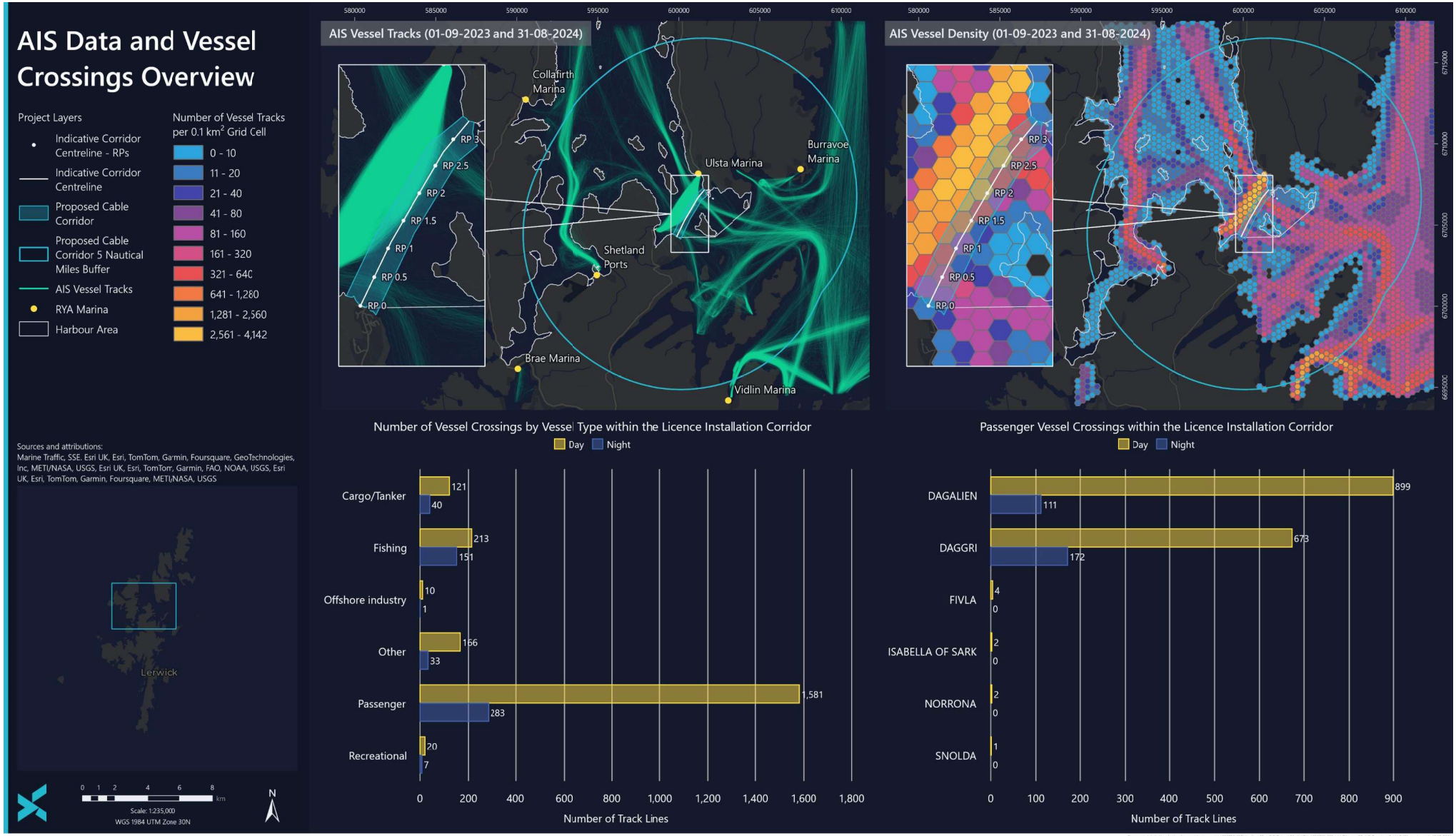


Figure 3-5 AIS Data Summary, Including Vessel Tracks, Vessel Densities, and Vessel Type Counts.

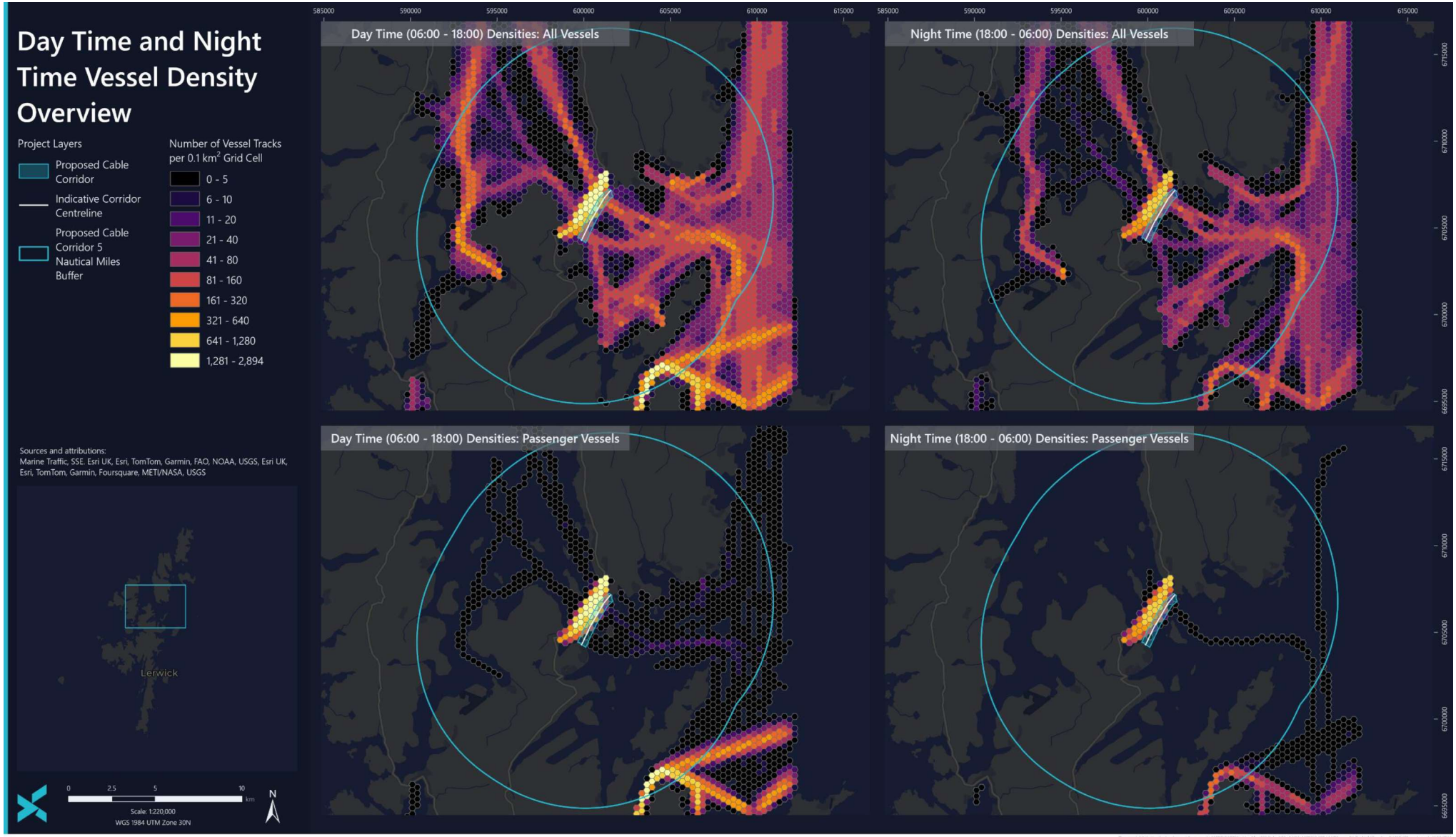


Figure 3-6 Day and Night Vessel Densities.

3.2.2 Vessel Type

A breakdown of the various vessel types occurring within the 5 NM study area and proposed cable corridor is provided in Table 3-3, and the track line densities of each vessel category are provided in Figure 3-7. An overview of each vessel category is provided below.

Cargo Vessels and Tankers

Cargo vessels and tankers are the third least frequently observed vessel types, accounting for 15.7% and 6.1% of vessel tracks within the 5 NM study area and proposed cable corridor, respectively. These vessels are primarily observed during the day in both the 5 NM study area and the proposed cable corridor. During the daytime, the predominant sub-category is cargo vessels, which account for 1,575 tracks (90.3%) in the 5 NM study area and 110 tracks (90.9%) in the proposed cable corridor, based on the total tracks in the cargo and tanker vessel category. A significant proportion of night-time tracks within this category (Table 3-3) is also attributed to cargo vessels, representing 413 tracks (86.6%) in the 5 NM study area and 34 tracks (85%) in the proposed cable corridor.

Fishing Vessels

Fishing vessels accounted for 8.1% and 13.9% of vessel tracks within the 5 NM study area and proposed cable corridor, respectively. These tracks were predominantly observed during the daytime, with 825 tracks (7.7%) in the 5 NM study area and 213 tracks (10.1%) in the proposed cable corridor. Nonetheless, it should be noted that the AIS dataset categorises fish carriers, fish factories, and fishery patrol vessels under the fishing category, despite these vessels not engaging in commercial fishing activities. A total of 543 tracks (47.2% of all fishing tracks) from these vessel types were recorded within the 5 NM study area. A similar proportion of tracks: 202 (55.5% of all fishing tracks) was recorded exclusively for fish carriers within the proposed cable corridor.

Fishing tracks intersected the proposed cable corridor primarily between RP 2.5 and RP 3 (Figure 3-7), and the tracks within the corridor are straight in nature, suggesting that the vessel are in transit, and not actively engaged in fishing. It's worth noting that due to their size, smaller inshore and creel fishing vessels are less likely to have AIS equipment installed, and therefore may be under-represented in the data.

Offshore Industry Vessels

Offshore industry vessels are the least frequently observed, accounting for 0.2% and 0.4% of vessel tracks within the 5 NM study area and the proposed cable corridor, respectively, and are associated with eight individual vessels. The most frequently observed vessel, with 17 tracks (50% of the total offshore industry tracks), was Athenia (MMSI: 235088194). Athenia is a high-speed craft offshore vessel with a length of 20 m and was observed almost exclusively during the day. High-speed craft were the most common sub-category within the offshore industry vessel category, comprising 12 daytime tracks (60%) in the 5 NM study area and 5 daytime tracks (50%) in the proposed cable corridor.

Other Vessels

Other vessels represent the second most frequent AIS vessel category, accounting for 16.5% and 7.6% of vessel tracks within the 5 NM study area and the proposed cable corridor, respectively. Within the 5 NM study area, most of these vessels were registered during the daytime, with 1,529 tracks (14.4% of the total number of tracks). Similarly, in the proposed cable corridor, tracks were recorded mainly during the daytime, with 166 tracks (7.9%) recorded during the day compared to 33 tracks (6.4%) at night. Among this category, tug was the predominant sub-category within the 5 NM study area, likely associated with the Sullom Voe port operations, while work vessels dominated within the proposed cable corridor.

Recreational Vessels

Recreational vessels were also observed, accounting for only 1.3% and 1% of vessel tracks within the 5 NM study area and the proposed cable corridor, respectively. The leading sub-category was sailing vessels, which accounted for 57.1% and 60% of daytime tracks within the recreational category in the 5 NM study area and the proposed cable corridor, respectively. Conversely the exhibition ship sub-category accounted for the smallest proportion (<1%), with only a single track observed during the study period (Juvel II, MMSI: 231005000). It's worth noting that due to their size recreational vessels are less likely to have AIS equipment installed and therefore may be under-represented in the data.

Passenger Vessels

Passenger vessels are the most frequently observed vessels within both the 5 NM study area and the proposed cable corridor, accounting for 58.3% and 71% of total tracks across each area. Ro-Ro/Passenger vessels were the most frequently occurring vessel type within the passenger vessel category. Within the 5 NM study area they accounted for 99.6% of passenger vessel tracks during the daytime and 99.9% for night-time tracks. A similar trend is present for the proposed cable corridor, where Ro-Ro/Passenger Ship accounted for 99.9% of passenger vessel tracks during the daytime and 100% of the night-time tracks. Within the 5 NM study area a 6.5% reduction in journeys during the night, was observed, compared to the day for passenger vessels, and a 19.9% reduction was also observed for tracks that crossed the proposed cable corridor (Table 3-3).

Two Ro-Ro vessels accounted for more than half (70.7%) of the total number of tracks crossing the proposed cable corridor. These were represented by Dagalien, and Daggri, which combined made a total of 1,855 crossings during the study period (Table 3-2). Of these 1,855 tracks, 1,572 (84.7%) occurred during the day and 283 (15.3%) during the night. Dagalien and Daggri are very similar vessels, with a length of 65.4 m and DWT of 324/325 t and they are part of the SIC Ferries fleet.

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Table 3-2 Track Line Summary for The Passenger Vessels.

VESSEL NAME	MMSI	LENGTH	DWT	SERVICE	5 NM BUFFER			PROPOSED CABLE CORRIDOR		
					Day	Night	Total	Day	Night	Total
Shetland Islands Council Ferries										
DAGALIEN	235014766	65.36	324	Yell Sound	2,508	840	3,348	899	111	1,010
DAGGRI	235014768	65.36	325	Yell Sound	1,994	855	2,849	673	172	845
FIVLA	232003596	30	100	Fleet Relief Vessel	415	31	446	4	0	4
SNOLDA	232003608	24.41	151	West Burrafirth to Papa Stour	1	0	1	1	0	1
B.K. Marine Ltd										
ISABELLA OF SARK	235013662	12	22.5	N/A (Vessel for Hire Service)-	20	1	21	2	0	2
Smyril Line										
NORRONA	231200000	164.56	6,113	Hirtshals (Denmark) – Tórshavn (Faroe Islands) – Seyðisfjörður (Iceland)	2	0	2	2	0	2

Table 3-3 Vessel Categories by Day/Night Within the 5 NM Study Area and Proposed Cable Corridor.

VESSEL CATEGORY	VESSEL TYPE	5 NM STUDY AREA							PROPOSED CABLE CORRIDORPROPOSED CABLE CORRIDOR						
		Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines	Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines
		Track Count Day (06:00-18:00)	Proportion of Track Lines	Track Count Night (18:00-06:00)	Proportion of Track Lines				Track Count Day (06:00-18:00)	Proportion of Track Lines	Track Count Night (18:00-06:00)	Proportion of Track Lines			
Cargo/Tanker	Cargo	1,575	90.3%	413	86.6%	-73.8%	1,988	14.0%	110	90.9%	34	85.0%	-69.1%	144	5.5%
	Cargo/Containership	1	0.1%	3	0.6%	200.0%	4	0.0%	0	0.0%	1	2.5%	N/A	1	0.0%
	Crude Oil Tanker	133	7.6%	42	8.8%	-68.4%	175	1.2%	0	0.0%	0	0.0%	N/A	0	0.0%
	General Cargo	3	0.2%	2	0.4%	-33.3%	5	0.0%	3	2.5%	2	5.0%	-33.3%	5	0.2%
	Oil Products Tanker	18	1.0%	7	1.5%	-61.1%	25	0.2%	0	0.0%	0	0.0%	N/A	0	0.0%
	Reefer	1	0.1%	2	0.4%	100.0%	3	0.0%	1	0.8%	2	5.0%	100.0%	3	0.1%
	Ro-Ro Cargo	7	0.4%	0	0.0%	-100.0%	7	0.0%	7	5.8%	0	0.0%	-100.0%	7	0.3%
	Ro-Ro/Container Carrier	0	0.0%	1	0.2%	N/A	1	0.0%	0	0.0%	1	2.5%	N/A	1	0.0%
	Shuttle Tanker	6	0.3%	7	1.5%	16.7%	13	0.1%	0	0.0%	0	0.0%	N/A	0	0.0%
	Cargo/Tanker Total	**1,744**	**16.4%**	**477**	**13.5%**	**-72.6%**	**2,221**	**15.7%**	**121**	**5.7%**	**40**	**7.8%**	**-66.9%**	**161**	**6.1%**
Fishing	Fish Carrier	339	41.1%	175	53.7%	-48.4%	514	3.6%	105	49.3%	97	64.2%	-7.6%	202	7.7%
	Fish Factory	16	1.9%	8	2.5%	-50.0%	24	0.2%	0	0.0%	0	0.0%	N/A	0	0.0%
	Fishery Patrol Vessel	0	0.0%	5	1.5%	N/A	5	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Fishing	351	42.5%	72	22.1%	-79.5%	423	3.0%	45	21.1%	14	9.3%	-68.9%	59	2.2%
	Fishing Vessel	66	8.0%	34	10.4%	-48.5%	100	0.7%	33	15.5%	19	12.6%	-42.4%	52	2.0%
	Trawler	53	6.4%	32	9.8%	-39.6%	85	0.6%	30	14.1%	21	13.9%	-30.0%	51	1.9%
	Fishing Total	**825**	**7.7%**	**326**	**9.2%**	**-60.5%**	**1,151**	**8.1%**	**213**	**10.1%**	**151**	**29.3%**	**-29.1%**	**364**	**13.9%**
Offshore industry	High Speed Craft	12	60.0%	1	33.3%	-91.7%	13	0.1%	5	50.0%	0	0.0%	-100.0%	5	0.2%
	Multi Purpose Offshore Vessel	1	5.0%	0	0.0%	-100.0%	1	0.0%	1	10.0%	0	0.0%	-100.0%	1	0.0%
	Offshore Supply Ship	6	30.0%	1	33.3%	-83.3%	7	0.0%	4	40.0%	1	100.0%	-75.0%	5	0.2%
	Supply Vessel	1	5.0%	1	33.3%	0.0%	2	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Offshore Industry Total	**20**	**0.2%**	**3**	**0.1%**	**-85.0%**	**23**	**0.2%**	**10**	**0.5%**	**1**	**0.2%**	**-90.0%**	**11**	**0.4%**
Other	Buoy-Laying Vessel	2	0.1%	1	0.1%	-50.0%	3	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Dive Vessel	52	3.4%	2	0.2%	-96.2%	54	0.4%	3	1.8%	1	3.0%	-66.7%	4	0.2%

VESSEL CATEGORY	VESSEL TYPE	5 NM STUDY AREA							PROPOSED CABLE CORRIDORPROPOSED CABLE CORRIDOR						
		Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines	Day Track Line Counts		Night Track Line Counts		Percentage Change from Day to Night	Total	Proportion of Total Track Lines
		Track Count Day (06:00-18:00)	Proportion of Track Lines	Track Count Night (18:00-06:00)	Proportion of Track Lines				Track Count Day (06:00-18:00)	Proportion of Track Lines	Track Count Night (18:00-06:00)	Proportion of Track Lines			
	Dredger	106	6.9%	49	6.0%	-53.8%	155	1.1%	35	21.1%	4	12.1%	-88.6%	39	1.5%
	Inland, Unknown	0	0.0%	3	0.4%	N/A	3	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Local Vessel	6	0.4%	0	0.0%	-100.0%	6	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Military Ops	2	0.1%	2	0.2%	0.0%	4	0.0%	2	1.2%	2	6.1%	0.0%	4	0.2%
	Other	25	1.6%	2	0.2%	-92.0%	27	0.2%	8	4.8%	0	0.0%	-100.0%	8	0.3%
	Pilot Ship	74	4.8%	36	4.4%	-51.4%	110	0.8%	1	0.6%	0	0.0%	-100.0%	1	0.0%
	Pilot Vessel	204	13.3%	62	7.6%	-69.6%	266	1.9%	2	1.2%	0	0.0%	-100.0%	2	0.1%
	Port Tender	161	10.5%	112	13.8%	-30.4%	273	1.9%	0	0.0%	0	0.0%	N/A	0	0.0%
	Research/Survey Vessel	7	0.5%	1	0.1%	-85.7%	8	0.1%	5	3.0%	0	0.0%	-100.0%	5	0.2%
	Search and Rescue (SAR)	1	0.1%	0	0.0%	-100.0%	1	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Special Vessel	1	0.1%	0	0.0%	-100.0%	1	0.0%	1	0.6%	0	0.0%	-100.0%	1	0.0%
	Tug	614	40.2%	434	53.3%	-29.3%	1,048	7.4%	13	7.8%	1	3.0%	-92.3%	14	0.5%
	Unspecified	2	0.1%	0	0.0%	-100.0%	2	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Utility Vessel	17	1.1%	0	0.0%	-100.0%	17	0.1%	4	2.4%	0	0.0%	-100.0%	4	0.2%
	Work Vessel	255	16.7%	110	13.5%	-56.9%	365	2.6%	92	55.4%	25	75.8%	-72.8%	117	4.5%
	Other Total	**1,529**	**14.4%**	**814**	**23.0%**	**-46.8%**	**2,343**	**16.5%**	**166**	**7.9%**	**33**	**6.4%**	**-80.1%**	**199**	**7.6%**
Passenger	Passenger	22	0.3%	1	0.1%	-95.5%	23	0.2%	2	0.1%	0	0.0%	-100.0%	2	0.1%
	Passenger Ship	1	0.0%	1	0.1%	0.0%	2	0.0%	0	0.0%	0	0.0%	N/A	0	0.0%
	Ro-Ro/Passenger Ship	6,351	99.6%	1,884	99.9%	-70.3%	8,235	58.1%	1,579	99.9%	283	100.0%	-82.1%	1,862	70.9%
	Passenger Total	**6,374**	**59.9%**	**1,886**	**53.4%**	**-70.4%**	**8,260**	**58.3%**	**1,581**	**74.9%**	**283**	**55.0%**	**-82.1%**	**1,864**	**71.0%**
Recreational	Exhibition Ship	0	0.0%	1	3.8%	N/A	1	0.0%	0	0.0%	1	14.3%	N/A	1	0.0%
	Pleasure Craft	67	42.9%	11	42.3%	-83.6%	78	0.6%	8	40.0%	1	14.3%	-87.5%	9	0.3%
	Sailing Vessel	89	57.1%	14	53.8%	-84.3%	103	0.7%	12	60.0%	5	71.4%	-58.3%	17	0.6%
	Recreational Total	**156**	**1.5%**	**26**	**0.7%**	**-83.3%**	**182**	**1.3%**	**20**	**0.9%**	**7**	**1.4%**	**-65.0%**	**27**	**1.0%**
	Grand Total	**10,648**	**100.0%**	**3,532**	**100.0%**	**-66.8%**	**14,180**	**100.0%**	**2,111**	**100.0%**	**515**	**100.0%**	**-75.6%**	**2,626**	**100.0%**

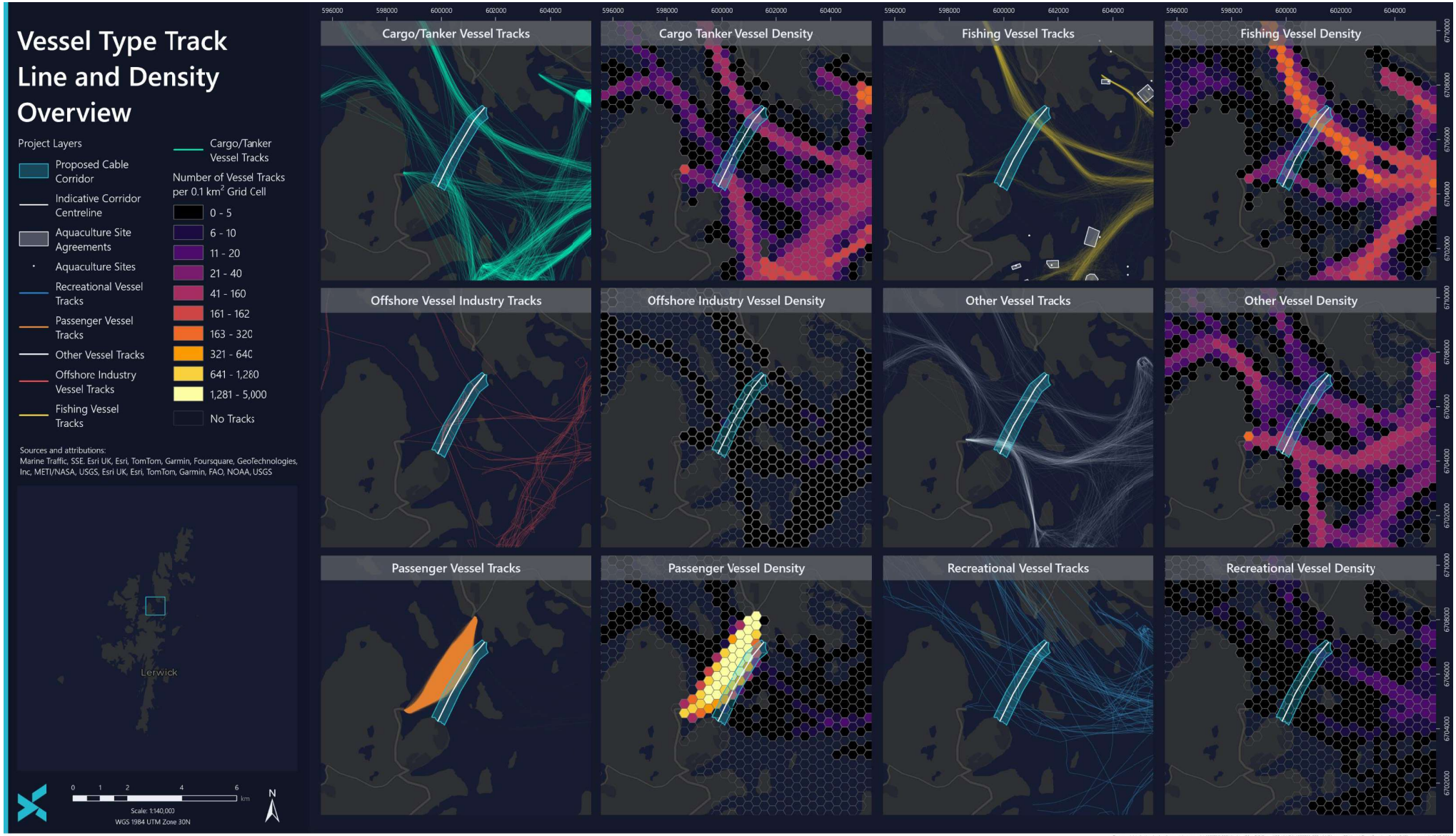

Figure 3-7 Vessel Type Tracks and Densities.

3.2.3 Anchoring Summary

Figure 3-8 provides an overview of vessels at-anchor, including the time spent at anchor for each vessel type. Vessel track segments were classified as "at-anchor" if the vessel's status was set to 1 (at-anchor) and its speed was less than 0.5 knots. Within the 5 NM study area, a total of seven vessels spent an estimated 2,140 hours (89 days) at anchor (Table 3-4). These anchored vessels were located outside the harbour limits, primarily concentrated near Vidlin (Mainland, Shetland), where designated anchorage areas are available. These areas recorded densities of up to 75 hours per 0.05 km^2 grid cell. Notably, no vessels were at-anchor within the proposed cable corridor during the study period, as reported by AIS data.

Fish carriers accounted for the majority of anchoring activity, spending approximately 2,077 hours at anchor—97% of the total anchoring time within the 5 NM study area (Table 3-4). These vessels were primarily distributed in the waters near Vidlin and to the northeast of the proposed cable corridor adjacent to Houlland, close to aquaculture sites.

Table 3-4 Vessels At-Anchor Overview.

VESSEL CATEGORY	VESSEL NAME	HOURS SPENT AT-ANCHOR	PROPORTION
Fishing (Fish Carrier)	INTER CALEDONIA	930.8	43.5%
	NJORD PIONER	249.5	11.7%
	RONJA CHRISTOPHER	93.4	4.4%
	RONJA COMMANDER	5.5	0.3%
	RONJA KVALOEY	796.9	37.2%
	RONJA SUPERIOR	1.4	0.1%
Other (Buoy-Laying Vessel)	PHAROS	62.4	2.9%
Grand Total		2,139.81	100%

Figure 3-8 Vessels At-Anchor Summary.

4 FORMAL SAFETY ASSESSMENT

4.1 Results

The Mossbank-Yell proposed cable corridor passes through a well trafficked and marked navigation channel, predominantly associated with the Yell ferry route, and vessels transiting through Yell Sound (Figure 1-2). At the highest rate, 69 vessels were recorded in the 5 NM study area on the busiest day in the MTS study period. On the busiest day within the proposed cable corridor, only 11 vessel tracks were reported. The slow-moving cable installation vessels, which will be limited in their ability to manoeuvre, pose little threat to the established ferry services which operate parallel and to the west of the channel, and this positioning, coupled with robust communication practices within the Sullom Voe Harbour Authority and the ferry operators, heavily mitigates the risks of collision.

The assessment identified eight distinct hazards / impacts to shipping from the Project. The individual summaries of these assessments of the identified hazards can be seen in Table 4-1 below. The eight hazards are:

- Vessel collision (Third party vessel with project vessel) during installation, maintenance and decommissioning;
- Disruption to established vessel routes and areas during installation, maintenance and decommissioning;
- Interactions with vessel anchors during installation, maintenance and decommissioning
- Interactions with vessel anchors during normal operations;
- Interactions with fishing gear during installation, maintenance and decommissioning
- Interactions with fishing gear during normal operations;
- Reduction in under keel clearance during; and
- Electromagnetic field (EMF) effects and compass deviation.

From the assessments undertaken, one identified no risk, whilst four were assessed as being Broadly Acceptable' therefore, no further consideration of risk reduction measures is necessary for these hazards. The remaining three were assessed as Tolerable if ALARP and therefore required further consideration. However, no additional risk reduction measures above the embedded mitigations were considered appropriate, and no recommendations have been made following the assessment. The assessment therefore determined that all risks to navigation associated with the development are considered ALARP. A brief summary of the key considerations of each impact included in the sections following.

4.1.1 Vessel Collision – Installation, Maintenance and Decommissioning

Vessel collision risk is highest at the busiest section of the navigable channel (around RP 1 to RP 2.5 See Figure 3-2) and within daylight hours, see Table 3-3. The Project includes several specific embedded mitigation measures designed to minimise vessel interactions and reduce collision risk, namely:

- Issuing of NtMs;
- The implementation of a 500 m RCZ (reduced to a proposed 250 m (or other agreed distance) for the Yell ferries, and vessels under pilotage to/from Sullom Voe Port);

- Potential provision of a guard vessel or small support vessel on standby to reduce risk of collision if vessels pass too close to the installation vessel. The requirement for a guard vessel will be considered through consultation with the Sullom Voe Harbour Authority and Installation Contractor;
- Compliance with IRPCS, including displaying appropriate lights and day shapes; and
- Proactive engagement with navigational consultees (Sullom Voe Harbour Authority and the Yell ferry operators).

The vast majority of the traffic passes to the west of the cable corridor between RP 1 to RP 2.5, and is routine traffic which will not normally interact/cross paths with the installation vessels. The Project activities are anticipated to last for 48 days (including weather down time), and as such are considered to be of short duration. In addition, the VTS operated by Sullom Voe Harbour Authority will ensure vessels transiting through Yell Sound are aware of the cable installation activities, and necessary safety and navigation requirements. Furthermore, the VTS allows vessels to be monitored using Radar, meaning that potentially unsafe situations will be identified and mitigated in advance. These considerations combine to provide considerable inherent collision safety over and above the industry standard mitigations, such as guard vessel protection (as required), NtMs and weather condition limits.

Considering the limited duration of potential interaction between the installation vessel and vessels operating in the area, as well as the high efficacy of the embedded mitigation measures described above, the likelihood is considered 'Remote'. The worst-case credible outcome of a collision would be loss of life, so a consequence severity is assessed as 'High'. This results in overall assessment of 'Tolerable if ALARP' As such consideration of additional risk reduction measures should be made.

However, given the very short duration of the operations in the navigable channel and at periods of low traffic, no further measures are considered to represent justifiable or effective risk reduction. The risk is therefore considered ALARP.

4.1.2 Disruption to Established Vessel Routes and Areas – Installation, Maintenance and Decommissioning

The risk of disruption to vessels is most relevant to the lifeline ferry service between Mainland Shetland and Yell from the slow moving and restricted installation vessels. The ferries run parallel to the cable channel, with tracks showing closest on average to RP 1, RP 1.5, RP 2 and RP 2.5 (see Figure 3-5), and within the busiest hours being during daytime hours. In addition, there is potential to disrupt larger vessels under pilotage to/from Sullom Voe Port. The embedded mitigation measures outline in Section 1.2 will reduce the potential to significantly disrupt existing vessel activity, specifically:

- Reduction of the RCZ from 500 m to 250 m (or other agreed distance) for the Yell ferries, and vessels transiting under pilot to/from Sullom Voe Port, through engagement with Sullom Voe Harbour Authority, and the Yell ferry operators;
- Proactive engagement with navigational consultees (Sullom Voe Harbour Authority and the Yell ferry operators); and
- Deconfliction with the Yell ferry timetable where practicable, including consideration of night time operations.

The measures combine with the limited duration of the proposed cable installation activities to provide considerable inherent mitigation to ensure disruption to existing vessel movements are minimised.

Considering the limited duration of potential interaction between the installation vessels, ferries and vessels operating in the area, as well as the high efficacy of the embedded mitigation measures described above, the likelihood is considered 'Remote'. The worst-case credible outcome would be protracted delays to ferry schedules, so a consequence severity is assessed as 'Medium'. This results in overall assessment of 'Broadly Acceptable' and no further consideration of additional risk reduction measures required.

4.1.3 Interaction with Vessel Anchors – Installation, Maintenance and Decommissioning

The interaction of vessels anchors with the cable during the activities associated with installation maintenance or decommissioning of the Project is considered highly unlikely. The principal reason being that there are no charted anchorage areas in the vicinity of the proposed cable corridor, and no anchoring activity in the vicinity of the Project was identified in the baseline data (See Figure 3-8). This reflects the fact that the cable corridor is wholly situated within a charted subsea cables area, and crosses the navigable channels through Yell Sound. Moreover, the cable corridor lies within the jurisdiction of Sullom Voe harbour authority, providing additional prevention of anchoring outside designated areas. Embedded mitigation measures further reduce the risk of vessels' anchors interacting with cables during the installation, maintenance and decommissioning phases, including the issuing of NtMs and navigation warnings, and potential use of a guard vessel or small support vessel to advise vessels as required.

If a vessel fouls its anchor on the subsea cable, there is the potential for the severe damage or foundering to occur if inappropriate attempts to recover the anchor are made. Injury could also occur through interactions with lines under load. Thus, the consequences are considered to be 'Medium'. This is combined with a 'Remote' assessment of likelihood, given the mitigation outlined above and the fact that vessels are not expected to anchor in the vicinity of the cable corridor. This results in an overall assessment of 'Broadly Acceptable', and no further mitigation is required.

4.1.4 Interaction with Vessel Anchors – Normal Operations

As the operations phase of the Project endures for the lifetime of the cable, the likelihood is considered to be greater. Indeed, during the operations no guard vessel patrol or recent NtMs will inform vessels of the cable. Similarly, the risk of vessel breaking down and adverse weather conditions throughout the lifetime of the cable present an increased possibility of a vessel requiring to drop anchor in case of emergency. In such a scenario adverse weather would potentially exacerbate the incident endangering the risk of any crew. Embedded mitigation measures reduce this risk, including:

- Provision of as-built survey data to the UKHO and Kingfisher for inclusion on Admiralty Charts, and KIS-ORCA charts; and
- Cable marker beacons will be installed at each landfall location, warning mariners of the presence of cables on the seabed in the area.

As detailed above, the consequence of fouling an anchor is considered to be 'Medium'. The mitigation detailed above, combined with the low probability of a vessel either anchoring intentionally or requiring to emergency anchor in the proposed cable corridor means that the likelihood is 'Remote' is assigned. This results in an overall assessment of 'Broadly Acceptable', and no further mitigation is required.

4.1.5 Interactions with Fishing Gear – Installation, Maintenance and Decommissioning

The interaction of fishing gear with the cable during the activities associated with installation maintenance or decommissioning is considered highly unlikely. The principal reason being that no demersal fishing behaviour is seen in the AIS data; fishing vessels are recorded only transiting the area (See Figure 3-7). This reflects the fact that the cable corridor crosses the navigable channels through Yell Sound, and is within a charted subsea cables area, thus demersal trawling in this area is unlikely for safety reasons. Embedded project mitigation includes:

- Use of a FLO during the cable installation activities;
- Issuing of NtMs, including Kingfisher Bulletins; and
- Potential use of a guard vessel or small support vessel to advise vessels, as required
- Adherence to the Shetland FLMAP.

If a vessel fouls its fishing gear on the subsea cable, there is the potential for the severe damage or foundering to occur if inappropriate attempts to recover the gear are made. Injury and loss of life could also occur through interactions with lines under load. Thus, the consequences are considered to be '**High**'. This is combined with a '**Remote**' assessment of likelihood, given the mitigation outlined above and the fact that vessels are not expected to engage in demersal fishing in the vicinity of the cable corridor. This results in an overall assessment of '**Tolerable if ALARP**', however given the presence of multiple existing subsea cables in the area, there is no material change from baseline conditions, and no further mitigation is required.

4.1.6 Interactions with Fishing Gear – Normal Operations

As the operations phase of the Project endures for the lifetime of the surface laid cable in the subtidal region, the likelihood in the operational phase may be raised. Indeed, during the operations no FLO, guard vessel patrol or recent NtMs will be present to inform fishers of the presence of the cable. This notwithstanding, demersal trawling activity is not expected to occur in the vicinity of the proposed cable corridor, given the existing subsea cable, and the presence of the navigable channels. Embedded mitigation further reduces the risk of interactions with fishing gear during the operation phase:

- SHEPD advise fishers to follow the advice provided by SOLAS, UKHO, and the Mariner's Handbook, and avoid demersal trawling over subsea cables;
- Provision of as-built survey data to the UKHO and Kingfisher for inclusion on Admiralty Charts, and KIS-ORCA charts; and
- Cable marker beacons will be installed at each landfall location, warning mariners of the presence of cables on the seabed in the area.

As detailed above, the consequence of fouling fishing gear is considered to be '**High**'. The mitigation detailed above, combined with the low probability of a vessel engaging in demersal trawling in the proposed cable corridor means that the likelihood is '**Remote**' is assigned. This results in an overall assessment of '**Tolerable if ALARP**', however given the presence of multiple existing subsea cables in the area, there is no material change from baseline conditions, and no further mitigation is required.

4.1.7 Reduction in Under Keel Clearance – Normal Operations

The cable will be surface laid between Mean Low Water Springs (MLWS) at Mossbank and MLWS at Yell, where depths increase steeply towards the open channel. SHEPD have in place design criteria for mitigating this in accordance with MCA guidance, keeping depth reductions below 5% in existing water depth. Additionally, the provision of as-built survey data of the surface laid cable and the presence of cable marker beacons also reduce this risk. As the vast majority of vessel tracks are concentrated in deeper water the likelihood of any related issues is considered to be 'Remote' with a consequence outcome of 'Low' (Minor damage to equipment). This impact is therefore assessed to be 'Broadly Acceptable' and warrants no further consideration.

4.1.8 Electromagnetic field (EMF) and compass deviation effects – Normal Operations

Magnetic compasses are designed to work with the earth's stationary geomagnetic fields and can therefore be affected by other stationary magnetic fields such as ones generated by direct current (DC) cables. Alternating current (AC) cables such as the 33 kilovolts (kV) cable proposed for this Project generate an oscillating sinusoidal EMF with respect to time, which fluctuates in polarity with frequency of 50 hertz (Hz). The average EMF strength is therefore 0 microteslas (μT), meaning that the deviation effect on ships' compasses will therefore be 0 degrees. There is therefore No Risk from EMFs from the Project on compass deviation, and this hazard is therefore not considered further in this HLNRA.

4.1.9 Risk Assessment Output

The following table captures the results of the FSA process and results of the HLNRA. All hazards are ultimately assessed as being ALARP with no recommendations for additional risk reduction measures or further action beyond continual monitoring of the risks for changes to the Project / assessment basis.

Table 4-1 Navigational Risk Assessment output / Hazard Log

PHASE / ACTIVITY	HAZARD / IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST / BENEFIT	NOTES
		MANDATORY / INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Installation / Maintenance / Decommissioning	Vessel Collision Passing vessel collides with installation vessel (restricted in its manoeuvrability)	IRPCS Harbour Bylaws and General Directions VTS Communication (From Port) Guard Vessel (as required) and RCZ AIS Broadcast NtMs Notification of Regular Runners Wave / Wind limits	Short operational duration Installation schedule deconflicted with Ferry schedule and peak times in so far as practicable	Operations halted indefinitely Loss of a crew member, or multiple serious injuries Major/Severe damage to vessel	Remote	High	Tolerable	None Identified	ALARP	N/A	Short installation duration across navigable channel (busy area) including deconflicting with the ferry sailings where possible, in addition to embedded mitigation represents substantial inherent risk reduction which brings the likelihood to remote. No further risk reduction measures have been considered necessary / effective due to the associated existing inherent safety. The RCZ is 500 m, however this may be reduced to 250 m (or other agreed distance) for ferries and vessels under pilotage. (Maintenance Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours)

PHASE / ACTIVITY	HAZARD / IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST / BENEFIT	NOTES
		MANDATORY / INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Installation / Maintenance / Decommissioning	Disruption to established vessel routes and areas	IRPCS Port Bylaws and General Directions VTS Communication (From Port) Guard Vessel (as required) and RCZ AIS Broadcast NtMs Notification of Regular Runners Wave / Wind limits	Short operational duration Installation schedule deconflicted with Ferry schedule and peak times in so far as practicable Engagement with Sullom Voe Harbour Authority and Yell ferry operators Reduced RCZ for vessels which are regularly present, reducing disruption.	Protracted operational delays	Remote	Medium	Broadly Acceptable	N/A	ALARP	N/A	Short installation duration across navigable channel (busy area) including deconflicting with ferry sailings where possible, is considered to limit disruption risk to broadly acceptable levels. A reduced 250 m RCZ (or other agreed distance) may be implemented to account for ferries and vessels under pilotage which will reduce disruption where the channel geography would restrict vessel passage with the normal 500 m RCZ recommendation. (Maintenance Inspection and Decommissioning activities assumed to be similarly short and outwith busy hours)
Installation / Maintenance / Decommissioning	Interactions with vessel anchors Vessel drags anchor across exposed cable	NtMs Guard Vessel (as required)	Cable corridor is within a charted subsea cables area and within Sullom Voe Harbour Authority jurisdiction	Protracted operational delays Serious injury to person Notable damage to infrastructure or vessel	Remote	Medium	Broadly Acceptable	N/A	ALARP	N/A	No evidence of vessels anchoring with the proposed cable corridor. Short installation duration across a charted subsea cables area. NTMs and presence of a guard vessel limits the potential consequences to medium.
Installation / Maintenance / Decommissioning	Interactions with fishing gear Fishing activity conducted in vicinity of cable and installation activities	NtMs including Kingfisher Bulletins Guard Vessels (as required) and RCZ	Adherence to Shetland FLMAP FLO	Serious injury to person Notable damage to infrastructure or vessel	Remote	High	Tolerable	None Identified	ALARP	N/A	No evidence of demersal fishing within the installation corridor.

PHASE / ACTIVITY	HAZARD / IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST / BENEFIT	NOTES
		MANDATORY / INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Normal Operations	Interactions with vessel anchors Vessel drags anchor across cable	Promulgation of information on the installation and locations Cable Marker beacons at each landfall, marking cable presence As-built locations of cable and protections supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) Industry guidance on avoidance of anchoring in the vicinity of subsea cables	Route Selection (Avoids designated anchorage areas)	Loss of a crew member, or multiple serious injuries Major/Severe damage to infrastructure or vessel	Remote	Medium	Broadly Acceptable	None Identified	ALARP	N/A	No evidence of vessels anchoring with the proposed cable corridor. Vessels are also advised in the Mariners Handbook (NP100) not to anchor within 500 m of the cable.
Normal Operations	Interactions with fishing gear Fishing vessel drags gear across cable	Promulgation of information on the installation and locations As-built locations of cable and protections supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) Cable Marker beacons at each landfall, marking cable presence Industry guidance on avoidance of demersal trawling in the vicinity of Subsea cables	Cable corridor is within a charted subsea cables area	Loss of a crew member, or multiple serious injuries Major/Severe damage to infrastructure or vessel	Remote	High	Tolerable	NA	ALARP	N/A	No evidence of demersal fishing within the installation corridor. In line UKHO and SOLAS guidance, SHEPD recommend that fishing vessels should avoid trawling over installed seabed infrastructure. Vessels are also advised in the Mariners Handbook (NP100) not to fish (trawl) within 500 m of the cable. Cable landfalls will be marked with beacons with the position charted by UKHO and KIS-ORCA, the risk is considered to be broadly acceptable and ALARP, especially as there are already multiple existing cables in the area.

PHASE / ACTIVITY	HAZARD / IMPACT	EMBEDDED MITIGATION		WORSE CASE OUTCOME	LIKELIHOOD	CONSEQUENCE	INITIAL RISK	ADDITIONAL RRMS	RESIDUAL RISK	COST / BENEFIT	NOTES
		MANDATORY / INDUSTRY PRACTICE	PROJECT SPECIFIC MEASURES								
Normal Operations	Reduction in Under Keel Clearance	As-built Locations of cable and external protections supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) Cable Marker beacons (AtoNs) at each landfall, marking cable presence	Navigable water depths not reduced by more than 5% Cable buried (as a minimum) from Mean High Water Springs (MHWS) to MLWS at each landfall.	Minor injury to person minor damage to vessel	Remote	Low	Broadly Acceptable	NA	ALARP	N/A	It is also noted that the vast majority of vessel movements are concentrated away from landfall in deeper water
Normal Operations	EMF effects disturb magnetic compass navigation	NA	EMFs from AC cables do not affect magnetic compasses	No effect	N/A	N/A	No Risk	N/A	No Risk	N/A	

5 CONCLUSION

The Mossbank to Yell Cable Replacement passes through a well trafficked and marked navigation channel, predominantly carrying vessels in the Sullom Voe Harbour Authority area to and from Yell Sound. The slow-moving cable installation vessels, which will be limited in their ability to manoeuvre, cross perpendicular to the channel and parallel to the Yell ferry route, which represent a potential hazard to shipping in the area.

However, the operation is an appreciably minor activity given its short expected duration in the busiest parts of the channel, providing considerable inherent safety. The approach taken by the Project is to continue to compliance with international regulations such as IRPCS, and facilitate good communication between the installation contractor, SHEPD and SIC to deconflict issues with ferries as much as possible. Additionally, the use of a guard vessel or small support vessel, capable of rapidly intervening if vessels pass too close to the installation vessels, will be considered in consultation with the Harbour Authority and Installation Contractor. Finally, a plan will be implemented with engagement from the Sullom Voe Harbour Authority and the Yell ferry operators which will deconflict the RCZ, from 500 m to 250 m (or other agreed distance) to account for the narrow channel the vessel will be operating in, in relation to regular vessel traffic including ferries and piloted vessels. Ongoing awareness of the installation activities through the necessary involvement of Sullom Voe Harbour Authority and promulgation of the operation details to SIC and mariners in general completes a very low risk profile for the activities. This is reflected in the assessment of the installation, maintenance and decommissioning phases of the Project, which determined the risks associated with the proposed Mossbank – Yell Emergency Cable Replacement are ALARP.

The cable will be surface laid up to Mean Low Water Spring (MLWS) at both landfalls. An exposed cable represents an obvious hazard to trawlers and anchoring. However, the cable itself will be laid within an existing charted subsea cables area, and well outside any designated anchoring areas. The MTS found no evidence of demersal trawling or anchoring activity in the immediate vicinity of the cable corridor (See Figure 3-8 and Figure 3-7). In addition, as-built locations of the cable and any external protection measures will be supplied to UKHO (Admiralty) and Kingfisher (KIS-ORCA) and the cable will be marked at leach landfall point by cable marker beacons (Aids to Navigation) which will be inspected and maintained for the life of the cable. Industry guidance on avoidance of trawling within in the vicinity of subsea cables is in place to further reduce the potential for interactions with fishing gear.

Given the inherent safety associated with the Sullom Voe Harbour Authority jurisdiction, and industry standard practice, the risks posed to navigation from the presence of the seabed cable are therefore all considered to be ALARP.