ELMED INTERCONNECTOR

Cable Laying Navigation Risk Assessment

European Bank of Reconstruction and Development (EBRD)

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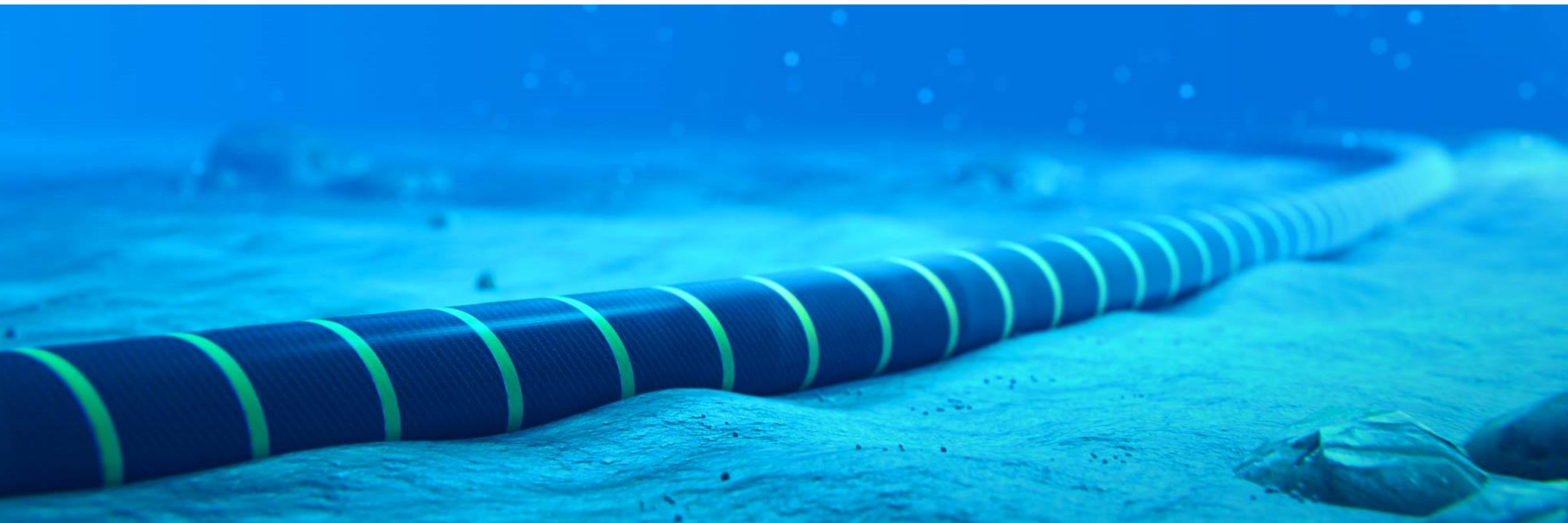

EXECUTIVE SUMMARY

NASH Maritime have been requested to conduct a Navigation Risk Assessment (NRA) for the offshore cable-laying activities for the ELMED interconnector which lies in Italian and Tunisian waters.

The NRA follows the International Maritime Organization (IMO) Formal Safety Assessment (FSA) process which defines a risk as “the combination of the frequency and the severity of the consequence”. 25 hazards were identified and assessed based on the vessel types and hazards within the study area.

Of the 25 hazards assessed, 23 were ranked as Broadly Acceptable with only the embedded mitigations in place. Two hazards were ranked as Tolerable if ALARP. It is therefore recommended that confirming embedded risk controls are in place could include:

- The selected contractor confirms adherence to the relevant international conventions, local regulations.
- An independent vessel survey inspection is considered prior to operations to confirm suitability of all key ships required for cable laying activities, including but not limited to, verification of valid ship certification, vessel suitability and compliance with international conventions.

Although additional risk controls were not deemed necessary, addiotnal recommendations for the following additional risk measures have been advised in order to further enhance navigational safety:

- **Promulgation of planned cable route** - Information promulgated to vessels in advance via weekly Temporary and Preliminary Notices or other navigational warnings. Once installed, cable would, eventually, be permanently charted by means of a chart correction.
- **Hourly VHF broadcasts** - Hourly broadcast on VHF Channel 16 giving position, nature of works and action required of other vessels (including minimum passing distance and/or speed reduction).
- **Route planning to cable junctions in low-traffic areas** – Minimise time spent stationary in higher-risk / high-volume traffic areas.
- **Installation planning to avoid higher risk areas at peak fishing seasons** (where possible) - Cable lay planning to lay cable in key fishing areas during low fishing seasons (to the extent possible with consideration for weather windows and delays). This may not be practically possible, but would assist in reducing risk from collision, whilst also minimising impact of potential disruption to the respective cable laying and fishing activities.

Furthermore, the stakeholder feedback was only received from one party from the six parties approached. This included Italian and Tunisian Navy and Coastguard services. It is therefore recommended:

- The Project follow up with engagement with the remaining stakeholders to ensure awareness of the project, gather any further information on possible restrictions or

limitations, and determine any obligations for ongoing engagement or notification during the cable playing preparatory and installation work.

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ABBREVIATIONS

Abbreviation	Detail
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
CPA	Closest Point of Approach
DP	Dynamic Positioning
EBRD	European Bank for Reconstruction and Development
ESIA	Environmental and Social Impact Assessment
FRA	Fisheries Restricted Area
FSA	Formal Safety Assessment
GT	Gross Tonnage
HDD	Horizontal Directional Drilling
HVDC	High-voltage-Direct Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICW	In Collision With
IMO	International Maritime Organisation
km	Kilometre
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coast Guard Agency
MGN	Marine Guidance Note
MW	Mega Watt
nm	Nautical Mile
NRA	Navigation Risk Assessment
OMMP	Office de la Marine Marchande et des Ports
RAM	Restricted in Ability to Manoeuvre
ROV	Remotely Operated Vehicle
SIRA	Simplified IALA Risk Assessment method
SOLAS	Safety of Life at Sea
STCW	Standards of Training Certification and Watchkeeping
STEG	Société Tunisienne de l'Électricité et du Gaz
TSS	Traffic Separation Scheme
UNCLOS	United Nations Convention on the Law of the Sea

VHF	Very High Frequency (radio communication)
VMS	Vessel Monitoring System

1. INTRODUCTION

1.1 BACKGROUND

The European Bank for Reconstruction and Development (EBRD) is considering providing finance through a loan to Société Tunisienne de l'Électricité et du Gaz (STEG). STEG is Tunisia's 100% state-owned vertically integrated national electricity and gas utility company and is administered by the Ministry of Energy, Mines and Energy Transition. STEG has a monopoly on the distribution and transmission of electricity and gas and acts as the single buyer for all electricity generated. STEG controls electricity generation through its monopoly position as the sole owner of the 5,944 Mega Watt (MW) domestic installed capacity, which is provided through 25 power plants. The proceeds of the loan will be used to finance a 200 kilometre (km) 600 MW High-voltage-Direct Current (HVDC) marine cable interconnection between two landing points in Cap Bon Tunisia and a single landfall site in Sicily, Italy.

NASH Maritime have been requested to conduct a Navigation Risk Assessment (NRA) for the offshore cable-laying activities for the entire cable route within both Italian and Tunisian waters.

1.2 OBJECTIVES

The requested scope of work for the NRA included the following objectives, where possible:

- Obtain and analyse data from the Tunisian and Italian Navy, Coastguard and Fisheries department with regard to the existing vessel movements and areas that may affect the timing and movement of the marine cable laying vessel;
- Obtain and analyse data on commercial and passenger ferry routes and movement frequency from the Office de la Marine Marchande et des Ports (OMMP) and relevant authority in Italy, which may either affect the timing of the cable laying or face traffic restrictions due to the cable laying operations;
- Obtain and analyse data on leisure and recreational vessels or scientific research vessels using the area that might be affected by the marine cable laying activity;
- Obtain and analyse data from the International Maritime Organization (IMO) on Marine Traffic Separation procedures and Rules to understand how these may affect the timing of the cable laying activity; and
- Gather anecdotal evidence of illegal fishing and migration routes and movement patterns that may pose marine safety risks.

2. POLICY, GUIDANCE AND LEGISLATION

The United Nations Convention on the Law of the Sea (UNCLOS) (UN, 1982) is an international agreement that establishes a legal framework for all marine and maritime activities. Article 60 concerns artificial islands, installations and structures in the exclusive economic zone. Article 60(7) states that “Artificial islands, installations and structures and the safety zones around them may not be established where interference may be caused to the use of recognised sea lanes essential to international navigation.” As per Article 22(4), “The coastal state shall clearly indicate such sea lanes and traffic separation schemes on charts to which due publicity shall be given”.

Vessels navigating must also adhere to requirements under the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). Furthermore, vessels will navigate in accordance with the Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended (COLREGs).

Additional guidance used to inform the NRA includes the Maritime and Coastguard Agency’s (MCA) Marine Guidance Note (MGN) 364 on Traffic Separation Schemes as well as MGN 199 on Dangers of Interaction, which contains guidance on manoeuvring at close quarters.

The NRA has been undertaken using the IMO’s Formal Safety Assessment (FSA) methodology, which is detailed within **Section 3** and **Section 8.1**.

3. NAVIGATION RISK ASSESSMENT METHODOLOGY

3.1 OVERVIEW

The NRA follows the IMO's FSA. This assessment considers all identified impacts between the cable-laying activities and existing shipping and navigation within the study area. The FSA defines a risk as "the combination of the frequency and the severity of the consequence" (IMO, 2018). Therefore, the likelihood and consequence of these impacts are assessed through the collection of high-quality datasets and consultation. Details on the risk criteria and matrix methodology are contained within **Section 8**.

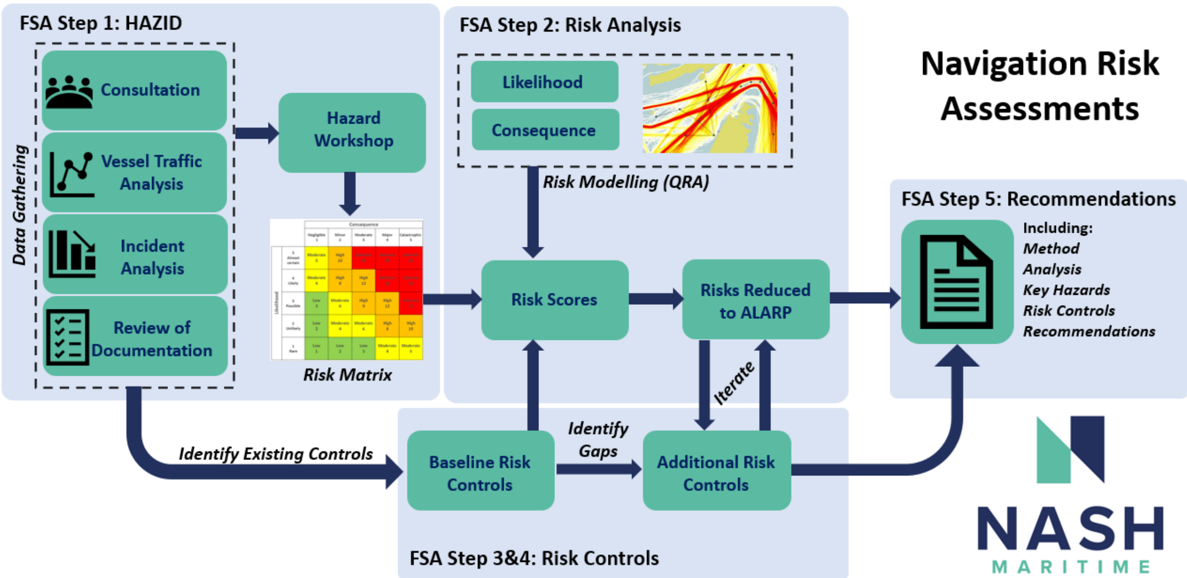

Figure 1: NRA methodology

3.2 SHIPPING AND NAVIGATION STUDY AREA

The study area used to assess the shipping and navigation risks in relation to the ELMED cable-laying activities covers a minimum of 24 nm around the cable route, as shown in **Figure 2**.

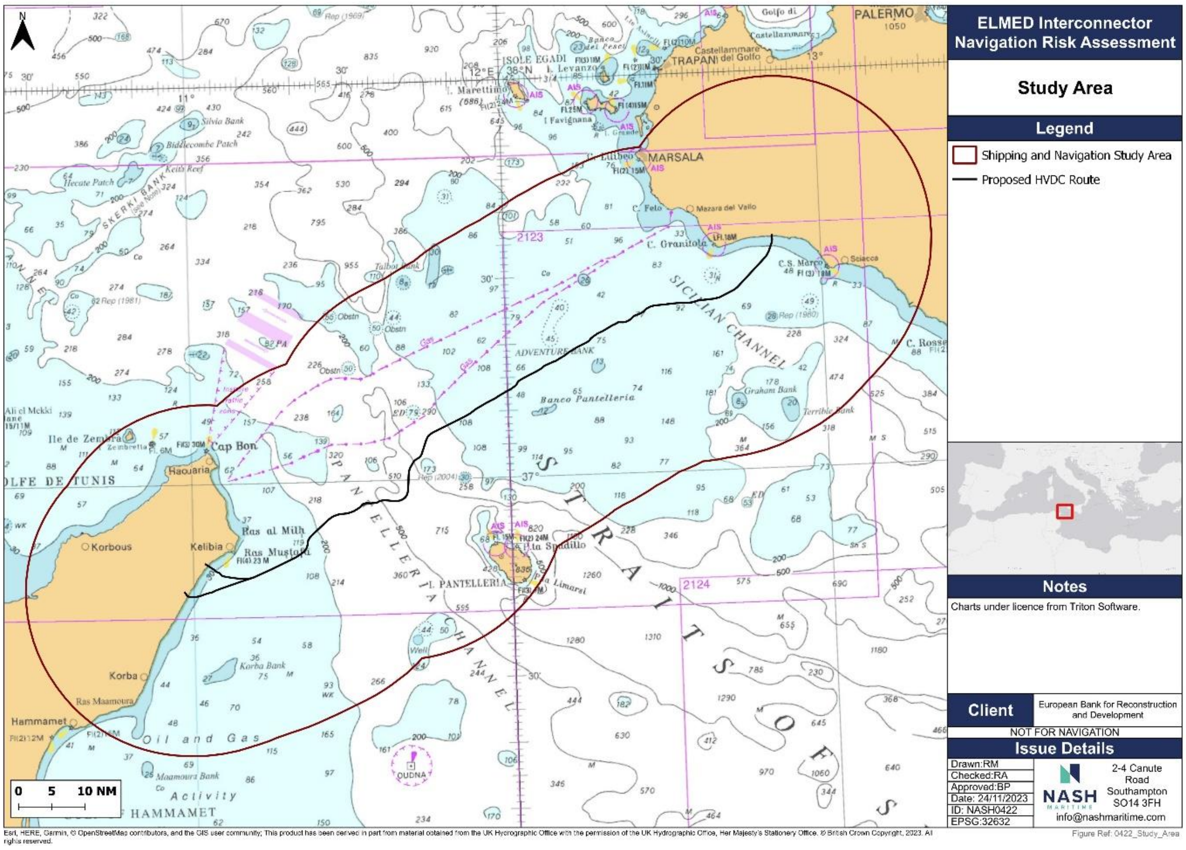

Figure 2: Shipping and navigation study area

3.3 IALA RISK MANAGEMENT TOOLS

3.3.1 SIRA

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Simplified IALA Risk Assessment Method (SIRA) follows the FSA process and allows organisations to assess maritime and navigation risk to meet obligations for the management of navigation safety (e.g., obligations under international conventions such as SOLAS, national domestic legislation, etc.). The principles of the SIRA approach have been used to conduct the risk assessment.

Details of the overarching methodology are provided in the following IALA Guidance:

- IALA (2022) G1018–- Risk Management.
- IALA (2017) G1138–- The Use of The SIRA.

3.3.2 IWRAP

The collision risk analysis was performed using the IWRAP (IALA Waterway Risk Assessment Program) Mk2 Version as recommended by IALA. More details are discussed later in **Section 7**. IWRAP is a dedicated risk modelling software for the quantitative modelling to calculate the frequency of collision and allision based on existing traffic patterns and data.

3.4 DATA SOURCES

3.4.1 Questionnaire

In order to obtain further information on fishing activity, military activity and maritime incidents in proximity to the proposed cable-laying activities, a questionnaire was circulated to the following six Italian and Tunisian authorities:

- Italian Navy;
- Tunisian Navy;
- Italian Coastguard;
- Tunisian Coastguard;
- Italian Fisheries Department; and
- Tunisian Fisheries Department.

Responses were received from the Tunisian Fisheries Department, and are presented in **Table 1**.

Table 1: Questionnaire responses - Tunisian Fisheries Department

Question	Response
Can you please identify on a chart the locations of key fishing areas near the cable laying route?	The entire study area is considered a fishing zone for all types of activities (trawling, pelagic fishing, coastal fishing and probably adjacent to the floating cage aquaculture projects at sea in Beni Khiar) in addition to a passage zone for fishing boats between the northern zone (zone I) and the other zones (zones II and III).
Can you provide any information about the seasonality of fishing activities in proximity to the proposed cable laying activities? For example: a) Do fishing activities shift move throughout the year and if so how/where? b) Is there a large variation in the number of fishing vessels throughout the year? c) Can you give some information about the most common gear types and species targeted used in proximity to the proposed cable laying activities?	Fishing activity in the governorate of Nabeul provides on average (last 10 years) 16 thousand tonnes/year which represents approximately 12% of the national production of the sector. The sector in the governorate of Nabeul has nearly 550 fishing units offering a source of employment for around 3,000 fishermen (direct employment) in addition to the activity linked to passenger ships (between 60 to 80 units throughout the year). In the governorate of Nabeul we observe all types of fishing activity and all fishing gear (Benthic trawl, light fishing, purse seine fishing, fishing with different types of nets, longlines (bottom and pelagic), etc.). Let us note as an example: • Chevrettes during the months of March and April for benthic trawling; • Pelamide during the months of May and June for coastal fishing (nets); • Sardines and anchovies during the months of November and December for fire fishing.
Can you provide details on Automatic Identification System (AIS) carriage requirements for fishing vessels? If known, is this also the same requirement for private recreational vessels?	AIS equipment is not compulsory for fishing boats. However, all fishing units greater than 15m in length are equipped with Vessel Monitoring System (VMS).
Can you give any insight into the proportion of fishing vessels using AIS vs. non-AIS?	None

Question	Response
Is there any fishing legislation relevant to our study that we may be unaware of?	None
How are formal Notice to Mariners (NtM) shared with fishing vessels?	Communication between fishing boats and with the control tower is ensured via Radio (VHF) which is compulsory for fishing boats greater than 5 GRT.
Are you able to provide any information on illegal fishing activities? For example: a) Where these locations are (marked on a chart)? b) When they occur most (which months/times of year) and variability throughout the year? c) How prevalent (number of vessels or frequency of illegal fishing activities)?	a) Most of the offenses were noted against the banks of Korba, Maâmoura and Nabeul. b) Most offenses are committed during periods of bad weather (winter season) for fear of moving away from the coast and especially in the months of November and December in order to meet market demands in preparation for the New Year celebrations. c) Irregularly.
Are there any specific areas, marine traffic junctions, marine operations, routes or vessel types that you would consider to present a higher risk of collision that we should be aware of in our assessment?	None
Are there any other comments or information that you would like to mention with regard to the risk of cable laying operations?	We recommend that the cable laying work period be carried out during the December-May period to give professionals more chance to work and take advantage of periods of good weather.

3.4.2 Vessel Traffic Datasets

The vessel traffic data used within this NRA is listed below:

- AIS data; March 2023 – August 2023 (six months); and
- Global Fishing Watch AIS fishing effort data 2020.

3.4.3 Incident Data

The following accident datasets were utilised to support this assessment;

- IMO Global Integrated Shipping Information System Marine Casualties and Incidents (2003-2022); and
- Marine Accident Investigation Branch (MAIB) (1991-2022).

3.4.4 Other Data Sources

Other datasets utilised to support this assessment include:

- Admiralty charts (2023); and
- Admiralty Sailing Directions: Mediterranean Pilot Vol. I (NP45).

3.4.5 Project Documentation

Documents provided by the client were used to inform the details of the project, including installation method, project components and the weather conditions in proximity to the project. The main documents used to inform the NRA are listed below:

- Interconnessione Italia – Tunisia Valutazione di Incidenza – Relazione generale (ELMED doc no. RGFR18400B2380653);
- Progetto di Interconnessione Elettrica Italia-Tunisia Relazione di posa ai sensi del D.M. 24/1/1996 (company doc no. RVFR18400A00018);
- Progetto di Interconnessione Elettrica Italia-Tunisia Relazione di posa ai sensi del D.M. 24/1/1996 ALLEGATO IX - Area tra il limite delle acque territoriali ed il limite della Zona Economica Esclusiva (company doc no. RVFR18400B2772035);
- Projet d'interconnexion électrique Tunisie-Italie Etude d'Impact Environnemental et Social Résumé Exécutif – Partie 1 Draft pour consultations;
- Tunisia-Italy Power Interconnector Project Environmental and Social Impact Assessment (ESIA) (contractor doc no. ES-03);
- Marine Feasibility Studies for Tunisia-Italy Power InterconnectorDTS Report (company doc no. RVFR18400A00012);
- Italy – Tunisia Interconnection Terrestrial And Submarine Cable Installation (document code PVFR18400C2666031);
- HVDC Line – Chronological Program (GANTT) (doc no. TVFR18400C2658380); and
- Italy – Tunisia Interconnection Terrestrial And Submarine Cable Installation (doc code PVFR18400C2666031).

4. PROJECT OVERVIEW

4.1 PROJECT COMPONENTS

The offshore components of the ELMED interconnector (previously presented in **Figure 2**) will consist of an HVDC cable of approximately 200 km in length, which will run between two landing points in Cap Bon (Tunisia) and a single landfall site in Sicily (Italy). A fibre optic telecommunications cable will also be laid in the same trench as the power cable. The two Tunisian landfalls are located at Menzel Horr and Kelibia, whilst the Italian landfall is located at Marinella.

4.2 INSTALLATION

4.2.1 Method

Prior to the laying process, the route is cleared using a pre-lay grapnel run to remove any potential obstacles. In sensible areas, this operation will be carried out by underwater technical operators. The laying of undersea cables is carried out by a special cable-laying ship; using a winch, the reel of the cable is unwound, and the cable is laid across the seabed. Examples of cable-laying vessels are shown in **Section 4.2.2**. The laying of the submarine cables shall be assisted by a Remotely Operated Vehicle. The purpose of the NRA is to assess the navigational risk to the cable lay vessel only, rather than other project vessels involved. Vessels carrying out other activities (including possible boulder clearance, ground preparation works, survey and inspection vessels, etc) would be considered to have similar hazards and hazard likelihood profiles but with lower consequences to the business and the project.

Cables are planned to be predominantly protected via burial; however, other methods of protection, such as rock placement, may be employed where burial is not feasible. Burial coverage for the cable is aimed to be 1.5m deep for jetting and 1.0m deep for trenching. The choice of which cable protection is used will depend on seabed soil characteristics and will, therefore, be defined directly by the contractor during the final planning phase. Methods of protection other than burial will also be required where the ELMED cable crosses existing subsea infrastructure (see **Section 5.1.4**). An example of a typical crossing with mattresses is shown below.

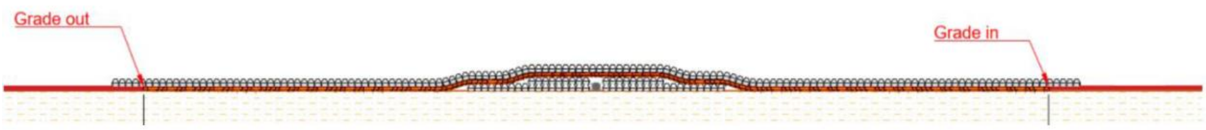

Figure 3: Typical crossing with mattresses

Landfalls will be installed using the Horizontal Directional Drilling (HDD) technique, with the cables being pulled from the sea towards the land through the conduits.

4.2.2 Project Vessels

It is understood that the cable laying vessel will be Dynamic Position (DP) capable with DP2 or DP3 level redundancy. There are various vessels with this capability and examples of similar cable-laying vessels are presented in **Figure 4** (Nexans Skagerrak) and **Figure 5 (**Giulio Verne). The Nexans Skagerrak is purpose-built to install and repair subsea high-voltage cable Systems. Her payload capacity, shallow draft and equipment are designed for transport, installation and protection of cables, umbilicals and flowlines. Giulio Verne is a cable-laying vessel built for the challenging worldwide subsea operations. The vessel has a large cable carousel capacity and is equipped to conduct the deepwater power cable lay up to 1,600m depth..

Figure 4: Cable laying vessel Nexans Skagerrak

Figure 5: Cable laying vessel Giulio Verne

Other project vessels will include supply vessels due to the 24/7 nature of the cable-laying activities. Hence, there will be a requirement for crew/personnel transfers and potential supply deliveries for the vessel crew, equipment or supplies. It is understood that the vessel is intended to have enough supplies, spare parts and crew to sustain ongoing operations for the duration of the cable laying activities; however, we note that there may be up to one vessel every two weeks for personnel transfers for stakeholder or client representatives and inspections. Therefore, other support vessels are assumed. Fuelling is unclear and may depend on the actual vessel selected; however, for this NRA, it is also assumed that vessel re-fuelling will take place enroute as a form of supply vessel.

4.2.3 Schedule

The actual schedule is indicative at the time of this assessment; however, from information provided, the total duration of work for the entire interconnector is estimated to be approximately four years, including testing and final commissioning. The installation of the submarine power cable is to commence in 2026 and last for approximately 115 days from July to October (inclusive). The actual laying time is anticipated to take 90 days in total. Cable laying works will be a 24/7 activity. A guard vessel is assumed to be on-site for the duration of the submarine power cable installation works.

Submarine cable protection is to be carried out over a duration of 1,156 days from July 2024. This includes the jetting, trenching, and rock dumping operations, as well as a post-construction survey.

5. DESCRIPTION OF THE MARINE ENVIRONMENT

5.1 NAVIGATIONAL FEATURES AND EXISTING INFRASTRUCTURE

The navigational features in proximity to the ELMED interconnector cable route are presented within **Figure 6.**

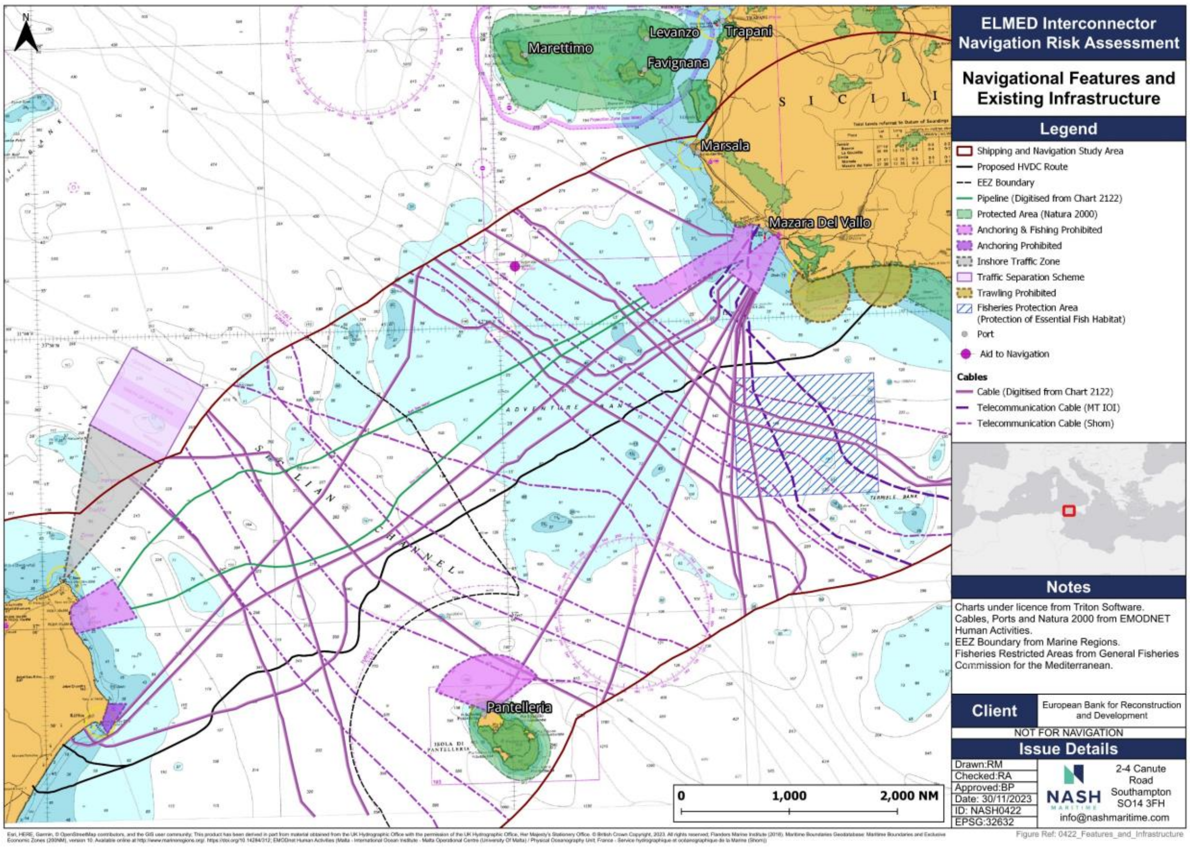

Figure 6: Navigational features and existing infrastructure

5.1.1 Local Ports and Harbours

Local ports and harbours can attract busier vessel movements on approach and departure, and can be used for vessel supplies or crew/personnel transfers. The closest port/harbour to the ELMED interconnector is located at Mazara Del Vallo, 13.1nm from the Italian landfall. The port of Marsala is located further west, situated 22.1nm from the closest point of the ELMED interconnector. Both ports handle approximately 110 vessels annually[1].

Mazara Del Vallo is an artificial harbour, at which pilotage is compulsory for all vessels of 500 gross tonnage (GT) and over. Pilots board approximately 0.5nm from the harbour entrance.

[1] https://shipnext.com/

Marsala port is fronted by a large artificial harbour. The port's main import is wood and the main export is wine. Pilotage at Marsala is also compulsory for all vessels of 500 GT and over. Pilot boarding takes place about 1nm south-southwest of the head of Diga Foranea.

5.1.2 Routeing Measures

The Traffic Separation Scheme (TSS) North of Cape Bon is located immediately west of the study area, approximately 24.2nm from the ELMED interconnector cable route. An inshore traffic zone lies between the TSS North of Cape Bon and Cape Bon in Tunisia.

5.1.3 Restricted Areas

Restricted areas can exhibit different traffic patterns as vessel actively avoid the area and can present as additional locations of potential higher risk. A Natura 2000[2] protected area is located around Pantelleria Island which lies within the study area. A large square-shaped Fisheries Restricted Area (FRA) is located 0.3nm southeast of the cable route, where trawling is prohibited in order to protect fish habitats.

There are four areas within the study area where anchoring is prohibited. Fishing is also prohibited within three of these. There are two areas where trawling is prohibited along the Italian coastline, one of which overlaps the cable landfall.

5.1.4 Subsea Infrastructure

Figure 7 presents the existing subsea infrastructure that will be crossed by the ELMED interconnector. The cable route crosses a total of 26 existing cables within the study area. Two pipelines are present within the study area but are not crossed by the ELMED interconnector. The majority of the crossings take place within Italian waters. Where crossings take place, alternative methods are likely to be used to protect the subsea cable, such as rock dumping or mattresses.

[2] Natura 2000 is a network of protected areas covering Europe's most valuable and threatened species and habitats.

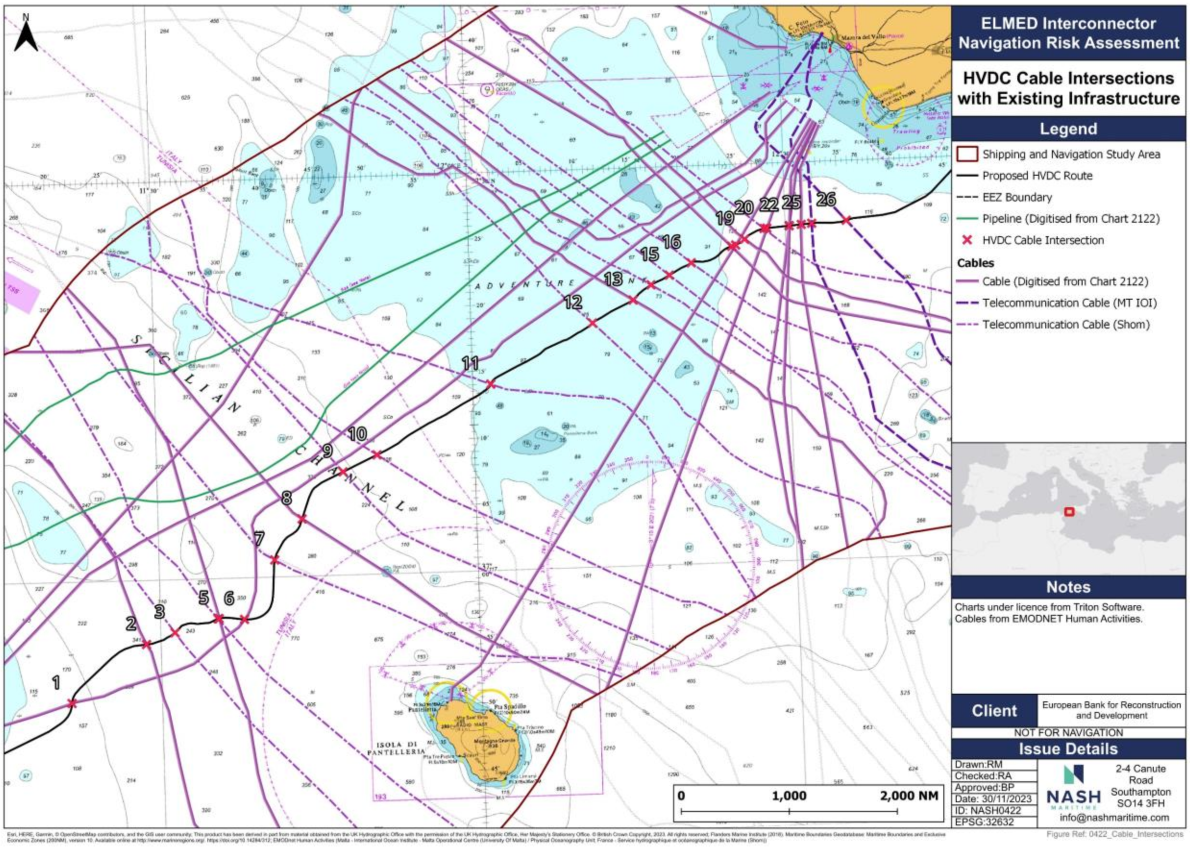

Figure 7: HVDC crossings with existing active subsea infrastructure

5.1.5 Aids to Navigation

One aid to navigation is located within the study area 19.1nm north west of the ELMED cable route. This is an Ocean Data Acquisition Systems buoy equipped with racon. This is not considered further within this risk assessment.

5.2 METOCEAN DATA

5.2.1 Wind

Typical wind conditions in proximity to the offshore cable route are presented in **Figure 8** in the form of an annual wind rose. The prevailing winds are typically from the north west (almost 40% of the time) with wind recorded over 45 knots at times, but typically less than 20 knots.

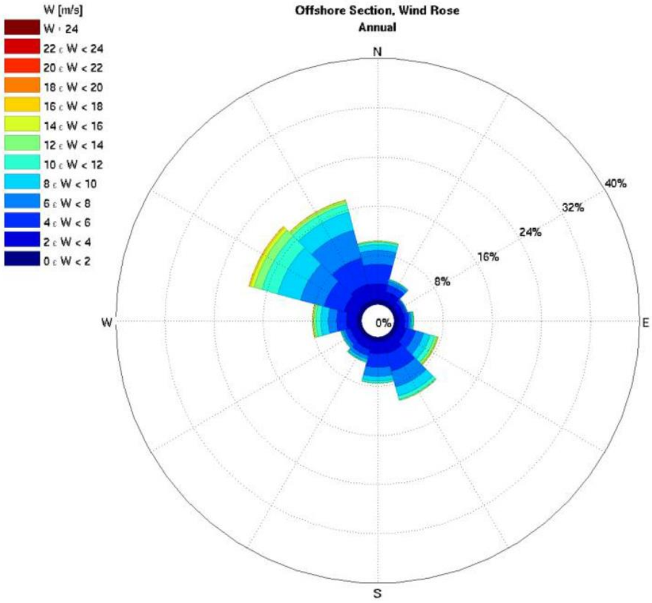

Figure 8: Annual wind rose – offshore section

5.2.2 Waves

The wave climate from the three selected offshore points has been considered for the characterisation of the offshore section. The resulting tables are therefore representative of the cumulative condition along the offshore route. The annual wave data or the offshore cable route is presented in **Figure 9** in the form of a wave rose. Waves are largest in line with the west north westerly winds and to a lesser extent the south south east. Waves can be large with over 7m significant wave height in adverse weather, but are typically less than 1.5 or 2m significant wave height. Waves nearer shore are likely to be less.

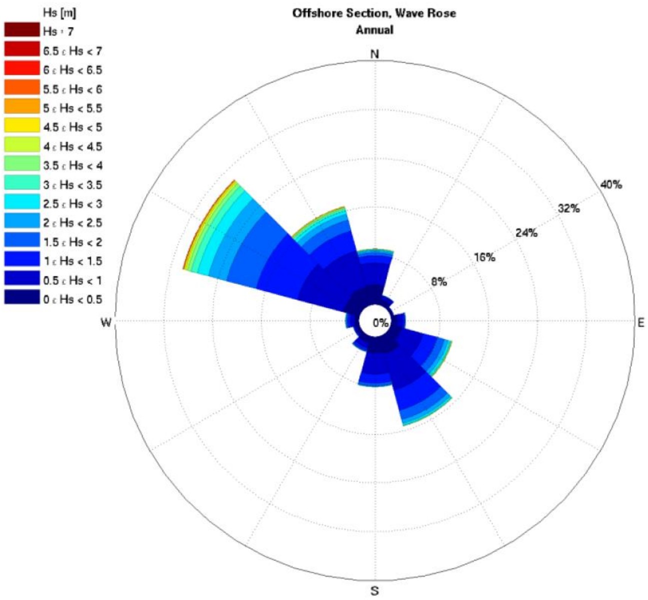

Figure 9: Annual wave rose – offshore section

5.2.3 Tide and Current

The general circulation of the water masses in the Mediterranean is mainly determined by exchange of heat and salt/thermohaline circulation and by earth rotation effect (Coriolis force). As a result, circulation roughly runs counterclockwise along the continental slopes, but dynamical activity at mesoscale[3] is superimposed nearly everywhere in the Mediterranean, modifying locally and episodically this mean path. Mesoscale phenomena are typically upwellings, fronts, meanders and eddies. Locally and episodically (up to several months, (Millot ,1999)), they can strongly perturb the general circulation.

5.2.4 Visibility

The percentage frequency of fog across the Strait of Sicily is less than 1% of the time (Admiralty Sailing Directions, NP45). Reduced visibility may occur with south scirocco winds affecting a large area. Sand storms off the north African coast can also affect visibility, with potential for visibility to be less than 1km. Sand storms are usually short-lived and localised.

5.3 EMERGENCY RESPONSE RESOURCES

An overview of the search and rescue bases in proximity to the ELMED cable routes are shown within **Figure 10**. The closest bases are located at MRCC Tunis in Tunisia and MRSC Palmero in Sicily. There is also a search and rescue base at Malta.

[3] Of intermediate size. especially of or relating to a meteorological phenomenon approximately 10 to 1000 kilometres in horizontal extent.

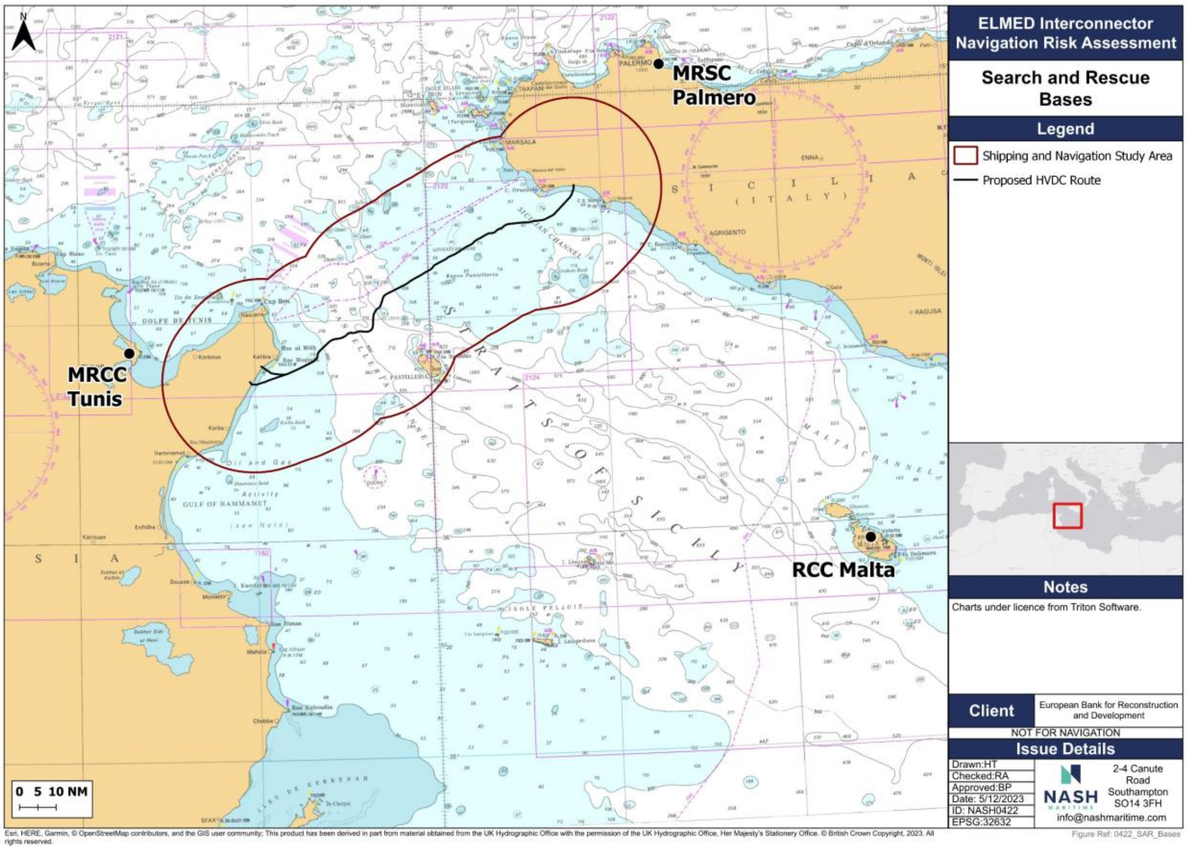

Figure 10: Search and rescue bases

6. EXISTING MARITIME ACTIVITIES

6.1 INTRODUCTION

A vessel traffic analysis was undertaken using AIS data from the period March 2023 to August 2023 (inclusive) in order to inform the baseline vessel movements that typically take place in proximity to the proposed cable laying activities.

6.2 VESSEL TRAFFIC ANALYSIS

6.2.1 Overview

A vessel density heatmap for all of the vessel traffic recorded during the six-month period is shown in **Figure 11**. The predominant areas of highest vessel density (over 30 vessels per day on average) were observed at the entrance/exit of the TSS North of Cape Bon. A route with an average of five to ten vessels per day was observed between Trapani and Pantelleria Island.

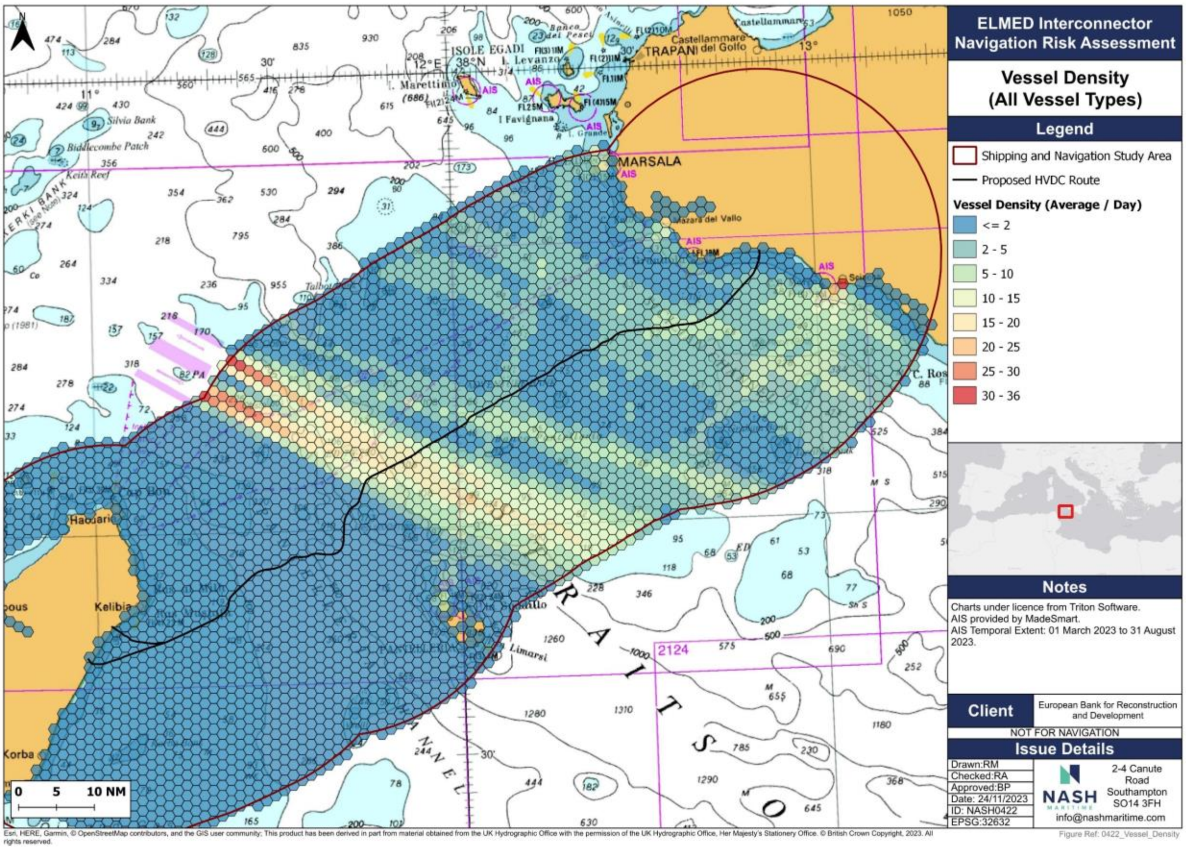

Figure 11: Vessel density

6.2.2 Vessel Types

6.2.2.1 Commercial

The tracks of the cargo vessels recorded during the six month period are shown in **Figure 12**. The majority of cargo vessel tracks were observed using the TSS North of Cape Bon crossing the mid-section of the cable route. Cargo vessel tracks were also frequently observed passing to the southwest of Sicily.

The tracks of the tankers recorded during the six-month period are shown in **Figure 13**. Tanker activity was similar to cargo vessels, with a high volume recorded transiting through the TSS North of Cape Bon. Tankers were also recorded on routes southwest of Sicily between the TSS and the coast.

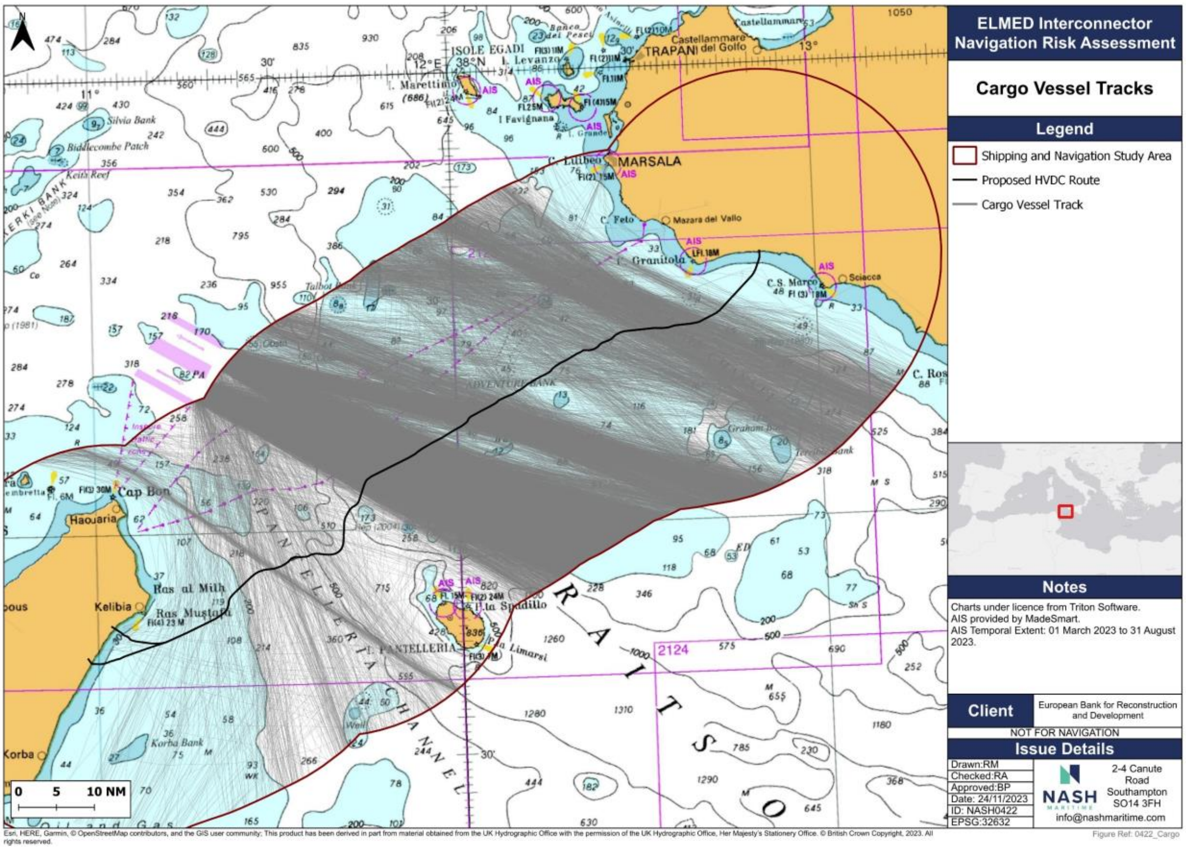

Figure 12: Cargo vessel tracks

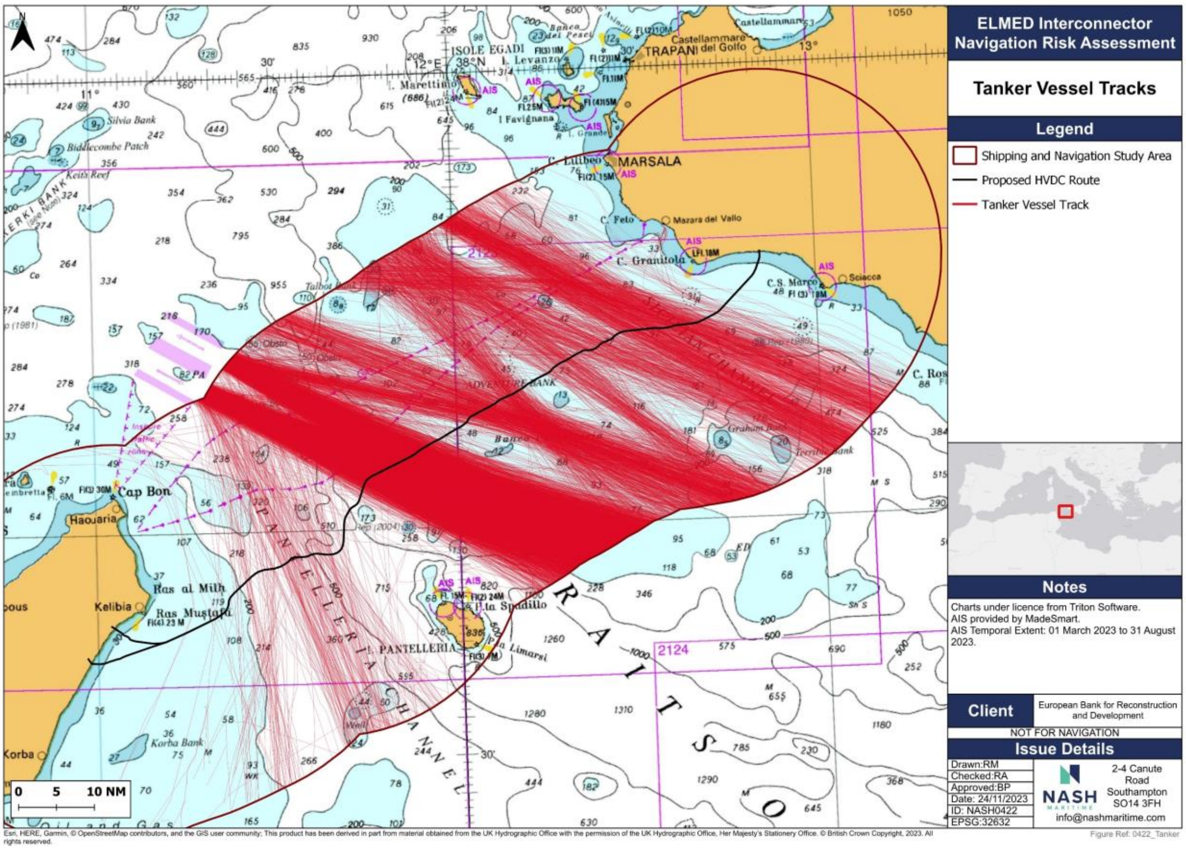

Figure 13: Tanker vessel tracks

6.2.2.2 Passenger

Figure 14 presents the tracks of passenger vessels recorded during the six-month period. A main ferry route was observed between Trapani and Pantelleria Island. The ferry service offers a total of 14 sailings per week, nine of which are operated by Siremar and the other five are operated by Liberty Lines. Passenger vessels were also recorded less frequently using routes similar to those used by the cargo vessels and tankers.

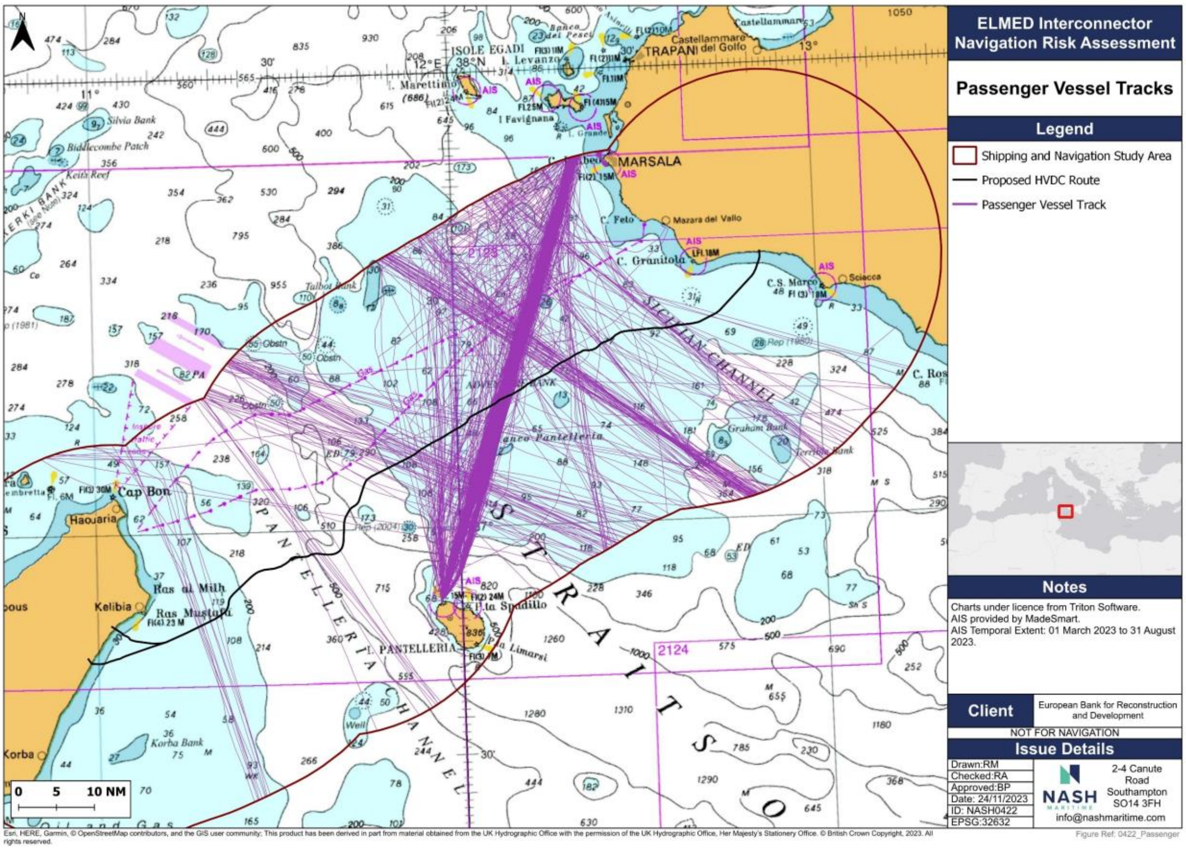

Figure 14: Passenger vessel tracks

The OMMP publish quarterly statistics for port arrivals and departures at the Port of Goulette in Tunisia from quarter one 2016 onwards, which are presented below in **Figure 15**. Although vessels entering Goulette do not necessarily cross the cable route, this data is useful for identifying patterns in seasonal variation. Strong seasonal variation was observed, with the majority of arrivals and departures taking place in quarter four of each year. The average number of arrivals within quarter four of each year was 519 whilst the average number of arrivals during quarter one of each year was only 100. The AIS data analysed predominantly covers quarter two and quarter three of 2023, and may be higher in quarter four based on the data for the Port of Goulette.

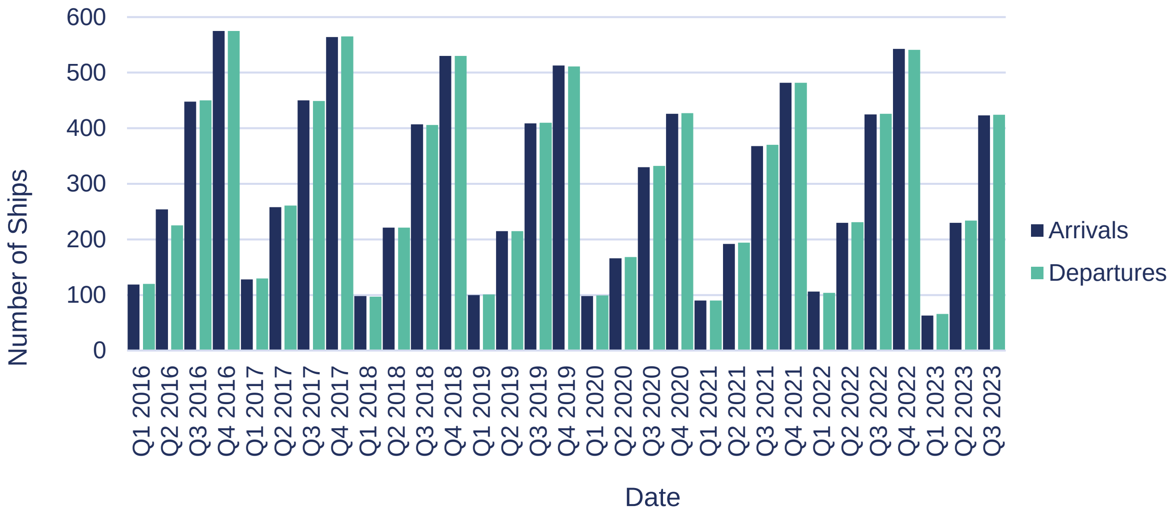

Figure 15: Passenger Ship Arrivals at Port of Goulette, Tunisia (OMMP, 2023)

6.2.2.3 Fishing Activity

Fishing vessel activity during the six-month period is shown in **Figure 16**. Dense fishing activity was observed within Italian waters, particularly east of the cable route in proximity to the coast. Low levels of activity were also recorded around Pantelleria Island. there is a substantial increase in fishing activity offshore of the Sicilian coast immediately north and west of the FRA and that this is in close proximity to the cable route. It is noted that fishing activity, particularly within Tunisian waters, is likely underrepresented due to the fact that AIS equipment is not compulsory for fishing boats. Fishing intensity data for 2020 (Global Fishing Watch, 2023) reflected the same areas of dense fishing activity observed within the AIS data analysed, as can be seen in **Figure 17**.

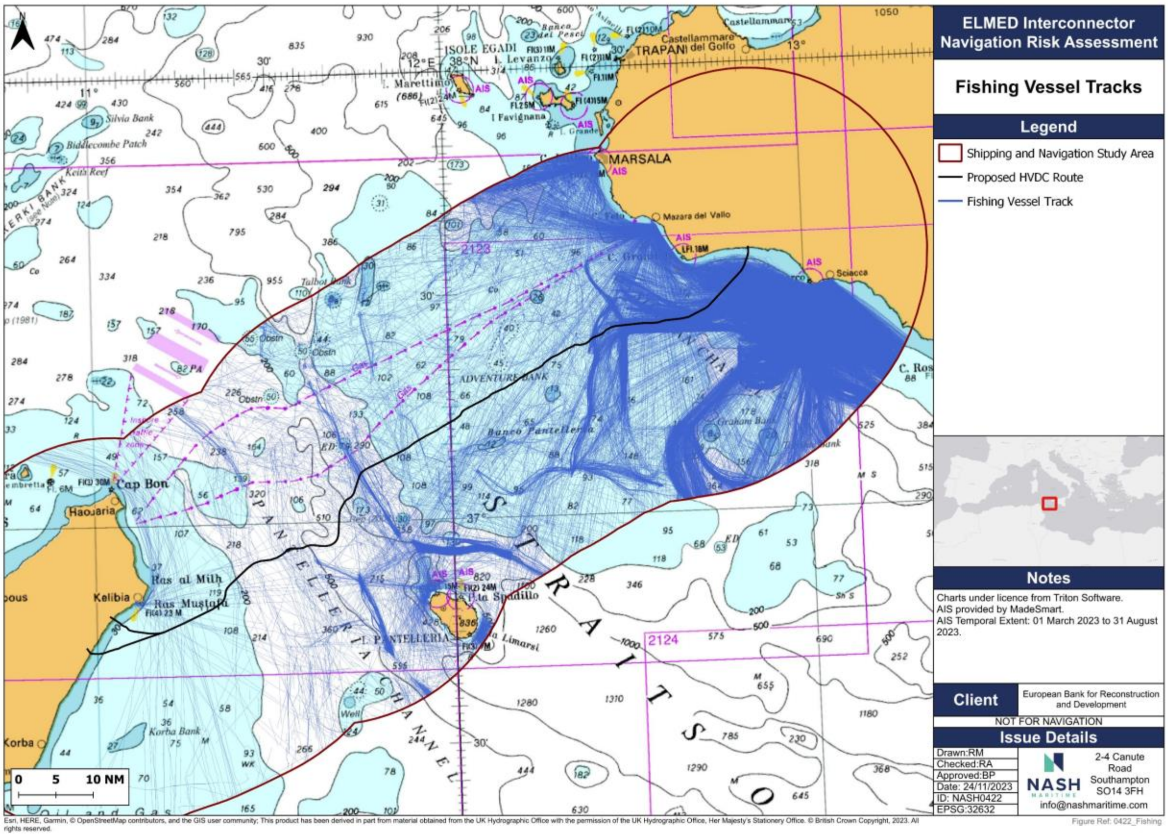

Figure 16: Fishing vessel tracks

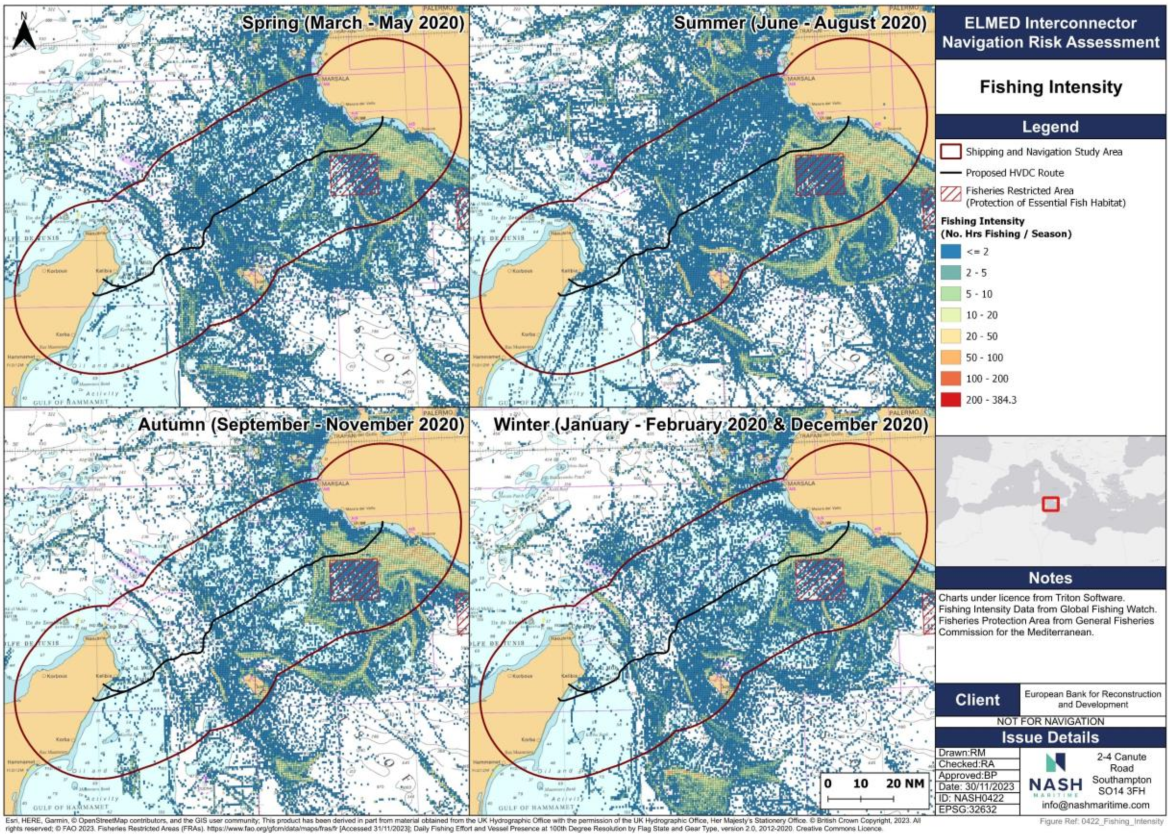

Figure 17: Seasonal fishing intensity (2020)

6.2.2.4 Recreational Activity

The tracks of recreational vessels recorded during the six month period are shown in **Figure 18**. Recreational activity was observed to be mainly focused nearshore, particular in proximity to the Italian landfall. It is noted that recreational activity may be underrepresented as recreational vessel are not required to carry AIS receivers.

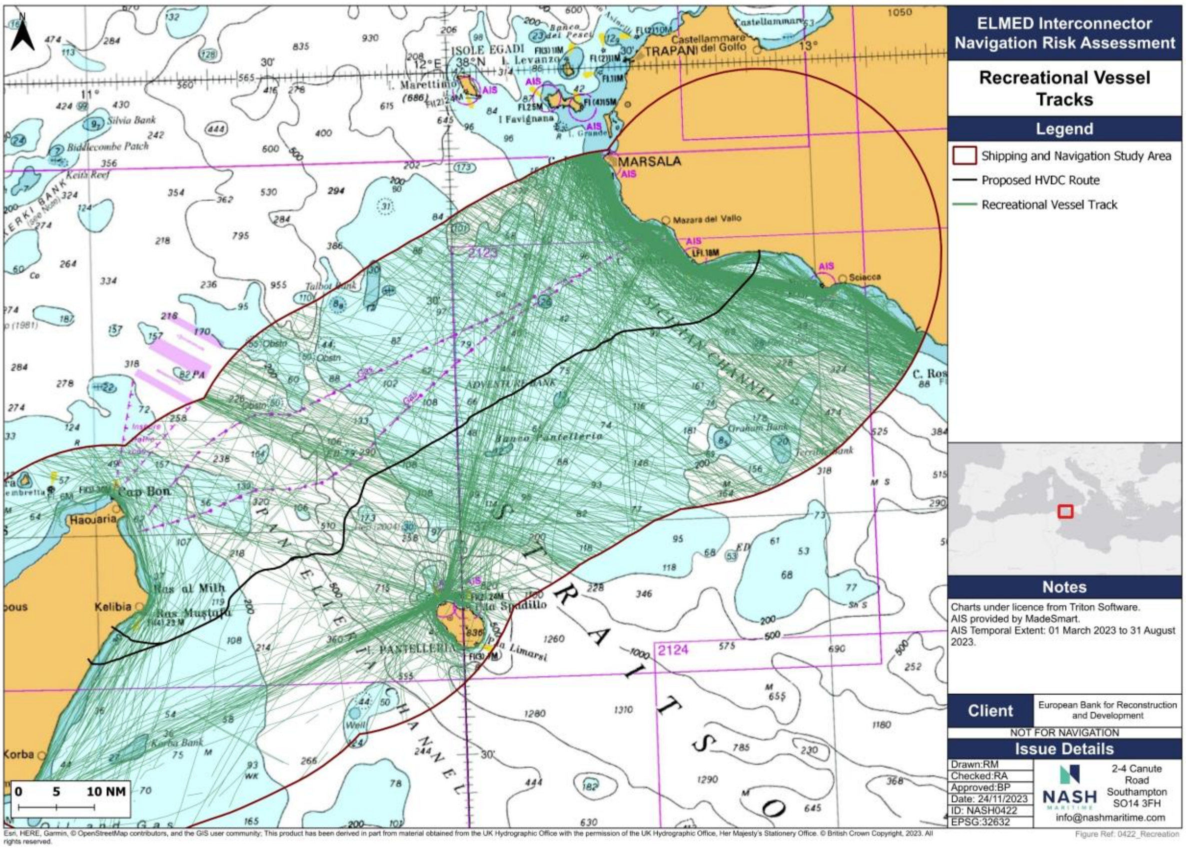

Figure 18: Recreational vessel tracks

6.2.2.5 Tug & Service Tracks

The tracks of tug and service vessels are shown in **Figure 19**. Vessels were observed transiting to and from the TSS, as well as transiting a main route between Sicily and Pantelleria Island. Activity was also observed in proximity to the Italian coast.

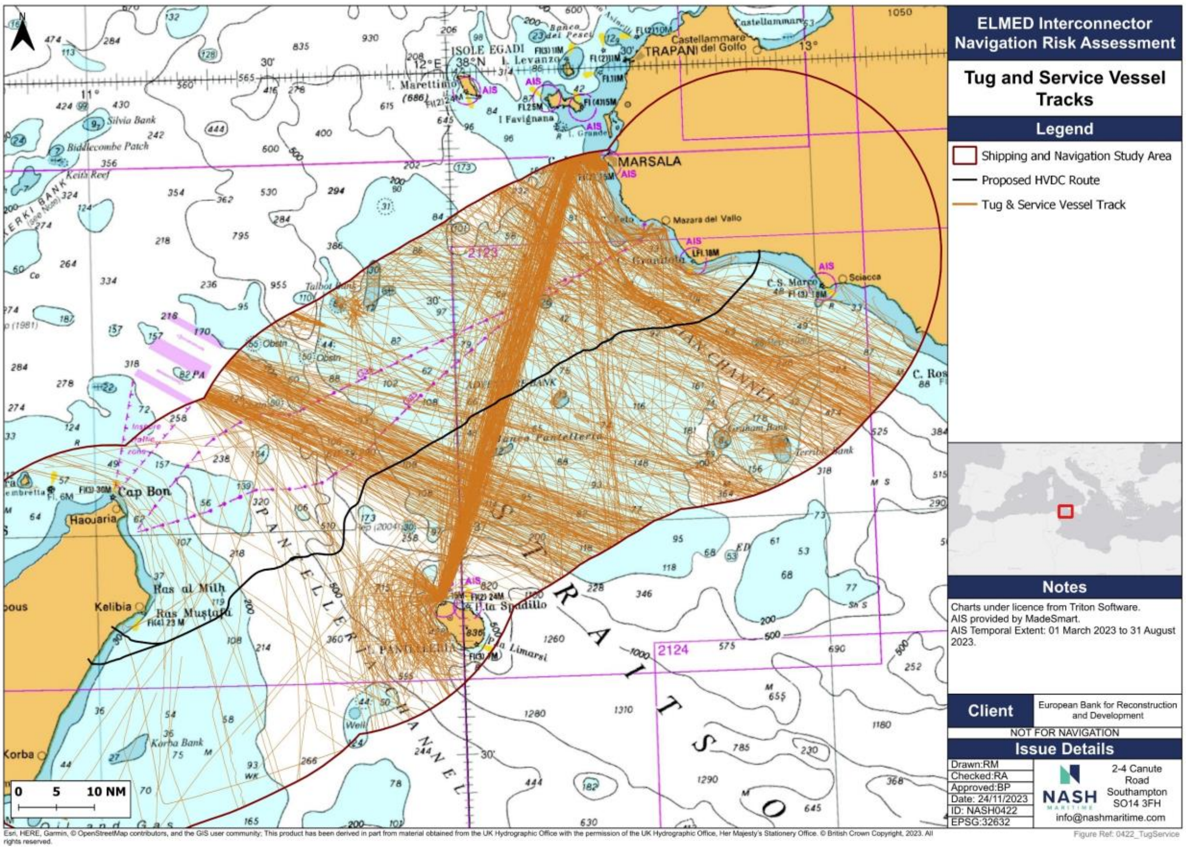

Figure 19: Tug and service vessel tracks

6.2.3 Vessel Size

All vessel tracks recorded during the six month period are shown in **Figure 20** categorised by length overall (LOA). Vessels under 100m in length largely comprised of fishing vessel activity, particularly close to the Italian coast. Vessels over 100m tended to be observed using defined routes. The majority of vessels over 300m in length were recorded transiting to/from the TSS North of Cape Bon.

All vessel tracks recorded during the six month period are shown in **Figure 21** categorised by maximum vessel draught. Vessels with draughts under 2m tended to be smaller vessels such as fishing and recreational vessels. Vessels with draughts over 10m were deep draft ocean going commercial vessels frequently recorded transiting to/from the TSS North of Cape Bon (such as vessels transiting the Suez Canal). Few vessels with draughts over 20m were recorded.

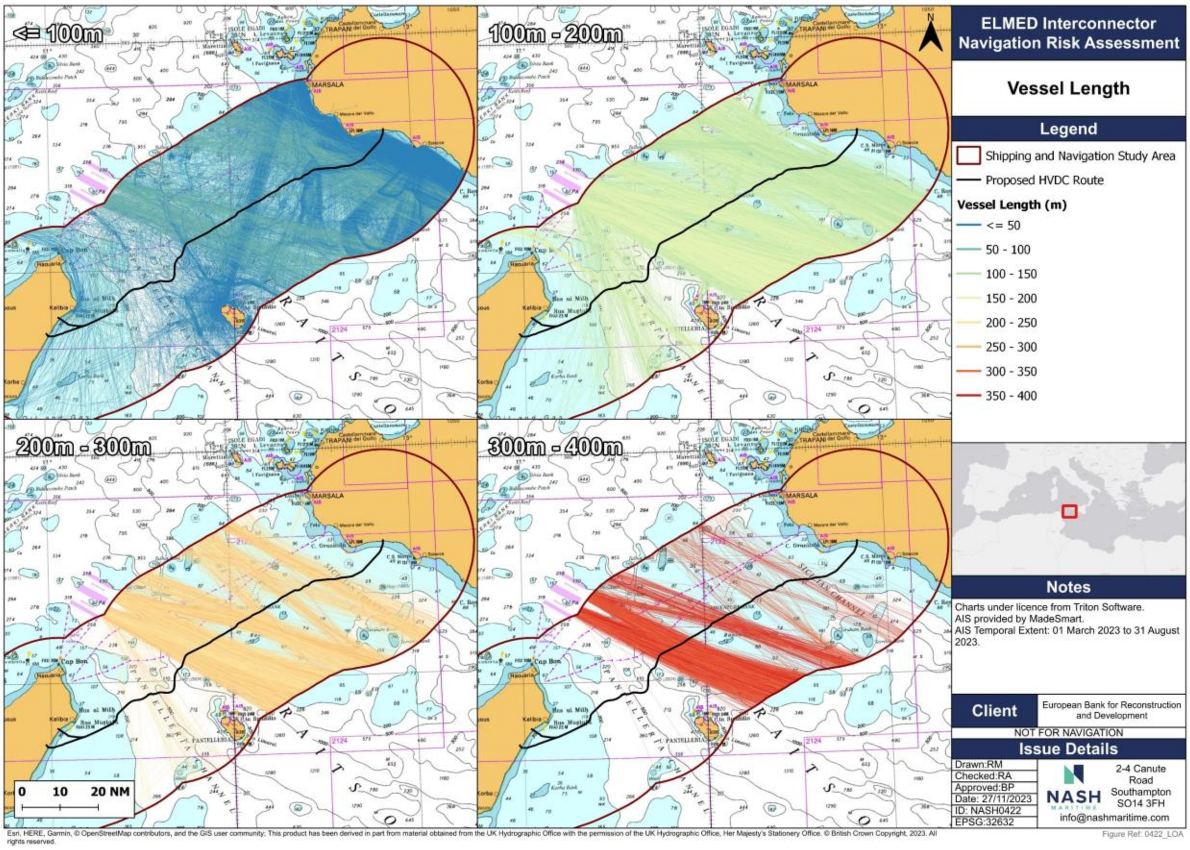

Figure 20: Vessel size by LOA

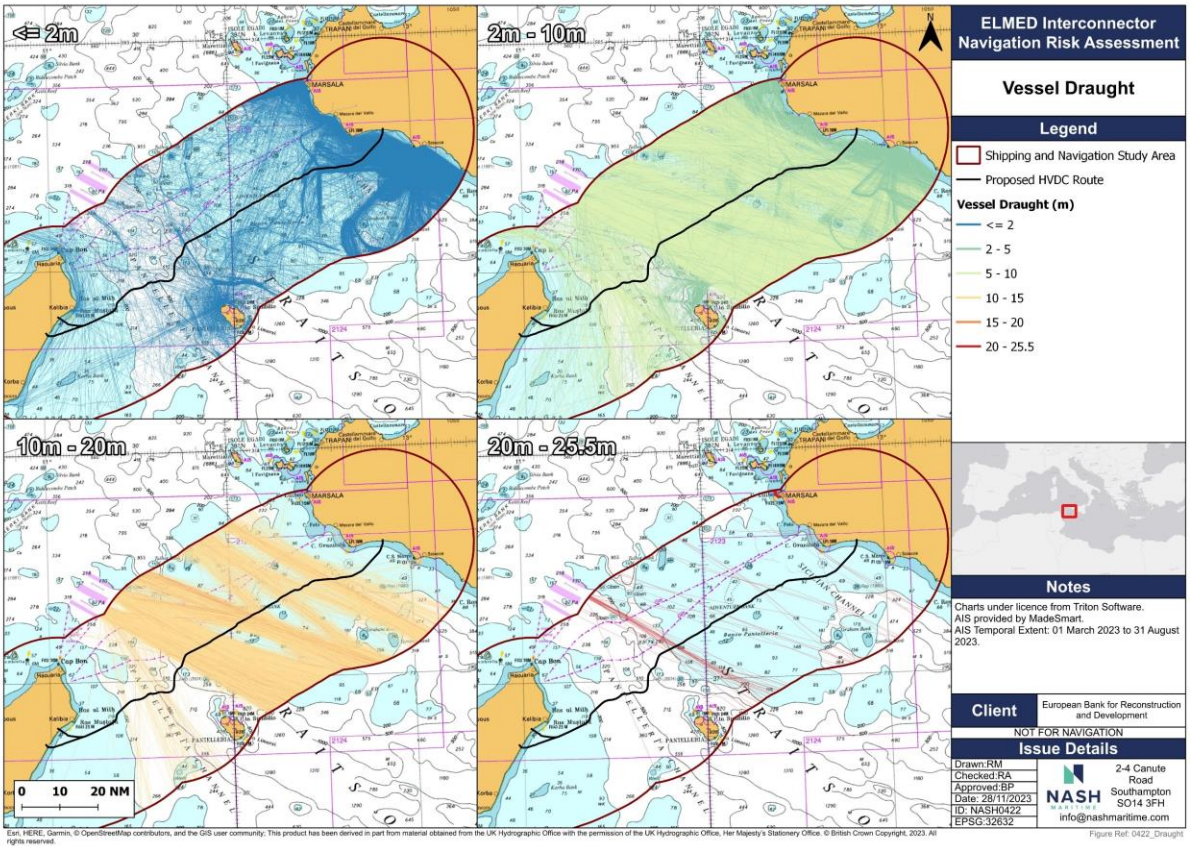

Figure 21: Vessel size by draught (maximum)

6.2.4 Non-Transit Activity

Figure 22 presents a grid showing the time spent by vessels at speeds less than 0.4 knots, which are considered to be non-transiting. This highlights the key areas of anchoring activity within the study area. The main locations of activity for vessels travelling at less than 0.4 knots within the study area were east of the cable route in proximity to the Italian coast, as well as around Pantelleria Island and may be partially attributed to fishing vessel activity.

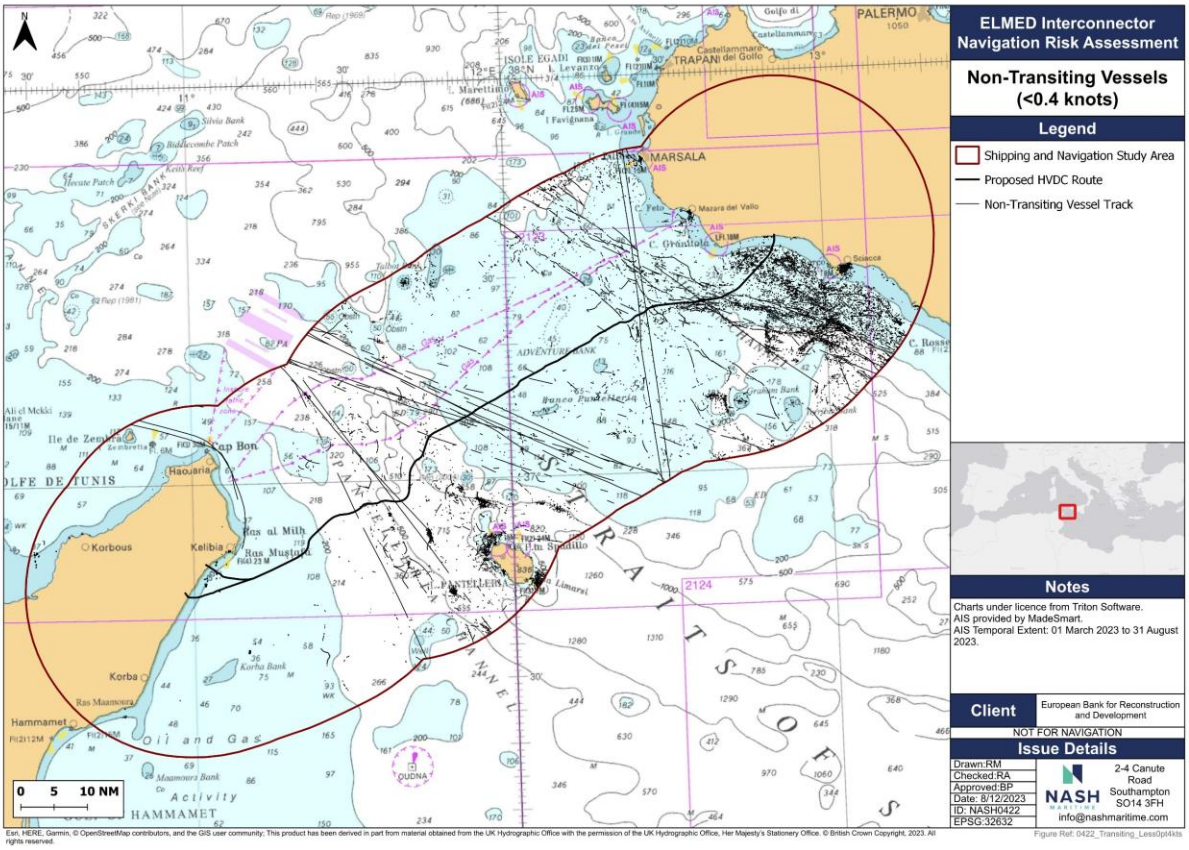

Figure 22: Non-transiting vessel activity

6.2.5 Vessel Routes

Vessel routes within the study area were identified and are presented within **Figure 23**. **Table 2** provides details about the vessel types and proportions transiting each route.

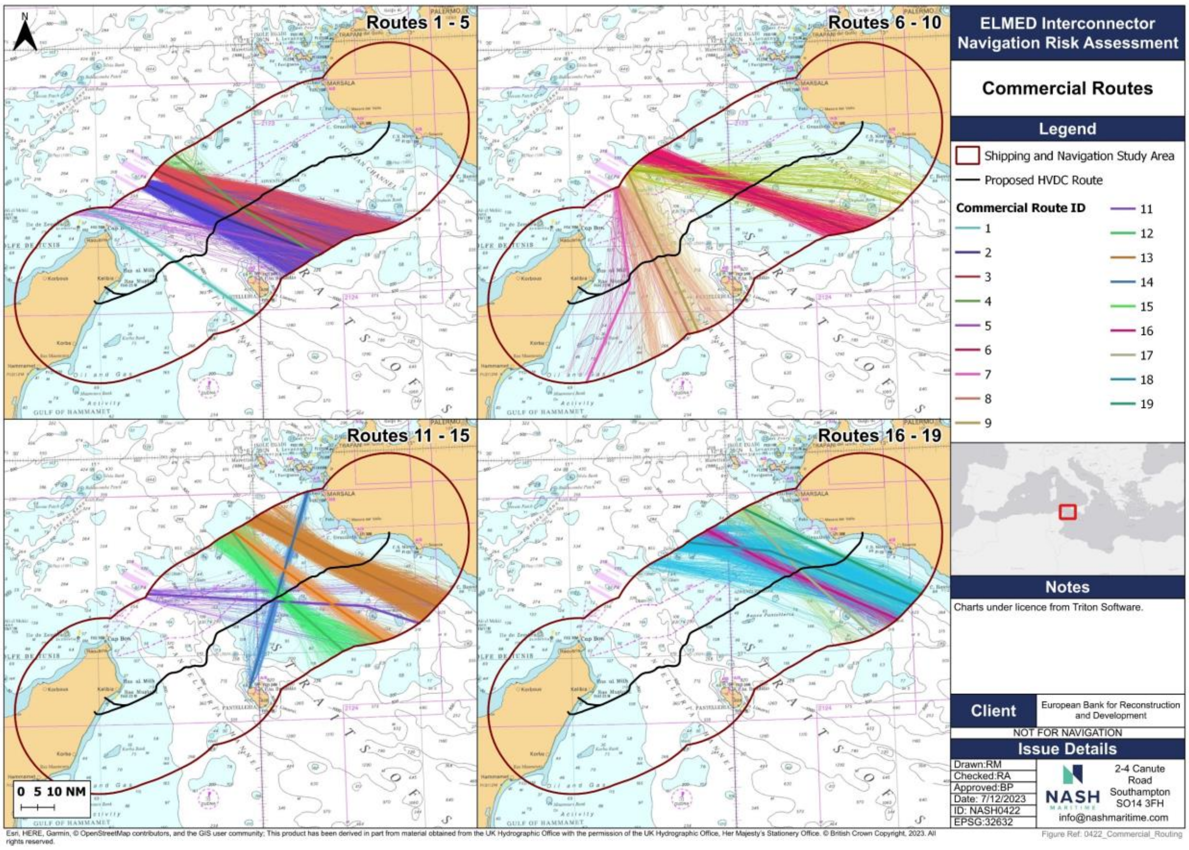

Figure 23: Commercial vessel routes identified within the study area

Table 2: Vessel route details (bold indicating majority)

Plot Quadrant	Route ID	Cargo	Tanker	Passenger
Top Left	1	**100%**	0%	0%
	2	**67%**	32%	0%
	3	**64%**	36%	0%
	4	38%	**60%**	2%
	5	**90%**	8%	2%
Top Right	6	**64%**	36%	0%
	7	**91%**	9%	0%
	8	**61%**	37%	2%
	9	**68%**	32%	1%
	10	**78%**	21%	2%

Plot Quadrant	Route ID	Cargo	Tanker	Passenger
Bottom Left	11	**92%**	8%	0%
	12	29%	**69%**	1%
	13	**54%**	**45%**	1%
	14	0%	0%	**100%**
	15	35%	**54%**	11%
Bottom Right	16	**52%**	**48%**	0%
	17	**77%**	17%	7%
	18	**72%**	27%	0%
	19	**86%**	14%	0%

6.2.6 Cable Route Analysis

Figure 24 and **Figure 25** present vessel traffic counts crossing each part of the ELMED interconnector during the 6 months AIS data coverage, broken down by vessel type. The figures start from the Tunisian end (0km). A spike in cargo vessels and tankers crossing the cable route was observed approximately half way along the cable route (near the 100km point) due to the segment of cable crossing the traffic into and out of the TSS. The junction of various traffic routes crossing the cable can be observed around the 125km point with cargo, tanker and passenger vessel crossing in a similar location. Heightened fishing activity was recorded within Italian waters, particularly along the final 50km of the cable route.

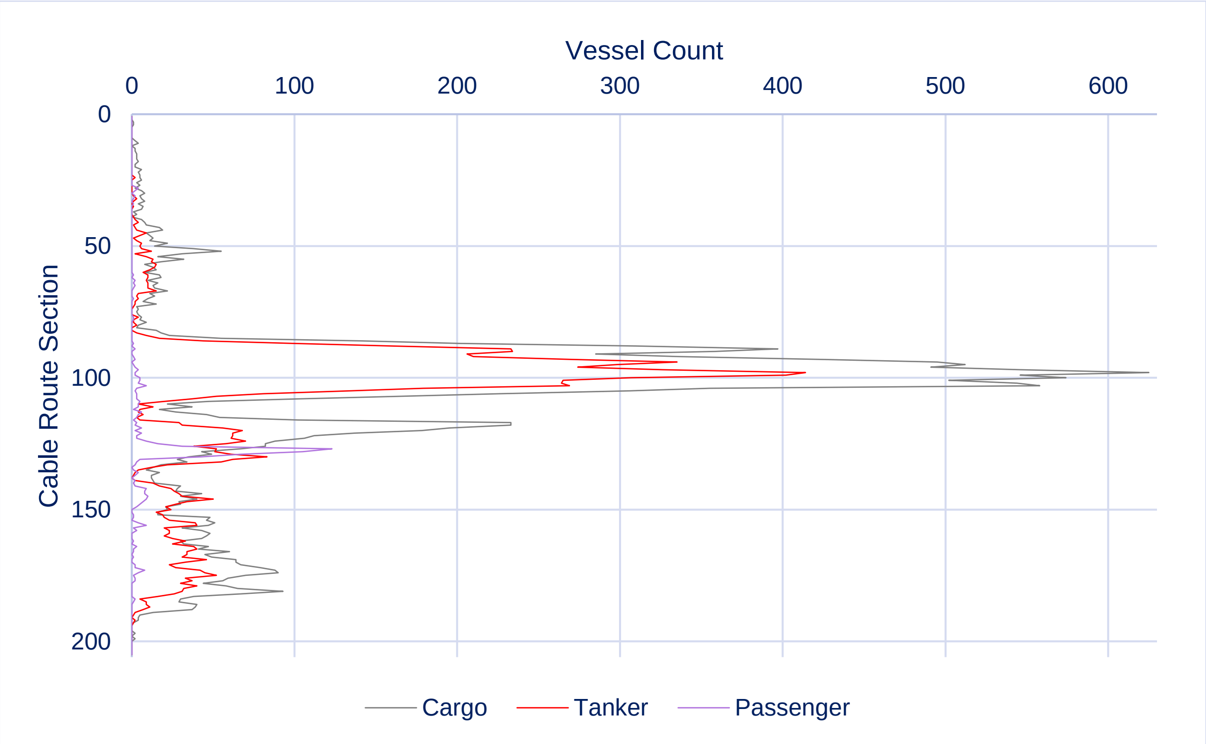

Figure 24: Cargo, Tanker and Passenger vessel counts across each 1km cable section (0km starting at Tunisian end)

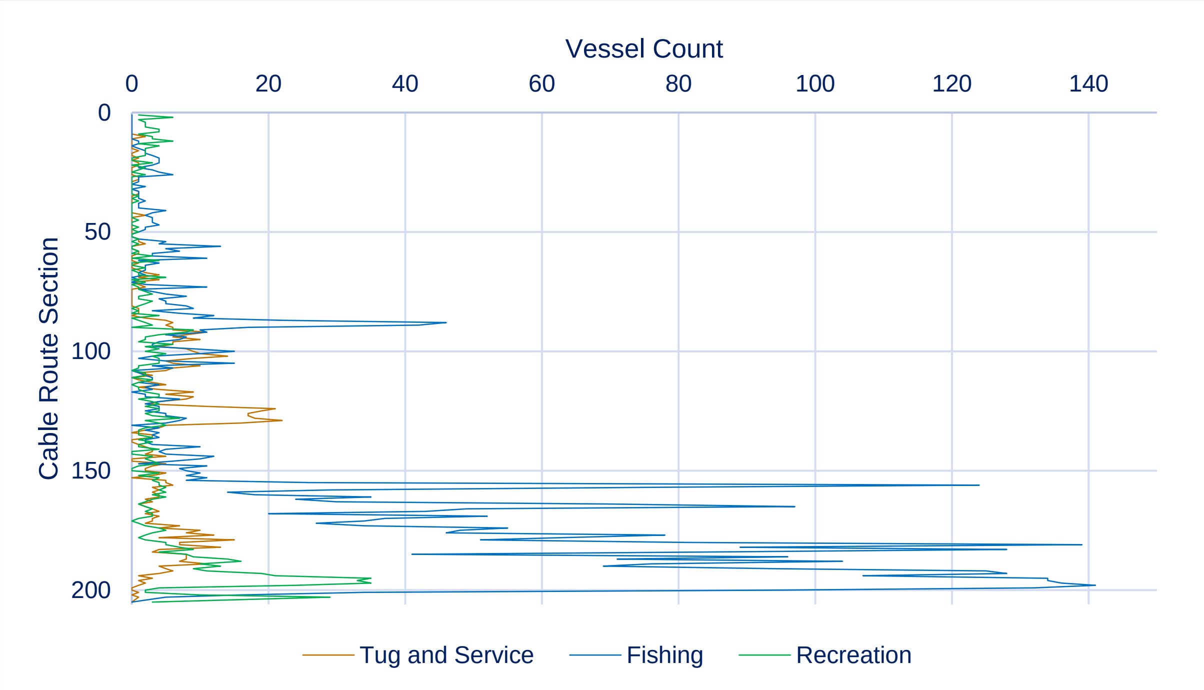

Figure 25: Tug/Service, Fishing and Recreational vessel counts across each 1km cable section (0km starting at Tunisian end)

6.3 ILLEGAL FISHING ACTIVITY

Recent research revealed dozens of suspected cases of bottom trawlers operating in FRAs that have been designated and approved by all the countries around the Mediterranean to protect certain species or habitats[4]. Most of these possible infringements occurred in the Strait of Sicily and specifically east of Adventure Bank, off the coast of Sicily, where activities in the seabed are banned because it is a nursery spot for hake fish.

In June 2016, this area and another two FRAs were established in the Strait of Sicily to preserve spawning and nursery areas for hake and deep-sea water rose shrimp. The protection of the three areas entered into force in October 2016. Oceana notified the European Commission in June 2017 that it had detected over 13,000 hours of fishing activity by Italian-flagged bottom trawlers in the three FRAs.

The response from the Tunisian Fisheries Department under the Ministry of Agriculture to the fishing questionnaire informed that most instances of illegal fishing take place over the Tunisian banks of Korba, Maâmoura and Nabeul during periods of bad weather due to fear of moving away from the coast. November and December also heightened levels of illegal fishing due to the market demands for New Year celebrations.

[4] Source: https://europe.oceana.org/

6.4 HISTORICAL MARITIME INCIDENTS

6.4.1 Maritime Incidents in Proximity to the Study Area

Maritime incidents for Tunisia, Italy and Malta were downloaded from the IMO's GISIS database for the most recent 20 years (2003-2022). A total of 28 incidents were reported, 11 of which did not have corresponding co-ordinates. The incidents with corresponding coordinates were plotted in **Figure 26**, one of which took place within the study area, 7.1nm from the ELMED interconnector. The incident took place in May 2017 and involved Gaz Century (tanker) and Hatem Koussay (vessel type not known).

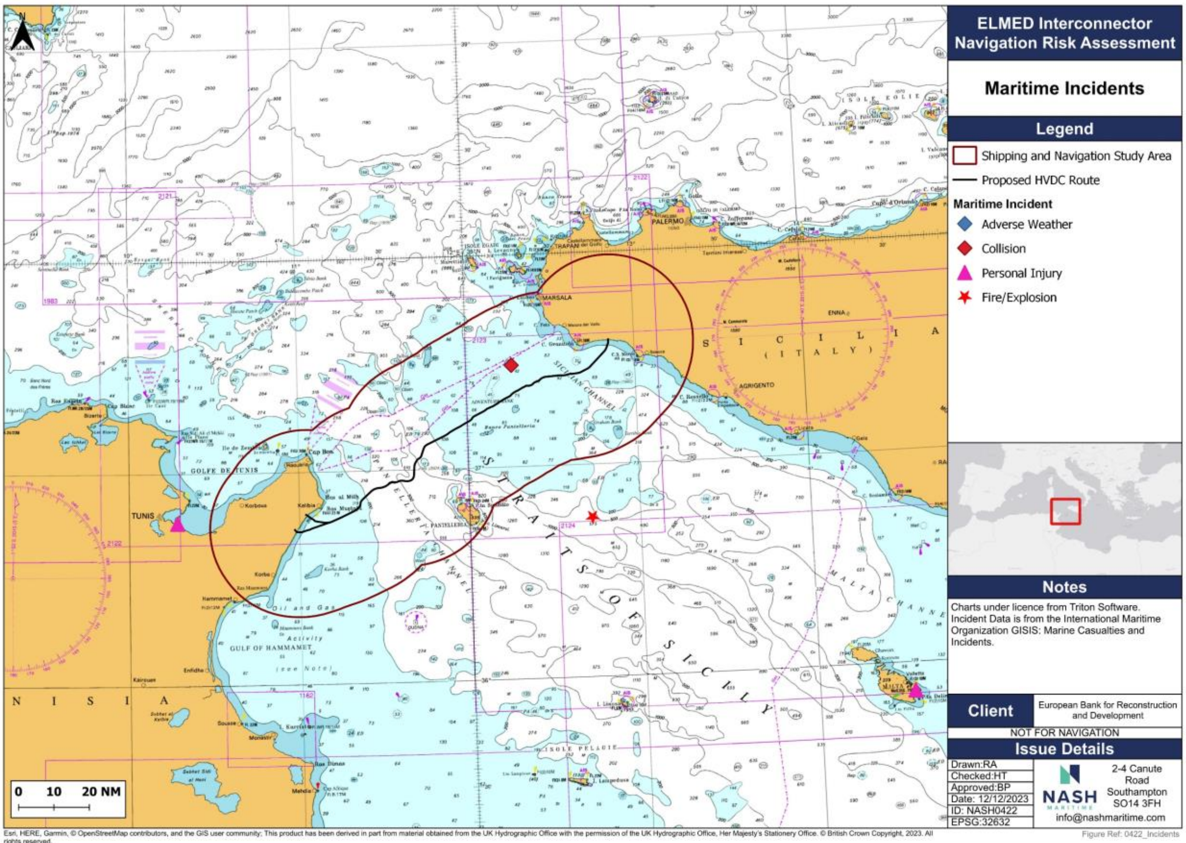

Figure 26: Maritime Incidents

6.4.2 Maritime Incidents involving Cable Laying Vessels

Collision incidents involving cable laying vessels were researched in order to inform of the likely consequences should a collision occur during installation of the ELMED interconnector.

The MAIB database held data for such incidents, which are presented in **Table 3** below. The MAIB works with the Department for Transport and investigates marine accidents involving UK vessels worldwide and all vessels in UK territorial waters.

Table 3: MAIB incidents involving cable laying vessels

Incident ID	Date	Vessels Involved	Incident Details	Outcome
16055	Apr-1995	Fishing vessel Cable laying vessel	French fishing vessel failed to keep clear of vessel engaged in cable laying.	Close quarters situation
22056	Jul-1998	Fishing vessel Cable laying vessel	Fishing vessel failed to keep out of the way of a vessel engaged in cable laying operations exhibiting signals for a vessel restricted in her ability to manoeuvre. Fishing vessel was on passage.	Collision
22106	Aug-1998	Cargo ship Cable laying vessel	Cargo vessel passed cable layer at less than 0.2 mile without taking avoiding action. Radio communications and sound signals made in an attempt to warn cargo vessel of danger. Cable layer was exhibiting signals.	Close quarters situation
32112	May-2005	Fishing vessel Cable laying vessel	A fishing vessel was operating about 75 miles north east of Fraserburgh when she was involved in a near miss situation.	Close quarters situation
40759	Sep-2010	Fishing vessel Cable laying vessel	A stationary vessel was engaged in cable laying operations and had displayed the required signals. The vessel had marked the position of the cable with a buoy and a navigational warning was in place.	Close quarters situation

Outside of the MAIB database, a collision involving a cable laying vessel took place in January 2019 within the Indonesian waters just north of Bintan. An undersea cable and pipe-laying ship, the Vanuatu-flagged MV Star Centurion, capsized in the Indonesian waters of the Singapore Straits after a collision with Hong Kong-flagged tanker Antea. The cable and pipe-laying ship was anchored in the Horsburgh OPL zone for bunkering, on the eastern edge of the Singapore Straits, and the Pertamina-owned oil product tanker was steaming past it when the incident occurred. The Star Centurion subsequently capsized and the Antea sustained damage to its hull. There were no fatalities or injuries. **Figure 27** shows the damage incurred by the two vessels involved.

Figure 27: Damage sustained by Antea and MV Star Centurian following collision

7. QUANTITATIVE MODELLING

7.1 METHODOLOGY

7.1.1 Model Scope

The model investigated the following risks during the cable laying operation:

- Collision between cable lay vessel and third-party vessels during the laying operation
- Collision between third-party vessels within the model area

Initially, the model was prepared with the same 6 months of AIS data from (March - August 2023) without including the cable lay vessel to determine the baseline collision risk between third-party vessels in the model area (that is, the present day risk of collision). Subsequently, the model was developed to include the cable route and the presence of the cable lay vessel to investigate the change in collision risk between the third-party vessels and the risk of third-party vessels contacting the cable lay vessel.

7.1.2 Model Area

The model area assumed in the study is presented in **Figure 28** below. The figure also illustrates the vessel traffic density derived from the 2023 AIS data and the proposed cable route. The cable runs from south of Kelibia in Tunisia, crosses the high density traffic in Sicilian Channel (east of North of Cape Bon TSS), and landfalls north west of Sciacca in Sicily.

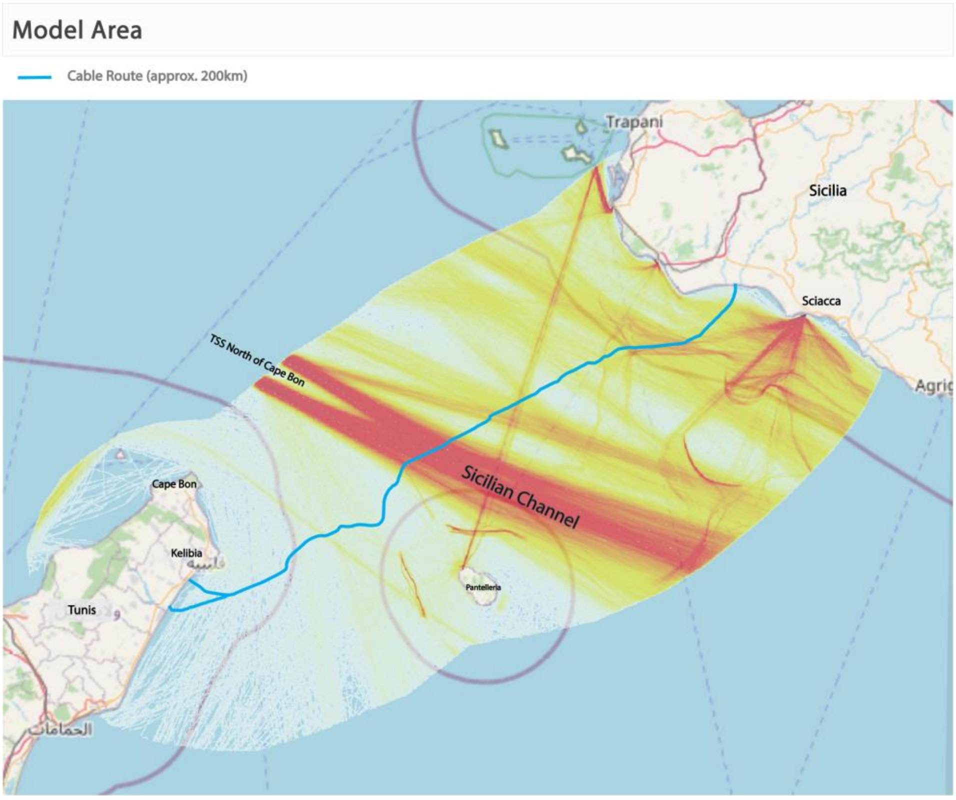

Figure 28: Collision Risk Model - Area

7.1.3 Software

The collision risk analysis was performed using the IWRAP Mk2 Version. IWRAP is a traffic analysis and collision/grounding frequency calculation tool recommended by IALA.

The vessel traffic was modelled using a number of vessel routes called legs. A leg starts and ends with a waypoint. Several legs may be connected to form a complex traffic system to depict realistic vessel movements as observed from the AIS data.

IWRAP calculations in the study included the following types of collision incidents:

- Collisions:
- Head-on
- Overtaking
- Crossing
- Merging
- Bending

The cable lay vessel was assumed to be a DP vessel and was modelled with a 1000m radius exclusion zone around the vessel. Encroachment of the 1000m radius exclusion zone by third-party traffic was registered as an encounter. The encounters could be either:

- powered encounters (third party vessel is under control, but enters the exclusion zone by mistake), or
- drifting encounters (third-party vessel not under command due to propulsion/rudder failure, consequently, drifts and enters the exclusion zone).

Both the above encounters were modelled in the study.

For drifting encounters, the influence of environmental conditions on vessel drifts was included in the IWRAP model. More details of environmental conditions are presented in **Section 5.2**.

7.1.4 Cable Lay/Trenching/Jetting Speed

Cable laying speed varies depending on vessel specifications. For example, the cable lay speed of MV Maersk Connector, as provided in its vessel specification document, was observed to be 1,200 m/hr. Another vessel, MV Ndurance, had a speed of 1,000m/hr. Though these are listed speeds, the actual cable laying speed will vary depending on operational factors such as sea state, traffic conditions in the navigable waters.

Trenching or Jetting activities will be undertaken at a much lower speed of about 100m/hr, depending on underlying seabed conditions, bathymetry slopes and geotechnical demands.

For the purpose of collision risk modelling, a conservative speed of 100m/hr was assumed. Therefore, assuming a 24/7 operation, the approximate 200km cable length will be completed in approximately 2,000 hours (about 83 days). This is comparable to time allowed in the provided project preliminary Ghantt chart which identified 90 days laying operations (45 days each for Tunisian and Italian sides). This does not include the time that may be required to join the cables, which may not be required and depends on cable lay vessel capacity. Since

the potential for joints, number of and possible locations are not specified, the analysis assumes constant laying activities. The potential for cable joints has been considered qualitatively in the risk assessment.

The results presented in this section are for the cable lay operation but can also be considered applicable to trenching/jetting operations.

7.1.5 IWRAP Model

Figure 29 (below) shows the traffic density plot and routes assumed in the model. The figure also shows the traffic volume in the major routes the proposed cable route will cross. The cable laying operations are likely to commence in 2027. Therefore, a 7% increase in traffic volume was apportioned to the present 2023 levels based on the latest International Transport Forum Transport Outlook 2023 published by the Organisation for Economic Co-operation and Development.

The most significant traffic volume was observed to be at the main channel crossing (Sicilian Channel), with about 27,100 movements per year (eastbound + westbound). A stream of traffic north of the channel, running almost parallel to the main channel, was also observed. The traffic volume in this stream of traffic was observed to be about 3,800 movements per year (mostly westbound). In general, traffic in the rest of the area, both north and south of the main channel, was relatively low in comparison to the main channel traffic. Fishing and recreational vessel activity that were observed close to the Sicilian coast, which would be crossed by the cable route, were also included in the model.

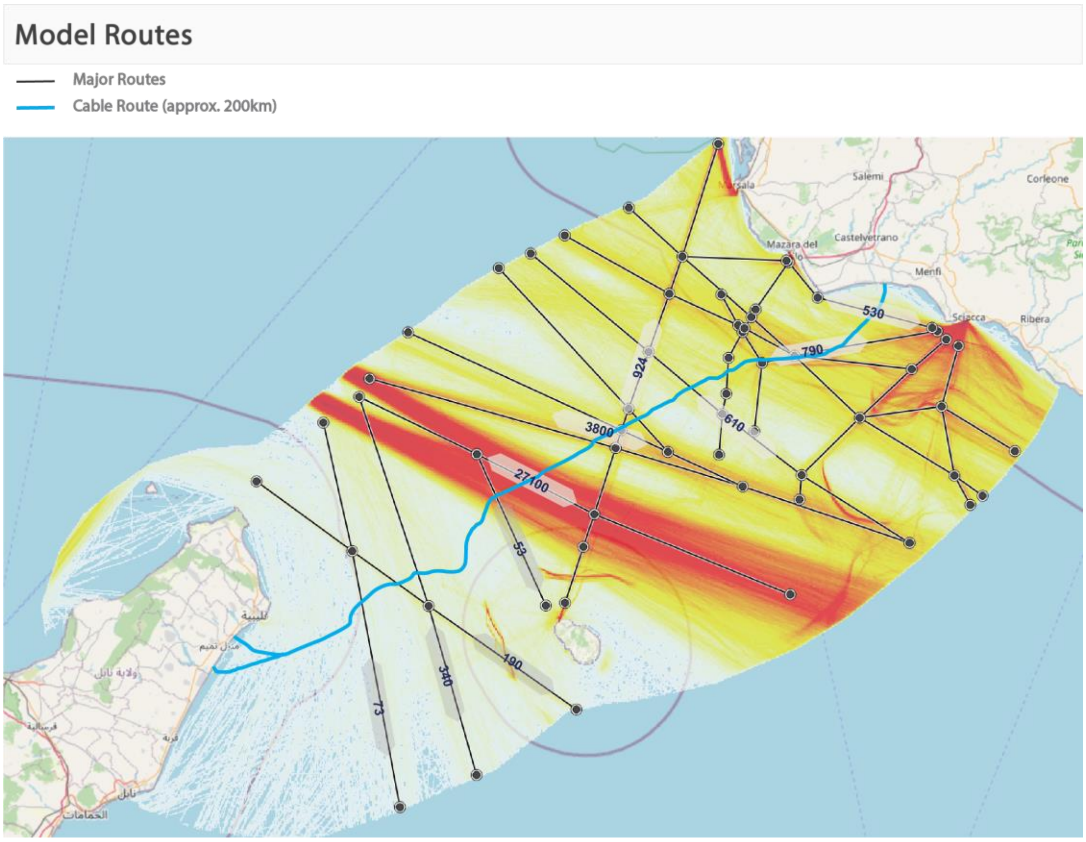

Figure 29: Collision Risk Model – Routes and movements per year

7.1.6 Analysis Cases

For the purpose of the modelling, the cable route was divided into five segments based on traffic density, as shown below in **Figure 30** and in higher resolution with segment start and end coordinates in **Appendix D**. Detailed analyses were undertaken for the cable lay vessel in each segment separately and combined to determine the cumulative collision risk along the entire cable length.

Note that the cable segments shown below, used in the collision risk modelling, are solely based on traffic density patterns and are not related to any other cable design or operations parameters, such as cable joints.

Model Cable Segments

Proposed Cable Route

Example Cable Lay Vessel Locations

Model Cable Segment Boundaries

Segment	Segment Cable Length (km)
1	75.7
2	27.9
3	39.7
4	35.6
5	16.8

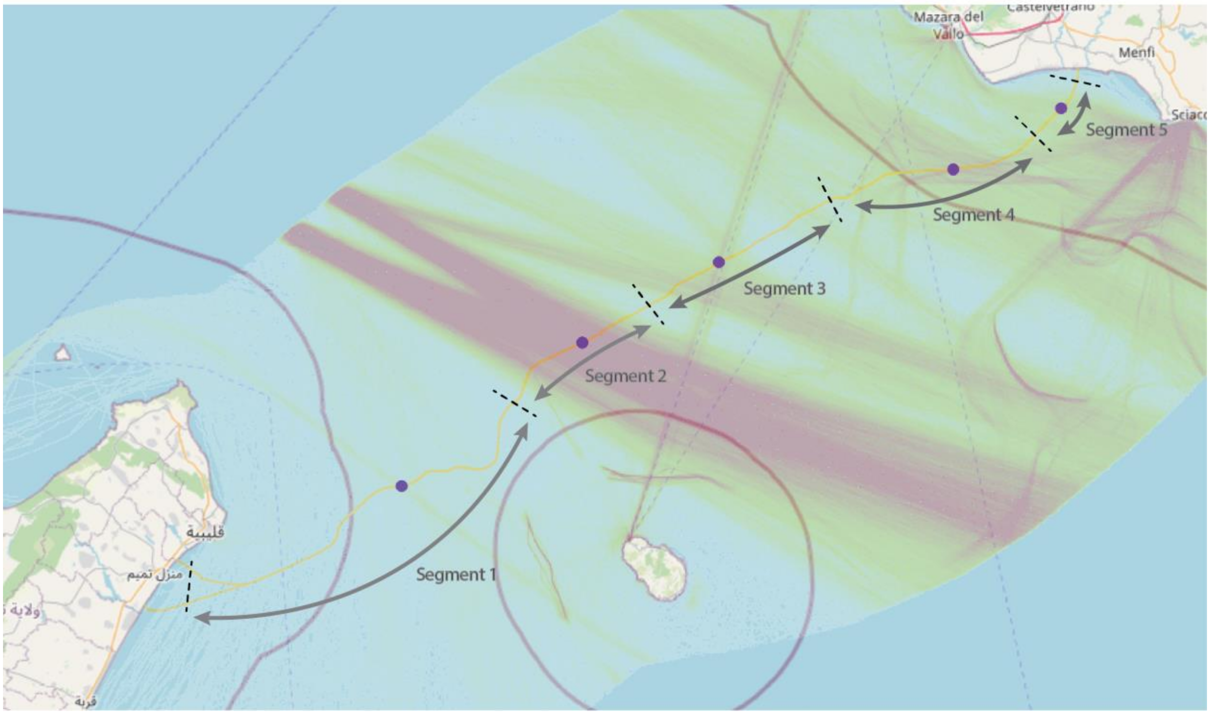

Figure 30: Collision Risk Model - Cable Segments

Based on the cable segments, the following cases were analysed:

Table 4: Cases analysed

Cases	Description	Traffic Volume	Approx. Cable Length (km)
Baseline	Traffic routes as observed from the AIS data but with 2027 traffic volume and no cable lay operation	2027	Not applicable
Case 1	Segment 1 - cable lay vessel positioned south of the main channel in Segment 1 - as shown in **Figure 30**	2027	75.7
Case 2	Segment 2 - cable lay vessel positioned in the main channel in Segment 2 - as shown in **Figure 30**	2027	27.9
Case 3	Segment 3 - cable lay vessel positioned north of the main channel in Segment 3 - as shown in **Figure 30**	2027	39.7
Case 4	Segment 4 - cable lay vessel position in the dense fishing traffic close to the Sicilian coast in Segment 4 - as shown in **Figure 30**	2027	35.6
Case 5	Segment 5 - cable lay vessel positioned in the dense pleasure traffic close to the Sicilian coast in Segment 5 - shown in **Figure 30**	2027	16.8

From the above table, the Baseline case was initially analysed to establish a reference for collision risk between third-party vessels in the model area. Subsequently, a cable lay vessel was introduced in the model at different segments to monitor the change in collision risk between third-party vessels and also between third-party vessels and the cable lay vessel, i.e., Cases 1 to 5.

7.2 COLLISION FREQUENCY RESULTS

7.2.1 General

In this section, the following results are discussed:

- Collision hotspot for Baseline - an overall view of the present traffic collision hotspot is presented to understand how the traffic behaved without cable laying operations and to identify routes/sections of routes that may pose a higher risk.
- Collision risk between third-party vessels.
- Collision risk between the cable lay vessel and third-party vessels.

7.2.2 Collision Hotspot for Baseline

Figure 31 shows the collision hotspot for the Baseline case. The Baseline case represents the present traffic routes with 2027 traffic volume (an increase of 7% compared to 2023 levels) and without cable lay operation. The following can be observed from the figure:

1. A section of the main channel east of the TSS North of Cape Bon, as indicated by [Arrow 1] in the figure below, recorded the highest collision risk compared to other routes in the model area. The main reason for the hotspot was due to the fact the westbound vessels were observed to correct course to align themselves before entering the TSS, and eastbound vessels were found to alter course to their respective destination after leaving the TSS. The higher course alteration occurring in this section, combined with higher traffic volume, resulted in the collision hotspot.
2. The stream of traffic running almost parallel to the main channel located to the north of the main channel, combined with crossing north-south traffic, was also observed to pose a collision risk hotspot to the cable lay operations [Arrow 2], albeit to a lesser extent when compared to the main channel.
3. Further to the north, closer to the Sicilian coast [Arrow 3], the presence of denser fishing vessel traffic resulted in a collision hotspot in this location. The existence of a FRA to the southeast of this location resulted in fishing vessels staying on the boundaries and contributing to higher fishing vessel traffic in the area.

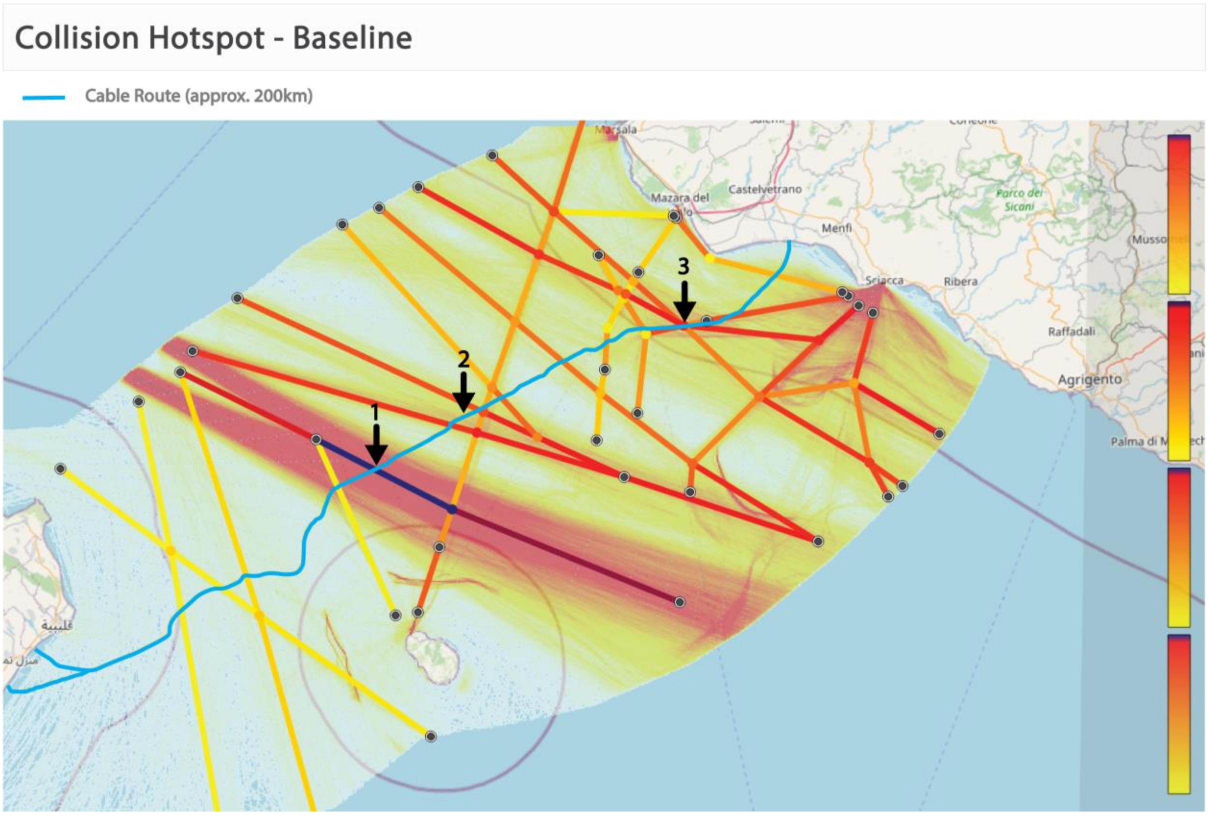

Figure 31: Collision Risk Model – Hotspot

7.2.3 Collision between Third Party Vessels

The collision risk between third-party vessels for all the analysed cases is summarised in the table below. Note that the Baseline case was modelled without the cable lay vessel, and the rest of the cases, i.e., Cases 1 to 5, were analysed with cable laying operations at various cable segments, as illustrated previously in **Figure 30.** Also, the results shown in the table below assume that the cable lay vessel was present for the entire year – whereas, in reality, the vessel will only be present for days/weeks in each of the particular segments. However, the results can be used to compare the risk of collisions involving two third-party vessels due to the presence of the cable lay vessel.

Cases	Description	Traffic Volume	Collision Risk between third party vessels	
			Annual Probability	Return Period Years
Baseline	Traffic routes as observed from the AIS data but with 2027 traffic volume and no cable lay operation	2027	0.0282	35.4
Case 1	Cable lay vessel positioned south of the main channel in **Segment 1** - as shown in **Figure 30**	2027	0.0294 (+3.7%)	34.1
Case 2	Cable lay vessel positioned in the main channel in **Segment 2** - as shown in **Figure 30**	2027	0.0320 (+12.0%)	31.3
Case 3	Cable lay vessel positioned north of the main channel in **Segment 3** - as shown in **Figure 30**	2027	0.0295 (+4.8%)	33.9
Case 4	Cable lay vessel position in the dense fishing traffic close to the Sicilian coast in **Segment 4** - as shown in **Figure 30**	2027	0.0293 (+3.5%)	34.2
Case 5	Cable lay vessel positioned in the dense pleasure traffic close to the Sicilian coast in **Segment 5** - shown in **Figure 30**	2027	0.0294 (+3.8%)	34.1

The results show minimal difference between the Baseline case and the modified configurations with the cable lay vessel, i.e., Cases 1 to 5. Introducing the Cable Lay vessel will interrupt the traffic flow in a route, which is more evident in Case 2 (Segment 2 Main Channel Traffic). However, with the embedded mitigation measure in place, as discussed in **Section 8.5**, the increase in collision risk between thirty-party vessels was observed to be minimal.

The collision risk between third-party vessels for the Baseline case was observed to be approximately 0.0282 collisions per year. The collision between third-party vessels increased marginally to about 0.029 collisions per year for Cases 1,3,4 and 5.

For Case 2, where the cable lay vessel was assumed to be located in the main channel (Segment 2), the increase was more evident but still similarly comparable to Baseline. The

collision risk between third-party vessels was observed to be 0.0320 collisions per year for Case 2.

From the analysis, it can be concluded that the addition of the cable lay vessel, in comparison to the baseline environment, is minimal, and thus, the increase in collision frequency between the third-party vessels is not considered significant.

7.2.4 Collision between Cable Lay vessel and third-party vessels

The table below shows the collision risk between the cable-lay vessel and third-party vessels with embedded mitigation measures in place as discussed in **Section 8.5**. The second column in the table shows the annual probabilities assuming the cable lay vessel is present at the locations of the full year. The third column shows the collision risk, assuming the cable lay vessels move at an average of about 100m/hr in each of the segments. The last column shows the corresponding return periods in years.

Summing the collision risk to the cable lay vessel from third-party traffic in each of the segments (cases) provides the cumulative risk for the entire length of the cable route. The cumulative collision risk to the cable lay vessel from third-party vessels was observed to be approximately 0.0042 (Return Period of 239.1 years) for the entire cable length. The risk can be considered to be mildly on the higher side; however, the application of additional mitigation measures, as presented in **Section 9.2**, will assist in alleviating the collision risk to the cable lay vessel from third-party traffic.

Cases	Collision Risk assuming Cable Lay vessel present full year	Collision Risk assuming Cable Laying at an average of 100m/hr	Corresponding Return Period in years
Baseline	Not applicable	Not applicable	Not applicable
Case 1	0.0099	0.0009	1169.4
Case 2	0.0419	0.0013	749.5
Case 3	0.0211	0.0010	1045.4
Case 4	0.0238	0.0010	1035.8
Case 5	0.0037	0.0001	14072.4
Total		**0.0042**	**239.1**

Figure 32 below shows the vessel types involved in collision encounters with the cable lay vessel. The following can be observed from the below figure:

- Top Left Bar Chart – shows the vessel types involved in Segment 1 (Case 1) of the cable route. It was observed that the majority of encounters were observed with tankers (about 60%) and also with bulk vessels (about 16%) to some extent. It should be noted that legal or illegal fishing or other vessels invisible to AIS could not be considered in the model and, therefore, not presented here. Though they may pose a risk, these small vessels tend to keep away from laying operations even during the night when the operations are floodlit.

- Middle Charts – represent vessel types encountered in the main channel (Segment 2) and stream of traffic parallel to the main channel in the north (Segment 3), respectively. Most of the encounters in these segments were observed with large commercial vessels such as ocean-going tankers and bulkers using the main channel. Encounters with smaller vessels, such as fishing and recreational, are relatively low in these segments.
- Bottom Charts – represents vessel type encounter in areas closer to the Sicilian coast in Segment 4 and Segment 5. These segments of the cable route were mainly impacted by smaller vessels, such as fishing and recreational vessels. Segment 4 had a higher portion (about 70%) of the encounters with fishing vessels, while Segment 5 had fishing (about 65%) and recreational (about 20%) encounters.

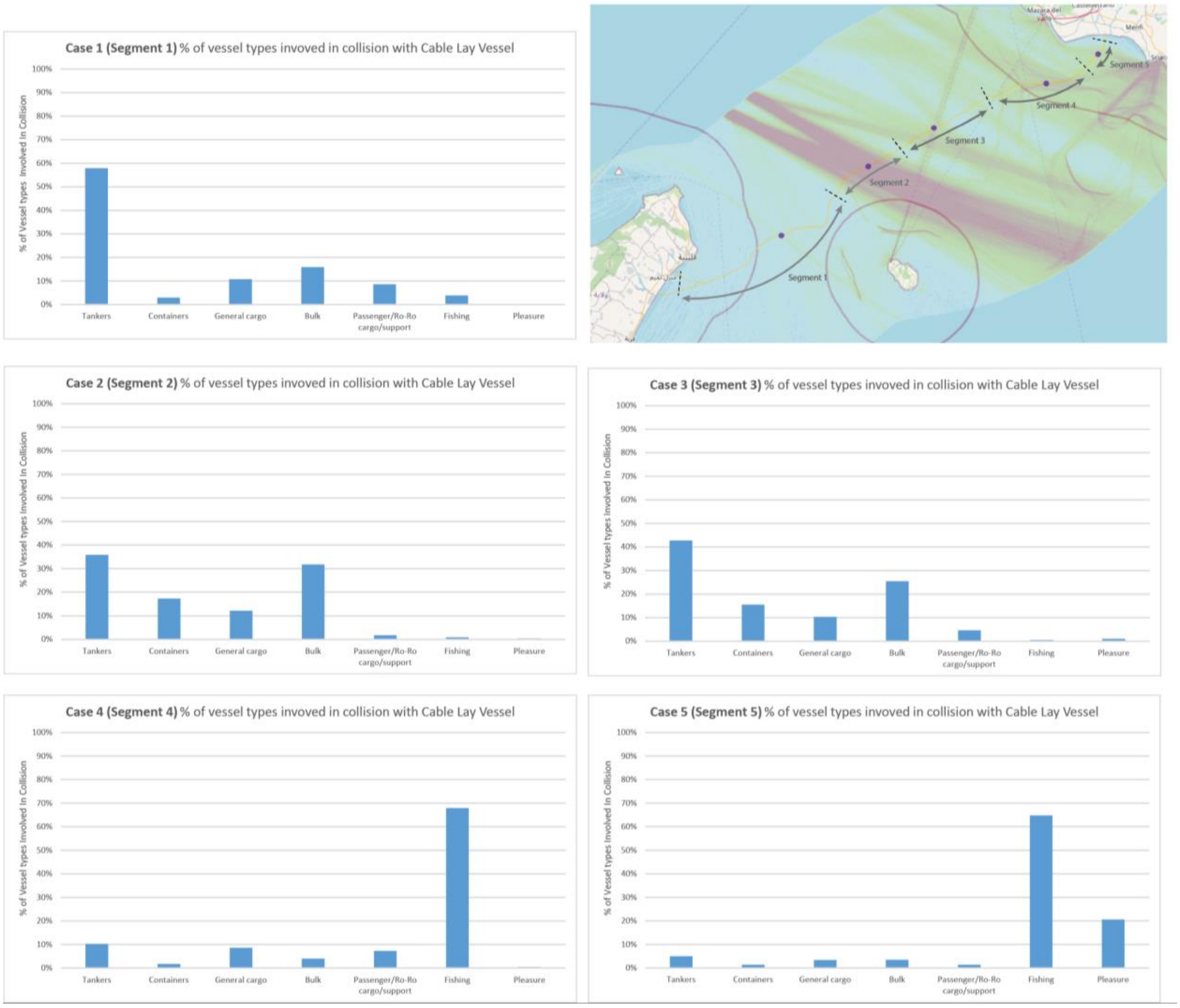

Figure 32: Collision Risk Model – Vessel Types in Collision with Cable Lay Vessel

7.3 TRANSIT VARIABILITY ASSESSMENT

From the AIS dataset, the variability in the number of vessel transits by week and on average by hour of the day was analysed, as shown in **Figure 33** and **Figure 34**, respectively. The assessment shows there is minimal variation in the number of vessel transits week by week on all of the segments. Similarly, there is little variation throughout the day (on average) for each of the segments and numbers are relatively low for all areas except Area 2 (near the TSS). This suggests that the risk analysis undertaken will not substantially vary based on traffic volume variability as shown in the AIS data.

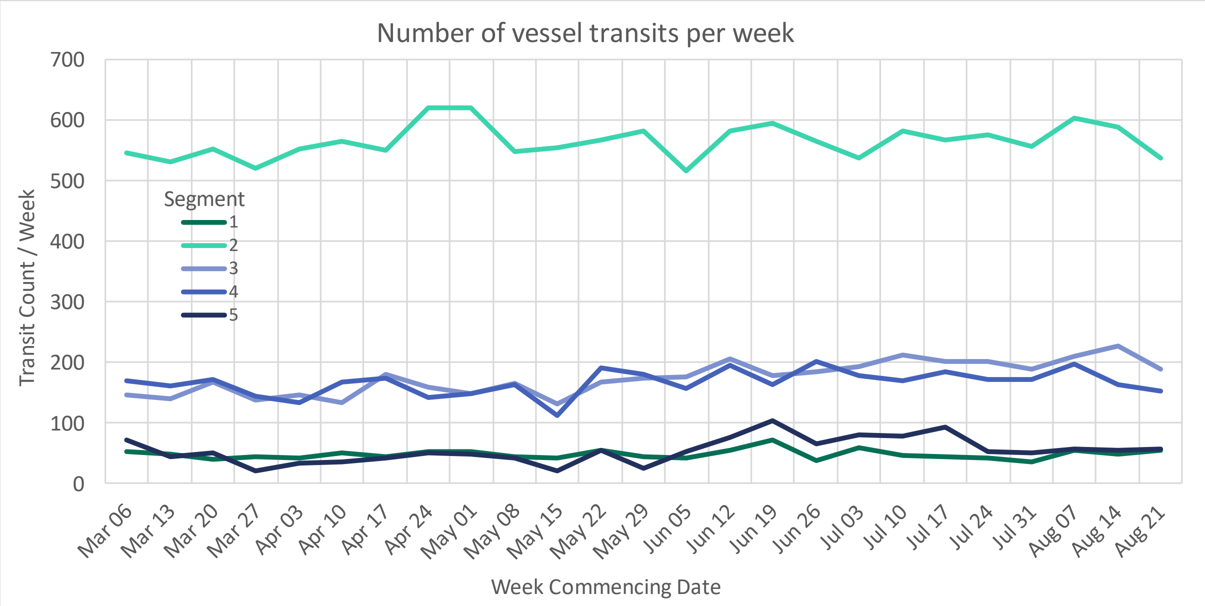

Figure 33: Number of vessel transits per week in AIS dataset

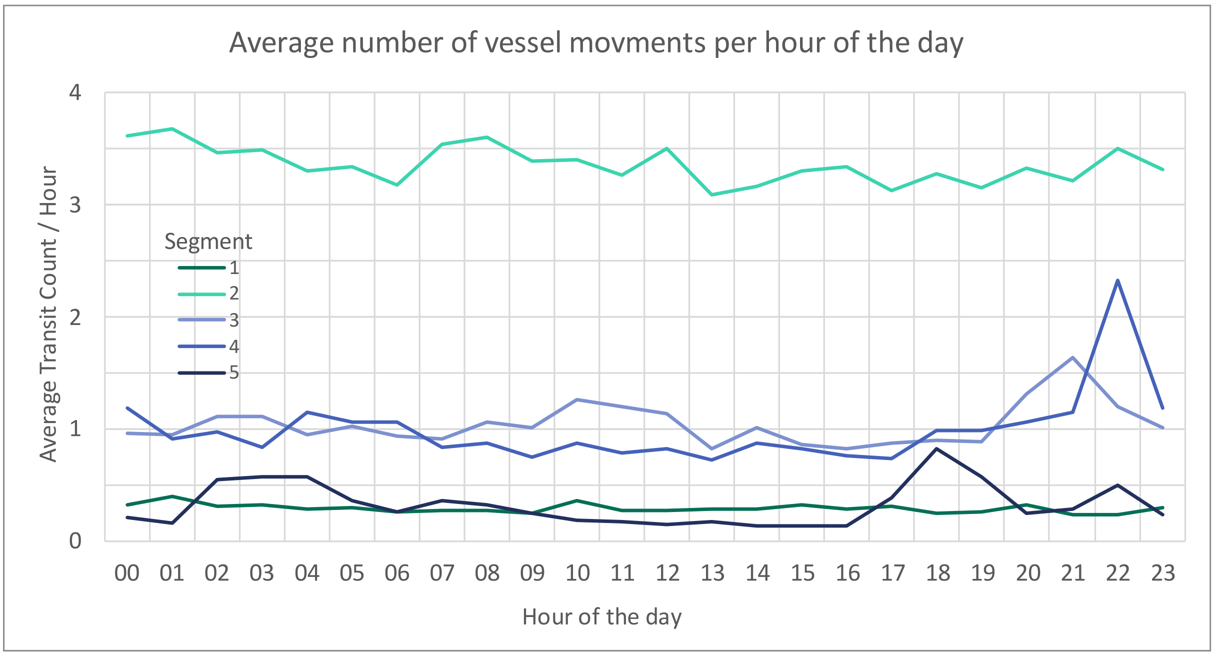

Figure 34: Average number of vessel movements per hour of the day in AIS dataset

8. NAVIGATION RISK ASSESSMENT

8.1 INTRODUCTION

The NRA follows the IMO's FSA methodology, as discussed in **Section 3.1**. The development of the NRA, hazard log and associated risk scoring process is based on the following data, analysis, modelling and expertise of the Project team:

- Data gathered form relevant Italian and Tunisian authorities (see **Section 3.4.1**);
- Project description (see Section 4);
- Overview of the marine environment (see **Section 5**); and
- Description of existing maritime activities (see **Section 6**).

The risk assessment methodology employed for the Project is the IALA SIRA process, which is endorsed by the IMO via SN.1/Circ.296 in December 2010. The following sections outline:

- The overarching methodology of the risk assessment;
- The process of hazard identification;
- Embedded risk controls (applied or designed in);
- Results of the assessment of risk with the applied mitigations in place; and
- Possible additional risk controls if required to reduce risk to acceptable levels.

The risk assessment project methodology follows the FSA and is based on the principles set out in IALA Guidelines 1018 and 1138 which are endorsed by the IMO and the IMO's FSA. Navigation hazards are identified through project team experience, supplemented where possible by consultation and data analysis, before being assessed in terms of their likelihood and consequence. A risk matrix is then utilised to identify the significance of each hazard with possible additional risk controls identified based on the resultant risk score to reduce the risks to acceptable levels.

A description of the FSA process is as follows.

- **FSA Step 1: HAZID:** The project team identifies navigation hazards related to defined and agreed assessment parameters, such as geographic areas, marine operation, or vessel type. This is achieved using a suite of quantitative (e.g. statistical vessel traffic analysis) and qualitative (e.g. consultation with stakeholders) techniques which enables an evidentially robust identification of navigation hazards.
- **FSA Step 2: Risk Analysis:** A detailed investigation of the causes, including the initiating events, and consequences of the hazards identified in Step 1 is undertaken. This is completed using a risk matrix, and enables ranking of hazards based on navigation risk, and a determination of hazard acceptability / tolerability. This process allows attention to be focused upon higher-risk hazards enabling identification and evaluation of factors which influence the level of risk.
- **FSA Step 3 and 4: Risk Controls:** The identification of existing risk controls measures (which are assumed to be included in the assessment of navigation risk), and the

identification of possible additional risk controls, not currently in place for the assessment parameters is undertaken. Possible additional risk control measures are identified based on prioritising mitigation of higher-risk hazards. During this stage risk control measures may be grouped into a defined and thought-out risk mitigation strategy.

- **FSA Step 5: Findings:** The assessment findings are developed and documented into a technical report and then presented to the relevant decision makers in an auditable and traceable manner. The findings are based upon a comparison and a ranking of all hazards; the comparison and ranking of possible additional risk control options as a function of associated costs and benefits (if required); and the identification of those options which mitigate hazards to acceptable or a level that is As Low As Reasonably Practicable (ALARP).

8.2 SCORING CRITERIA

Having identified all relevant impacts and hazards as a result of the cable-laying activities, a hazard log is constructed. Whilst there is no generally accepted standard for risk matrices, the matrix outlined in this section was proposed to EBRD and agreed as suitable for the Project as it meets IMO and IALA guidance and is consistent with industry best practice.

Each hazard is scored based on its predicted frequency of occurrence (**Table 5**) and consequence (**Table 6**) for two scenarios, the 'most likely' and 'worst credible'. Severity of consequence with each hazard under both scenarios is considered in terms of damage to:

- People – hazards may result in injuries or fatalities;
- Property – hazards may result in damage or loss of vessels or structures;
- Environment – hazards may result in environmental pollution such as oil spills; and
- Commercial and reputation – hazards may result in loss of economic output, disruption to cable laying activities and adverse media coverage.

This NRA assumes that vessels will be compliant with international conventions (e.g. COLREGS and STCW), and National regulations and Guidance. This is expected due to being requirement of registry for commercial vessels to have audited procedures and management systems in place compliant with these regulations.

Table 5: Frequency of Occurrence Criteria

Rank	Title	Description	Definition (return period, years [probability])
1	Remote	Remote probability of occurrence at project site and few examples in wider industry.	<1 occurrence per 1,000 years [<0.001]
2	Extremely unlikely	Extremely unlikely to occur at project site and has rarely occurred in wider industry.	1 per 100 – 1,000 years [0.01 – 0.001]

Rank	Title	Description	Definition (return period, years [probability])
3	Unlikely	Unlikely to occur at Project site during project construction and has occurred at other subsea cables.	1 per 10 – 100 years [0.1 – 0.01]
4	Reasonably probable	May occur once or more during project construction.	1 per 1 – 10 years [1 – 0.1]
5	Frequent	Likely to occur multiple times during project construction.	Yearly [1]

Table 6: Severity of Consequence Categories and Criteria

Rank	Description	People	Property	Environment	Commercial and Reputation (Business)
1	Negligible	Minor injury	Less than £10,000	Minor spill no assistance required.	No negative publicity. No perceptible impact on cable laying activities.
2	Minor	Multiple minor injuries	£10,000-£100,000	Tier 1 local assistance required	Local negative publicity. Short term loss of revenue to vessel operator.
3	Moderate	Multiple major injuries	£100,000-£1million	Tier 2 limited external assistance required	Widespread negative publicity. Temporary suspension of cable laying activities.
4	Serious	Fatality	£1million-£10million	Tier 2 regional assistance required	National negative publicity. Prolonged suspension of cable laying activities.
5	Major	Multiple fatalities	>£10million	Tier 3 national/international assistance required	International negative publicity. Serious disruption to cable laying operations.

8.3 RISK MATRIX

The combination of the frequency and consequence scores for each scenario are then combined to produce an overall risk score, which is used to assign hazard risk rating in the Project risk matrix (**Table 7**). The methodology utilised is consistent with other NRAs submitted for subsea cables.

The assessment of risk is calculated eight times for each identified hazard; four times for the "realistic most likely" occurrence for each consequence category and four times for the "realistic worst credible" outcome for each consequence category. An overall risk score is then calculated using an averaging function weighted to the highest risk score for the "realistic most likely" and the highest risk score for the "realistic worst credible". The weighted averaging calculation is an average of:

- average of all the "realistic most likely" risk scores;
- average of all the "realistic worst credible" risk scores;
- highest individual score from the "realistic most likely" scores; and
- highest individual score from the "realistic worst credible" scores.

The tolerability of these hazard risk scores with regards to significance and acceptability with or without further action are shown in **Table 8.**

Hazards are then defined as either Broadly Acceptable, Tolerable if ALARP or Unacceptable. Where risks are scored as Medium Risk, "Further risk control options must be considered to the point where further risk control is grossly disproportionate (i.e. the ALARP principle) and an ALARP justification and declaration made." Therefore, hazards scored as Medium Risk can only be Tolerable if ALARP is met.

Table 7: Risk Matrix

Severity of Consequences							
	Major	5	5	10	15	20	25
	Serious	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Minor	2	2	4	6	8	10
	Negligible	1	1	2	3	4	5
			1	2	3	4	5
			Remote	Extremely unlikely	Unlikely	Reasonably probable	Frequent
			Likelihood of occurrence				

Table 8: Tolerability and Risk Ratings

Hazard Score	Tolerability	Description
Negligible risk (< 4)	Broadly Acceptable	Generally regarded as not significant and adequately mitigated. Additional risk reduction should be implemented if reasonably practicable and proportionate.
Low risk (≥ 4 and < 6)		
Medium risk (≥ 6 and < 12)	Tolerable if ALARP	Generally regarded as within a zone where the risk may be tolerable in consideration of the Project. Requirement to properly assess risks, regularly review and implement risk controls to maintain risks to within ALARP where possible.
High risk (≥ 12 and < 20)	Unacceptable	Generally regarded as significant and unacceptable for the project to proceed without further risk controls.
Extreme risk (≥ 20)		

8.4 HAZARD IDENTIFICATION

An NRA should consider all identified hazards of the cable-laying activities and existing shipping and navigation within the study area. In developing the hazard log, consideration was given to different hazard types, hazard areas and vessel types.

8.4.1 Hazard types

Four hazard types were assessed, of which six were scoped out. **Table 9** presents all hazards identified, whether they were scoped in/out, and if scoped out, an explanation.

Table 9: Identified Hazards

Hazard Type	Definition	Scoped In	Explanation
Collision	Collision between two vessels underway (also includes striking of an anchored/moored vessel or DP vessel, including the cable layer).	Yes	N/A
Foundering / capsize	Vessel sinks or grounds caused by loss of stability, buoyancy or water tight integrity (e.g. may be caused by severe adverse weather or mechanical failure).	Yes	N/A
Personnel	Incident to personnel associated with navigation related activities - e.g. pilot / crew / passenger boarding, mooring a vessel, tender operations, etc.	Yes	N/A
Wake wash	Vessel wave wake wash effect from other passing vessels.	Yes	N/A
Fire/Explosion	Fire or explosion aboard a vessel.	No	Not considered as part of this risk assessment and would be part of operational planning and standard vessel operating practices.
Vessel Motions	Project puts vessels on routes which exposes them to increased risks associated with vessel motions such as cargo shift and injuries.	No	Vessel motions and cargo shift not considered due to nature of operations. Risk assessment focussed on safety risk not operational risk of downtime.
Allision	Vessel makes contact with Fixed or Floating Object (FFO) (e.g. WTGs / substation / O&G platform / Other fixed structure)	No	No objects located in way of cable route and therefore no allision risks are considered to be present within the Study Area
Grounding	Vessel makes contact with the seabed/shoreline or underwater assets.	No	Not considered realistic given nature of operations, purpose of vessel and level of understanding of sea bed along route prior to installation activities commencing. This is controlled through usual

Hazard Type	Definition	Scoped In	Explanation
			operational planning i.e. geotechnical surveys and high resolution bathymetry data.
Snagging	Vessel's subsea equipment snags an existing subsurface hazard (e.g. export cable).	No	Snagging risk to the cable layer on its own cable is not considered realistic. Cable layer snagging on other subsurface hazards not considered realistic due to level of understanding of sea bed along cable route prior to operations. Cable understood to be buried where feasible, with external protection utilised where burial is not feasible. Third-party snagging risk on cable will not directly affect the installation vessel's safety and cables assumed to be laid/buried before exposed to other vessels.

8.4.2 Vessel types

The vessel types identified are shown in **Table 10**. A total of eight vessel categories were used within the NRA.

Table 10: NRA Vessel Types

ID	Description	Definition	Vessel Type General
1	Ferry / Passenger Vessel	Passenger Ferry Cruise Ship High-speed ferry	Passenger
2	Liquid and Dry Bulk Vessels	General Cargo Dry Bulk Carrier Tanker (Oil, Chemical, Gas etc.)	Large Commercial
3	Container	Container vessels	
4	Tug / Service Vessels	Tugs Offshore Supply Vessels Standby Rescue Vessels Pilot Boats Wind Farm CTVs Other Service Vessels (Excludes Project vessels)	Small Commercial
5	Fishing	Trawlers Fishing Boats	Fishing
6	Recreational	Sailing Yachts Pleasure Boats	Recreational
7	Cable-Lay Vessel	Cable-Lay Vessel	Project Vessel
8	Supply / Support Vessel	Supply Vessel Support Vessel CTVs Re-supply tug and barge	Project Support Vessels

8.4.3 Hazard areas

Five areas were identified to assist with the assessment of the identified hazards. These correspond to the five segments identified and used within the quantitative modelling (see **Section 7**, and in particular **Figure 30**).

Based on the hazard areas, hazard types and vessel types, a total of 25 hazards were identified, as shown in **Table 11**.

Table 11: Hazards Identified

ID	Area	Hazard Type	Hazard Title
1	1 and 5	Collision	Collision - Passenger vessel ICW Cable-Lay Vessel

ID	Area	Hazard Type	Hazard Title
2	1 and 5	Collision	Collision - Large Commercial vessel ICW Cable-Lay Vessel
3	1 and 5	Collision	Collision - Small Commercial vessel ICW Cable-Lay Vessel
4	1 and 5	Collision	Collision - Fishing vessel ICW Cable-Lay Vessel
5	1 and 5	Collision	Collision - Recreational vessel ICW Cable-Lay Vessel
6	2	Collision	Collision - Passenger vessel ICW Cable-Lay Vessel
7	2	Collision	Collision - Large Commercial vessel ICW Cable-Lay Vessel
8	2	Collision	Collision - Small Commercial vessel ICW Cable-Lay Vessel
9	2	Collision	Collision - Fishing vessel ICW Cable-Lay Vessel
10	2	Collision	Collision - Recreational vessel ICW Cable-Lay Vessel
11	3	Collision	Collision - Passenger vessel ICW Cable-Lay Vessel
12	3	Collision	Collision - Large Commercial vessel ICW Cable-Lay Vessel
13	3	Collision	Collision - Small Commercial vessel ICW Cable-Lay Vessel
14	3	Collision	Collision - Fishing vessel ICW Cable-Lay Vessel
15	3	Collision	Collision - Recreational vessel ICW Cable-Lay Vessel
16	4	Collision	Collision - Passenger vessel ICW Cable-Lay Vessel
17	4	Collision	Collision - Large Commercial vessel ICW Cable-Lay Vessel
18	4	Collision	Collision - Small Commercial vessel ICW Cable-Lay Vessel
19	4	Collision	Collision - Fishing vessel ICW Cable-Lay Vessel
20	4	Collision	Collision - Recreational vessel ICW Cable-Lay Vessel
21	All	Collision	Collision - Project Support Vessel ICW Cable-Lay Vessel
22	All	Collision	Collision - Third-Party Vessel ICW Third-Party Vessel
23	All	Wake wash	Wake wash - Cable-Lay Vessel
24	All	Foundering / Capsize	Foundering / Capsize - Cable-Lay Vessel
25	All	Personnel	Personnel - Cable-Lay Vessel and Project Support Vessel

8.5 EMBEDDED RISK CONTROLS

Embedded risk controls are those that are assumed in place for undertaking the operation and are therefore considered to be applied in when assessing risk. The embedded mitigations for the duration of the cable laying operations are listed within **Table 12**.

Risk Control (RC) 1: International Conventions, are requirements by the flag state for commercial vessel registry and compliance is assessed through regular survey inspections. It is assumed that all commercial vessels required for the cable laying activities will have in place appropriate and valid certification, vessel condition, safety systems and work practices in line with international maritime conventions.

Table 12: Embedded Risk Controls

RC ID	Title	Justification / Detail
1	International Conventions (as applicable at time of works)	COLREGs, as amended
		International Conventions for SOLAS, as amended (note: Chapter XV Industrial Persons Code is expected to be in place at time of installation)
		Exhibit day and night signals in line with COLREGS, communicating that the cable-laying vessel is restricted in ability to manoeuvre (RAM)
2	External Broadcasting and Awareness	Correct broadcasting of vessel status via AIS, to reflect the vessel is restricted in manoeuvrability;
		Use of navigational warnings (NAVTEX[5] and NAVAREA II[6])
		Notice to Mariners to circulate information about the ongoing works.
		VHF communication channel with dedicated VHF Channel 16 (distress, calling and safety channel).
		Operational floodlighting
3	Guard Vessel	Presence of a guard vessel to keep watch and notify third-party vessels of the installation works for the entire length of the cable route.
4	Installation Contractor Standard Operating Procedures	Vessel-specific safety management plans and manuals.
		Regular advanced weather forecasts
		Pre-deployment Hazard Identification and Risk Assessment
		Operational ISM and HSE system compliance and onboard operational safety management systems
		Compliance with the "Installation Manual" document as required by Project Contracting requirements.(reviewed and approved prior to activities at sea)
5	Minimum CPA	Installation vessel to request a minimum closest point of approach (CPA) distance of at least 1000m[7] due to the cable-layer being restricted in manoeuvrability and vulnerable to passing vessel wake wash.
6	External Stakeholder Liaison	Early and ongoing liaison with all local ports/harbours/marinas in Italy and Tunisia
7	Project Vessel Minimum Requirements for Contractors	The vessels proposed by the Contractor shall be suitable and adequately equipped to perform the activities required, including: • being equipped with AIS and AIS detection system; • dynamic stationing controlled by satellite system; • adequate personnel for execution of 24/7 work; • equipment, instrumentation and spare parts to ensure reliability of the vessel and • satellite and radio communication facilities to enable contact with land and other vessels.

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[5] NAVTEX is an international automated medium frequency direct-printing service for delivery of navigational warnings and forecasts, as well as urgent maritime safety information to ships.

[6] NAVAREA warnings contain information specific to ocean-going mariners. They're broadcast over satellite and remain in force until cancelled or transmitted by other means. An example of a NAVAREA warning is shown in Appendix C.

[7] 1000m has been assumed as the anticipated minimum CPA distance to cable laying operations. The cable laying contractor may have greater preferred or required distances.

8.6 NAVIGATION RISK ASSESSMENT RESULTS

The results of the NRA, based on the approach described above shows that in total:

- No hazards were assessed as High Risk – Unacceptable;
- Two hazards were assessed as Medium Risk – Tolerable (if ALARP);
- Six hazards were assessed as Low Risk – Broadly Acceptable; and
- 17 hazards were assessed as Negligible Risk – Broadly Acceptable.

The full hazard log is available in **Appendix A**. **Table 13** describes the top 10 hazards identified in the NRA.

Table 13: Top 10 Hazards across All Identified Risks

ID	Rank	Area	Hazard title	Score	Rating
22	1	All	Collision - Third-Party Vessel ICW Third-Party Vessel	6.4	Medium Risk - Tolerable (if ALARP)
21	2	All	Collision - Project Support Vessel ICW Cable-Lay Vessel	6.4	Medium Risk - Tolerable (if ALARP)
6	3	2	Collision - Passenger vessel ICW Cable-Lay Vessel	5.5	Low Risk - Broadly Acceptable
11	3	3	Collision - Passenger vessel ICW Cable-Lay Vessel	5.5	Low Risk - Broadly Acceptable
16	3	4	Collision - Passenger vessel ICW Cable-Lay Vessel	5.5	Low Risk - Broadly Acceptable
7	6	2	Collision - Large Commercial vessel ICW Cable-Lay Vessel	5.3	Low Risk - Broadly Acceptable
12	6	3	Collision - Large Commercial vessel ICW Cable-Lay Vessel	5.3	Low Risk - Broadly Acceptable
17	6	4	Collision - Large Commercial vessel ICW Cable-Lay Vessel	5.3	Low Risk - Broadly Acceptable
1	9	1 and 5	Collision - Passenger vessel ICW Cable-Lay Vessel	4.0	Negligible Risk - Broadly Acceptable
23	9	All	Wake wash - Cable-Lay Vessel	4.0	Negligible Risk - Broadly Acceptable

8.6.1 Collision

Table 14 presents the 22 collision hazards identified and their associated hazards scores and ratings.

Table 14: Collision Hazards, Scores and Ratings

ID	Rank	Area	Hazard title	Score	Rating
22	1	All	Collision - Third-Party Vessel ICW Third-Party Vessel	6.4	Medium Risk - Tolerable (if ALARP)
21	2	All	Collision - Project Support Vessel ICW Cable-Lay Vessel	6.4	Medium Risk - Tolerable (if ALARP)
6	3	2	Collision - Passenger vessel ICW Cable-Lay Vessel	5.5	Low Risk - Broadly Acceptable
11	3	3	Collision - Passenger vessel ICW Cable-Lay Vessel	5.5	Low Risk - Broadly Acceptable
16	3	4	Collision - Passenger vessel ICW Cable-Lay Vessel	5.5	Low Risk - Broadly Acceptable
7	6	2	Collision - Large Commercial vessel ICW Cable-Lay Vessel	5.3	Low Risk - Broadly Acceptable
12	6	3	Collision - Large Commercial vessel ICW Cable-Lay Vessel	5.3	Low Risk - Broadly Acceptable
17	6	4	Collision - Large Commercial vessel ICW Cable-Lay Vessel	5.3	Low Risk - Broadly Acceptable
1	9	1 and 5	Collision - Passenger vessel ICW Cable-Lay Vessel	4.0	Negligible Risk - Broadly Acceptable
2	11	1 and 5	Collision - Large Commercial vessel ICW Cable-Lay Vessel	3.9	Negligible Risk - Broadly Acceptable
3	12	1 and 5	Collision - Small Commercial vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
4	12	1 and 5	Collision - Fishing vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
5	12	1 and 5	Collision - Recreational vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
8	12	2	Collision - Small Commercial vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
13	12	3	Collision - Small Commercial vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
18	12	4	Collision - Small Commercial vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
19	12	4	Collision - Fishing vessel ICW Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable
9	21	2	Collision - Fishing vessel ICW Cable-Lay Vessel	2.8	Negligible Risk - Broadly Acceptable
10	21	2	Collision - Recreational vessel ICW Cable-Lay Vessel	2.8	Negligible Risk - Broadly Acceptable
14	21	3	Collision - Fishing vessel ICW Cable-Lay Vessel	2.8	Negligible Risk - Broadly Acceptable
15	21	3	Collision - Recreational vessel ICW Cable-Lay Vessel	2.8	Negligible Risk - Broadly Acceptable

ID	Rank	Area	Hazard title	Score	Rating
20	21	4	Collision - Recreational vessel ICW Cable-Lay Vessel	2.8	Negligible Risk - Broadly Acceptable

Two collision hazards had an output risk ranking of Medium Risk – Tolerable if ALARP, whilst the other 20 had an output of either Negligible Risk – Broadly Acceptable or Low Risk – Broadly Acceptable. The two Medim Risk hazards related to the scenario of a collision between two third party vessels and a collision between a project support vessel and cable laying vessel.

A collision between two third party vessels in the realistic most likely scenario has potential to result in multiple minor injuries, £10,000 - £100,000 of property damage, no pollution, short term loss of revenue to the vessel operator and no negative publicity. **Section 7.2.3** presents the outputs for the calculated frequency of a collision occurring between two third party vessels. For all areas, the return period was between 31 and 35 years. In terms of the scoring criteria, this equivalates to a frequency ranking of Unlikely (i.e. 1 in 10-100 years). In the realistic worst credible scenario, such an incident could result in a single fatality, £1 million to £10 million property damage, a Tier 1 pollution event and widespread negative publicity.

Collision between a project support vessel and a cable laying vessel in the realistic most likely scenario has could result in minor injuries, £10,000 to £100,000 property damage, no pollution, short term loss of revenue to the vessel operator and no negative publicity. Given that the precise number of vessels involved in the installation activities is not known, a conservative frequency ranking of Unlikely was assigned. In the realistic worst credible scenario, such an incident could result in a single fatality, £1 million to £10 million property damage, a Tier 2 pollution event requiring limited assistance and widespread negative publicity.

Three collision hazards involving passenger vessels were ranked as the third highest ranking collision hazards, namely for areas 2, 3 and 4. This is due to the heightened passenger vessel activity in these areas, as well as the fact that collisions involving passenger vessels have a heightened potential for fatalities given the number of persons on board.

The 12 lowest ranked collision hazards related to small vessels (i.e. small commercial vessels, fishing vessels or recreational vessels) in collision with a cable laying vessel. The low scores are mainly driven by the lesser consequences of small vessels making contact with the cable layer, with less potential for business impact.

8.6.2 Foundering/Capsize

Table 15 presents the foundering/capsize hazard identified and the associated hazards score and rating.

Table 15: Foundering/Capsize Hazards, Scores and Ratings

ID	Rank	Area	Hazard title	Score	Rating
24	19	All	Foundering / Capsize - Cable-Lay Vessel	3.8	Negligible Risk - Broadly Acceptable

The rating for the foundering/capsize of a cable lay vessel was Negligible Risk – Broadly Acceptable. The foundering/capsize of a cable lay vessel in the realistic most credible scenario may result in multiple major injuries, £100,000 - £1 million property damage, Tier 1 pollution, temporary suspension of cable laying activities and widespread negative publicity. The frequency of such an event occurring was ranked as Remote (i.e. once every 1000+ years). In the credible worst case scenario, the foundering/capsize of a cable lay vessel could result in multiple fatalities, £1 million to £10 million property damage, Tier 2 pollution requiring regional assistance, prolonged suspension of cable laying activities and national negative publicity.

8.6.3 Personnel

Table 16 presents the personnel hazard identified and the associated hazards score and rating.

Table 16: Personnel Hazards, Scores and Ratings

ID	Rank	Area	Hazard title	Score	Rating
25	20	All	Personnel - Cable-Lay Vessel and Project Support Vessel	3.1	Negligible Risk - Broadly Acceptable

The rating for the risk to personnel on board a cable lay vessel due to shipping and navigation was Negligible Risk – Broadly Acceptable. The hazards to personnel on board a cable lay vessel in the realistic most credible scenario may result in minor injuries, less than £10,000 property damage, no pollution and no perceptible impact on cable laying activities. The frequency of such an event occurring was ranked as Unlikely. In the credible worst case scenario, the hazards to personnel on board a cable lay vessel could result in a single fatality, less than £10,000 property damage, minor pollution, temporary suspension of cable laying operations and widespread negative publicity. Risk to personnel does not consider general occupational health and safety on board the vessel, but does include aspects related to the cable laying activates, such as when carrying out activities on board the vessel or during crew transfer operations, which could take place up to every 2 weeks.

8.6.4 Wake Wash

Table 17 presents the wake wash hazard identified and the associated hazards score and rating.

Table 17: Wake Wash Hazards, Scores and Ratings

ID	Rank	Area	Hazard title	Score	Rating
23	9	All	Wake wash - Cable-Lay Vessel	4.0	Negligible Risk - Broadly Acceptable

The hazard rating output for a cable lay vessel experiencing wake as effects was Negligible Risk – Broadly Acceptable. A cable lay vessel experiencing effects of wake wash in the realistic most credible scenario may result in multiple minor injuries, less than £10,000

property damage, no pollution and no perceptible impact on cable laying activities. Although the embedded mitigation measures include a minimum CPA of 1000m for third party vessels in proximity to the cable works, a conservative frequency rating of Unlikely was assigned for the wake wash hazard. In the realistic worst credible scenario, wake wash effects could result in a single fatality, £10,000 to £100,000 property damage, minor pollution with no assistance required, short term loss of revenue to the vessel operator and local negative publicity.

8.7 ADDITIONAL RISK CONTROLS

The study did not determine that any additional risk controls are required for the proposed cable laying activities; however, further additional risk controls were identified to enhance the safety and further reduce risk. these are shown in **Table 18**.

Table 18: Additional Risk Controls

RC ID	Title	Justification/Detail
1	Promulgation of planned cable route	Information promulgated to vessels in advance via weekly Temporary and Preliminary Notices or other navigational warnings. Once installed, cable would, eventually, be permanently charted by means of a chart correction.
2	Hourly VHF broadcasts	Hourly broadcast on VHF Channel 16 giving position, nature of works and action required of other vessels (including minimum passing distance and/or speed reduction).
3	Route planning to cable junctions in low traffic areas	Minimise time spent stationary in higher-risk / high volume traffic areas.
4	Installation planning to avoid particular higher risk areas at peak fishing seasons (where possible)	Cable lay planning to lay cable in key fishing areas during low fishing seasons (to extent possible with consideration for weather windows and delays).

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

Navigational risk assessment following the IMO's FSA methodology for the cable-laying activities was undertaken. The assessment considered all identified impacts of the cable-laying activities and existing shipping and navigation within the study area. The study included detailed quantitative and qualitative assessments using IALA-recommended tools – SIRA and IWRAP.

9.1.1 Baseline Environment

Key navigational features were identified in proximity to the ELMED cable route which may have an impact on the cable laying activities. It was noted that there would be a total of 26 cable crossings based on the navigational charts.

A review of the current vessel traffic in proximity to the cable route was undertaken using six months of recent AIS data (March 2023 – August 2023). Within the study area, 19 unique commercial routes were identified, used by cargo vessels, tankers and passenger vessels. Heightened fising and recreational activity was observed in proximity to the coast at Sicily.

An analysis of vessel numbers for each vessel type crossing the cable route was undertaken. A spike in cargo vessels and tankers crossing the cable route was observed approximately half way along the cable route (near the 100km point) due to the segment of cable crossing the traffic into and out of the TSS. The junction of various traffic routes crossing the cable can be observed around the 125km point with cargo, tanker and passenger vessel crossing in a similar location. Heightened fishing activity was recorded within Italian waters, particularly along the final 50km of the cable route.

9.1.2 Collision Modelling

For the purpose of the modelling, the cable route was divided into five segments based on traffic density and a detailed assessment was undertaken for each segment.

The collision hotspots for the Baseline case (i.e., Present 2023 traffic routes without the Cable Lay vessel and with increased traffic volume on each route to reflect the laying period of 2027) showed that the proposed cable route crosses three main collision hotspots. The hotspots for the Baseline case helped identify the geographic locations that posed a higher collision risk for the Cable Lay activities when compared to other areas in the model.

Collision frequencies between third-party vessels were assessed for all the analysed cases. The results show minimal difference between the Baseline case (No Cable Lay) and the modified configurations with the Cable Lay vessel, i.e., Cases 1 to 5. Introducing the cable lay vessel will interrupt the traffic flow in a route, which is more evident in Case 2 (Segment 2 Main Channel Traffic). However, with the embedded mitigation measure in place, as discussed in **Section 8.5**, the increase in collision risk between thirty-party vessels was observed to be minimal.

The collision risk per segment ranged between 0.0001 in Segment 5 on the Italian coastline (return period of 14,072 years) and 0.0013 in segment 2 in the entrance/exit of the North of

Cap Bon TSS (return period of 749 years). Summing the collision risk to the cable lay vessel from third-party traffic in each of the segments provides the cumulative risk for the entire length of the cable route. The cumulative collision risk to the cable lay vessel from third-party vessels was observed to be approximately 0.0042 (Return Period of 239.1 years) for the entire cable length. The risk can be considered to be mildly on the higher side; however, the application of additional mitigation measures, as recommended later in **Section 9.2**, will alleviate the risk to the cable lay vessel from third-party traffic.

The results presented in this study are for the cable laying activities but can also be considered applicable to jetting, trenching, and rock dumping operations, as well as post-construction survey operations.

9.1.3 NRA

A risk workshop was undertaken to identify all relevant navigational impacts and hazards as a result of the cable-laying activities. The hazards were scored based on the frequency of occurrence and consequences for People, Property, environment and Commercial and reputation.

The summary findings of the NRA are as follows:

- No hazards were assessed as High Risk – Unacceptable;
- 2 hazards were assessed as Medium Risk – Tolerable (if ALARP);
- 6 hazards were assessed as Low Risk – Broadly Acceptable; and
- 17 hazards were assessed as Negligible Risk – Broadly Acceptable.

9.1.4 Other Study Findings

- No responses were received from Tunisian or Italian navy to the questionnaire, but a review of navigational charts and sailing directions did not identify any military practice areas that may affect the timing and movement of the marine cable laying activities.
- No response was received from Tunisian or Italian Coast guard to the questionnaire regarding marine traffic accidents, incidents and near-misses and rescue operations, involving the ships with no AIS on board. Incident data was reviewed using MAIB and GISIS databases, which found that a collision took place in 2017 between a tanker and another vessel in the Strait of Sicily. A case study was also reviewed, detailing a serious collision between a tanker and a cable laying vessel in the Singapore Straits which resulted in damage to both vessels. This indicates that collisions can and have previously occurred and that consequences can be severe.
- Feedback was received from the Tunisian Fisheries which indicated that the December to May months would minimise disruptions to Tunisian fishing activities. Cable laying works are planned to be carried out between July and October, outside of the period preferred by the Tunisian Fisheries. Both fishing activities and cable laying activities are best carried out during periods of good weather. No feedback was received from Italian fisheries; however, AIS data also indicates that the area adjacent to the FRAs is highly utilised fishing space and could be considered higher risk.

- AIS data has been used to determine the relative density of recreational vessels which is primarily close to the coast and their routes may require deviation to remain outside the CPA distance. No information was obtained on scientific vessels through to 2027 and beyond and it is unclear what scientific research vessels may be required in the area during the months of cable laying activities.
- A review of the Office de la Marine Marchande et des Portes (the OMMP) website and AIS data did not indicate any traffic restrictions other than requirements under COLREGS and minor ferry route deviations. Although the waters have high volumes of traffic and various routes, passage course changes and crossing routes, the area remains as open sea navigation.
- There is limited information available on illegal fishing; however, the application of expected navigational highlight, marking and operational floodlighting is anticipated to be visually apparent for all vessels, partially for fishing vessels operating illegally as they would actively avoid being caught or seen in situation. Therefore, the risk is anticipated to be relatively low for illegal fishing.

9.1.5 Key embedded risk controls

The study assumes that all embedded risk controls are in place. If these embedded risk controls are not actually adopted or stronger controls are adopted in their place, then the risk may increase or decrease accordingly. For example, the study assumes that the 1000m CPA distance has been applied. If the cable laying contractor were to adopt a larger CPA distance then this would only serve to assist reducing risk.

Various embedded risk controls were identified (and assumed); however, of these, the key embedded risk controls identified include:

- Guard vessel;
- External broadcasting and awareness via NAVTEX / NAVAREA II, Notice to Mariners and operational floodlighting; and
- Minimum CPA distance.

9.2 RECOMMENDATIONS

Embedded risk controls are assumed to be in place; however, if embedded risk controls are not currently adopted for the operations, then we recommend that these are either adopted as part of the safety requirements of the project, or that a specific risk review is undertaken by the Project to confirm the omission of any of these controls is acceptable. This may be acceptable in some segments with reduced traffic or certain traffic types. With regard to confirming embedded risk controls it is recommended that:

- The selected contractor confirms adherence to the relevant international conventions, local regulations.
- An independent vessel survey inspection is considered prior to operations to confirm suitability of all key ships required for cable laying activities, including but not limited

to, verification of valid ship certification, vessel suitability and compliance with international conventions.

In addition to the embedded mitigation measures, the following additional mitigation measures were identified and would be recommended to enhance the preparation, awareness and safety of the cable laying operations:

- **Promulgation of planned cable route** - Information promulgated to vessels in advance via weekly Temporary and Preliminary Notices or other navigational warnings. Once installed, cable would, eventually, be permanently charted by means of a chart correction.
- **Hourly VHF broadcasts** - Hourly broadcast on VHF Channel 16 giving position, nature of works and action required of other vessels (including minimum passing distance and/or speed reduction).
- **Route planning to cable junctions in low-traffic areas** – Minimise time spent stationary in higher-risk / high-volume traffic areas. The number of cable joints and time required to undertake cable joining is not yet determined. This recommendation is to avoid undertaking cable joints within high traffic areas to reduce the number of passing vessels and reduce the potential for collisions with the cable lay vessel or disruption to joining activities; and reduce the number of vessels deviating around the cable lay vessels and thereby reducing the potential for third-party collisions. Examples of these locations are in Segment 2 (near the TSS), Segment 3 (near the intersection of various traffic routes) and Segment 4 (near the areas of high fishing activity).
- **Installation planning to avoid higher risk areas at peak fishing seasons** (where possible) - Cable lay planning to lay cable in key fishing areas during low fishing seasons (to the extent possible with consideration for weather windows and delays). This may not be practically possible, but would assist in reducing risk from collision, whilst also minimising impact of potential disruption to the respective cable laying and fishing activities.

Furthermore, the stakeholder feedback was only received from one party from the six parties approached. This included Italian and Tunisian Navy and Coastguard services. It is therefore recommended:

- The Project follow up with engagement with the remaining stakeholders to ensure awareness of the project, gather any further information on possible restrictions or limitations, and determine any obligations for ongoing engagement or notification during the cable playing preparatory and installation works.

Appendix A
Hazard Log

ID	Individual Haz. Rank	Project Phase	Area	Hazard Type	Vessel Type	Hazard Title	Baseline Risk Ranking														Additional Risk Controls	Residual Risk Ranking													
							Realisitic Most Likely Scenario	Realistic Most Likely Scores					Realisitic Worst Credible Scenario	Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating		Realisitic Most Likely Scenario	Realistic Most Likely Scores					Realisitic Worst Credible Scenario	Realistic Worst Credible Scores					Baseline Risk Score	Residual Risk Rating
								People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency					People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency		
1	9	C	1 and 5	Collision	Passenger vessel ICW Cable-Lay Vessel	Collision - Passenger vessel ICW Cable-Lay Vessel	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	1	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	4.0	Negligible Risk - Broadly Acceptable	N/A	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	1	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	4.0	Negligible Risk - Broadly Acceptable
2	11	C	1 and 5	Collision	Large Commercial vessel ICW Cable-Lay Vessel	Collision - Large Commercial vessel ICW Cable-Lay Vessel	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	1	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	3.9	Negligible Risk - Broadly Acceptable	N/A	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	1	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	3.9	Negligible Risk - Broadly Acceptable
3	12	C	1 and 5	Collision	Small Commercial vessel ICW Cable-Lay Vessel	Collision - Small Commercial vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
4	12	C	1 and 5	Collision	Fishing vessel ICW Cable-Lay Vessel	Collision - Fishing vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
5	12	C	1 and 5	Collision	Recreational vessel ICW Cable-Lay Vessel	Collision - Recreational vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
6	3	C	2	Collision	Passenger vessel ICW Cable-Lay Vessel	Collision - Passenger vessel ICW Cable-Lay Vessel	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	2	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	5.5	Low Risk - Broadly Acceptable	N/A	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	2	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	5.5	Low Risk - Broadly Acceptable
7	6	C	2	Collision	Large Commercial vessel ICW Cable-Lay Vessel	Collision - Large Commercial vessel ICW Cable-Lay Vessel	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	2	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	5.3	Low Risk - Broadly Acceptable	N/A	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	2	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	5.3	Low Risk - Broadly Acceptable
8	12	C	2	Collision	Small Commercial vessel ICW Cable-Lay Vessel	Collision - Small Commercial vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
9	21	C	2	Collision	Fishing vessel ICW Cable-Lay Vessel	Collision - Fishing vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable
10	21	C	2	Collision	Recreational vessel ICW Cable-Lay Vessel	Collision - Recreational vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable
11	3	C	3	Collision	Passenger vessel ICW Cable-Lay Vessel	Collision - Passenger vessel ICW Cable-Lay Vessel	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	2	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	5.5	Low Risk - Broadly Acceptable	N/A	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	2	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	5.5	Low Risk - Broadly Acceptable
12	6	C	3	Collision	Large Commercial vessel ICW Cable-Lay Vessel	Collision - Large Commercial vessel ICW Cable-Lay Vessel	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	2	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	5.3	Low Risk - Broadly Acceptable	N/A	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	2	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	5.3	Low Risk - Broadly Acceptable

ID	Individual Haz. Rank	Project Phase	Area	Hazard Type	Vessel Type	Hazard Title	Baseline Risk Ranking														Additional Risk Controls	Residual Risk Ranking													
								Realistic Most Likely Scores						Realistic Worst Credible Scores									Realistic Most Likely Scores						Realistic Worst Credible Scores						
							Realisitic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realisitic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating		Realisitic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realisitic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Baseline Risk Score	Residual Risk Rating
13	12	C	3	Collision	Small Commercial vessel ICW Cable-Lay Vessel	Collision - Small Commercial vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
14	21	C	3	Collision	Fishing vessel ICW Cable-Lay Vessel	Collision - Fishing vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable
15	21	C	3	Collision	Recreational vessel ICW Cable-Lay Vessel	Collision - Recreational vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable
16	3	C	4	Collision	Passenger vessel ICW Cable-Lay Vessel	Collision - Passenger vessel ICW Cable-Lay Vessel	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	2	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	5.5	Low Risk - Broadly Acceptable	N/A	Multiple major injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	3	3	2	Multiple fatalities; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	5	5	5	5	1	5.5	Low Risk - Broadly Acceptable
17	6	C	4	Collision	Large Commercial vessel ICW Cable-Lay Vessel	Collision - Large Commercial vessel ICW Cable-Lay Vessel	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	2	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	5.3	Low Risk - Broadly Acceptable	N/A	Multiple minor injuries; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; required; Temporary suspension of cable laying activities; Widespread negative publicity.	2	3	3	3	2	Single fatality; Over £10 million property damage; Tier 3 pollution, national assistance required; Serious disruption cable laying activities; International negative publicity.	4	5	5	5	1	5.3	Low Risk - Broadly Acceptable
18	12	C	4	Collision	Small Commercial vessel ICW Cable-Lay Vessel	Collision - Small Commercial vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
19	12	C	4	Collision	Fishing vessel ICW Cable-Lay Vessel	Collision - Fishing vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	2	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	3.8	Negligible Risk - Broadly Acceptable
20	21	C	4	Collision	Recreational vessel ICW Cable-Lay Vessel	Collision - Recreational vessel ICW Cable-Lay Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; £10,000 - £100,000 property damage; Tier 1 pollution, local assitance required; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	2	2	1	Single fatality; £100,000 - £1 million property damage; Tier 2 pollution, limited external assitance; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	3	3	1	2.8	Negligible Risk - Broadly Acceptable
21	2	C	All	Collision	Project Support Vessel ICW Cable-Lay Vessel	Collision - Project Support Vessel ICW Cable-Lay Vessel	Minor injuries; £10,000 - £100,000 property damage; No pollution; Short term loss of revenue to vessel operator; Local negative publicity.	1	2	1	2	3	Single fatality; £1 million - £10 million property damage; Tier 2 pollution, limited assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	4	4	3	3	2	6.4	Medium Risk - Tolerable (if ALARP)	Increased minimum CPA; Additional bridge lookout / radio personnel; Additional guard vessel	Minor injuries; £10,000 - £100,000 property damage; No pollution; Short term loss of revenue to vessel operator; Local negative publicity.	1	2	1	2	3	Single fatality; £1 million - £10 million property damage; Tier 2 pollution, limited assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	4	4	3	3	2	6.4	Medium Risk - Tolerable (if ALARP)
22	1	C	All	Collision	Third-Party Vessel ICW Third-Party Vessel	Collision - Third-Party Vessel ICW Third-Party Vessel	Mulitple minor injuries; £10,000 - £100,000 property damage; No pollution; Short term loss of revenue to vessel operator; Local negative publicity.	2	2	1	2	3	Single fatality; £1 million - £10 million property damage; Tier 2 pollution, limited assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	4	4	3	3	2	6.6	Medium Risk - Tolerable (if ALARP)	Promulgation of planned cable route; Additional guard vessel; Route planning to cable junctions in low traffic areas	Mulitple minor injuries; Less than £10,000 property damage; No pollution; Short term loss of revenue to vessel operator; Local negative publicity.	2	1	1	2	3	Single fatality; £100,000 - £1 million property damage; Tier 1 pollution, local assitance required; Temporary suspension of cable laying activities; Widespread negative publicity.	4	3	2	3	2	6.1	Medium Risk - Tolerable (if ALARP)
23	9	C	All	Wake wash	Cable-Lay Vessel	Wake wash - Cable-Lay Vessel	Mulitple minor injuries; Less than £10,000 property damage; No pollution; No perceptible impact on cable laying activities; No negative publicity.	2	1	1	1	3	Single fatality; £10,000 - £100,000 property damage; Minor spill, no assistance required; Short term loss of revenue to vessel operator; Local negative publicity.	4	2	1	2	1	4.0	Negligible Risk - Broadly Acceptable	N/A	Mulitple minor injuries; Less than £10,000 property damage; No pollution; No perceptible impact on cable laying activities; No negative publicity.	2	1	1	1	3	Single fatality; £10,000 - £100,000 property damage; Minor spill, no assistance required; Short term loss of revenue to vessel operator; Local negative publicity.	4	2	1	2	1	4.0	Negligible Risk - Broadly Acceptable
24	19	C	All	Foundering / Capsize	Cable-Lay Vessel	Foundering / Capsize - Cable-Lay Vessel	Multiple major injuries; £100,000 - £1 million property damage; Tier 1 pollution, local assistance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	2	3	1	Multiple fatalities; £1 million - £10 million property damage; Tier 2 pollution, regional assitance required; Prolonged suspension of cable laying activities; National negative publicity.	5	4	4	4	1	3.8	Negligible Risk - Broadly Acceptable	N/A	Multiple major injuries; £100,000 - £1 million property damage; Tier 1 pollution, local assistance required; Temporary suspension of cable laying activities; Widespread negative publicity.	3	3	2	3	1	Multiple fatalities; £1 million - £10 million property damage; Tier 2 pollution, regional assitance required; Prolonged suspension of cable laying activities; National negative publicity.	5	4	4	4	1	3.8	Negligible Risk - Broadly Acceptable
25	20	C	All	Personnel	Cable-Lay Vessel and Project Support Vessel	Personnel - Cable-Lay Vessel and Project Support Vessel	Minor injuries; Less than £10,000 property damage; No pollution; No perceptible impact on cable laying activities; No negative publicity.	1	1	1	1	3	Single fatality; Less than £10,000 property damage; Minor pollution, no assistance required; Temporary suspension of cable laying activities; Widespread negative publicity.	4	1	1	3	1	3.1	Negligible Risk - Broadly Acceptable	N/A	Minor injuries; Less than £10,000 property damage; No pollution; No perceptible impact on cable laying activities; No negative publicity.	1	1	1	1	3	Single fatality; Less than £10,000 property damage; Minor pollution, no assistance required; Temporary suspension of cable laying activities; Widespread negative publicity.	4	1	1	3	1	3.1	Negligible Risk - Broadly Acceptable

Appendix B
Quantitative Modelling Collision Results

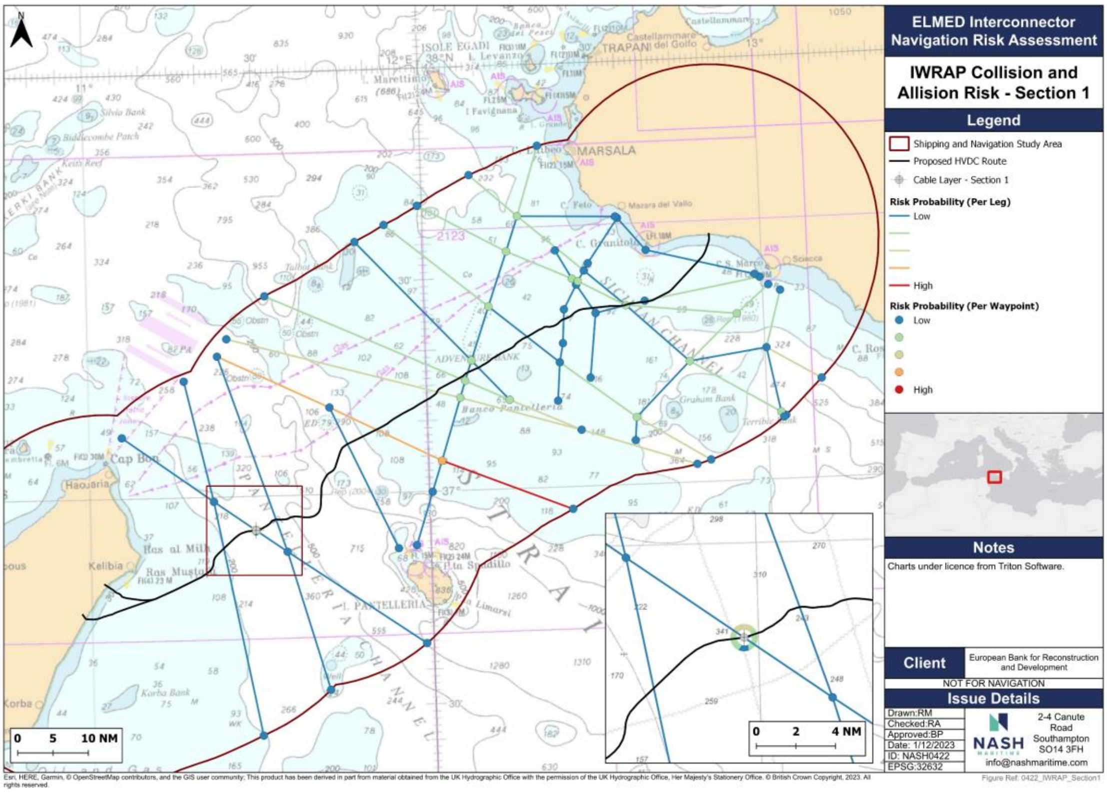

Figure 35: Segment 1 collision risk

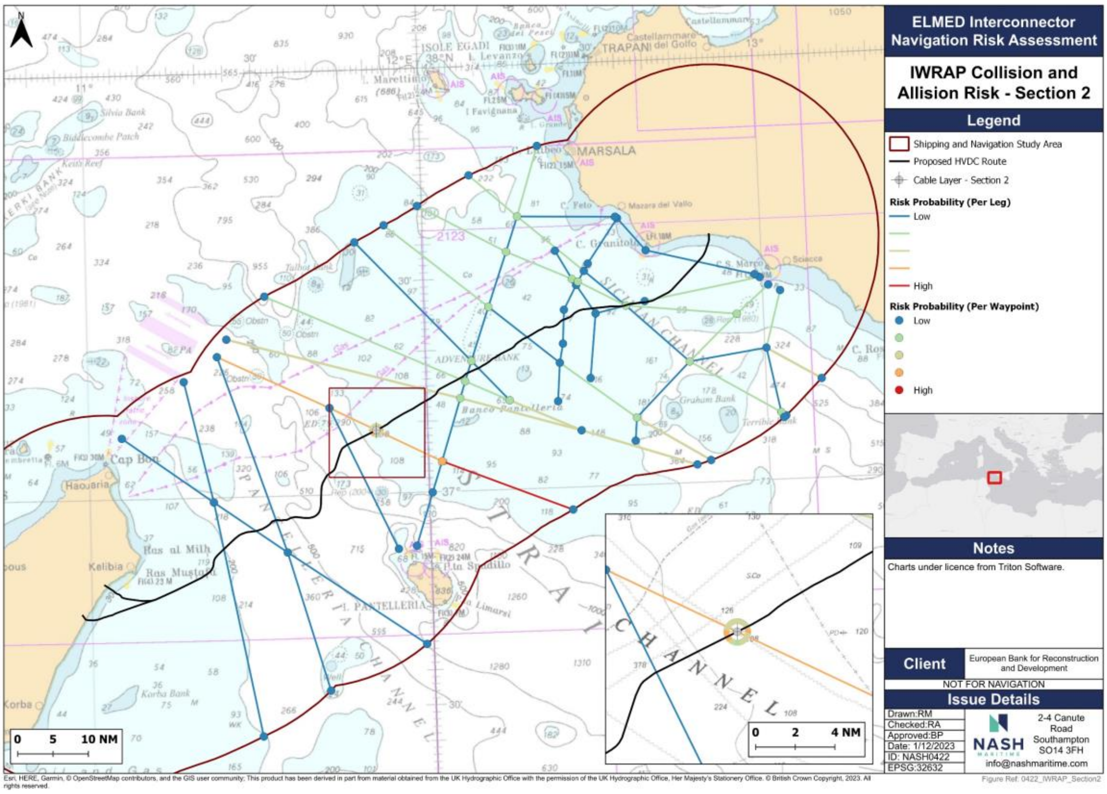

Figure 36: Segment 2 collision risk

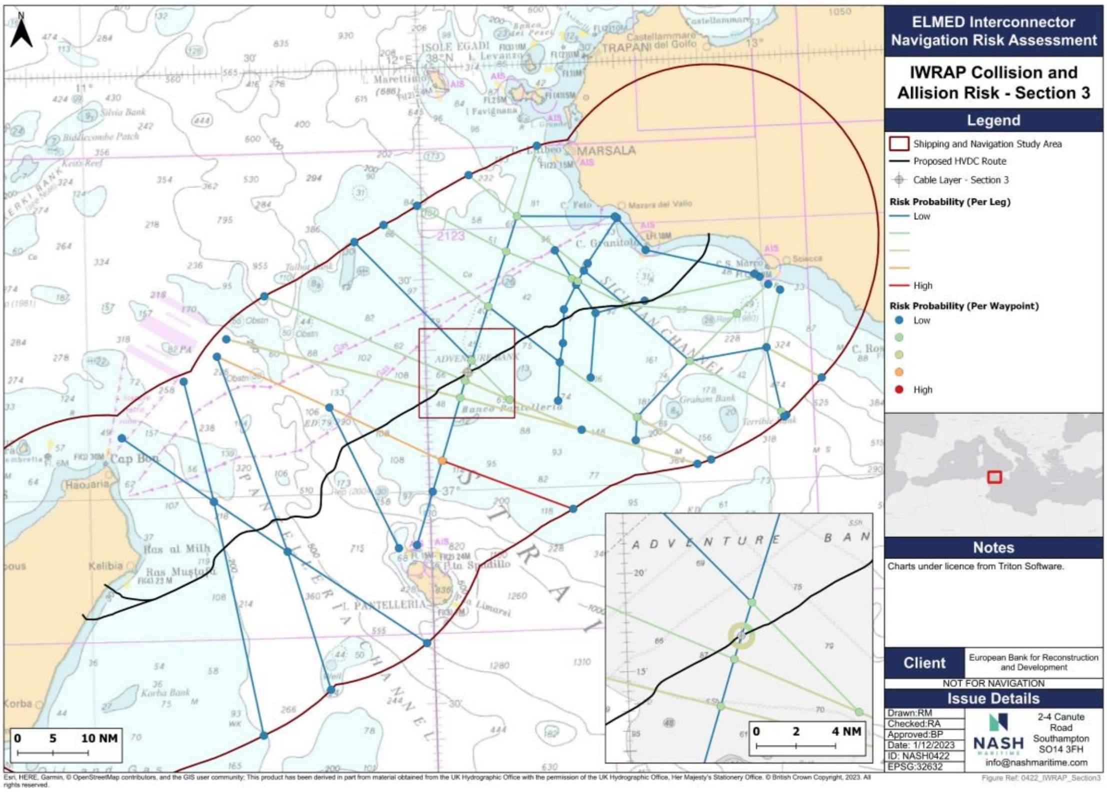

Figure 37: Segment 3 collision risk

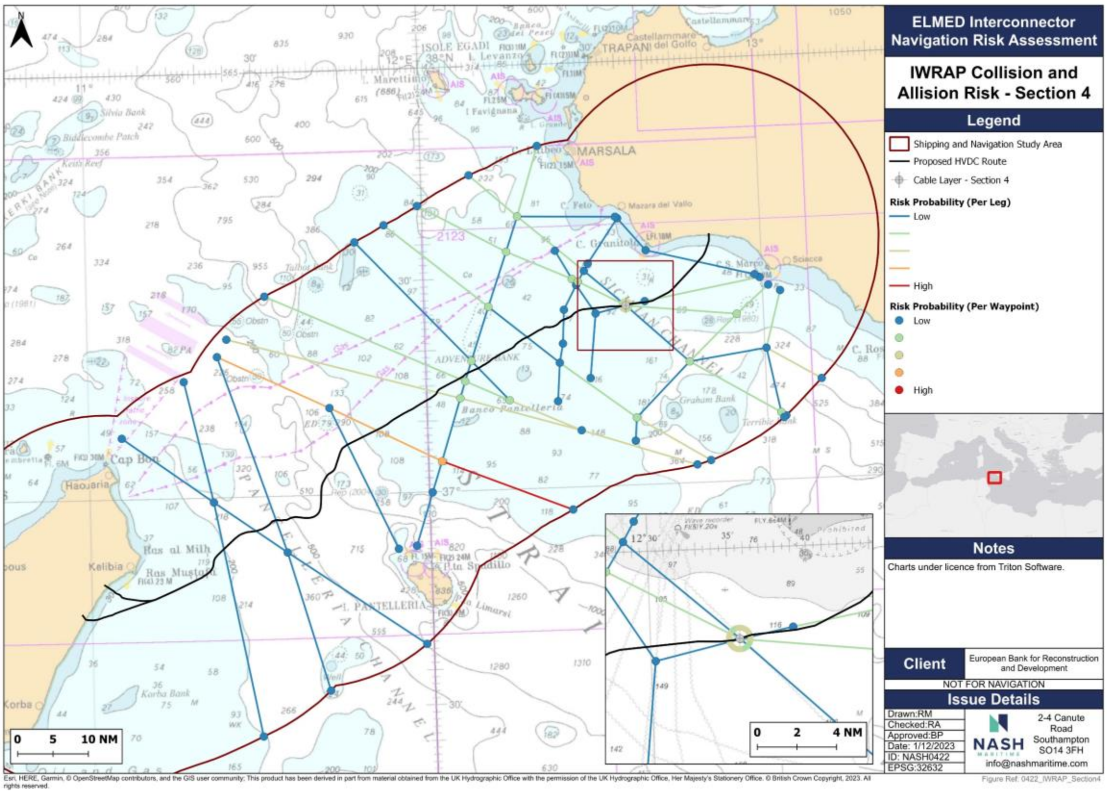

Figure 38: Segment 4 collision risk

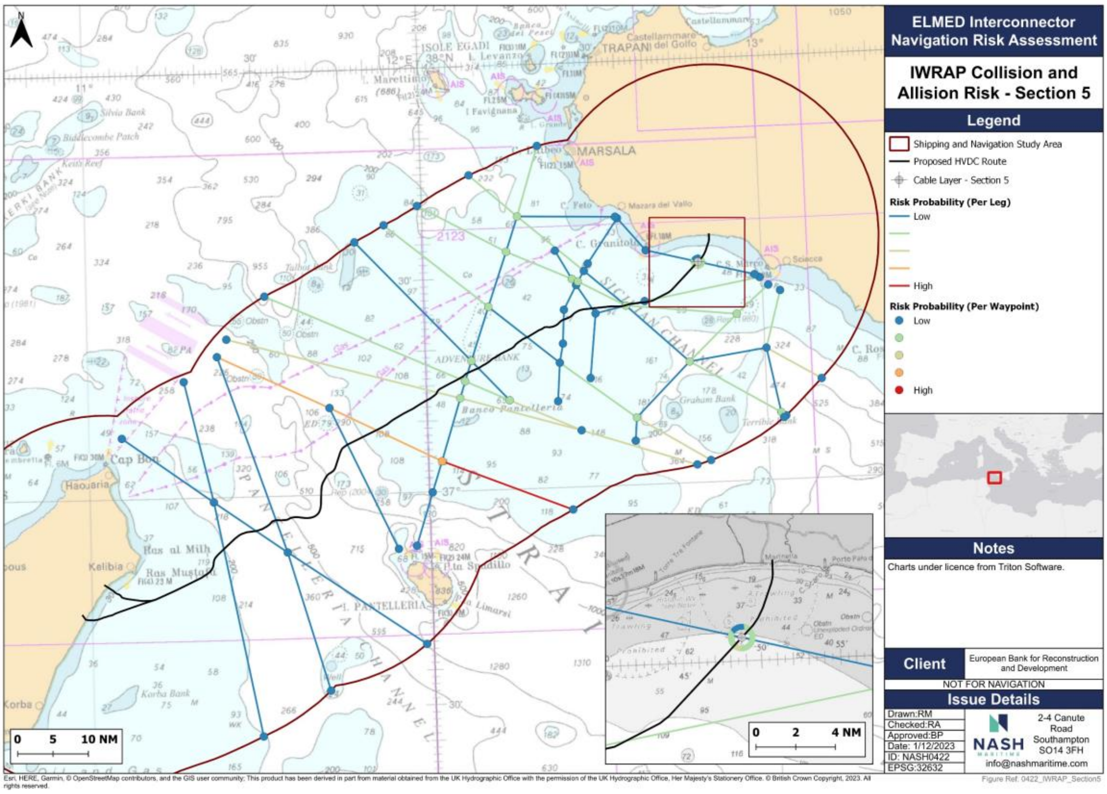

Figure 39: Segment 5 collision risk

Appendix C
NAVAREA Example

NAVAREA III COORDINATOR Report

a) Implementation of GMDSS in the MBS.

Within NAVAREA III region there are 28 NAVTEX stations working in international service (518 khz):

- 20 operational.
- 3 Italian stations near to be decommissioned: Cagliari, Trieste, Augusta.
- 3 Italian new stations on trials near to be commissioned to operational status: La Maddalena, Sellia Marina, Mondolfo.
- 1 Tunisian station on trials: Kelibia.
- 1 Libyan station on trials: Surt (the estimation was to begin NAVTEX trials during the second half of 2011, but due operations in Libya there is no news about this station).

b) MSI in Navarea III.

Radio Navigational Warnings within NAVAREA III region are sent from the Spanish Hydrographic Institute to Burum Land Earth Station (LES), in The Netherlands using a TCP/IP (Internet) connection and a Telnet Terminal.

From Burum those messages are sent to AOR-E SafetyNet Satellite for broadcasting over the whole region.

Broadcasting times: 1200Z, 2400Z (AOR-E).
Satellite Service Provider: Stratos Mobile.

Meteorological information: Submitted by METAREA III Coordinator (Greece).

c) Promulgation of Radio navigational warnings within the Navarea III area. Status of Navtex Service.

NAVAREA Warnings broadcast during the period of time covered by this report:

YEAR	NAVAREA WARNINGS
2009	452
2010	466

d) Other issues.

During the period covered by this report, the NAVAREA III Coordinator participated in the following international activities:

- WWNWS1 meeting held in Mónaco from 18 to 21 August 2009.

- Requested by the IHO, IHM as NAVAREA III Coordinator participated in a technical visit to the HO of the Republic of Georgia (GSHS) in December 2010. The technical visit was made at the request of the Georgia HO with a view to the possibility of entry as a member of the IHO.

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NAVAREA III

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http://www.armada.mde.es/ihm

Example NAVAREA notice:

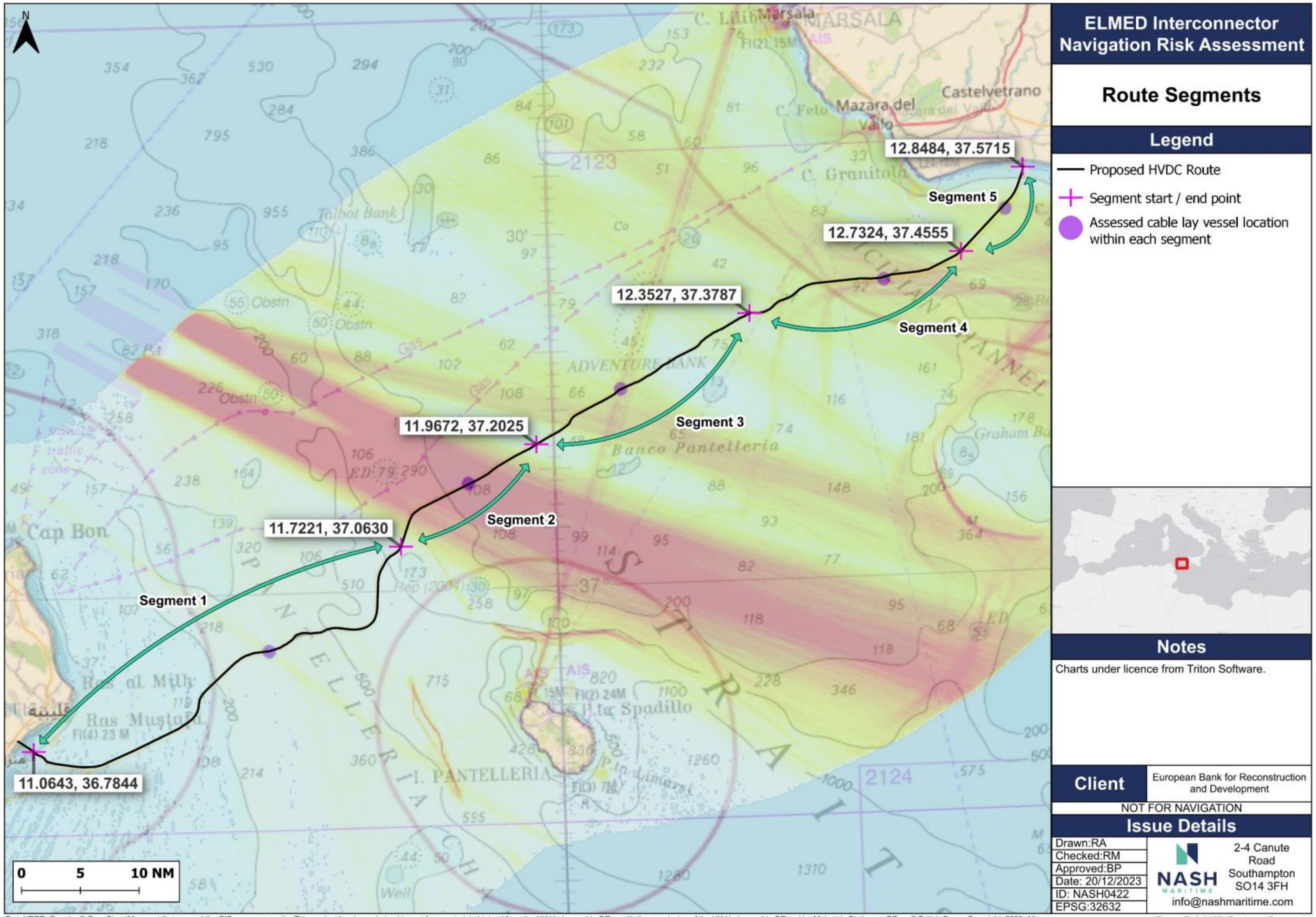
NAVAREA XI

NO.23-0383 Date:2023/11/06 12 UTC

MALACCA STRAIT.
SUBMARINE CABLE LAYING WORKS BY
CS RESOLUTE, 12184 TONS. UNTIL FURTHER
NOTICE. IN VICINITY OF LINE JOINING
03-03.13N 100-47.97E
03-57.47N 099-46.73E
05-48.10N 098-22.54E
06-02.51N 098-16.48E.
CANCEL 0345/23.

Appendix D
Risk Analysis Segment Definition

NASH MARITIME



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