SAINT HELENA GOVERNMENT

MARITIME RISK ASSESSMENT

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1. INTRODUCTION

The Overseas Territory of Saint Helena contracted Nash Maritime Ltd to undertake a maritime risk assessment for its coastal waters up to the Economic Exclusion Zone (EEZ) (see **Figure 1**) to the requirements of the International Maritime Organisation (IMO) Safety of Life at Sea (SOLAS) Chapter V Regulations, using the IMO approved International Association of Lighthouse Authorities (IALA) Waterway Risk Assessment Programme (IWRAP) MKII risk management software.

The funding to undertake the assessment was derived from the United Kingdom (UK) through the Conflict, Safety and Security Fund (CSSF), which for maritime matters is administered by the UK Maritime and Coastguard Agency (MCA) CSSF Secretariat.

The objective of the study was to enable Saint Helena to demonstrate that the need for SOLAS Chapter V obligations for Vessel Routeing, Vessel Reporting, Vessel Traffic Services (VTS) and Aids to Navigation (AtoN) have been assessed through determination of the "Volume of Traffic" and "Degree of Risk".

1.1. SAINT HELENA OVERVIEW

Saint Helena Island (15°58'S., 5°42'W.) (**Figure 1**) is approximately 10 nautical miles (nm) x 5nm and, 47m² in area, is composed largely of rugged terrain of volcanic origin and lies 703nm south-east of Ascension Island. Jamestown the capital, is situated at the head of James Bay.

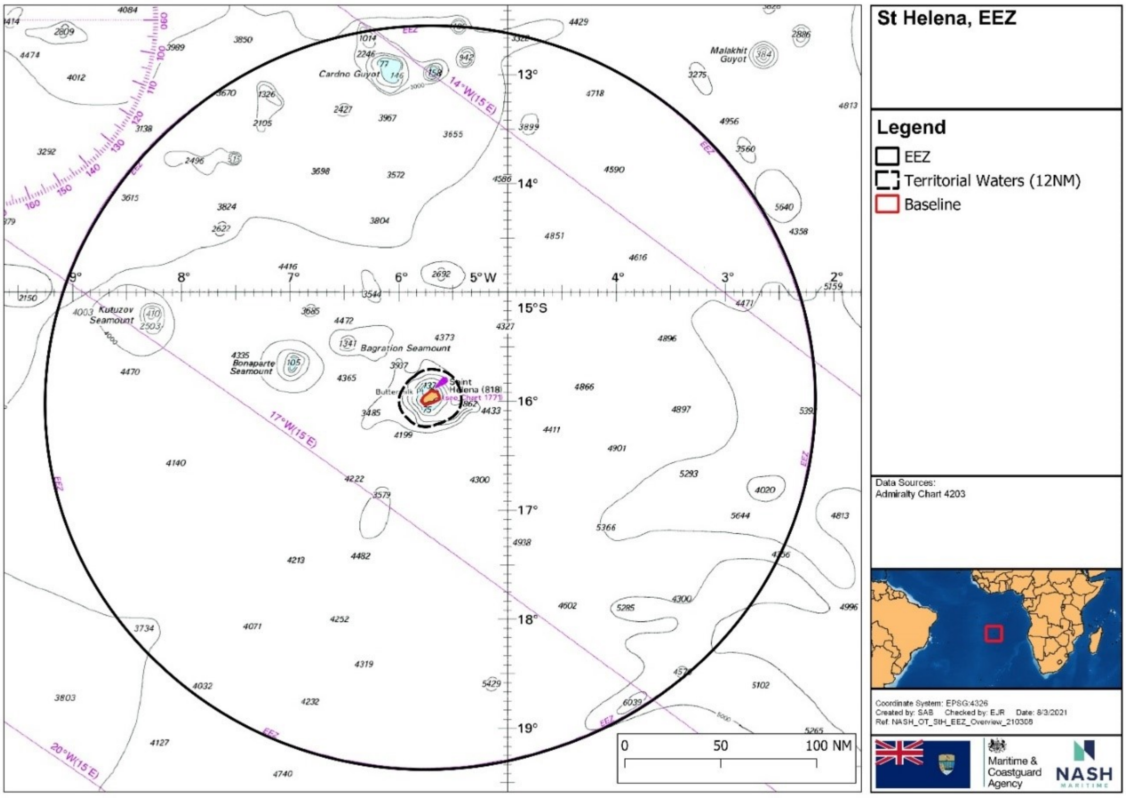


Figure 1: Admiralty Chart showing Maritime Boundaries.

1.2. PROJECT RATIONALE

A project strategy, which was developed in line with Overseas Territories and the UK MCA CSSF Secretariat was to assess SOLAS Chapter V obligations for UK Overseas Territories using IALA IWRAP MkII assessments whilst feeding into a wider aim on capacity building in partnership with IALA World-Wide Academy (WWA). The strategy was developed into a flow chart (see **Figure 2**) showing the relationships between:

- IMO responsible for SOLAS Chapter V Regulations;
- IALA standards;
- IALA WWA;
- Overseas Territories responsible discharging the requirements of SOLAS; and
- NASH Maritime – technical consultancy providing IWRAP MKII assessments.

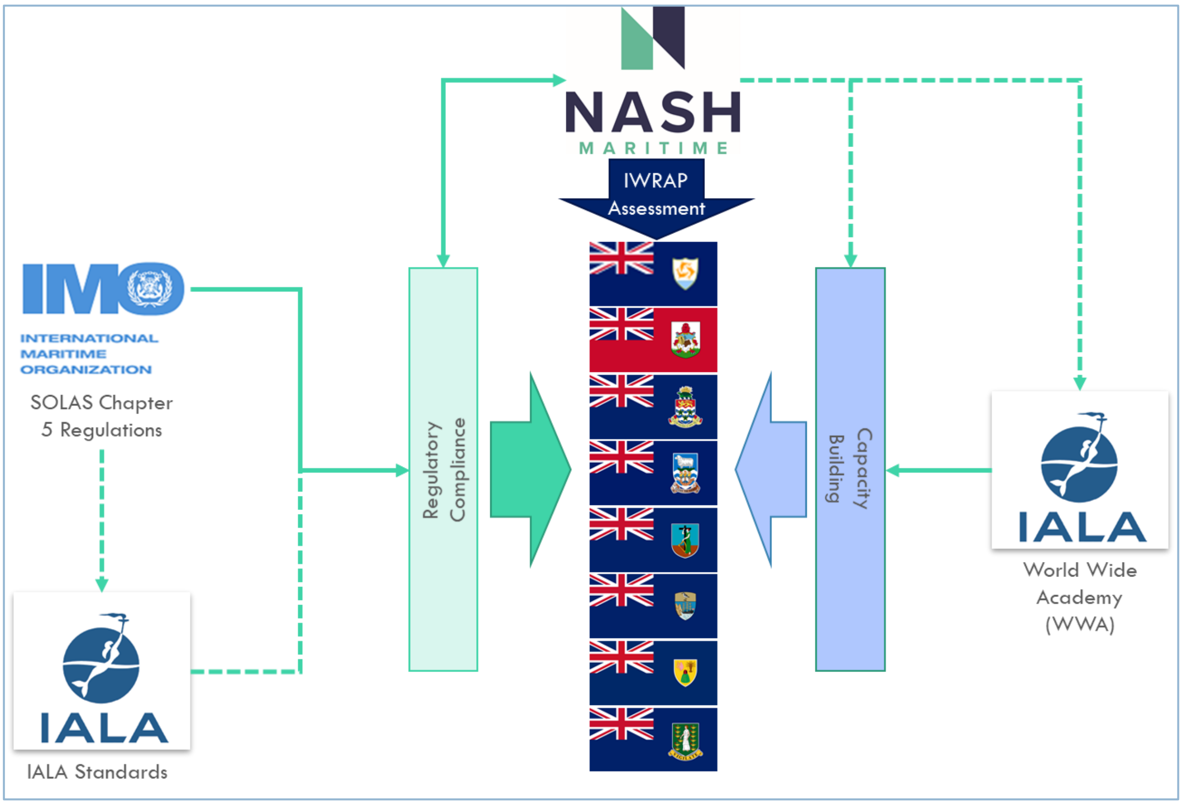


Figure 2: Project Strategy.

The primary objective of the project scope is to discharge Saint Helena's obligations/requirements under SOLAS Chapter V related to identifying the requirements for the following measures:

- Routeing Measures – Regulation 10;
- Reporting Measures – Regulation 11;
- Vessel Traffic Services (VTS) –Regulation 12; and
- Aids to Navigation (AtoN) – Regulation 13.

In all these cases the SOLAS obligations/requirement requests that contracting governments (e.g. Overseas Territories) provide such measures based on an assessment of:

- Volume of vessel traffic activity; and
- Degree of maritime risk.

In December 2010, the IMO drafted and issued Circular 296 entitled 'Degree of Risk Evaluation' (SN.1/Circ.296) in which it invited Member Governments to utilise the IALA Risk Management Tools Kit to address the SOLAS Chapter 5 Regulations.

The IALA Risk Management Tool Kit, and the relative application in relation to the IMO Formal Safety Assessment (FSA) Stages, is shown below in **Figure 3** and derived from the following IALA recommendations and guidelines:

- O-138 Dec 2007 - Use of Geographic Information System (GIS) and simulation by AtoN authorities.
  Covers rationale, the volume of traffic and degree of risk, geographic information systems and AtoN, and simulation;
- G1018 May 2013 - Risk Management.
  Outlines a general description of risk management methodology for AtoN including VTS through the analysis of all the hazards in a waterway;
- G1123 June 2017 - Use of IWRAP MK II.
  IWRAP is a risk assessment tool to provide authorities with a standardised quantitative method to evaluate the probability of collisions and groundings in a given waterway;
- G1124 June 2017 - Use of Ports and Waterways Safety Assessment (PAWSA MK II) tool.
  Provides guidance on PAWSA's systematic approach to the identification of major waterway safety hazards;
- G1138 Dec 2017 - Use of the SIRA.
  Provides guidance on SIRA's structured process which identifies hazards, and undesired incidents or scenarios in a given area; and
- G1104 Dec 2013 - Application of maritime surface picture for analysis in risk assessment and the provision of AtoN.
  Provides guidance on the use of GIS to assess the requirement and impact of AtoN in the area of interest. It covers the incorporation of charting overlays with new dangers and amplification of existing dangers.

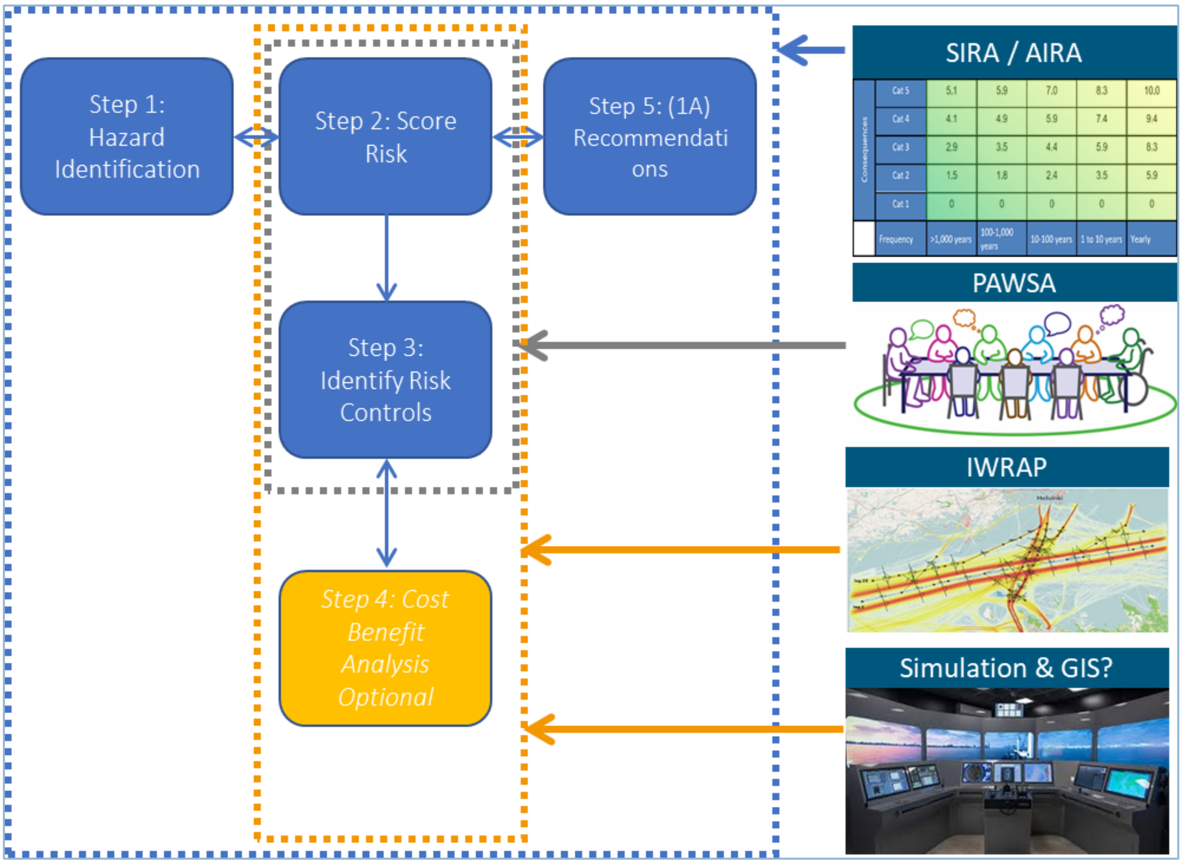


Figure 3: IALA Tool Kit (right hand side) and interface with the IMO FSA.

IWRAP MKII is a quantitative collision, contact and grounding probability model which enables wide geographical area assessment of coastal state waters. It identifies high risk areas (in terms of hazard probability) and can be used to determine the relative risk in coastal state waters.

It should be noted that whilst IWRAP, in isolation, does not address the consequence part of risk, it is possible to provide categories of consequence output by splitting vessel type outputs from the IWRAP MKII assessment and applying expert judgement of the team combined with tools and datasets. Where high risk areas are identified using the IWRAP tool, then it is recommended that the mitigation strategies as identified above (e.g., routeing, reporting, VTS and AtoN) are defined and implemented or a localised and focused assessments of navigation risk (e.g., using the IALA PAWSA or SIRA tools) is undertaken to provide a focussed nuanced assessment and determination of tailored and appropriate mitigation needs conducted with stakeholder input.

It is also the case that SOLAS obligations only apply to the Saint H and Territorial Waters and do not cover port or internal waters. IALA IWRAP is well suited to large area assessment where navigation risk mitigations are generic in nature – i.e., reliant on SOLAS and other international conventions. The degree of navigation risk in ports/harbours or internal waters of Saint Helena are therefore excluded from the assessment. Assessments of these areas, due to the complexity of vessel operations in confined waters, the change in navigation jurisdiction for port and harbours, and the application of other risk controls (e.g., pilotage, safety management procedures), mean such assessment is not suited to IWRAP and where assessment is needed for navigation safety, a qualitative approach to risk management (such as that provided for in a SIRA or PAWSA style IALA assessment) is more suitable.

The findings of this study are aimed at being able to provide the mandate behind the need for the SOLAS Chapter V obligations, although the specific detail of how any obligations are designed and developed may require further refinement and design, to provide sufficient detail for presentation to the IMO for international adoption.

1.3. ASSESSMENT AREA

The study area for this assessment consists of all water within the Saint Helena EEZ where the SOLAS convention applies (including Territorial Waters). SOLAS does not apply to internal or port waters defined as the areas landward of the baseline used to calculate the 12nm territorial sea, as specified in the Territorial Sea Order.

The extent of the Territorial Waters baseline, as defined by the Order, as well as the 12nm Territorial Waters limits, the EEZ are shown in **Figure 1**.

1.4. SCOPE OF REPORT

This report has been broken down into the following sections:

- **Introduction**: Overview of Saint Helena, the project rationale, and the scope of the assessment;
- **Assessment Measures**: Overview of the IMO SOLAS Chapter V Measures;
- **Data Collection and Processing**: Overview of project data type for input into modelling including data quality/fidelity;
- **Navigation Disposition**: Review of navigation disposition, features and characteristics for Saint Helena including:
    - Desk-based review of nautical publications; and
    - Vessel traffic analysis to determine "Volume of Traffic" requirements.
- **IWRAP Modelling**: Overview of the IWRAP modelling methodology and project modelling parameters;
- **IWRAP Model Results**: Presentation of IWRAP modelling results by incident category and vessel type;
- **Results Benchmark**: Review of existing SOLAS Chapter V measures for benchmarking to the "*Volume of Traffic*" and "*Degree of Risk*" assessment; and
- **Conclusions and Recommendations**: Commentary and discussion of the findings of the assessment.

1.5. CHARTS/CARTOGRAPHY

All cartography in this report, unless otherwise stated, is to WGS84 UTM Zone 30N standard. All marine charts are in a Mercator projection. Charts are not suitable for navigational purposes.

2. ASSESSMENT MEASURES

2.1. INTRODUCTION

The SOLAS convention is the most crucial international treaty relating to the safety of merchant ships. The first version of SOLAS was adopted in response to the Titanic disaster in 1914 with several subsequent revisions. The 1974 version included a mechanism whereby the convention could be amended, consequently the version of the convention in force today is referred to as the 1974 Convention, as amended. SOLAS has been updated at regular intervals with recent amendments introduced on 01-Jan-2020.

SOLAS Chapter V relates to safety of navigation and details services that contracting governments should provide, when necessary, within their Territorial Waters.

The primary objective of the project is to discharge the Overseas Territories obligations/requirements under SOLAS Chapter V related to identifying the requirements for the following measures:

- Routeing Measures – Regulation 10;
- Reporting Measures – Regulation 11;
- Vessel Traffic Services –Regulation 12; and
- Aids to Navigation – Regulation 13.

A summary relating to each of the above regulations as well as the relevant extracts from the SOLAS convention is included in the remainder of this section.

2.2. LEGAL FRAMEWORK

For an internationally recognised convention such as SOLAS to take effect in an Overseas Territory the UK must ratify the convention and inform the IMO that the convention has been extended to Overseas Territories. For SOLAS to come into effect legislation must be adopted by the Overseas Territory that implements the convention in local law. The UK has adopted the SOLAS convention and extended it to the Overseas Territories. However, the degree to which SOLAS has been implemented through local law varies between territories.

There are two types of provision within SOLAS Chapter V, the first being obligations or powers that are conferred on contracting governments to initiate action e.g., introduce a reporting measure. These types of legal provision are referred to in this report as "**Authorisations**". The second type of provision are those that allow contracting governments to impose actions on ships that mean they are required to comply with the Chapter V requirements in place e.g., mandatory reporting schemes. These provisions are referred to in this report as "**Enforcement Provisions**".

Saint Helena's territorial sea extends for 12nm and is established by the Saint Helena and Dependencies (Territorial Sea) Order 1989.[1] It is believed that Saint Helena has an EEZ, declared by legal notice in 2017 however it has not been possible to locate a copy of this notice online.

[1] St Helena and Dependencies (Territorial Sea) Order 1989

Saint Helena currently has not Merchant Shipping legislation, it is believed that the United Kingdom Merchant Shipping Act 1894 extends in part to Saint Helena. Saint Helena has also adopted a number of United Kingdom acts including parts of the Merchant Shipping act 1995. None of the United Kingdom acts adopted address the requirement for Saint Helena to have the relevant authorisation or enforcement powers in relation to SOLAS Chapter V.

Saint Helena is therefore developing new legislation in order that SOLAS Chapter V can be properly implemented. A new Merchant Shipping Ordinance has recently been approved by the Legislative Council, this will enable regulations enabling SOLAS Chapter V to be implemented, as yet it is not known when these regulations will be made.

Table 1 gives a summary of the current legislative position whilst **Table 2** summarises the powers Saint Helena may have if regulations are progressed.

Table 1: Summary of Existing Legislation.

Existing Legislation		
	Authorisation	**Enforcement**
Regulation V/10 (ships' routeing)	Implied only.	None.
Regulation V/11 (ship reporting)	Implied only.	None.
Regulation V/12 (VTS)	Implied only.	None.
Regulation V/13 (AtN)	Implied only.	Duty on Government only.
COLREG (TSS)	Implied only.	Art 2 Merchant Shipping Act 1979) Overseas Territories) Order 1989 [United Kingdom].

Table 2: Summary of Proposed Legislation.

Proposed Legislation		
	Authorisation	**Enforcement**
Regulation V/10 (ships' routeing)	Regulations are possibly being progressed in 2021.	Regulations are possibly being progressed in 2021.
Regulation V/11 (ship reporting)	Regulations are possibly being progressed in 2021.	Regulations are possibly being progressed in 2021.
Regulation V/12 (VTS)	Regulations are possibly being progressed in 2021.	Regulations are possibly being progressed in 2021.
Regulation V/13 (AtN)	Regulations are possibly being progressed in 2021.	Duty on Governments only.
COLREG (TSS)	To be included in Draft Safety of Navigation Regulations.	Art 2 Merchant Shipping Act 1979 (Overseas Territories) Order 1989 [United Kingdom). Local regulations may be progressed in 2021.

2.3. ROUTEING MEASURES

Ships' routeing measures are designed to contribute to safety of life at sea, safety, and efficiency of navigation and/or protection of the marine environment.

The practice of following predetermined routes for shipping originated in 1898 and was originally adopted, for reasons of safety, by shipping companies operating passenger ships across the North Atlantic. Related provisions were subsequently incorporated into the original SOLAS Convention.

Governments intending to establish a new routeing system, or amend an existing one, must submit proposed routeing measures to IMO's Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), which will then evaluate the proposal and make a recommendation regarding its adoption. The recommendation is then passed to the Marine Safety Committee (MSC) for adoption.

Routeing measures can consist of the following elements:

- **Traffic Separation Scheme**: A routeing measure aimed at the separation of opposing streams of traffic;
- **Traffic Lane**: An area within defined limits in which one-way traffic is established;
- **Separation Zone or Line**: A zone or line separating traffic lanes in which ships are proceeding in opposite or nearly opposite directions; or separating a traffic lane from the adjacent sea area; or separating traffic lanes designated for particular classes of ship proceeding in the same direction;
- **Roundabout**: A separation point or circular separation zone and a circular traffic lane within defined limits;
- **Inshore Traffic Zone**: A designated area between the landward boundary of a traffic separation scheme and the adjacent coast;
- **Recommended Route**: A route of undefined width, for the convenience of ships in transit, which is often marked by centreline buoys;
- **Deep-water Route**: A route within defined limits which has been accurately surveyed for clearance of sea bottom and submerged articles;
- **Precautionary Area**: An area within defined limits where ships must navigate with particular caution and within which the direction of flow of traffic may be recommended; and
- **Area To Be Avoided**: An area within defined limits in which either navigation is particularly hazardous, or it is exceptionally important to avoid casualties and which should be avoided by all ships, or by certain classes of ships.

SOLAS Chapter v - REGULATION 10

1. *Ships' routeing systems contribute to safety of life at sea, safety and efficiency of navigation and/or protection of the marine environment. Ships' routeing systems are recommended for use by, and may be made mandatory for, all ships, certain categories of ships or ships carrying certain cargoes, when adopted and implemented in accordance with the guidelines and criteria developed by the Organization.**
2. *The Organization is recognized as the only international body for developing guidelines, criteria, and regulations on an international level for ships' routeing systems. Contracting Governments shall refer proposals for the adoption of ships' routeing systems to the Organization. The Organization will collate and disseminate to Contracting Governments all relevant information with regard to any adopted ships' routeing systems.*

3. *The initiation of action for establishing a ships' routeing system is the responsibility of the Government or Governments concerned. In developing such systems for adoption by the Organization, the guidelines and criteria developed by the Organization * shall be taken into account.*
4. *Ships' routeing systems should be submitted to the Organization for adoption. However, a Government or Governments implementing ships' routeing systems not intended to be submitted to the Organization for adoption or which have not been adopted by the Organization are encouraged to take into account, wherever possible, the guidelines and criteria developed by the Organization.**
5. *Where two or more Governments have a common interest in a particular area, they should formulate joint proposals for the delineation and use of a routeing system therein on the basis of an agreement between them. Upon receipt of such proposal and before proceeding with consideration of it for adoption, the Organization shall ensure details of the proposal are disseminated to the Governments which have a common interest in the area, including countries in the vicinity of the proposed ships' routeing system.*
6. *Contracting Governments shall adhere to the measures adopted by the Organization concerning ships' routeing. They shall promulgate all information necessary for the safe and effective use of adopted ships' routeing systems. A Government or Governments concerned may monitor traffic in those systems. Contracting Governments shall do everything in their power to secure the appropriate use of ships' routeing systems adopted by the Organization.*
7. *A ship shall use a mandatory ships' routeing system adopted by the Organization as required for its category or cargo carried and in accordance with the relevant provisions in force unless there are compelling reasons not to use a particular ships' routeing system. Any such reason shall be recorded in the ships' log.*
8. *Mandatory ships' routeing systems shall be reviewed by the Contracting Government or Governments concerned in accordance with the guidelines and criteria developed by the Organization.**
9. *All adopted ships' routeing systems and actions taken to enforce compliance with those systems shall be consistent with international law, including the relevant provisions of the 1982 United Nations Convention on the Law of the Sea.*

2.4. REPORTING MEASURES

Reporting Measures contribute to safety of life at sea, efficiency of navigation and protection of marine environments by providing a mechanism by which contracting governments can understand the volume, nature, size, and type of vessel traffic within Territorial Waters. This allows for effective vessel monitoring, management and evidenced based future decision making.

Contracting governments may decide to introduce reporting measures for all manner of reasons. For example, when there is concern regarding vessel traffic frequency, nature of vessel cargo (perhaps within environmentally protected areas) or geographic vessel disposition within a given area.

As an example, the government of Portugal applied to the IMO in March 2008 to introduce a compulsory reporting scheme (COREP) covering an existing 'Area to be Avoided' (ATBA) around Berlenga Island, and the existing Traffic Separation Schemes (TSS) "Off Cape Roca" and "Off Cape Vincente" as well as pinch points along the Portuguese Coast. The Portuguese government put the proposal forward in response to growing concerns regarding a steady increase in the number of vessels calling at Portuguese ports and a general increase in vessel traffic along the Portuguese coast. The government also felt the introduction of a reporting system was necessary in order that full advantage could be taken of a newly established VTS service covering the entire Portuguese continental coast and introduced in December 2003. By introducing a reporting system, the Portuguese government hoped to "*further enhance safety of navigation and protect the marine environment along Portuguese waters, in any traffic or weather conditions, taking full advantage of the Portuguese VTS capabilities*".

Contracting governments should refer any proposals for the adoption of reporting measures to the IMO. The IMO will then assess the proposal and if approved will assist in disseminating information to member states. To facilitate their assessment and approval by the Sub-Committee on Safety of Navigation (NAV) and final adoption by the Maritime Safety Committee (MSC) the IMO have produced a guidance note (MSC/Circ.1060) providing information to member governments on the drafting, development and submission of reporting and reporting measure proposals[2].

Applications to the IMO for proposed reporting measures should give due consideration to:

- The objectives and demonstrated need for the proposed system;
- Categories of ships required to participate in the system;
- Relevant information pertaining to the hydrographical and meteorological elements, the characteristics of ship traffic and any environmental aspects of the area;
- The geographical coverage of the proposed system and the number and edition of the reference chart used for the delineation of the system;
- The format and content of the reports required, the times and geographical positions for submitting reports, the shore-based authority to whom these reports should be sent and, if any are to be provided, the available services;
- The information to be provided to the participating ship and the procedures to be followed;
- The proposed communication requirements for the system, including frequencies on which reports should be transmitted and information to be reported;
- The relevant rules and regulations in force in the area of the proposed system;
- The shore-based facilities (including hardware and software) and personnel qualifications and training required to support the operation of the proposed system;
- Summary of the measures used to date, if any, and the reasons why these measures are inadequate;
- Information concerning the applicable procedures if the communication facilities of the shore-based authority fail;
- A description, if appropriate, of any plans that have been prepared for responding to an emergency involving the safety of life at sea or threats to the marine environment;

[2] MSC/Circ.1060, "Guidance Note on the Preparation of Proposals on Ship Routeing Systems and Ship Reporting Systems for Submission to the Sub-Committee on Safety of Navigation", 6th Jan 2003.

- Details of the measures to be taken if a ship fails to comply with the requirements of the system; and
- The proposed effective date of the system which should be as soon as practicable but not earlier than six months after adoption by the Organization.

SOLAS Chapter v - REGULATION 11

1. *Ship reporting systems contribute to safety of life at sea, safety, and efficiency of navigation and/or protection of the marine environment. A ship reporting system, when adopted and implemented in accordance with the guidelines and criteria developed by the Organization pursuant to this regulation, shall be used by all ships, or certain categories of ships or ships carrying certain cargoes in accordance with the provisions of each system so adopted.*
2. *The Organization is recognized as the only international body for developing guidelines, criteria and regulations on an international level for ship reporting systems. Contracting Government shall refer proposals for the adoption of ship reporting systems to the Organization. The Organization will collate and disseminate to Contracting Governments all relevant information with regard to any adopted ship reporting system.*
3. *The initiation of action for establishing a ship reporting system is the responsibility of the Government or Governments concerned. In developing such systems provision of the guidelines and criteria developed by the Organization shall be taken into account.*
4. *Ship reporting systems not submitted to the Organization for adoption do not necessarily need to comply with this regulation. However, Governments implementing such systems are encouraged to follow, wherever possible, the guidelines and criteria developed by the Organization. Contracting Governments may submit such systems to the Organization for recognition.*
5. *Where two or more Governments have a common interest in a particular area, they should formulate proposals for a co-ordinated ship reporting system on the basis of agreement between them. Before proceeding with a proposal for adoption of a ship reporting system, the Organization shall disseminate details of the proposal to those Governments which have a common interest in the area covered by the proposed system. Where a co-ordinated ship reporting system is adopted and established, it shall have uniform procedures and operations.*
6. *After adoption of a ship reporting system in accordance with this regulation, the Government or Governments concerned shall take all measures necessary for the promulgation of any information needed for the efficient and effective use of the system. Any adopted ship reporting system shall have the capability of interaction and the ability to assist ships with information when necessary. Such systems shall be operated in accordance with the guidelines and criteria developed by the Organization pursuant to this regulation.*

2.5. VESSEL TRAFFIC SERVICES MEASURES

Vessel Traffic Services (VTS) are a service implemented by a Competent Authority designed to improve the safety and efficiency of vessel traffic, ensure the safety of life at sea, and protect the marine environment, worksites, and offshore installations from possible adverse effects of maritime traffic.

A VTS may be responsible for a port/harbour or coastal region but the service requires the capability to interact with the traffic and respond to traffic situations developing in a VTS area. Three levels of service are described in IMO Resolution A.857(20):

- An Information Service (INS) broadcasts at fixed intervals or on request the positions/intentions of vessels, waterway conditions, weather or any other hazards which might impact another vessel's transit;
- A Traffic Organisation Service (TOS) involves the operational management of vessel traffic and the forward planning of movements to prevent congestion and dangerous situations; and
- A Navigation Assistance Service (NAS) provides essential and timely navigational information to assist on board navigational decision-making and monitor its effects, such as to avoid an incident or following a defect. At no point does a NAS absolve the master of their responsibility.

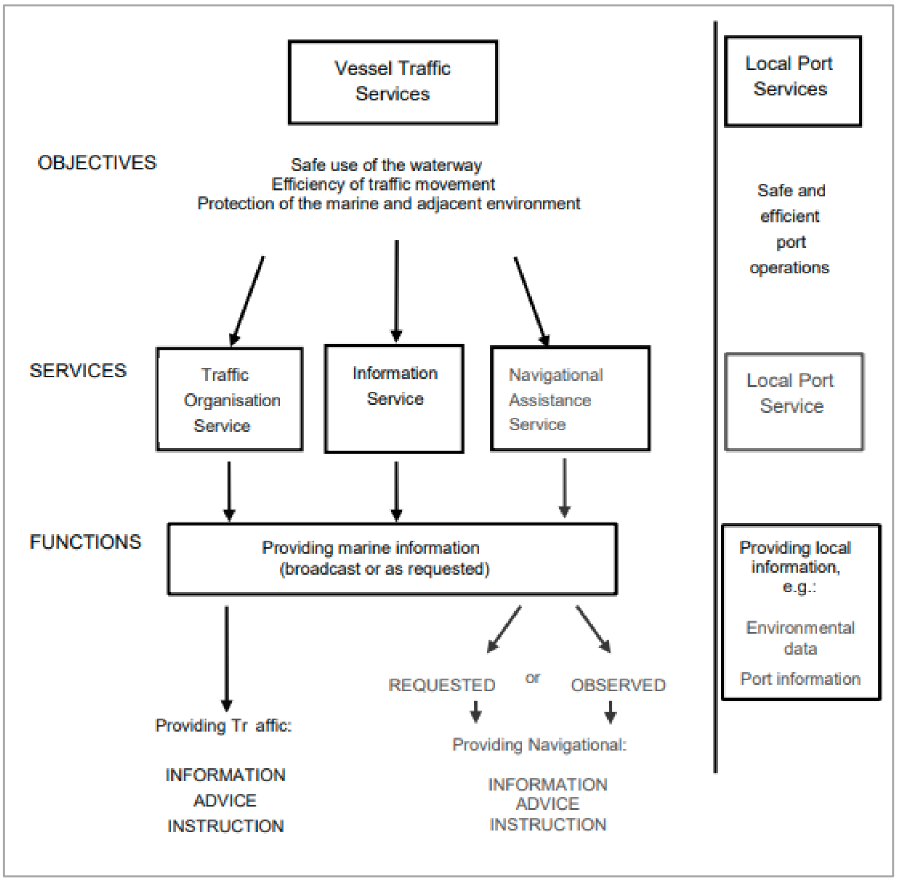


Figure 4: VTS Service and Functions (Source: MCA MGN 401).

Essential to a VTS are the training and capability of the personnel and a VTS centre may involve VTS Operators, Supervisors and Managers. IALA Recommendation V-103 and Annex 2 of IMO Resolution A.857(20) sets out the standards for training and certification of VTS personnel. The equipment requirements of a VTS are set out by IALA (Guideline 1111) and comprise several systems:

- Radio communications;
- Sensors (Radar/AIS/Environmental Monitoring/Radio Direction Finder/CCTV etc.);

- Data Processing;
- VTS Human/Machine Interface;
- Decision Support Tools; and
- External Information Exchange.

The responsibility for implementing a VTS is that of the Contracting Government and determined following risk assessment and consultation with local users. IALA Recommendation V-119 describes a recommended process for determining the need of a VTS; from a preliminary assessment, feasibility and design study, formal risk assessment through to cost-benefit analysis. Through this process, there are several factors which might be identified that could contribute to the requirement for VTS:

- A high level of vessel traffic or carrying dangerous cargoes, either existing or forecast;
- Complex and conflicting traffic patterns, narrow channels, and restricted waterways with other marine based activities;
- Difficult hydrographical, hydrological, and meteorological elements, shifting shoals and other local hazards; and
- A record of frequent or significant maritime casualties.

SOLAS Chapter V - REGULATION 12

1. *Vessel traffic services (VTS) contribute to safety of life at sea, safety and efficiency of navigation and protection of the marine environment, adjacent shore areas, work sites and offshore installations from possible adverse effects of maritime traffic.*
2. *Contracting Governments undertake to arrange for the establishment of VTS where, in their opinion, the volume of traffic or the degree of risk justifies such services.*
3. *Contracting Governments planning and implementing VTS shall, wherever possible, follow the guidelines developed by the Organization*. The use of VTS may only be made mandatory in sea areas within the territorial seas of a coastal State.*
4. *Contracting Governments shall endeavour to secure the participation in, and compliance with, the provisions of vessel traffic services by ships entitled to fly their flag.*
5. *Nothing in this regulation or the guidelines adopted by the Organization shall prejudice the rights and duties of Governments under international law or the legal regimes of straits used for international navigation and archipelagic sea lanes.*

** Refer to the Guidelines on Vessel Traffic Services adopted by the Organization by resolution A.857(20).*

2.6. AIDS TO NAVIGATION MEASURES

A navigational aid, AtoN or Navaid is any sort of marker that guides the mariner to or marks safe waters. AtoN also play a vital role in helping mariners to determine their ships position with respect to land or any navigational hazard or hidden danger. Examples of aids to navigation include lighthouses, buoys, and beacons.

For hundreds of years, maritime authorities have marked safe water with buoys and beacons. Besides supporting commerce, these buoys and beacons help to improve safety at seas. For example, aids to navigation help mariners in finding and safely navigating a narrow channel in a wide expanse of water.

The IALA has a crucial role in ensuring consistency in AtoN across the world as well as encouraging best practice.

The below extract is taking directly from SOLAS Chapter V - REGULATION 13:

1. *Each Contracting Government undertakes to provide, as it deems practical and necessary either individually or in co-operation with other Contracting Governments, such aids to navigation as the volume of traffic justifies and the degree of risk requires.*
2. *In order to obtain the greatest possible uniformity in aids to navigation, Contracting Governments undertake to take into account the international recommendations and guidelines* when establishing such aids.*
3. *Contracting Governments undertake to arrange for information relating to aids to navigation to be made available to all concerned. Changes in the transmissions of position-fixing systems which could adversely affect the performance of receivers fitted in ships shall be avoided as far as possible and only be affected after timely and adequate notice has been promulgated.*

* *Refer to the appropriate recommendations and guidelines of IALA and SN/Circ.107 – Maritime Buoyage System.*

2.7. SUMMARY

This report assesses the need for Saint Helena to adopt any of the following four-risk mitigation measures specified in SOLAS Chapter V:

- Routeing Measures – Regulation 10;
- Reporting Measures – Regulation 11;
- Vessel Traffic Services –Regulation 12; and
- Aids to Navigation – Regulation 13.

In all these cases the SOLAS obligations/requirement requests that contracting governments (e.g., Overseas Territories) provide such measures based on an assessment of:

- Volume of vessel traffic activity, and
- Degree of maritime risk.

This report will make recommendations as to which, if any, of the mitigation measures should be adopted based on the above assessment criteria and the methodology outlined in **Section 1.2.**

3. DATA COLLECTION AND PROCESSING

3.1. INTRODUCTION

This section provides an overview of the data collected and presented within this report, which forms the basis of the IWRAP risk modelling, thereby enabling judgement to be made on implementation of additional SOLAS Chapter V risk mitigation measures. The following data is required for the assessments:

- AIS data for identifying vessel transits within the EEZ and determining baseline vessel traffic;
- Bathymetry data for identifying areas that pose a grounding risk;
- Locations and details of existing aids to navigation to help determine where additional measures may be required; and
- Historical incident data to enable benchmarking of the IWRAP results.

3.2. TERRESTRIAL AND SATELLITE AIS DATA

Automatic identification systems (AIS) transponders provide information about a vessel to both other vessels and coastal authorities. AIS data can be used to track vessel movements, whilst also providing details on the vessel, such as unique identification, position, vessel type, length, and draught. SOLAS Chapter V, Regulation 19 stipulates that the following vessels must be fitted with AIS:

- All ships of 300 gross tonnage and upwards engaged on international voyages;
- Cargo ships of 500 gross tonnage and upwards not engaged on international travel; and
- Passenger ships irrespective of size.

Smaller vessels, fishing vessels and recreational craft are not obliged to carry AIS and therefore could be underrepresented in any analysis of AIS data. The ability of AIS data analysis to provide a representative picture of the vessel activity taking place is limited by the number of vessels carrying AIS. Small vessels, particularly recreational and fishing vessels, are unlikely to carry AIS and therefore will not be represented in the AIS datasets. Furthermore, small vessels may carry smaller AIS transmitters with lower range.

Both satellite and terrestrial AIS data were procured from MarineTraffic for 12 months between 1-Jan-19 and 31-Dec-19. The AIS data presented throughout this report is a combination of both satellite and terrestrial transmissions.

Terrestrial AIS receivers are land-based stations that are restricted to receiving AIS transmissions from vessels within their line of site. Terrestrial AIS receivers are also limited by curvature of the earth and AIS transponder power. Terrestrial receivers are therefore limited in their range and only suitable for identifying vessels within coastal waters.

Satellite receivers do not require line of sight and are able to receive AIS transmissions over a much larger region sufficient to survey the entire EEZ.

Preliminary vessel track plots were presented to the project team in order to ‘ground truth’ and confirm that the AIS data procured was representative of the vessel movements observed in situ and aligned with local expectations.

Analysis of AIS data provided by MarineTraffic was undertaken to ensure it met project requirements, this included a review of the:

- Temporal Distribution:
    - Total number of transmissions per day through the analysis year to ensure AIS data is captured every day and no sudden changes in transmissions occurs indicating AIS data capture issues.
    - Number of unique vessels captured by AIS, with the total indicating the number of transiting vessels per day within the study area; and
    - Temporal Distribution – the duration between subsequent AIS transmissions from a particular vessel which can be used to infer data quality.
- Spatial Distribution:
    - AIS transmission data was plotted so that coverage across the EEZ could be assessed and deficiencies identified; and
    - Visualization of AIS transmission data was undertaken to ensure any areas with poor coverage were identified.
- Data Fidelity:
    - Missing attributes, such as vessel type, draught and length, were identified within the dataset;
    - Missing or incorrect attribute data may result in incorrect vessel categorisation during analysis; and
    - This allows vessel data from other sources to be obtained and used to supplement the AIS data.

3.2.1. AIS TEMPORAL DISTRIBUTION

The total number of AIS transmissions ranged between approximately 100 and 4200 per day within the EEZ, peaking in January and lowest in August (**Figure 5**).

The total number of unique vessels (based on MMSI number) within the EEZ ranged between approximately 2 vessels in June and 29 in January (**Figure 6**).

Figure 7 shows that the time between AIS transmissions largely remained under 7 minutes, although some transmissions occurred up to 30 minutes apart.

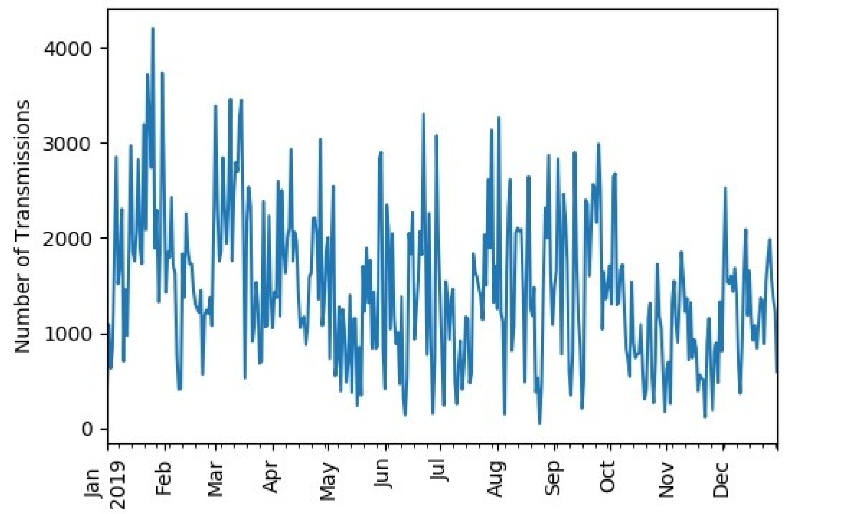


Figure 5: Total Number of Transmissions Per Day within the EEZ.

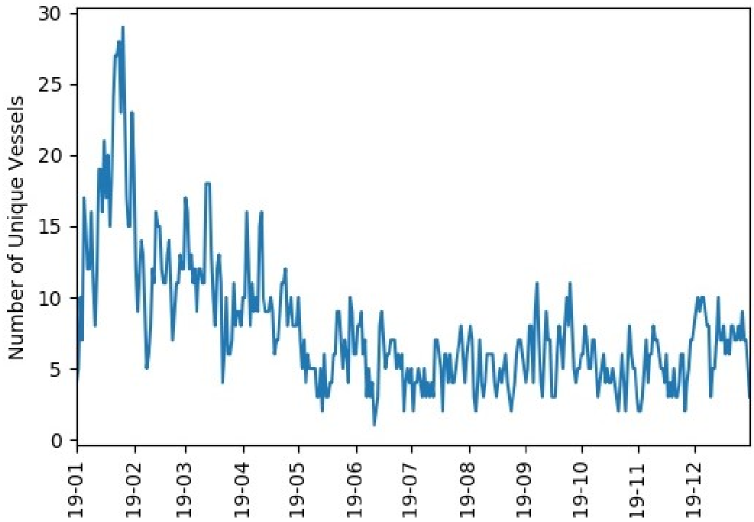


Figure 6: Total Number of Unique Vessels (based on MMSI number) Per Day within the EEZ.

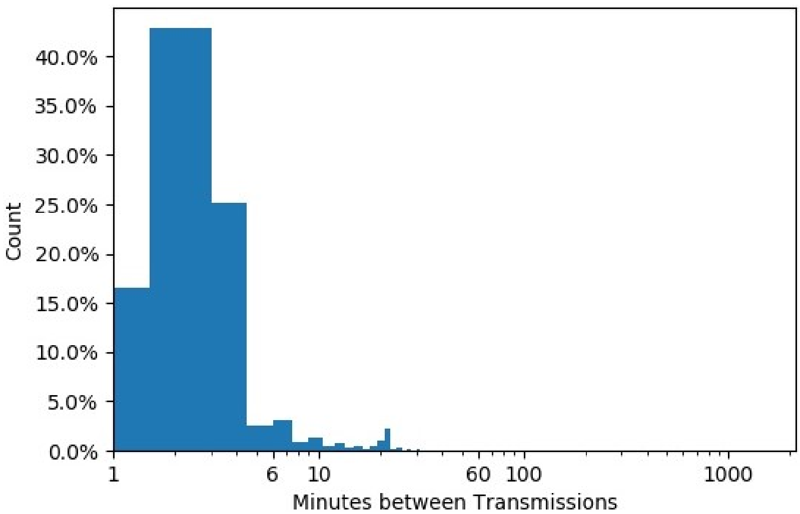


Figure 7: Time Between AIS Transmissions (Note logarithmic scale on x-axis).

3.2.2. AIS SPATIAL DISTRIBUTION

The extents of the AIS data procured were between 19° 26’ 19.537”S and 12° 33’ 24.034“S, and between 2° 07’ 34.884“W and 9° 16’ 04.138”W. **Figure 8** shows the extents of the AIS data and demonstrates that the AIS transmission data provides good coverage throughout the EEZ. For analysis, AIS data were clipped to the EEZ boundary. AIS data coverage was sufficient to track vessels throughout this study area.

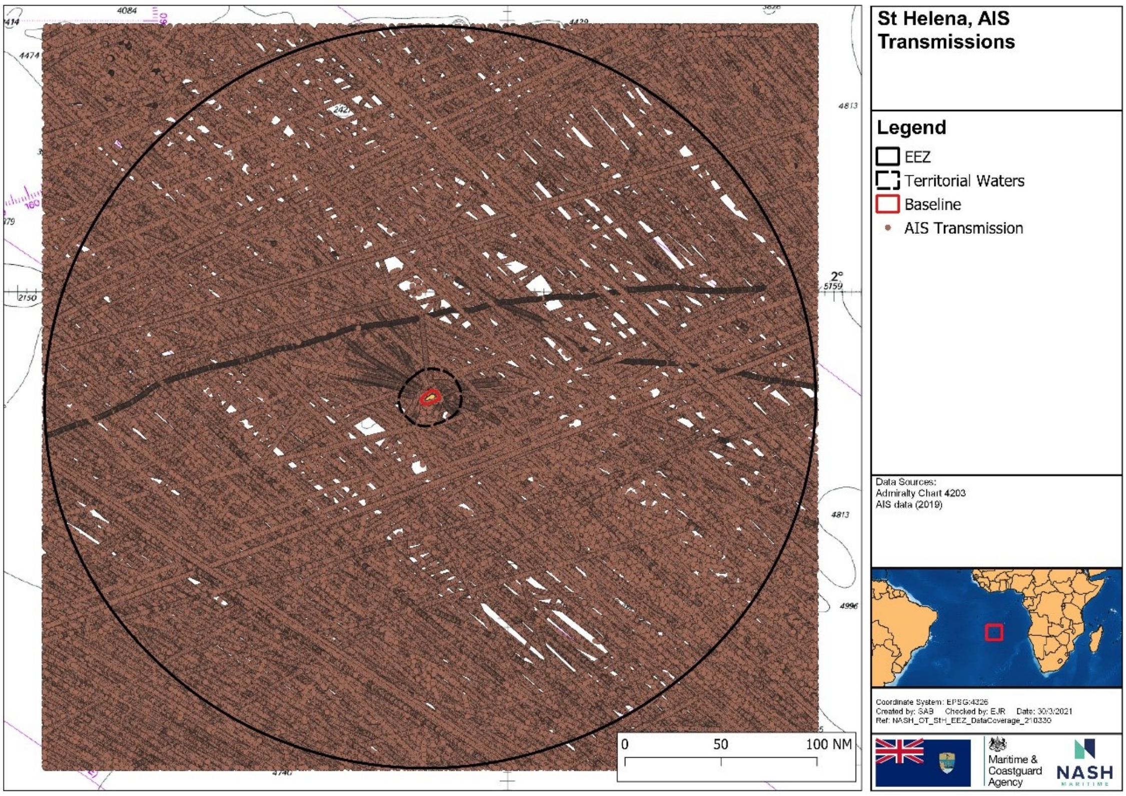


Figure 8: AIS Transmissions within the EEZ.

3.2.3. AIS DATA FIDELITY

The AIS data procured through MarineTraffic contained some missing attributes (e.g. vessel name or type). AIS transmissions with missing attribute data were identified and reviewed. Missing attribute values were supplemented using MMSI and IMO reference numbers to identify vessel name and type. Preliminary track plots were reviewed to identify unusual vessel movements and vessel categorisations were adjusted accordingly in consultation with the project team.

3.3. VESSEL MONITORING SYSTEM DATA

No vessel monitoring system data were provided.

3.4. BATHYMETRY

Bathymetry data is a key requirement for undertaking the IWRAP modelling exercise, as it allows areas with increased risk of grounding to be mapped geographically. Bathymetry data for inputting into IWRAP was collated using S57 and digitised raster Admiralty Charts provided by the UKHO. Depths greater than 30m were not included within the IWRAP model given that vessels transiting within the EEZ had a maximum draught of 25m.

3.5. NAVIGATION CHARTS

S-57 Standard Format is a type of electronic navigational chart (ENC) format. The S-57 ENC is a vector format digital chart, meaning that the hydrographic information contained within is a combination of descriptive and spatial characteristics. This allows information relating to bathymetry, aids to navigation and CATZOC scores to be retrieved and analysed. CATZOC is an attribute associated with the nautical chart and defines the reliability of the chart by defining the quality of the underlying hydrographic information. The additional information available with the S-57 format charts provides an advantage over traditional paper charts and are therefore preferred. S-57 format Admiralty charts were provided upon request by the UKHO, although some charts were unavailable due to permissions constraints. As a result, the S-57 charts available only provided partial coverage of the EEZ, and so additional charts were required. The S-57s provided are shown in **Table 3**.

Table 3: List of S-57 charts available for the EEZ.

Chart No.	Chart Name	Scale
GB327200	Saint Helena	1 : 90000
GB52721A	Rupert's and James Bay	1 : 12000
GB62721B	Ruperts Bay	1 : 4000

Admiralty raster charts were requested to supplement the S-57 charts and provided by the UK Hydrographic Office in GeoTIFF format (ARCS). These charts provided additional coverage of the study area and are used in the plots presented within this report. **Table 4** lists the raster charts available.

Table 4: List of raster charts available for EEZ.

Chart No.	Chart Name	Scale
1771	Saint Helena Apprs Ascension Island	Coastal
4203	Ascension Is Luanda to Walvis Bay	Overview

3.6. NATIONAL LEGISLATION

To better understand the legislative background to the authorisation, enforcement and geographic application of SOLAS Chapter V mitigation measures within Saint Helena Territorial Waters and EFZ, NASH Maritime Ltd requested legal guidance from Knightwood Legal. A comprehensive note providing:

- Details of the legislation that defines Saint Helena Territorial Waters, the baseline for which these are defined and the EEZ;
- The current legislative position regarding SOLAS Chapter V mitigation measures; and
- The future legislative position regarding SOLAS Chapter V mitigation measures.

A detailed summary of the note provided by Knightwood Legal can be found in **Section** Error! Reference source n ot found..

3.7. AIDS TO NAVIGATION

No information for aids to navigation were provided. Aid to navigation were identified through S-57 and raster Admiralty charts and are shown in **Figure 10.**

3.8. INTERFACE WITH SAINT HELENA MARITIME TEAM

A kick-off meeting was held on the 27-Nov-2020 to introduce the assessment methodology, data requirements and programme. Subsequently, biweekly meetings between the NASH Maritime project team and the relevant individuals from St Helena were held to provide project updates, discuss data availability and present vessel track plots and preliminary analyses. Feedback was requested for the results presented to ascertain whether the data was representative of the vessel traffic observed by the project team. Finally, a summary of the modelling results was provided, and recommendations were discussed. An outline of key meetings with the project team is shown in **Table 5.**

Table 5: Project Meeting Summary.

Date of Meeting	Meeting Notes
27-Nov-2020	**Kick-off Meeting:** - NASH project team presented PowerPoint introducing the scope of work, assessment methodology, data requirements and programme; - Potential data sources identified (e.g. AIS, Aid to Navigation); - No significant issues were identified; and - Bi-weekly project catch up meetings were agreed.
Held between 20-Jan-2020 and 31-Mar-2021	**Bi-weekly progress meetings:** - Provided general updates on project progress; and - Identifying outstanding data items.
20-Jan-2021	**Presentation of preliminary vessel traffic analysis plots:** - Track plots showing vessel traffic in the EEZ and Territorial Waters were presented to the project team; - Objective was to identify any AIS tracks which appeared erroneous or unexpected by the project team; and - Misclassified vessels were identified and corrected accordingly.
24-Mar-2021	**Meeting to discuss recommendations:** - Presented summary of results; and - Presented and discussed recommendations and requested data to support any recommendations. For example, data to show whether there has been a change in vessel traffic over the last 5 years.

3.9. ANY PREVIOUS NAVIGATION RISK ASSESSMENT OF COASTAL WATERS

No previous navigation risk assessments of coastal waters were identified.

3.10. MARINE SPATIAL PLANS

No marine spatial plans were identified.

3.11. INCIDENTS

No incident data were provided.

4. NAVIGATION DISPOSITION

The navigational disposition provides as an overview of shipping activity and the navigational features of Saint Helena EEZ and Territorial Waters. It is split into the following sections:

- **Key Navigation Features –** provides an overview of navigational features such as details on approaches to Saint Helena, ports, anchorages, fishing areas, etc.;
- **Meteorological Conditions –** provides details on weather and currents/tides;
- **SOLAS Measures –** documents existing SOLAS Chapter V measures in place; and
- **Vessel Traffic Analysis –** presents analysis of vessel activity based on collected data.

4.1. KEY NAVIGATION FEATURES

The navigation information described in this section has been extracted from Sailing Directions Pub. Pub. 123, Southwest Coast of Africa, Sixteenth Edition, 2017. The Sailing Directions have been corrected to up to 30 January 2021, including Notice to Mariners No. 5 of 2021.

4.1.1. OVERVIEW – SAINT HELENA

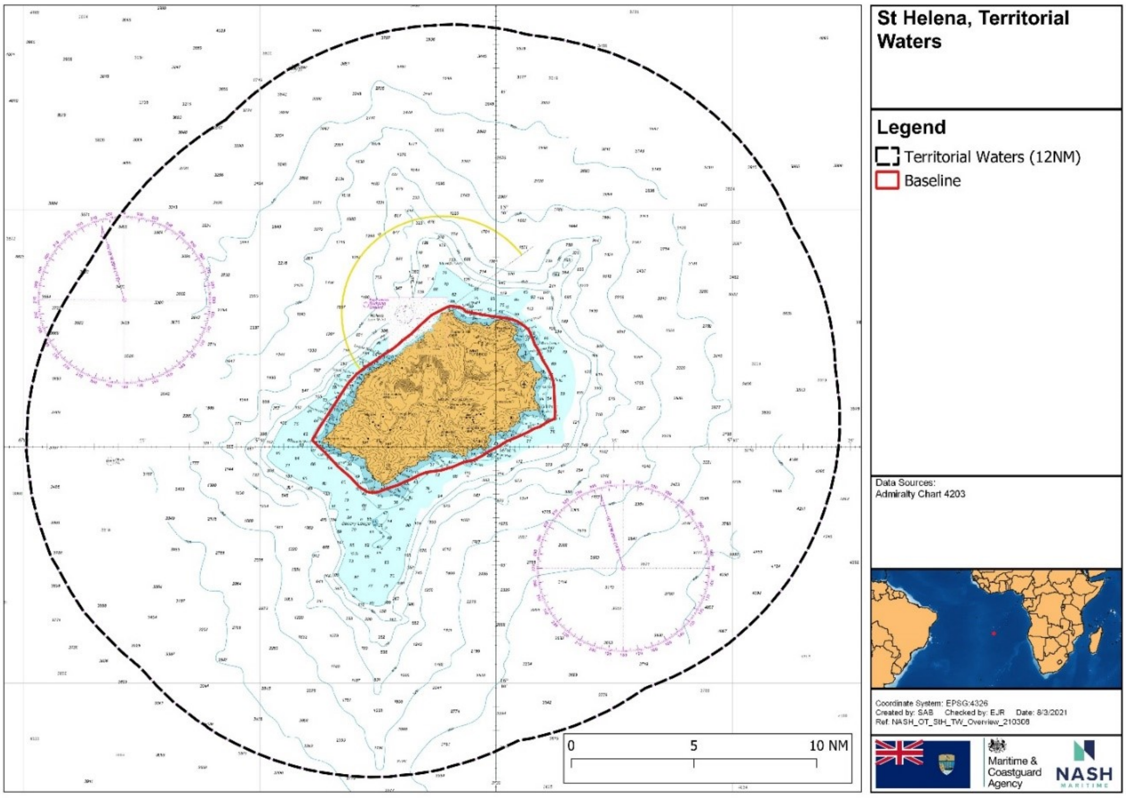


Figure 9: Saint Helena showing Territorial Waters.

Saint Helena Island (15°58'S., 5°42'W.) lies 703nm south-east of Ascension Island (**Figure 9**) is 47m² in area and composed largely of rugged terrain of volcanic origin. Jamestown the capital, is situated at the head of James Bay.

Landing is impracticable except on the north-west or leeward side of the island. In favourable weather, landing may be affected in Prosperous Bay and Sandy Bay, on the east and south sides, respectively, of the island.

Mv Helena (101m general cargo vessel) provides monthly calls to Saint Helena and quarterly calls to Ascension Islands from Cape Town and vice versa.

4.1.2. JAMESTOWN

Jamestown (15°55'S., 5°43'W.), the capital of Saint Helena Island, is situated at the head of James Bay. The bay is entered between Munden's Point and Ladder Hill Point, 0.4nm south-south-west. It provides an anchorage where cargo is worked from lighters.

James Bay and Ruperts Bay afford the only landing places on the island. Landing in ship's boats can usually be carried out at the wharf in James Bay. However, a dangerous swell can become heavy at times, especially during the months of January and February. During periods of heavy swell, it is better to lie off the landing place and make use of the shore boats to effect landing ashore.

A concrete wharf, 91m long, is situated on the north-east side of James Bay and has a depth of 2.7m alongside its outer end. The wharf is equipped with a crane for the discharge of lighters; steps at its north end are used by harbour launches to land passengers.

As marked on the chart there are several lighter and small craft moorings situated within James Bay.

There are numerous yellow and red yacht mooring buoys.

4.1.3. PROMONTORIES

Sugarloaf Point (15°54'S., 5°42'W.) is the northern extremity of Saint Helena Island. The land 0.3nm behind this point rises to Sugarloaf Hill, which has an elevation of 272m and is surmounted by a conspicuous white rock.

Buttermilk Point (15°54'S., 5°42'W.), marked by a light, is located 0.3nm west-south-west of Sugarloaf Point; Banks Point lies 0.2nm south-south-west of it.

Chubbs Point (15°55'S., 5°43'W.) is located 1nm south-west of Buttermilk Point. A light is shown from a mast standing on the north-west side of a building situated on this point and from the end of the breakwater extending north-east from the point. The wharf is reported to accommodate vessels up to 105m long with a draught of 5.5m.

Ruperts Bay (15°55'S., 5°43'W.) lies close north of Chubbs Point and is the site of a tanker discharging facility. A mooring buoy, to which the stern is secured, lies in the centre of the bay. Discharging is carried out through a floating hose, which is fixed to the shore by a gantry. Two range beacons, which assist vessels to berth, are situated on the east side of the bay and lead in an east direction. According to the Sailing Directions it is reported that these beacons have not been maintained and are difficult to identify.

Munden's Point (15°55'S., 5°43'W.) is located about 0.2nm west-south-west of Chubbs Point.

4.1.4. ANCHORAGES

Anchorage may be obtained off Ruperts Bay but in depths of not less than 30m due to the rollers, the Sailing Directions states that abandoned submarine cables lie in the vicinity. Anchorage may be taken as convenient off James Bay.

Three designated anchorage berths lie north, north-north-west, and north-west of Ladder Hill Point as shown on the Admiralty Chart.

4.1.5. PILOTAGE

Pilotage is not available but according to the Sailing Directions the harbour master will give advice to vessels on request.

4.1.6. TOWAGE

There is no available towage.

4.1.7. FISHING

A fish haven, shown on the chart, lies about 0.4nm west of Ladder Hill Point.

There was once an active commercial fishing operation out of Saint Helena. On 28th February 2020, the Government of Saint Helena announced that PQ Trading STH (Pty) Ltd had been endorsed to undertake fish processing operations on Saint Helena, with a plan to develop a co-operative called the Saint Helena Fisheries Co-operative[3].

4.1.8. DEPTHS AND LIMITATIONS

A historic wreck lies 0.3nm west-north-west of Munden's Point, anchoring is prohibited as marked on the chart.

Dangerous wrecks lie within James Bay about 150m and 250m north-north-east of Ladder Hill Point.

There is a detached shoal, with a depth of 66m, was reported (1974) to lie about 2nm north of Buttermilk Light.

A detached shoal, with a depth of 68m, lies about 4.3nm west-north-west of Chubbs Point Light.

A large wreck area, with a least depth of 17.8m, lies about 0.4nm north-north-west of Ladder Hill Point and a foul area, in which ammunition has been dumped, is located close north-east of it.

4.1.9. MAGNETIC ANOMALY

A local magnetic anomaly, causing variations of up to 7° greater than charted, was reported (1972) to exist in the vicinity of Munden's Point.

4.1.10. EXPLOSIVES DUMPING GROUND

An explosive dumping ground, as shown on the chart, sits about 3nm north-west of Jamestown. It consists of a circle, with a 0.2nm radius, centred on position 15°54.0'S, 5°45.5'W.

[3] Fish Processing | Saint Helena Island Info: All about St Helena, in the South Atlantic Ocean

4.1.11. FIRING PRACTICE AREA

There is a firing practice area marked on the chart on the north-east coast between North Point and North East Point.

4.1.12. OFF-LYING SEAMOUNTS

Cardno Seamount (12°53'S., 6°08'W.), with a depth of 77m, lies 180nm north of Saint Helena Island. A seamount, with a depth of 115m, lies 90nm north-north-east of Cardno Seamount.

Bonaparte Seamount (15°45'S., 6°52'W.), with a depth of 105m, lies 70nm west-north-west of Saint Helena Island.

Dampier Seamount (11°09'S., 0°28'W.), with a depth of 594m, lies 430nm north-east of Saint Helena Island.

Kutuzov Seamount, with a depth of 410m, lies 155nm west-north-west of Saint Helena Island.

An **unnamed seamount**, with a depth of 515m, lies 170nm north-west of Saint Helena Island and about midway between Cardno Seamount and Kutuzov Seamount.

4.2. METEORLOGICAL CONDITIONS

The following section provides a general overview of weather, wind, and tidal/currents in the study area.

4.2.1. WINDS AND WEATHER

The climate of Saint Helena is tropical, and mild, tempered by the Benguela Current and trade winds that blow almost continuously.

The south-east wind is prevalent in James Valley and Rupert Valley, but where there is high ground the prevailing wind is deflected so that a light north-east wind blows along the north-west side of the island. The interaction of this wind and the main south-east wind causes a confused sea in the vicinity of Ruperts Bay and Sugarloaf Point.

4.2.2. TIDES AND CURRENTS

The tidal rise at Saint Helena Island is 0.9m at MHWS and 0.7m at MHWN. The tidal current in James Bay is reported to set north during the rising tide and south-west during the falling tide.

The most singular phenomenon connected with this part of the ocean is the setting in of very heavy continuous swells or rollers from north-north-west. They are most prevalent during the months of January and February, when the waves break on the north-west coast of Saint Helena. The Sailing Directions advise that when rollers are setting in, landing in ships boats is dangerous. These rollers rise without any apparent cause for, as a rule, the weather is good and the wind light. If a vessel is moored in a depth of 31m there is no danger, as the rollers only commence to be dangerous within about 200m of the shore.

Local reports indicate that December to March is the time when rollers are most frequent. Ruperts Bay is reported to be more affected than James Bay. Up to 3 day's warning of rollers from the north-west may be passed from Ascension Island by radio, which is relayed to ships via VHF by Saint Helena Radio.

4.3. SOLAS MEASURES

IMO's responsibility for ships' Routeing, Reporting, and VTS is enshrined in SOLAS Chapter V, which recognises the Organisation as the only international body for establishing such systems (see **Section 2**).

4.3.1. ROUTEING MEASURES

There are no IMO routeing schemes within the Saint Helena EEZ study area.

4.3.2. REPORTING MEASURES

There are no IMO reporting schemes within the Saint Helena EEZ study area.

4.3.3. VESSEL TRAFFIC SERVICES (VTS)

There is a local port services operating on VHF Channels 16 and 14.

4.3.4. AIDS TO NAVIGATION

Figure 10 shows the disposition of Aids to Navigation for Saint Helena.

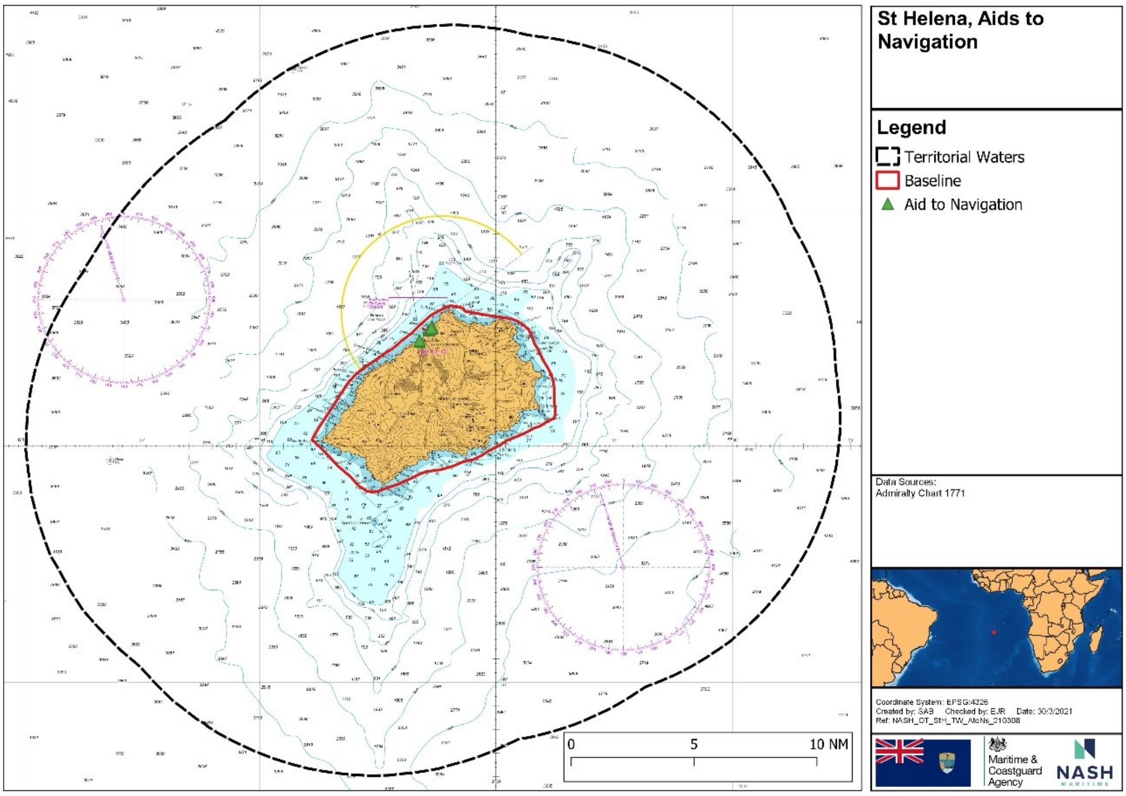


Figure 10: Saint Helena showing Aids to Navigation.

4.4. VESSEL TYPE ANALYSIS

This section presents analysis of vessel type and size passing through Saint Helena Territorial and EEZ waters using 12-months of AIS data for 2019. To produce the track plots the following steps were undertaken:

1. In all 113 different vessel sub- types were identified in the AIS transmissions received. In order present meaningful vessel track and density plots each vessel was categorised as either a cargo, fishing, passenger, recreational, tanker or tug and service vessel. Vessel type plots were produced using the vessel categories. **Table 6** gives a summary of the type of vessel sub-types included within each category;
2. Where values were missing e.g., loa, draught, vessel sub-type vessels were looked up and the missing data was input manually;
3. Initial track plots were produced to identify any anomalous vessel tracks, these were then investigated, and corrections were made to the data, as necessary e.g., a number of vessels were transmitting incorrect draught and loa;
4. The data was processed to maximum 3-hour time thresholds; and
5. The data was then clipped to the EEZ.

Initial track plots for each vessel category as well as track plots classifying vessel by length were presented to the Saint Helena project team. Any anomalous tracks identified were and corrected before the final track and density plots were completed.

Table 6: Summary of Vessel Categories.

Vessel Category	Summary of Vessel Types Included in Category
Cargo	Bulk Carriers, Container Ships, Ro-Ro Cargo, Vehicle Carriers
Fishing	Trawler, Fish Factory, Fish Carriers
Passenger	Passenger Ships, Ferry, Inland Ferry, High Speed Craft
Recreational	Yacht, Pleasure Craft, Sailing Vessel
Tanker	Oil Tanker, LPG Tanker, Chemical Tanker
Tug & Service	Tugs, Survey Vessel, Dredgers, Naval Vessels, Heavy Lift Ships, Pilot Vessels, Patrol Vessels

Vessel lengths were categorised using 50m increments and analysed using the following ranges:

- 0 - 50m;
- 50 - 100m;
- 100 -150m;
- 150 - 200m;
- 200 - 250m; and
- 250 - 300m.

Vessel draughts were categorised in 2.5m increments and analysed using the following ranges:

- 0 – 2.5m;
- 2.5 – 5m;
- 5 – 7.5m;
- 7.5 – 10m;

- 10 – 12.5m;
- 12.5 – 15m; and
- >15m.

Both track and density plots are presented to show vessel traffic by vessel type, draught, and length. Track plots were produced using AIS transmissions filtered to 3hr intervals and clipped to the EEZ.

It should be noted that density plots covering the entire EEZ use a larger grid size than density plots showing the Territorial Waters, therefore symbology between different scale plots are not directly comparable. Density plots covering the entire EEZ were produced using a 1,000m x 1,000m grid cell size, and a smaller 250m x 250m grid cell size for Territorial Waters.

4.4.1. ALL VESSEL TRACKS

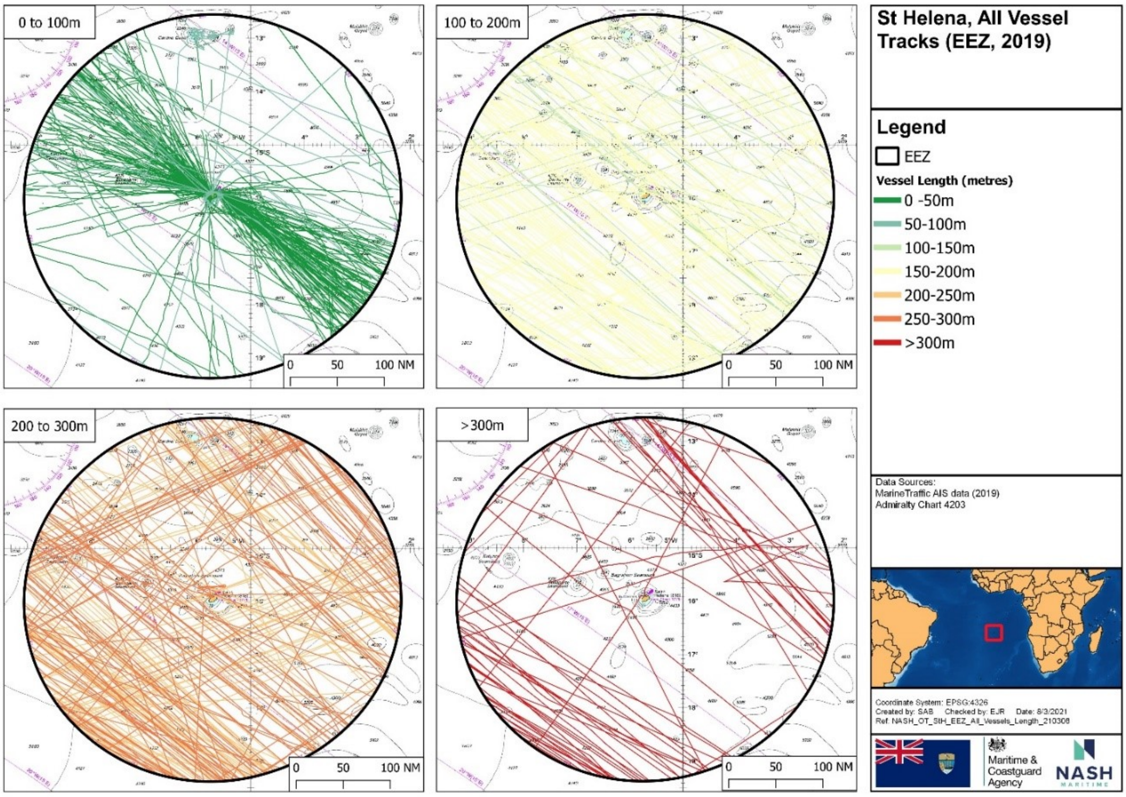


Figure 11: EEZ All-Vessel Tracks by loa.

The all-vessel tracks within the EEZ, by vessel length overall (loa), are shown above in **Figure 11**. The general traffic flow within the EEZ is in a north-westerly/south easterly direction, although there is evidence of vessel traffic heading to and from West African and South American ports.

Smaller vessels i.e., those <100m are shown as heading to and from Saint Helena from both the north-west and south-east. The plot indicates that vessels >100m transit throughout the EEZ passing clear of Saint Helena other than a few instances of larger vessels including one >300m heading to Jamestown.

Figure 12 shows the all-vessel density within the EEZ. Other than a spike of traffic heading to and from Jamestown the level of traffic is considered relatively low.

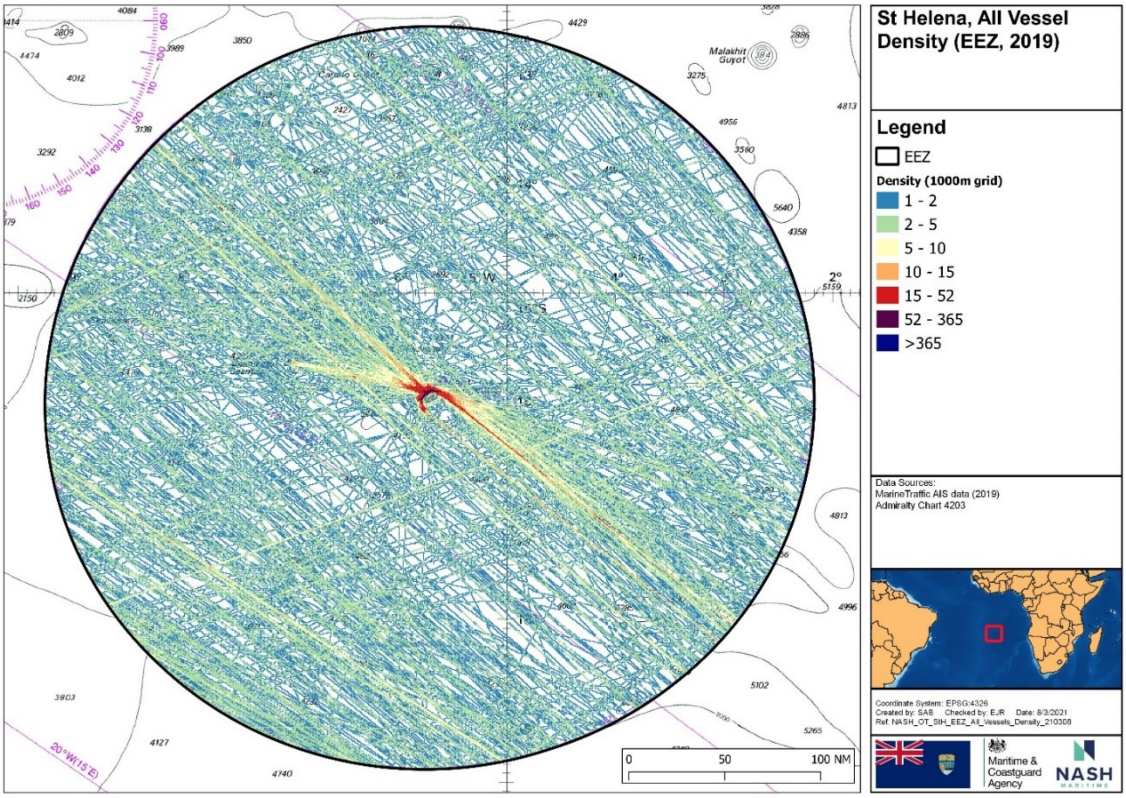


Figure 12: EEZ All-Vessel Density – 100m grid.

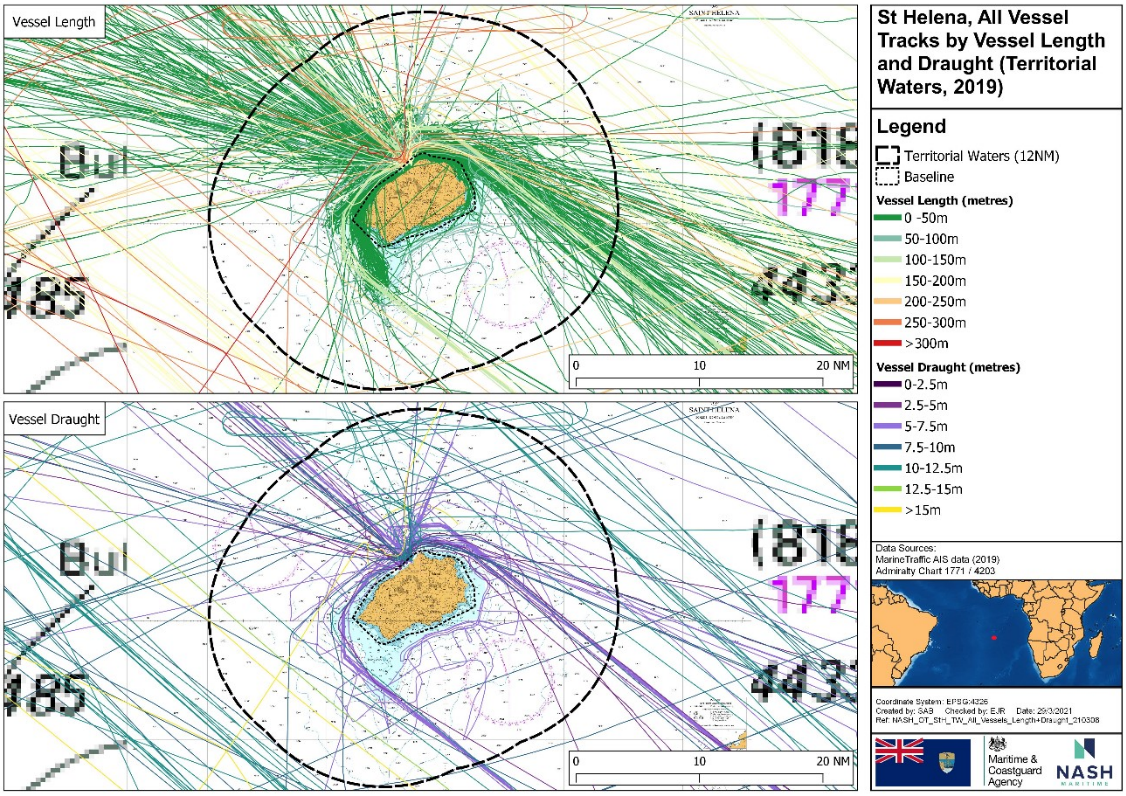


Figure 13: Territorial Waters All-Vessel Tracks by loa and Draught.

All-vessel tracks by loa and draught in Territorial Waters are shown in **Figure 13** verifying that the vessels transiting through the area are mainly around 100m loa with a draught of <7.5m. There are few exceptions to this with one vessel >300m heading to and from Jamestown.

The level of all-vessel traffic density can be seen in **Figure 14,** demonstrating that other than an expected spike heading to and from Jamestown traffic levels are relatively low.

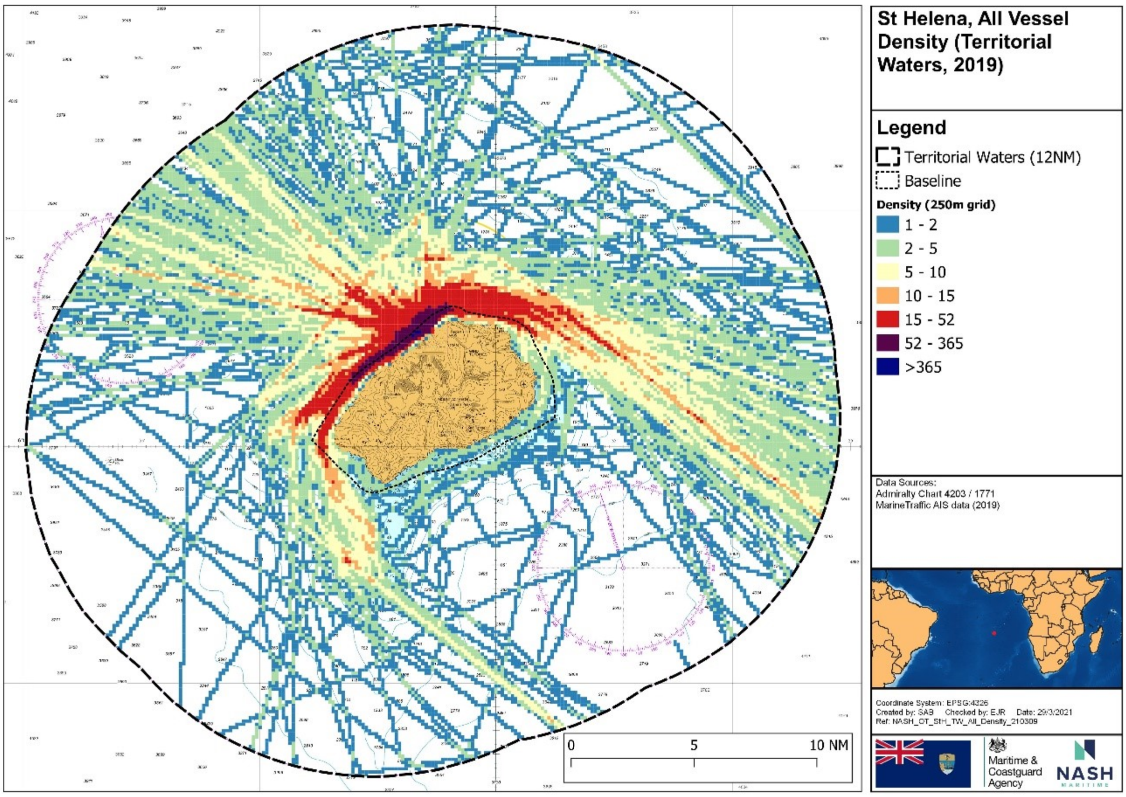


Figure 14: All-Vessel Density Territorial Waters - 250m grid.

4.4.2. CARGO VESSELS

Cargo vessel transiting through the EEZ (**Figure 15**) show the majority of this vessel type are <300m and, the density plot (**Figure 16**) shows a wide distribution of cargo vessels in the EEZ.

The Territorial Waters cargo vessel plots showing loa and draught (**Figure 17)** and density (**Figure 18**) confirm the level of activity is relatively low with, other than a few exceptions the majority of vessels in the area heading to and from Jamestown.

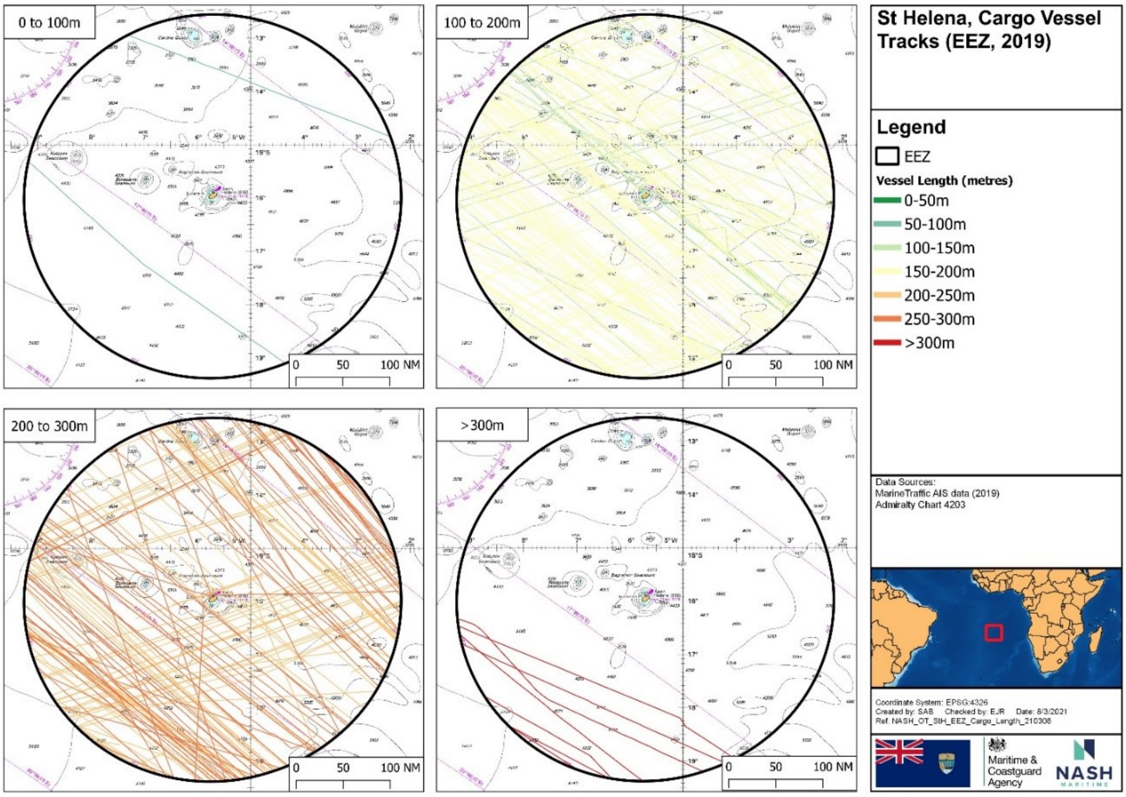


Figure 15: EEZ Cargo Vessel Tracks by loa.

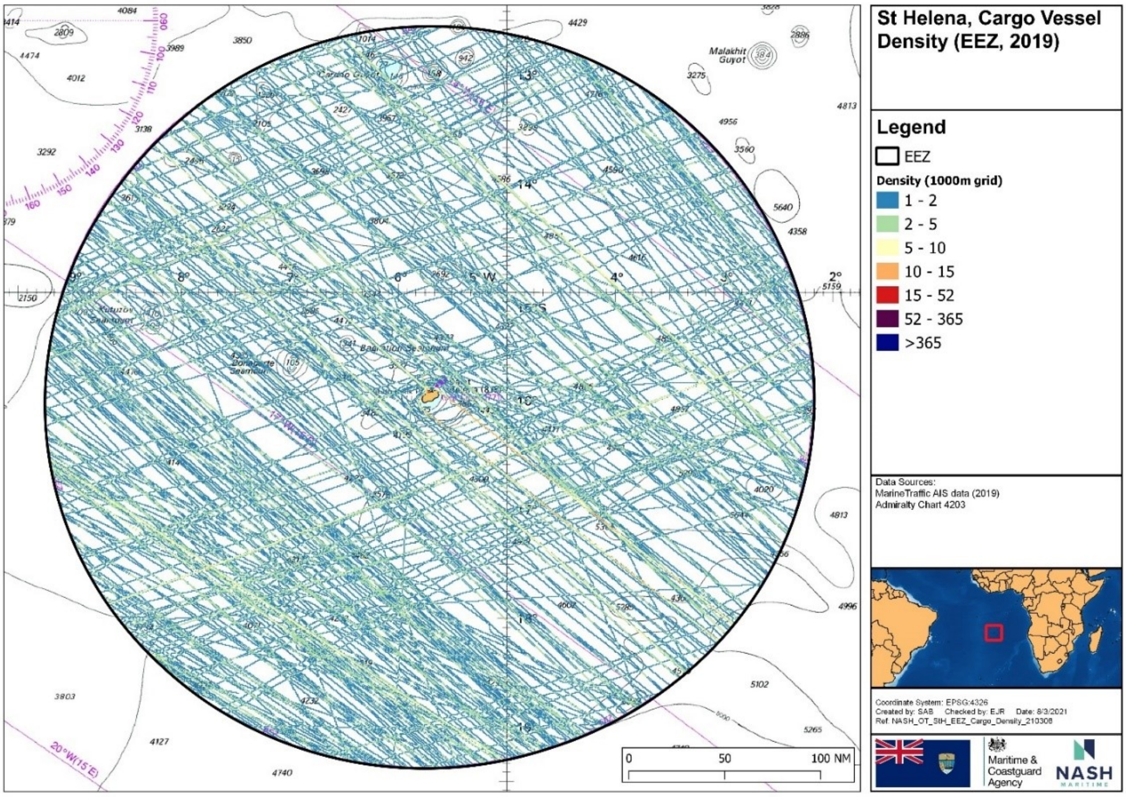


Figure 16: EEZ Cargo Vessel Density.

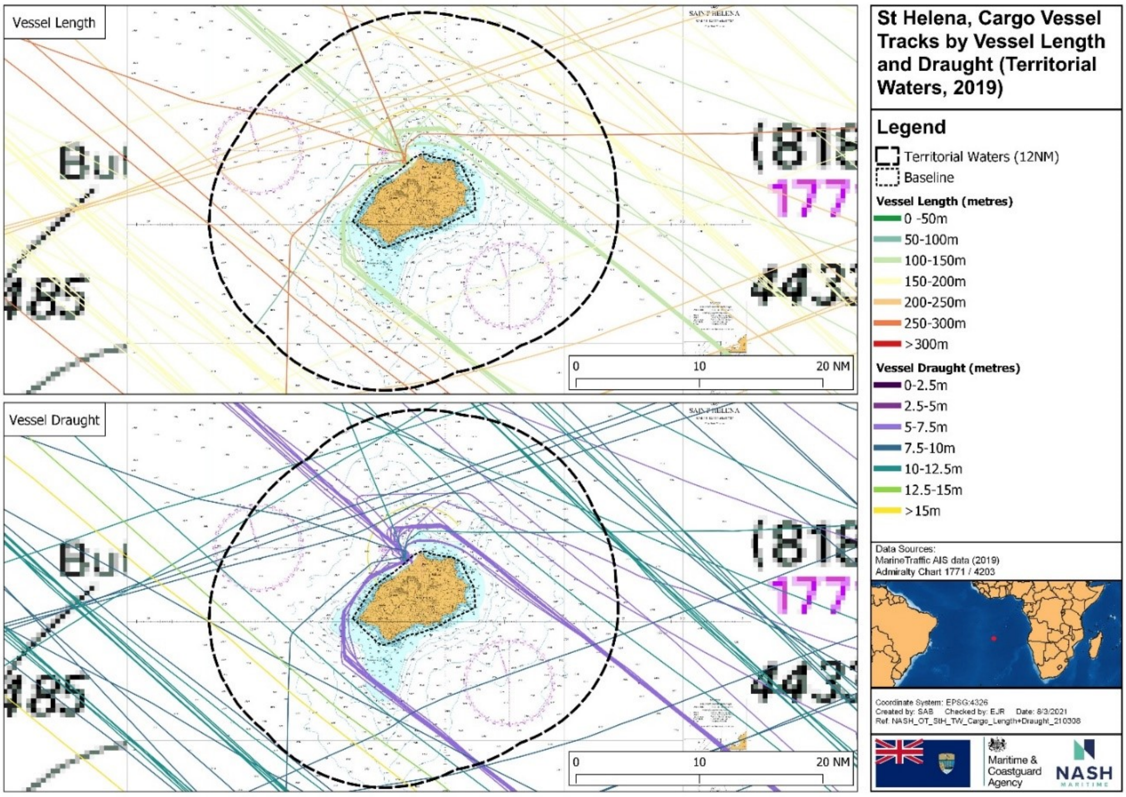


Figure 17: Territorial Waters Cargo Vessel Tracks by loa and Draught.

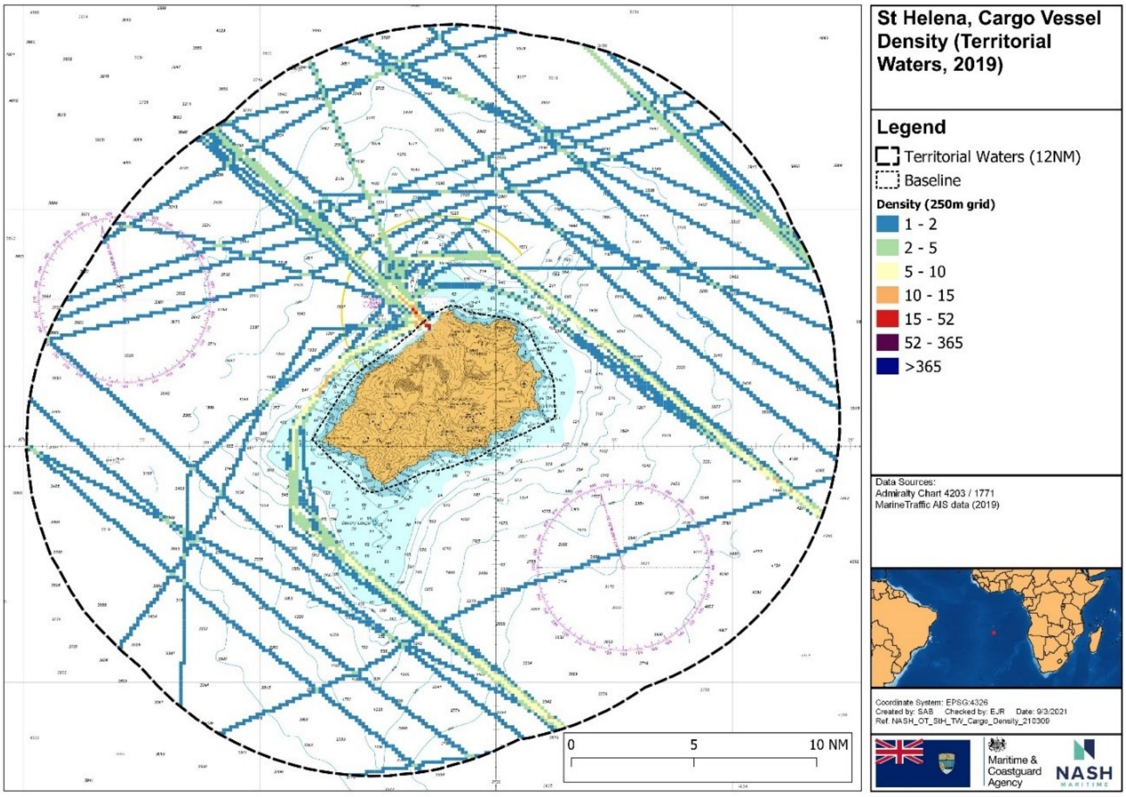


Figure 18: Territorial Waters Cargo Vessel Density.

4.4.3. FISHING VESSELS

As would be expected fishing vessel activity in the EEZ (see **Figure 19** and **Figure 20**) is low. Fishing vessels *John Mellis* (10m loa) and *Extractor* (22m loa), both registered in Saint Helena are seen heading to and from Jamestown and Bonaparte Seamount.

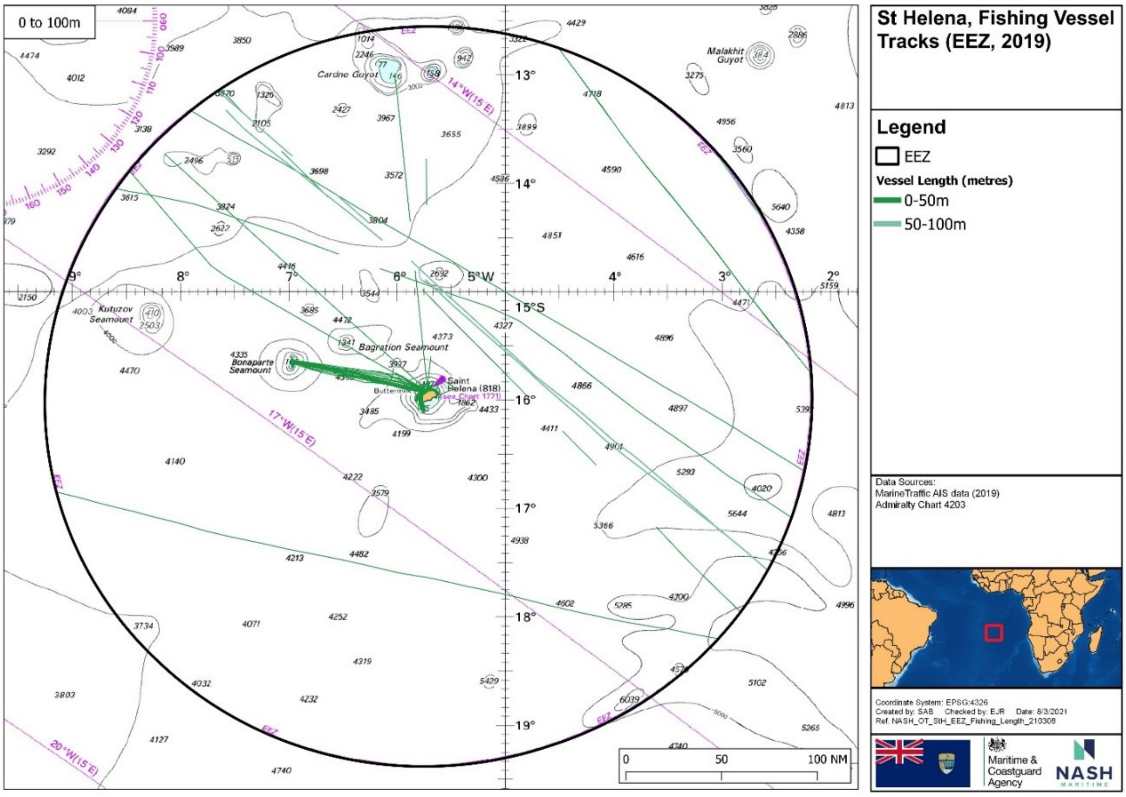


Figure 19: EEZ Fishing Vessel Tracks by loa.

The fishing vessel plots in the rest of this section show there is some activity in and around the inshore waters of Saint Helena with f/v *John Mellis*, 10m loa, shown as regularly transiting to and from Jamestown and Bonaparte Seamount, 70nm west-north-west of the island (see **Section 4.1.2**).

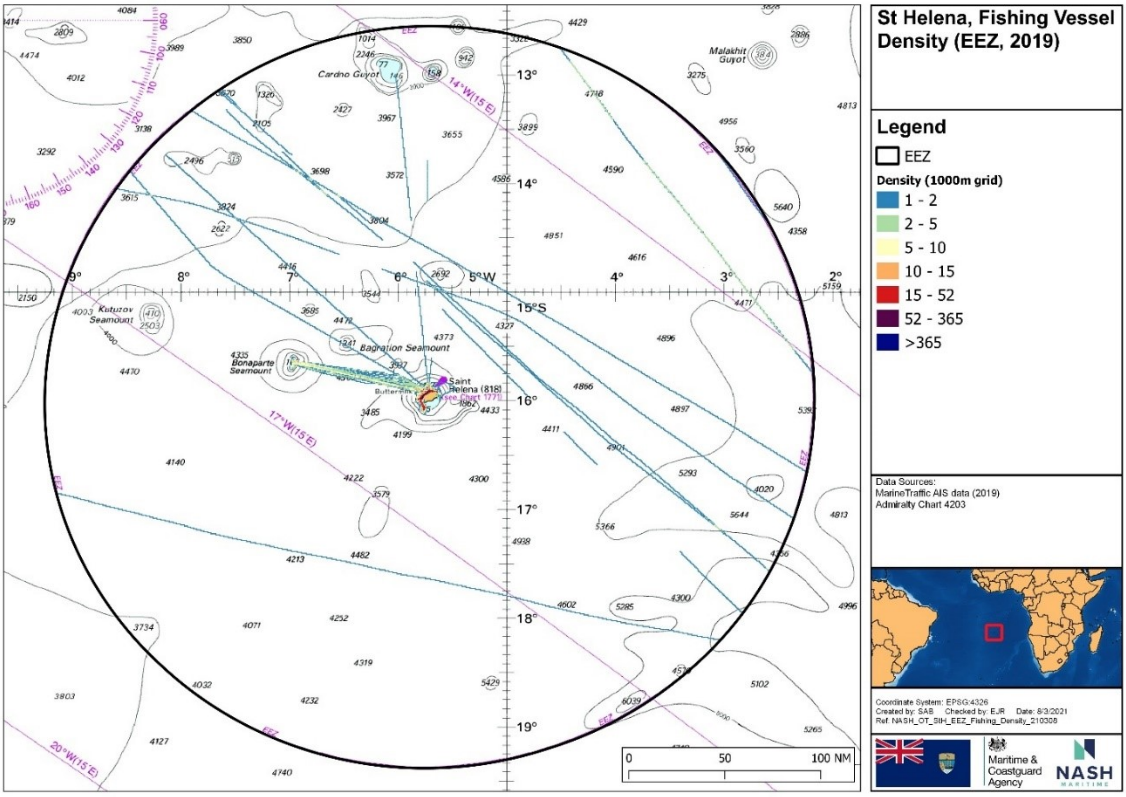


Figure 20: EEZ Fishing Vessel Density.

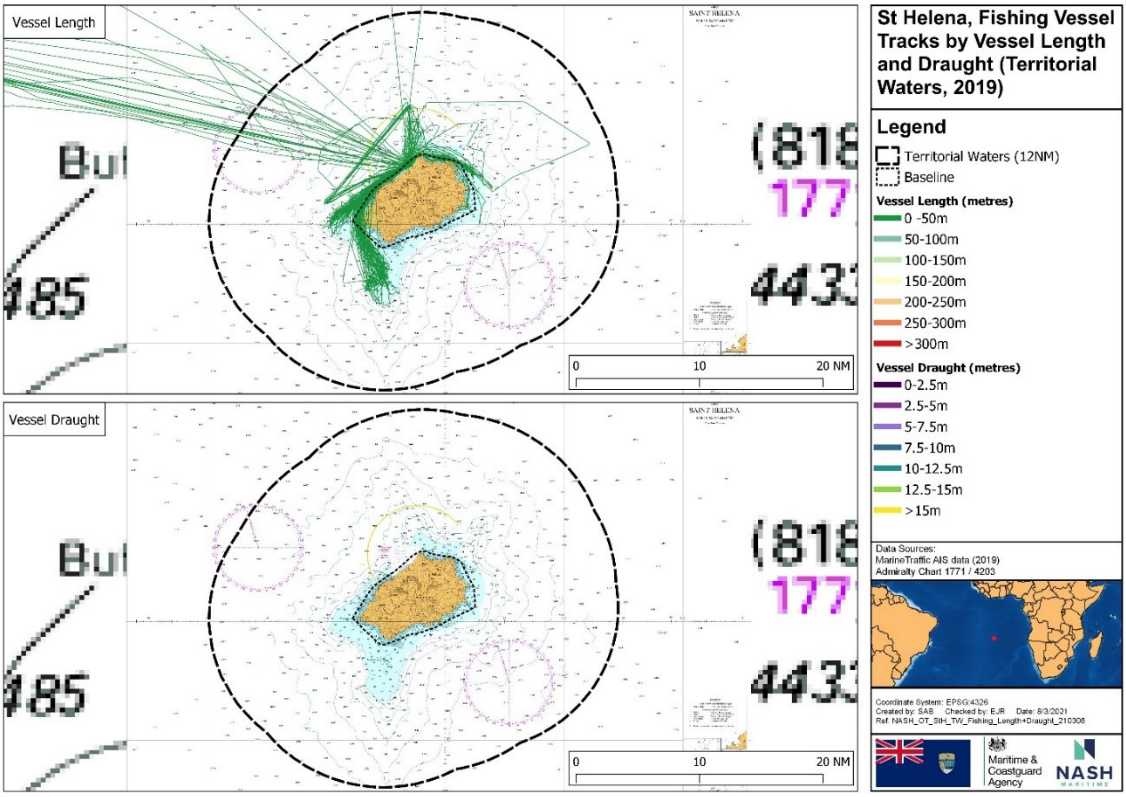


Figure 21: Territorial Waters Fishing Vessel Tracks by loa and Draught.

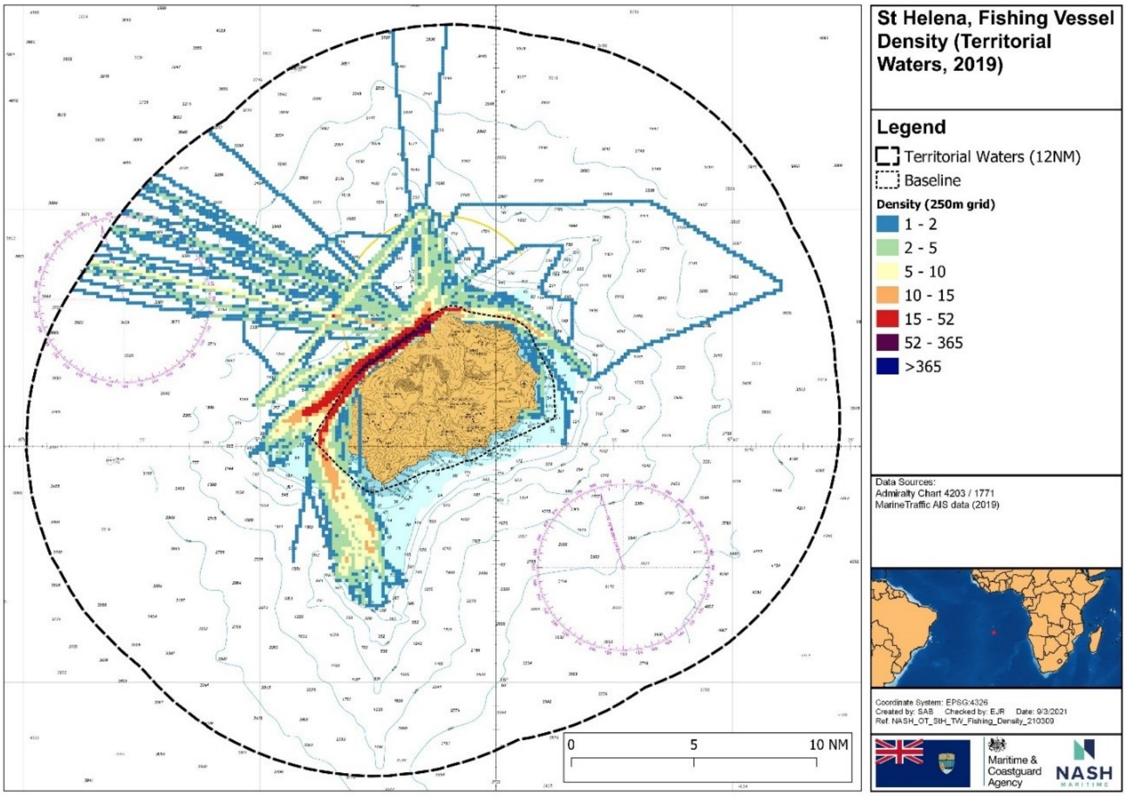


Figure 22: Territorial Waters Fishing Vessel Density.

4.4.4. PASSENGER VESSELS

The four passenger vessel plots (**Figure 23, Figure 24, Figure 25,** and **Figure 26**) in this section for both the EEZ and the Territorial Waters indicate that all of these vessels were heading to and from Jamestown. The medium sized cruise vessels were identified as: *mv Albatross* (178m loa)*; Pacific Princess* (181m), *Saga Pearl II* (165m), *Boudicca* (178m) and *Seven Seas Explorer* (223m).

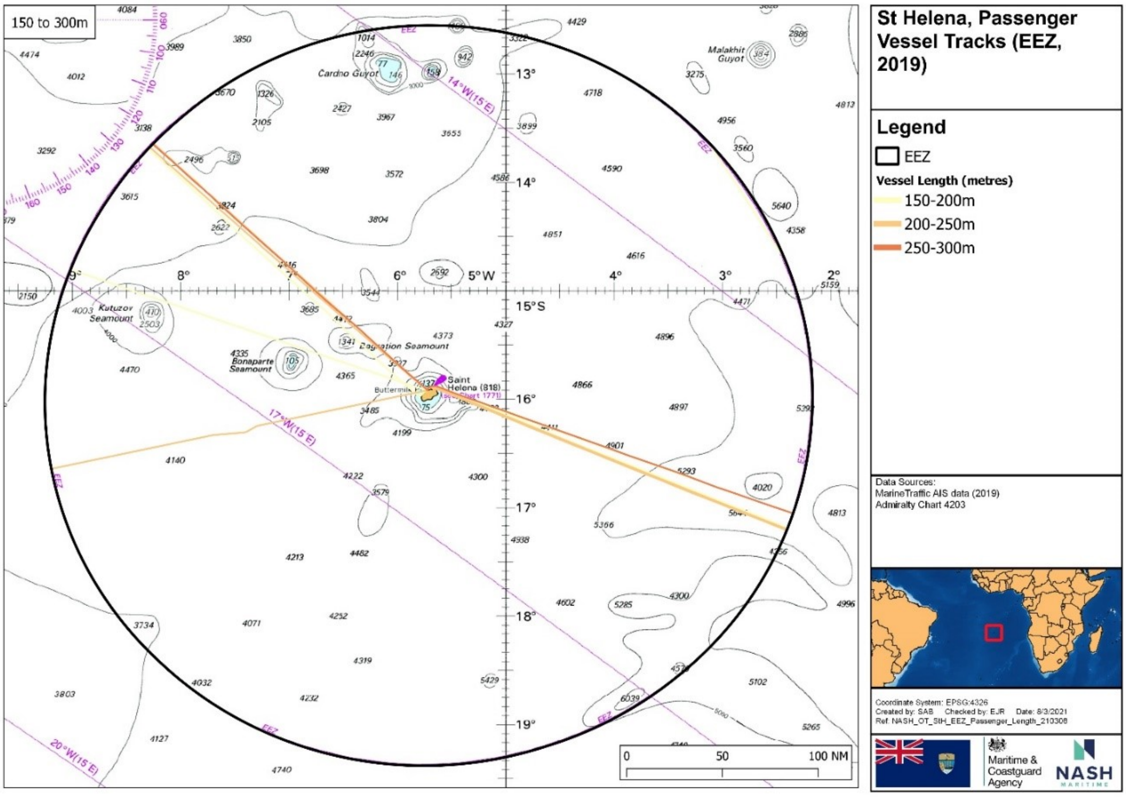


Figure 23: EEZ Passenger Vessel Tracks by loa.

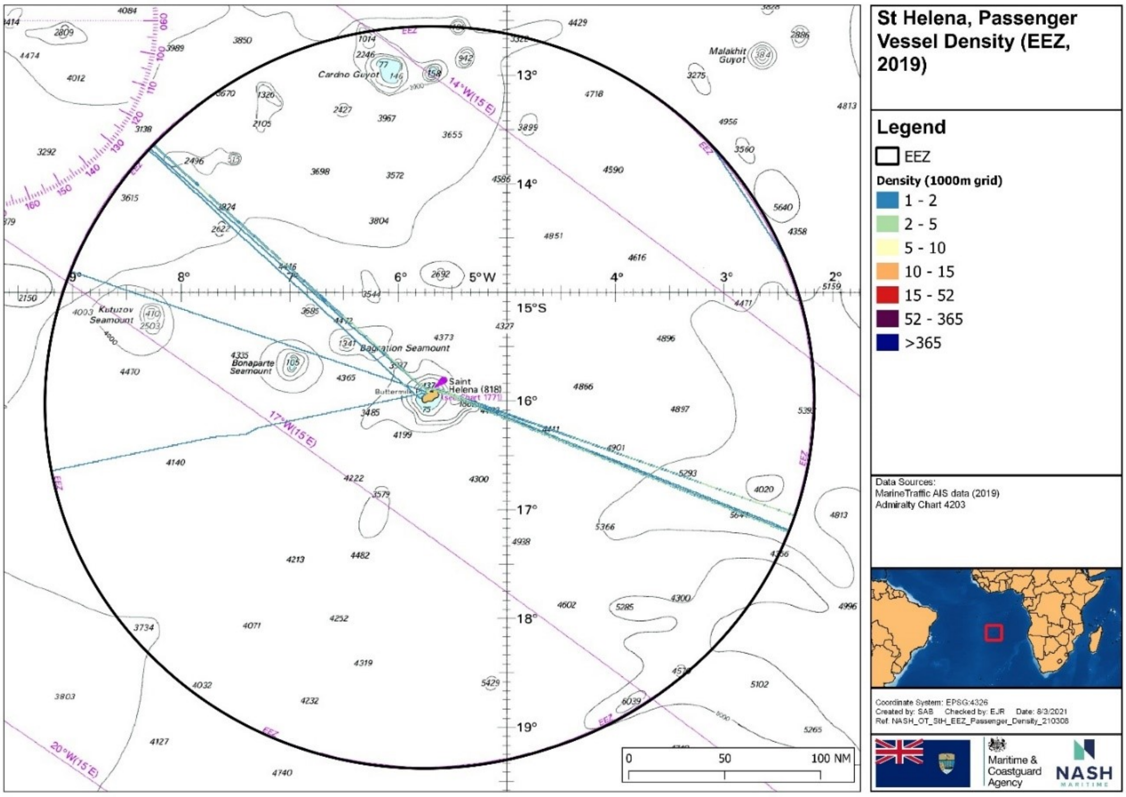


Figure 24: EEZ Passenger Vessel Density.

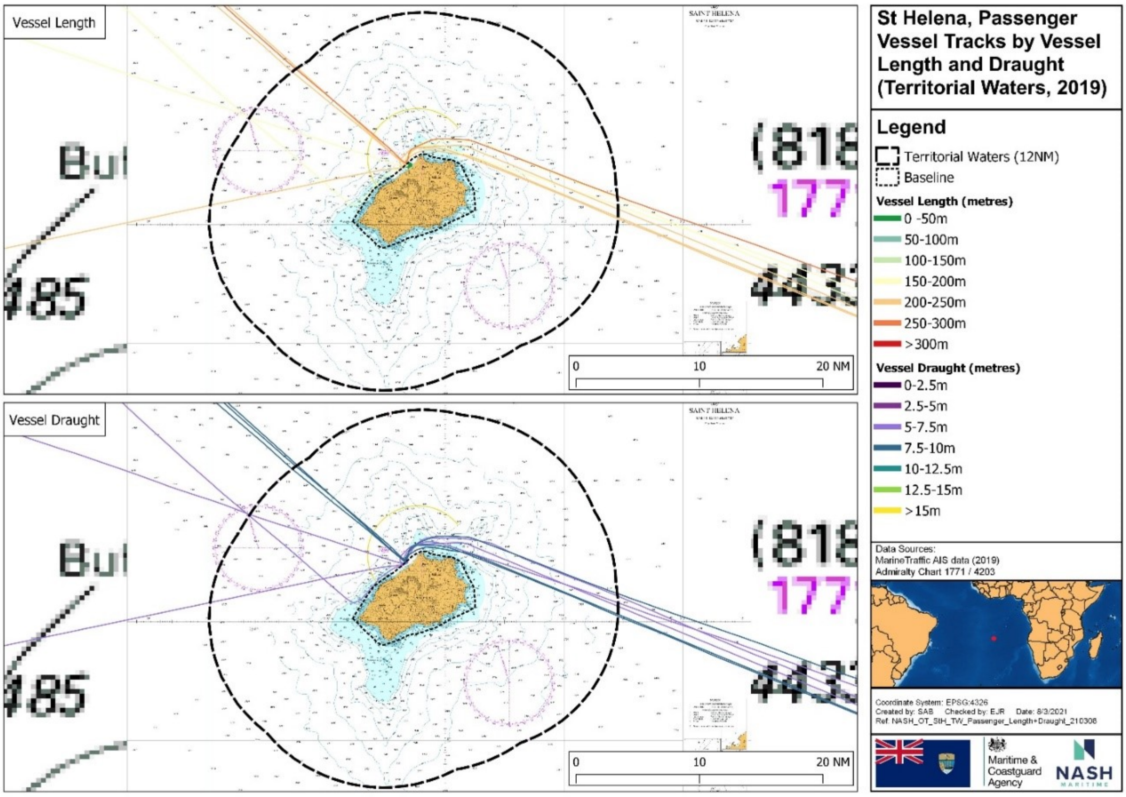


Figure 25: Territorial Waters Passenger Vessel Tracks by loa and Draught.

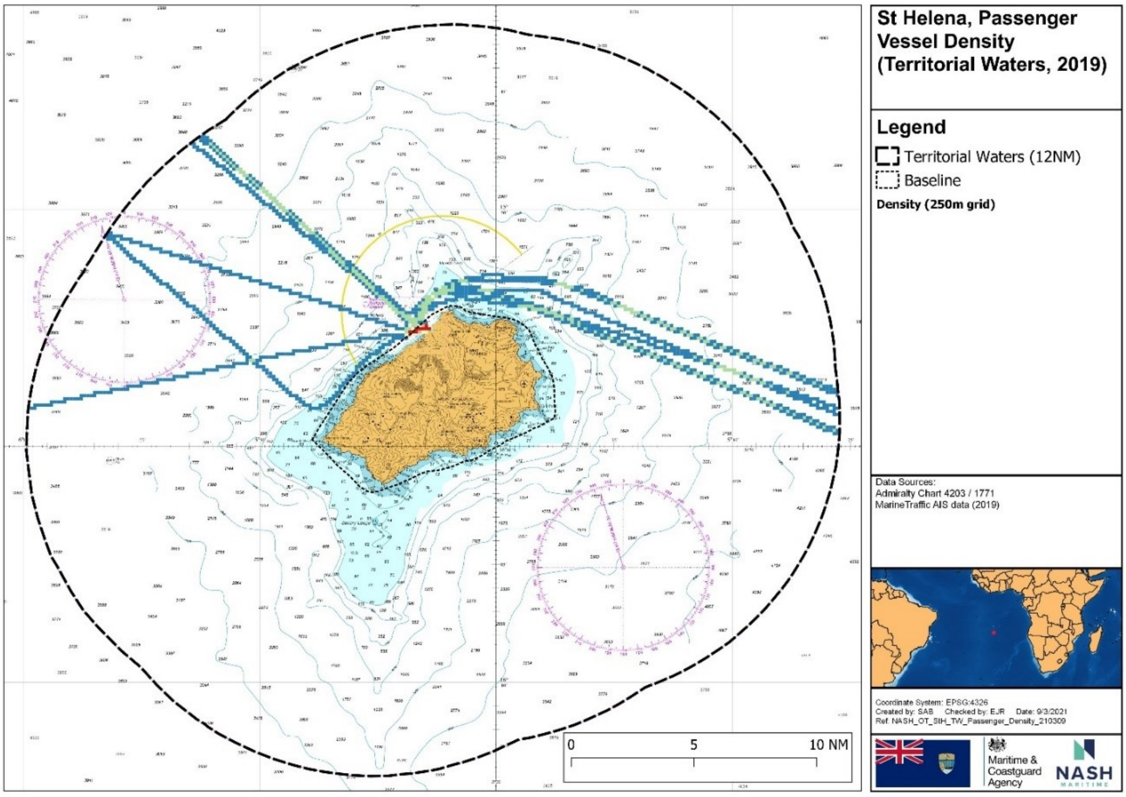


Figure 26: Territorial Waters Passenger Vessel Density.

4.4.5. RECREATIONAL VESSELS

As to be expected recreational vessels in the EEZ (see **Figure 27**) are generally less than 50m loa and can be clearly seen heading to from Jamestown from the north-west and south-east.

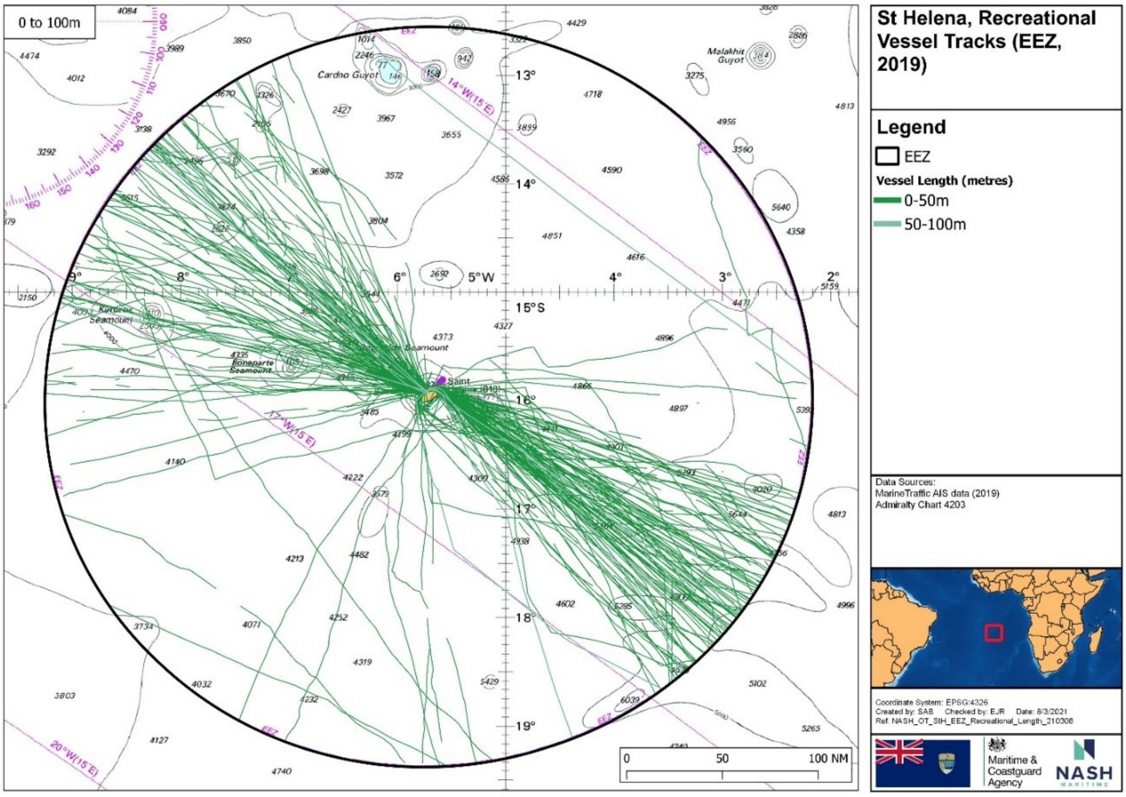


Figure 27: EEZ Recreational Vessel Tracks by loa.

The EEZ density plot for recreational vessels (**Figure 28**) shows the level activity is low and confined to the north-west and south-east areas.

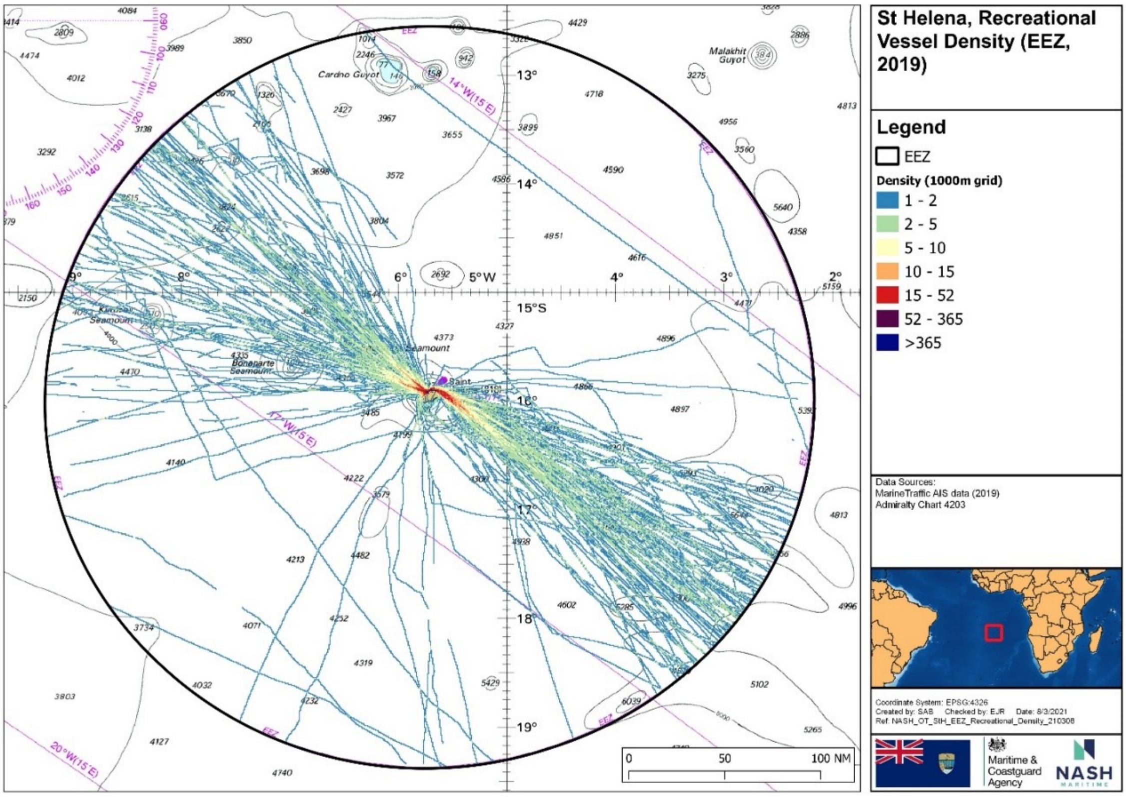


Figure 28: EEZ Recreational Vessel Density.

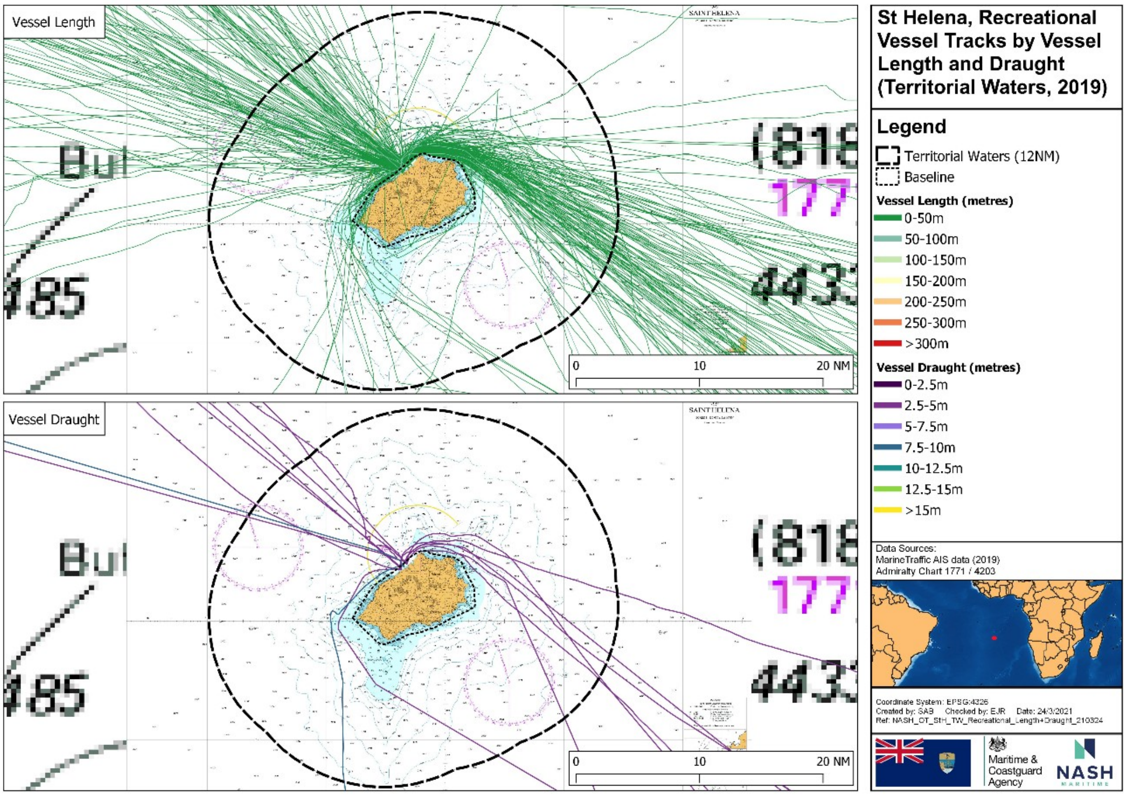


Figure 29: Territorial Waters Recreational vessel tracks by loa and draught.

The loa and draught plots for recreational vessels (**Figure 29**) within Territorial Waters are generally <50m loa, with draughts <5m.

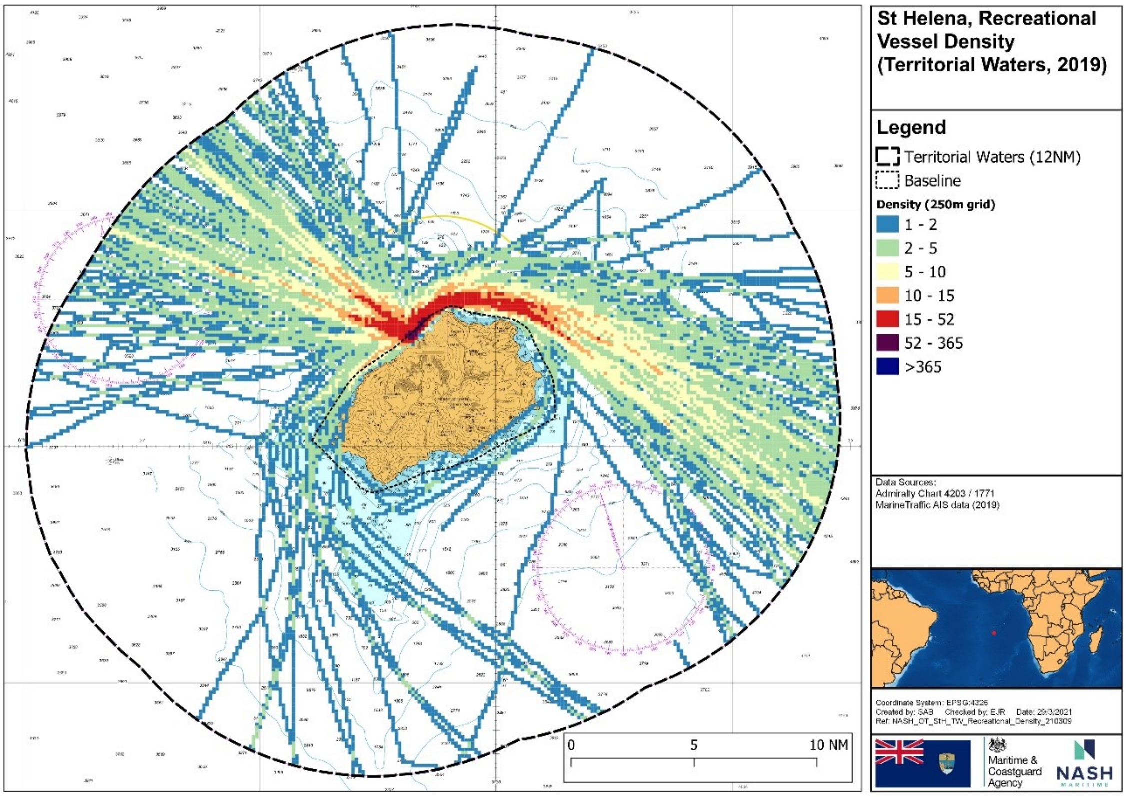


Figure 30: Territorial Waters Recreational Vessel Density.

The recreational vessel density plot (see **Figure 30**) identifies the key north and south transit routes for this vessel type when approaching and departing the island.

4.4.6. TANKERS

Tanker tracks by loa within the EEZ are shown in **Figure 31** and as expected are generally between 100m - 300m loa.

The EEZ tanker density plot (see **Figure 32**) shows the active routes are primarily in the south-west region of the EEZ with some evidence of routes heading in a north-easterly/south-westerly direction in the north-west quadrant.

Figure 33 indicates the level of tanker activity by vessel loa and draught in Territorial Waters is minimal. The large tanker showing close inshore off James Bay is the VLCC *Arafura* embarking crew members.

The tanker density plot (**Figure 34**) confirms most of this vessel type arrive and depart Jamestown from the north and south. Tankers transiting through Territorial Waters are generally confined to the northern half of the area.

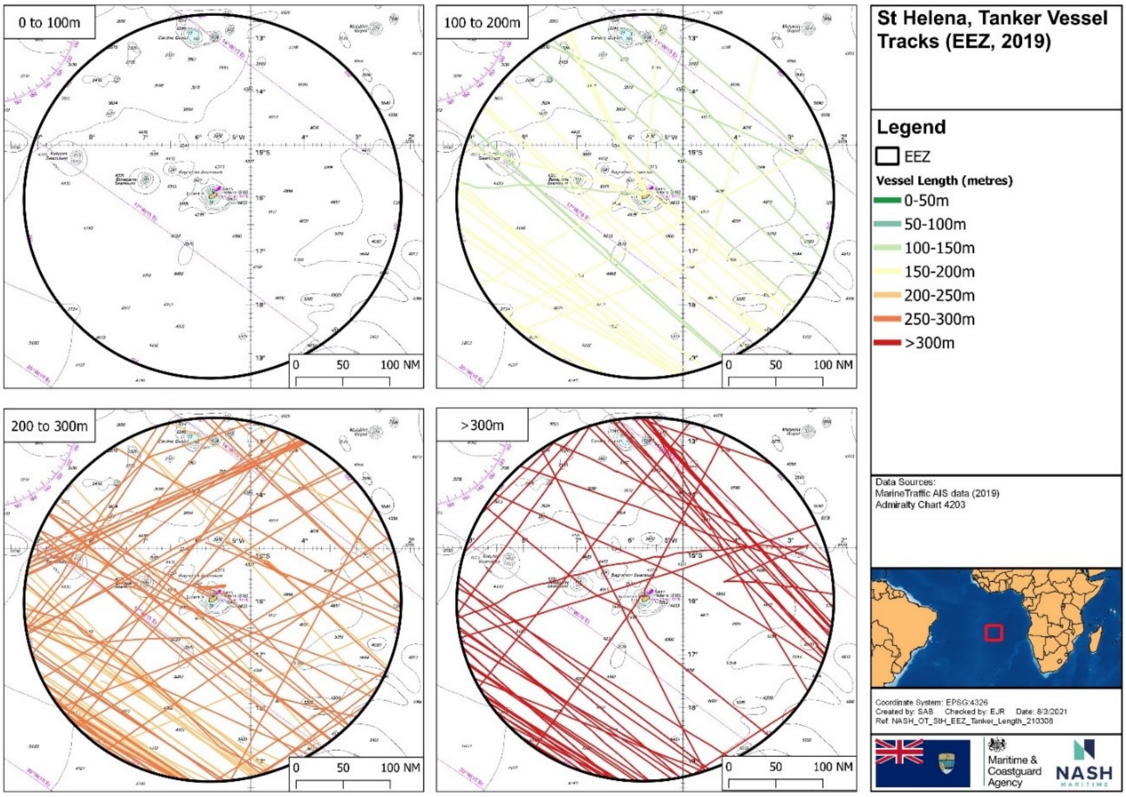


Figure 31: EEZ – Tanker Tracks by loa.

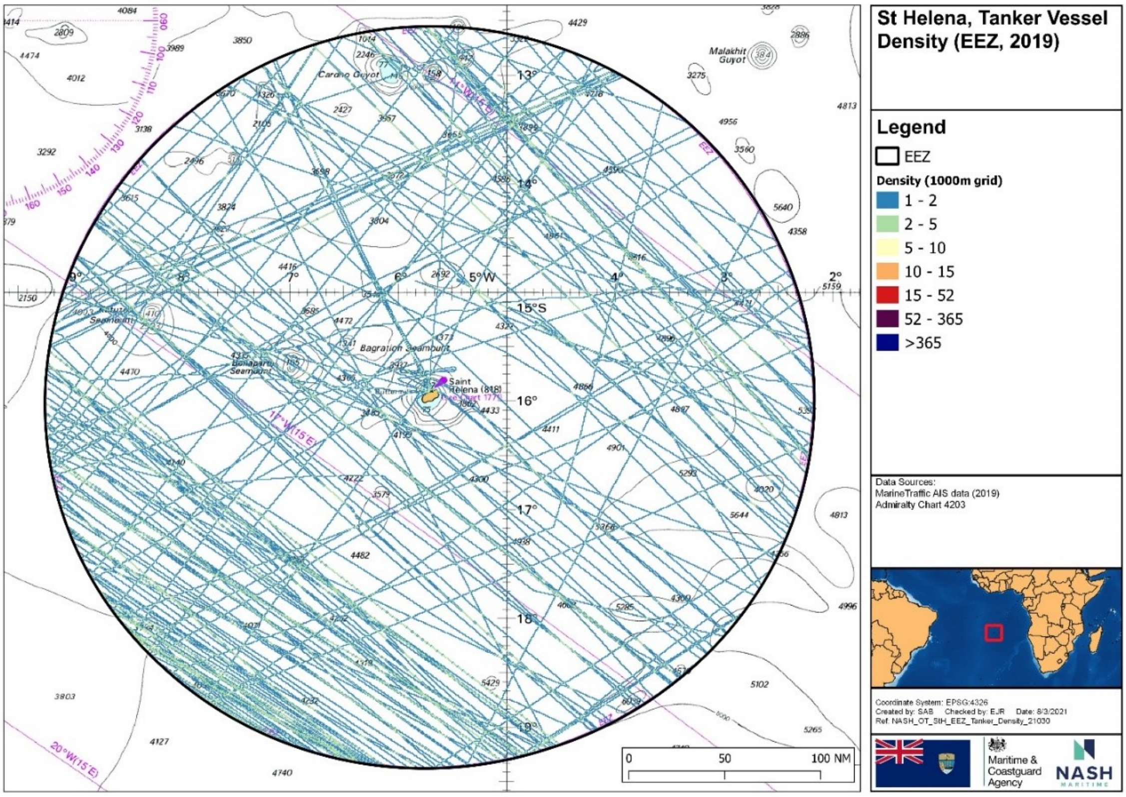


Figure 32: EEZ Tanker Density.

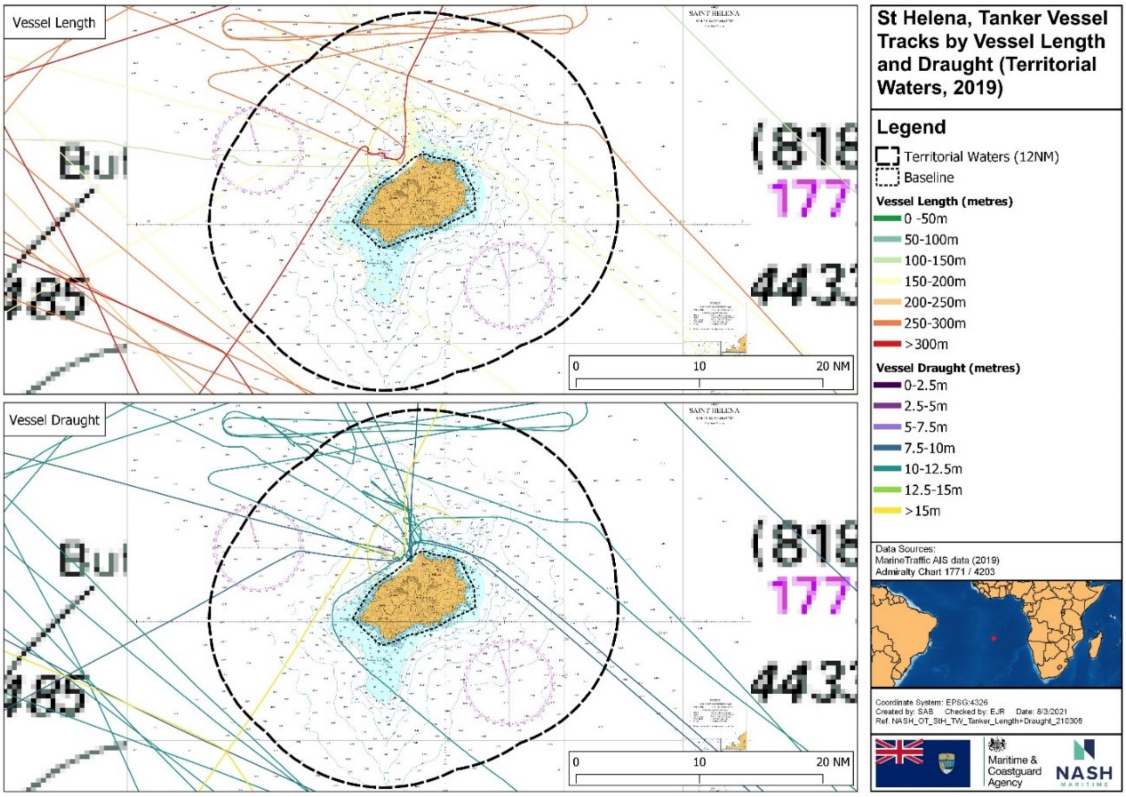


Figure 33: Territorial Waters Tanker Tracks by loa and Draught.

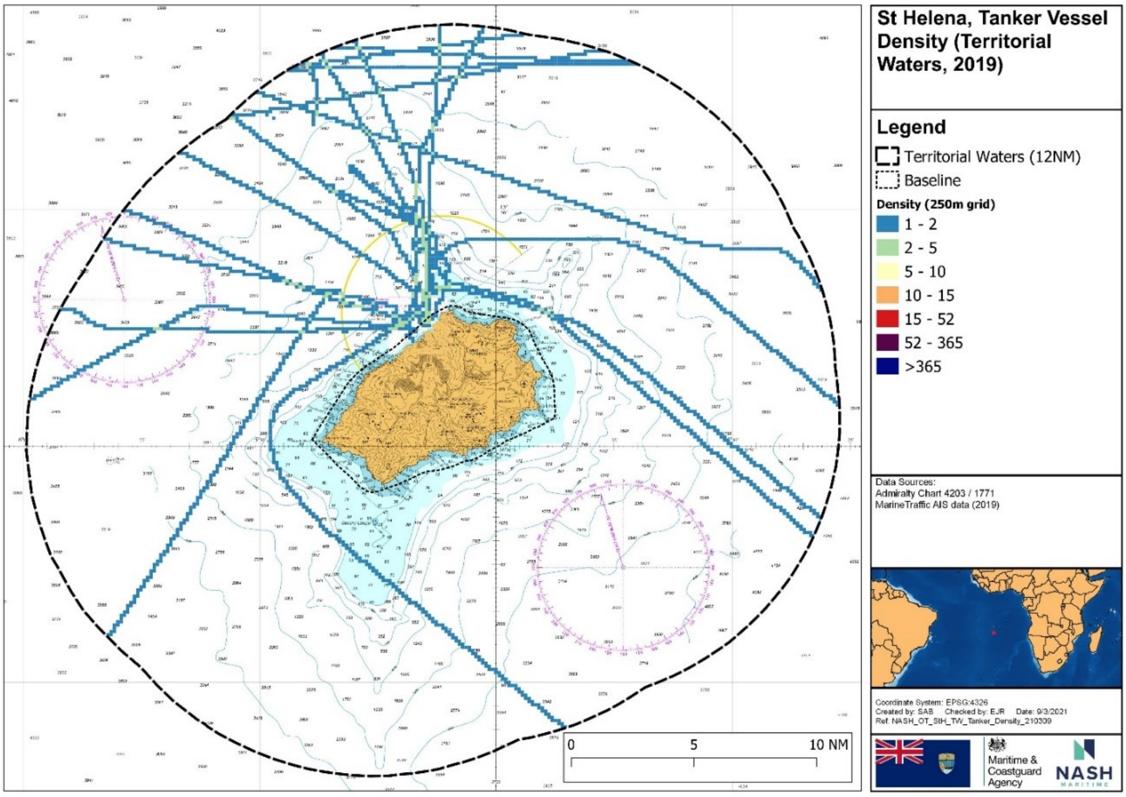


Figure 34: Tanker Density – Territorial Waters.

4.4.7. TUG & SERVICE VESSELS

As **Figure 35** and **Figure 36** show there are few tug and service vessel tracks observed in the EEZ.

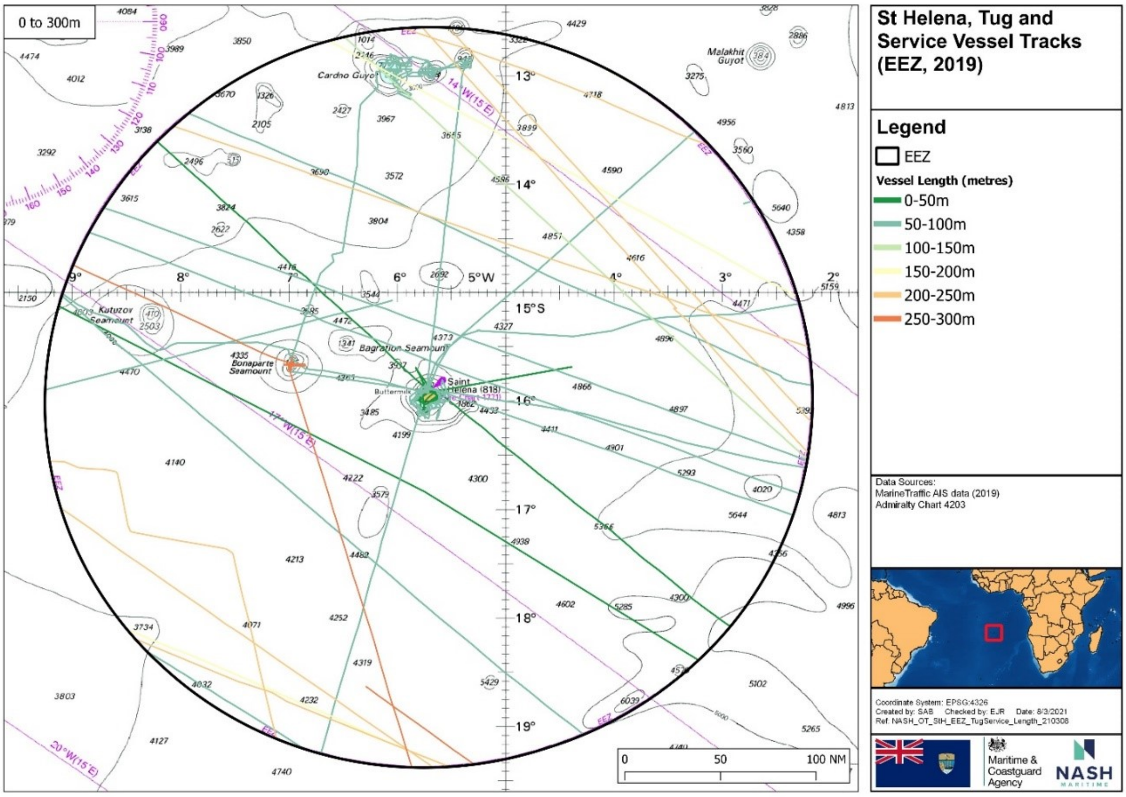


Figure 35: EEZ Tug and Service Vessel Tracks by loa.

Activity in Territorial Waters (**Figure 37** and **Figure 38**) shows the tug and service vessel loa to be mainly <100m with a draught of around 5m with the majority of this vessel type confined to inshore waters around Jamestown. The vessel heading out to the Bonaparte Seamount is the research and survey vessel *mv Discovery* seen to be undertaking survey work around the island. *USNS Sisler* (290m loa), one of US Navy Military Sealift Command's Ro-Ro vessels is observed heading to and from the same seamount.

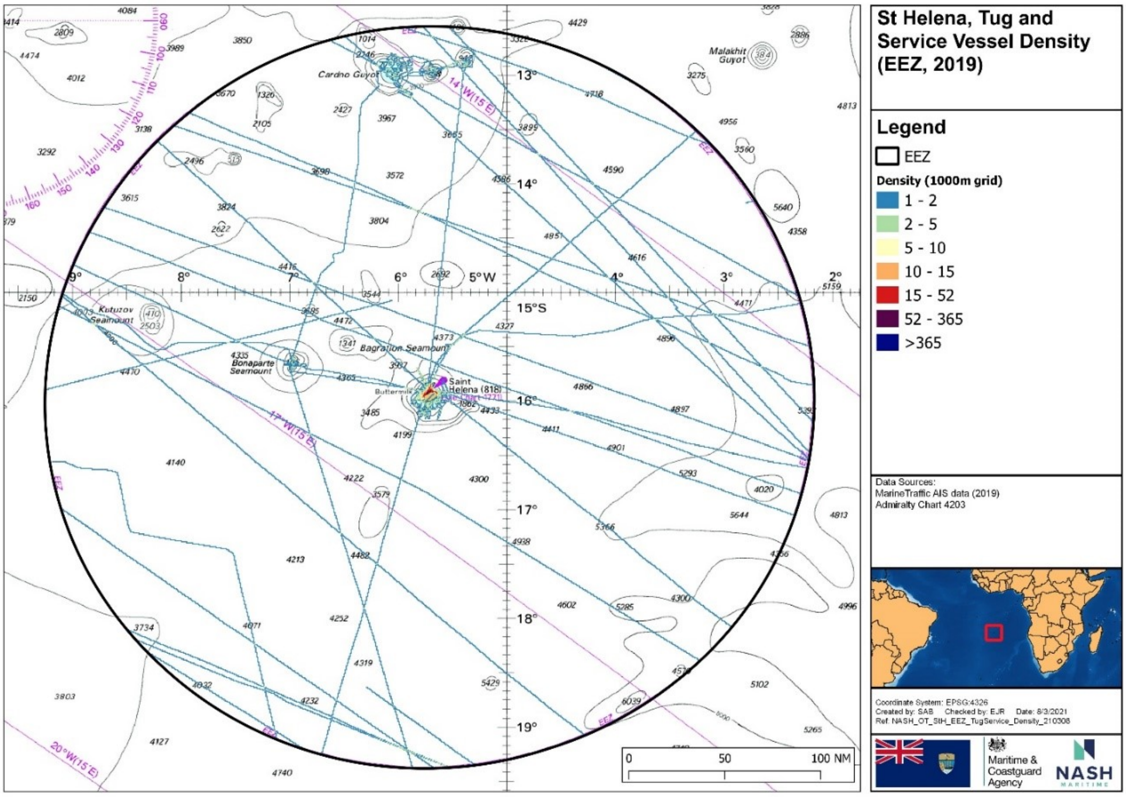


Figure 36: EEZ Tug and Service Vessel Density.

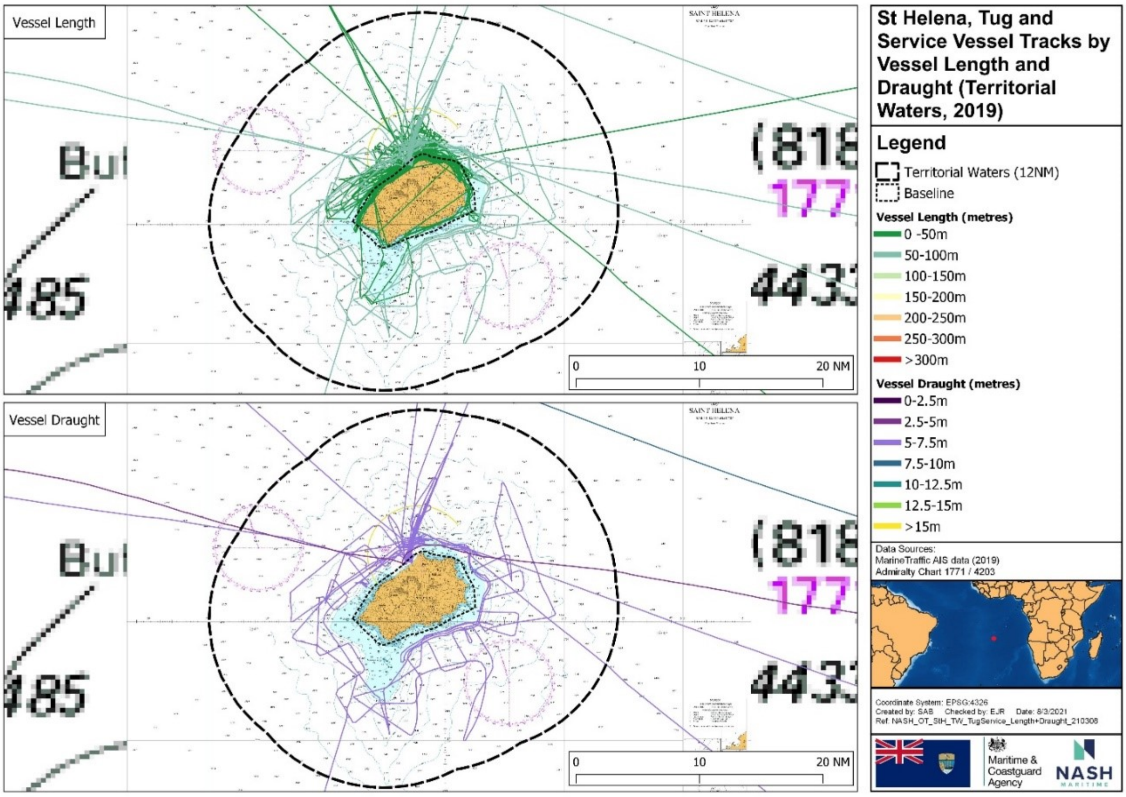


Figure 37:Territorial Waters Tug & Service Vessel Tracks by loa and Draught.

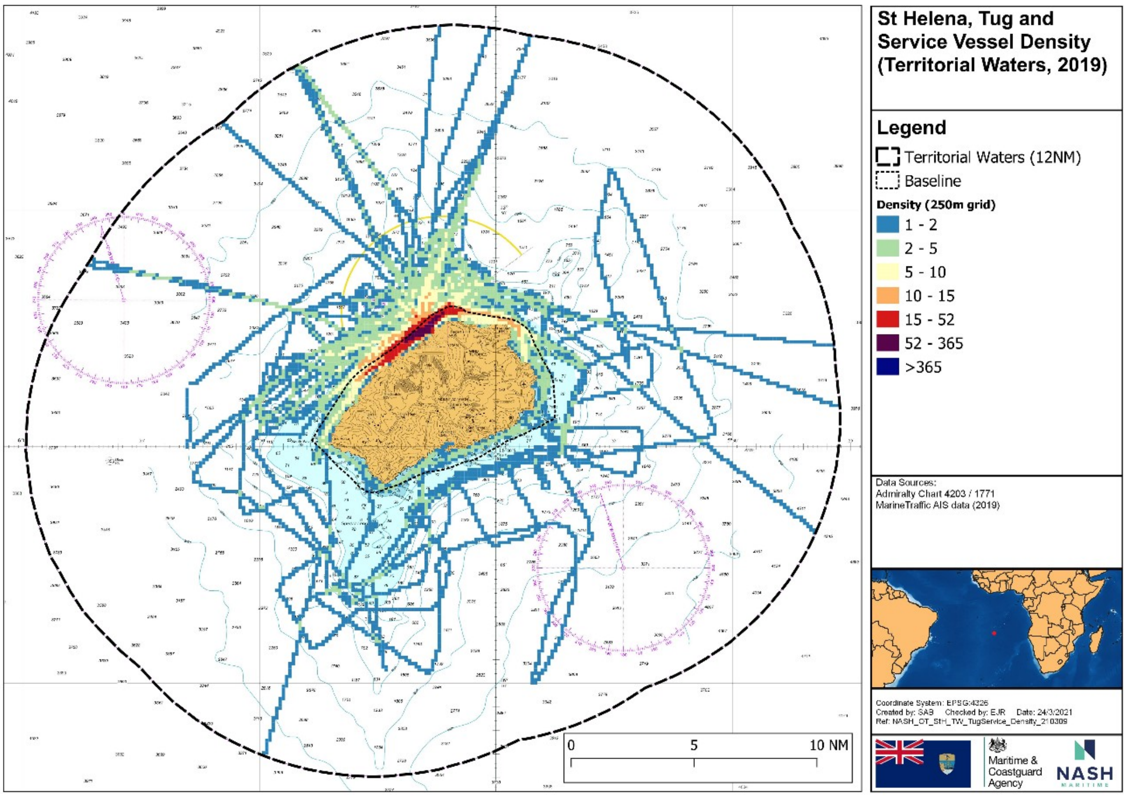


Figure 38: Tug & Service Vessel Density – Territorial Waters.

4.5. VESSEL TRAFFIC NUMBERS

By using density plots (produced in IWRAP) and aligning legs with the major shipping routes within the EEZ it is possible to gain an understanding of vessel transit numbers of individual shipping routes, see **Figure 39**.

Table 7 and **Figure 39** summarise the annual transits of the route identified from the density plot generated in IWRAP. Vessel traffic frequency was low across Saint Helena's Territorial Waters and EEZ with the most frequently transited route being transited approximately once every two days.

There were three main shipping routes identified as follows:

- South-west of Saint Helena - NW to SE orientation (A), there were 128 easterly transits and 55 westerly transits of this route. The route was mainly utilised by cargo and tanker vessels;
- Jamestown to NW (B), there were 55 westerly transits of this route and 22 easterly transits, vessels utilising this route were either cargo vessels navigating to and from Jamestown or recreational craft; and
- Jamestown to SE (C), there were 115 westerly transits of this route and 33 easterly transits, most transits were made by recreational craft that are likely to have used Saint. Helena as a stop off point as they continue to onward destinations.

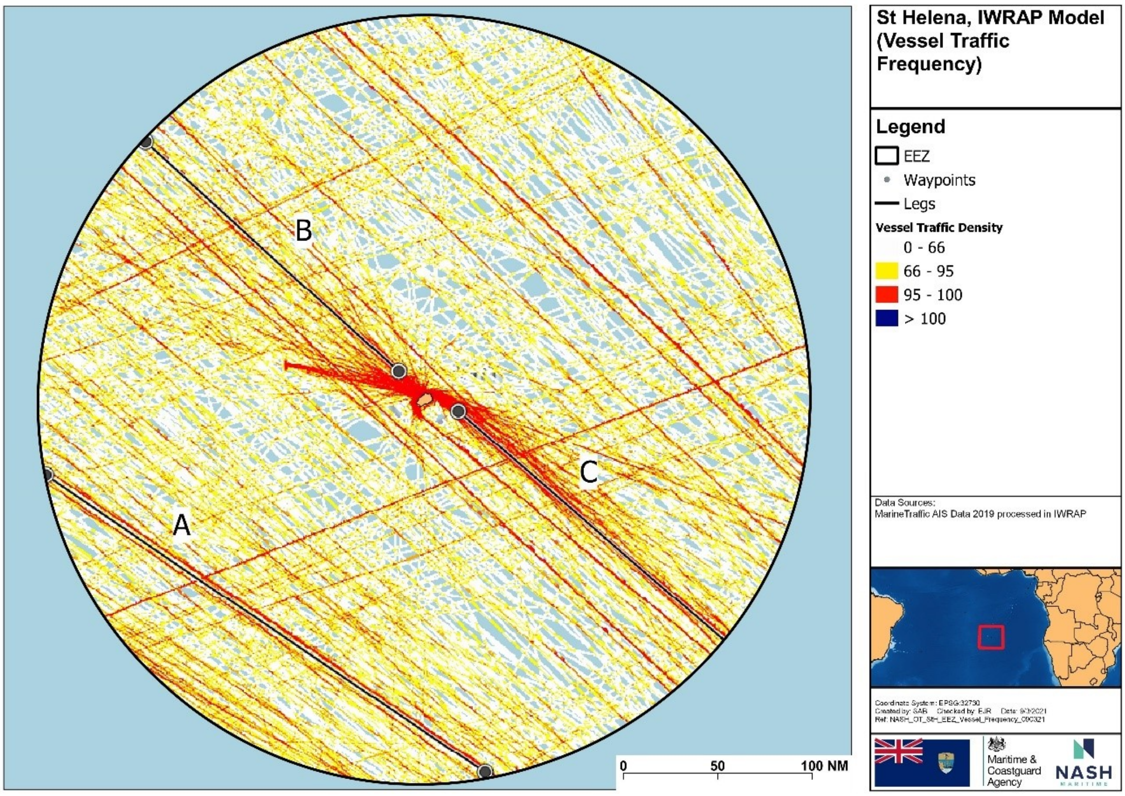


Figure 39: Vessel Traffic Density.

Table 7: Vessel Traffic Frequency.

Route Description	Route ID	Direction	Total traffic	Tanker	Cargo	Passenger	Tug & Service	Fishing	Recreational
SW of Saint Helena - NW to SE orientation.	A	West	55	19	32	0	3	0	1
		East	128	51	75	0	2	0	0
Jamestown to NW	B	West	55	3	23	2	0	2	25
		East	22	0	15	2	2	1	2
Jamestown to SE	C	West	115	7	42	2	1	0	63
		East	33	6	24	0	1	1	1

5. INTRODUCTION

This section describes the underlying IWRAP MKII methodology that is used to perform the risk frequency analysis for collision and grounding. The risk frequency analysis is based on a mathematical model first introduced in 1974 by Fuji & MacDuff, and since modified by Petersen and FriisHansen. The method is purely probabilistic, based on statistical analysis of vessel routes.

The study area is modelled using a number of vessel routes called legs. A leg goes from one waypoint to another. Several legs may be connected to the same waypoint, e.g., at a crossing or at a merging location. For each leg, a statistical distribution is assigned describing how far from the leg centre vessels are travelling.

The number and type of vessels transiting in each direction of the leg is also identified. The general principle is to calculate how many collisions, allisions or groundings will occur if all the vessels sail straight ahead without taking any evasive manoeuvres or actions to avoid the occurrence. This gives the number of theoretical geometrical collisions, allisions and groundings – termed encounters.

Vessels do not generally navigate in this manner, and in general, around 1 or 2 in 10,000 encounters are not avoided as they should be - this is called the causation factor. The causation factor models the probability that the vessel does not react in time when on a collision course with another vessel, or alternatively an allision or grounding course.

IALA has, together with a group of experts, defined a set of globally applicable causation factor values. The values have been determined by a number of analyses where the number of incidents has been known, this way it is possible to determine generic causation factors. Analysis of local incident data can be undertaken to supplement and locally calibrate the factors.

The total number of collisions, allisions or groundings is the number of geometrical candidates multiplied by the causation factor. The method has been extensively tested and found to estimate the number of collisions and allisions close to the observed numbers all around the world, however IWRAP is a risk model and provides only a theoretical evidenced based assessment of risk but is well suited to large area assessments as required in this study.

IWRAP can calculate the following types of incidents as also shown in **Figure 40**:

- Collisions:
  - Head-on collision, i.e., ships sailing straight or almost straight at each other;
  - Overtaking collision;
  - Crossing collision;
  - Merging collision, i.e., ships from several legs merge at a waypoint;
  - Bend collision, i.e., a ship makes a turn at a waypoint on to a new leg; and
  - Area traffic collision (ships not on routes, e.g., fishing).
- Groundings:
  - Drift; and

- Powered.

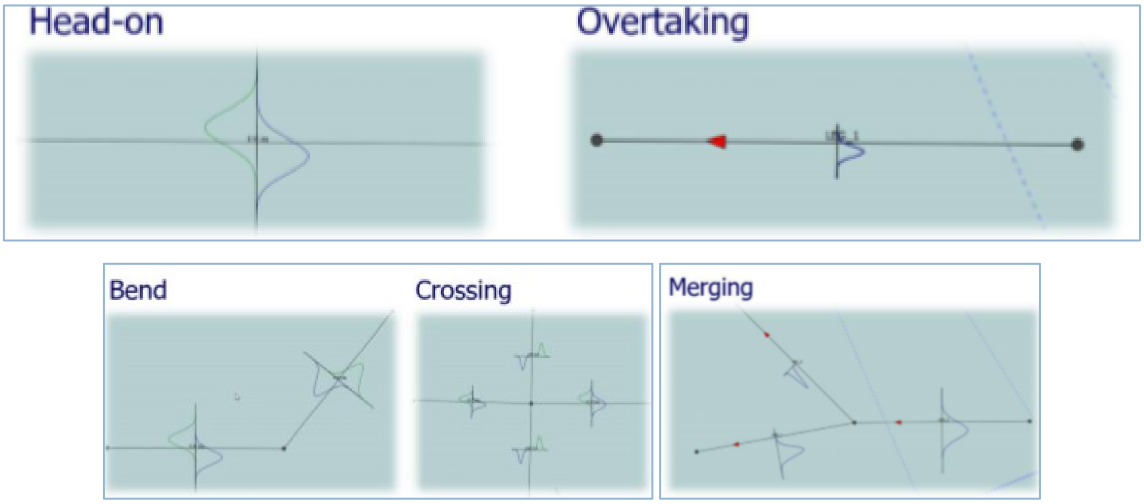


Figure 40: IWRAP Collisions Types.

Figure 41 shows an example of a calculation for a head-on collision. A statistical distribution for each direction is found. Given the width and speed of vessels the probability that two vessels will be on a collision course can be calculated. This is then multiplied by the probability that the vessels do not take evasive actions (i.e., the causation factor).

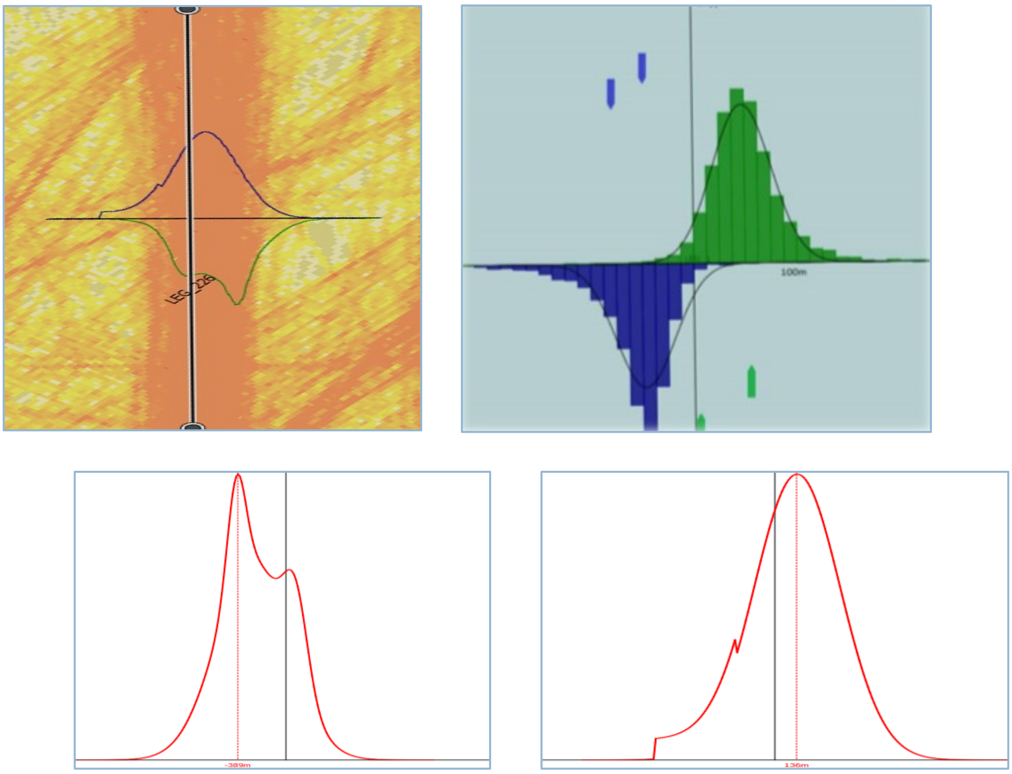


Figure 41:Top left - Example of IWRAP leg overlaid on vessel traffic density data. Top right - gate analysis north bound - green / south bound blue. Lower left - south bound (blue) leg vessel distribution. Lower right - north bound (green) leg distribution.

The statistical function can be found using historical AIS data. This is done by making a cross section of the leg and creating a histogram for each direction. IWRAP has the capability to create a mathematical representation of these histograms using several probability functions. **Figure 41** shows an example with a north/south going leg where the green north going traffic and the blue south going traffic is fitted/approximated using a Normal distribution. It is not uncommon that, given where there is sufficient volume of traffic, the traffic can be very well described using just one Normal distribution. Correspondingly, there are also many cases where just one Normal function is insufficient. The mathematical model in IWRAP can handle these cases by combining more Normal distributions or by combining Normal distributions with Uniform distributions. The distributions are also referred to as lateral distributions.

With regards to crossings, merging and collisions, if the angle between the two legs, number of vessels and the size of the vessels is known, it can be calculated how many vessels will be on a collision course. These are then multiplied by the causation factor.

5.1. MODEL SET UP

Before setting up any modelling in IWRAP the AIS Data procured by the project was filtered and sorted into a format suitable for inputting in to IWRAP. Both satellite and terrestrial AIS data were procured from MarineTraffic for 12 months between 1-Jan-19 and 31-Dec-19.

The data was processed and then vessel tracks where created based on sequential AIS transmissions (with a maximum time between transmissions set to 3-hour time thresholds (to avoid large gaps between individual vessels AIS transmissions) and the data clipped to cover the area of the EEZ.

The AIS data in IWRAP had the following fields:

- MMSI number;
- Status (e.g., under way using engine, at anchor, moored etc.);
- Longitude/latitude;
- Course;
- Heading;
- Time stamp (time at which AIS transmission was received);
- Speed over Ground;
- Vessel draught;
- Vessel name;
- IWRAP vessel type and;
- Vessel length.

All vessels were assigned IWRAP vessel categories according to the vessel sub-categories extracted from the AIS data. In all 113 vessel sub-categories were extracted from the AIS data, these were filtered down in to the following 13 categories available for use in IWRAP.

- Cargo:
  - General cargo;
  - Bulk carrier;
  - Container ship; and
  - Ro-Ro-Cargo.
- Tanker:
  - Oil product tanker;
  - Gas tanker;
  - Chemical tanker; and
  - Crude oil tanker.
- Passenger:
  - Fast Ferry; and
  - Passenger/cruise ship.
- Fishing vessel;
- Recreational vessel; and
- Support ship.

The first step in creating an IWRAP model is to define the model area, this is done by drawing a polygon surrounding the area to be included within the model, in the case of this assessment a polygon was drawn round the EEZ.

Once the model area is defined AIS data can be imported, the data was imported in a csv format and filtered to the fields described previously in this section. IWRAP then gives a number of options for further filtering of the AIS data.

Individual vessel trips (defined as a passage of a single vessel) were then filtered to:

- A minimum duration of 10 minutes;
- Minimum speed of 1.0 knots;
- A minimum time below the minimum specified speed of 60 minutes; and
- A minimum distance of 250m.

IWRAP then produces a report highlighting any data gaps where transmission have not been received. For the entire period during which AIS transmissions were collected (2019) there where 21 data outages lasting approximately 100 hours.

Once the data has been input to the model a traffic density plot to show vessel traffic distribution across the model area can be produced. An initial plot, showing traffic across the full model area was produced in order to develop an understanding of vessel traffic disposition across the full EEZ area, see **Figure 42.** This initial density plot was created using a grid cell size of 1,000m (1km). For a full overview of the settings used to create the density plot shown in **Figure 42** (as well as all other IWRAP modelling and input settings) see **Annex A**.

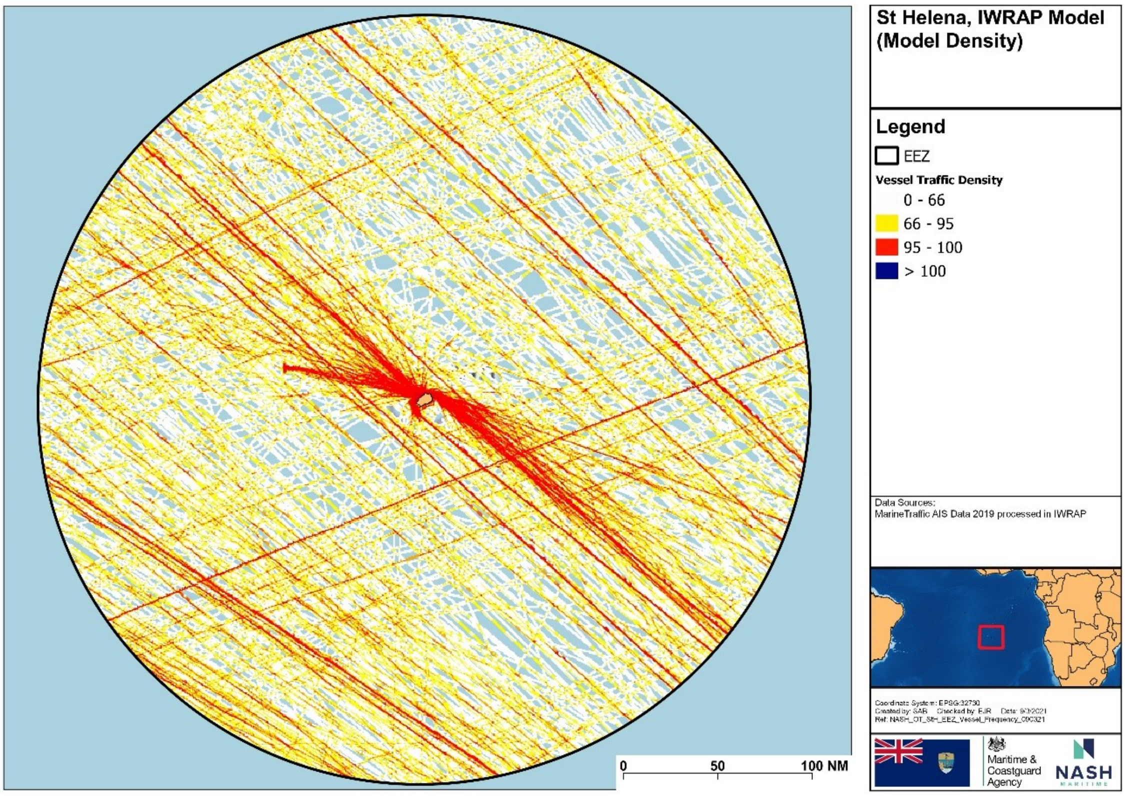


Figure 42: Density Plot, EEZ.

5.2. BATHYMETERY

As outlined in **Section 4.1**, there are several charted navigational features within Saint Helena waters. To accurately model these features bathymetric data was extracted from S-57 and raster charts provided by the UKHO. The inclusion of bathymetric data within the IWRAP model allows for the modelling of grounding probability.

5.3. LEGS & WAYPOINTS

The traffic density plot is used to inform the location of legs on the map, legs are placed along routes with defined traffic density as shown **Figure 43** waypoints are inserted where legs begin, end, cross or merge. The final design and positioning of the legs takes several iterations to ensure that only defined routes are included. It is important that each vessel trip is assigned to the correct leg so a process of fitting the legs to the correct route widths is carried out. Once the legs are fitted satisfactorily to the model the data is extracted and IWRAP summarises the number of transits made across the lateral distribution of each leg.

A detailed breakdown of the number of east and west transits, by vessel type, of each of the legs included within the model can be viewed in **Annex B.**

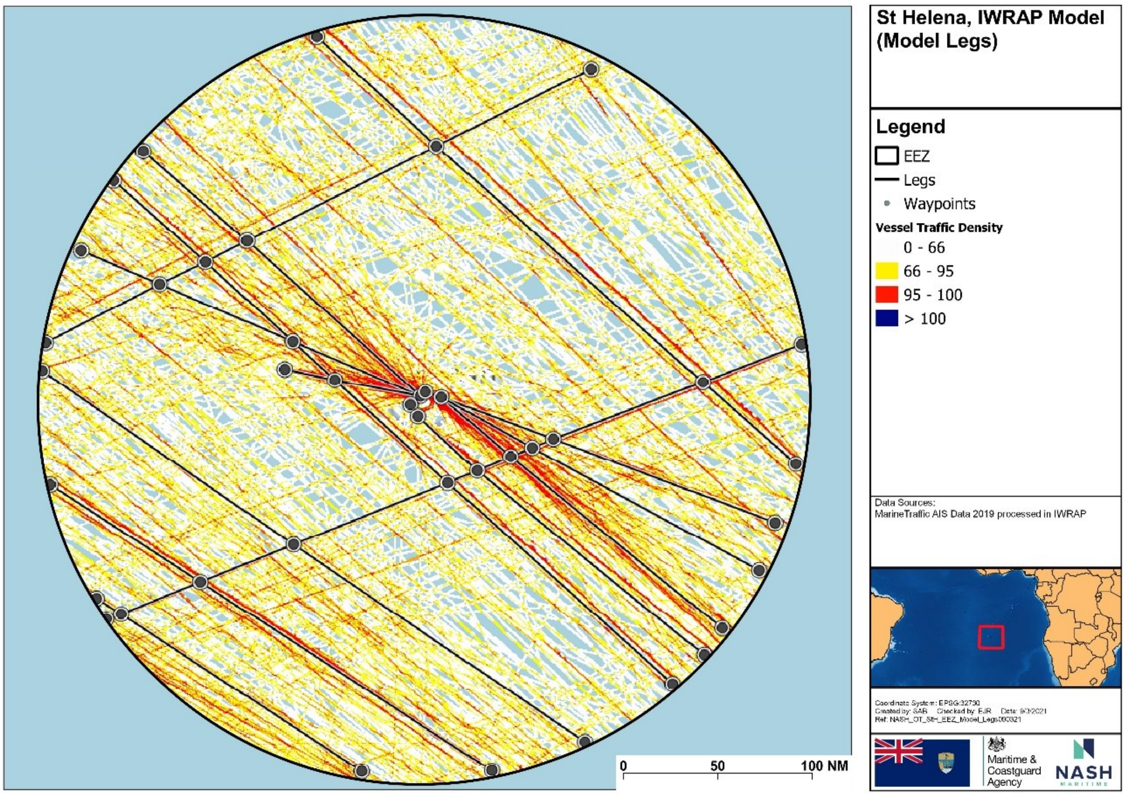


Figure 43: IWRAP Model EEZ.

6. IWRAP MODEL RESULTS

6.1. INTRODUCTION

Once the model layout is completed a probability analysis for collisions and groundings can be performed, this section details the results of the probability analysis conducted. The results of the probability analysis for collision and grounding risks for all vessel types across the full model area are presented in **Table 8**. A breakdown of the collision and grounding risk for each vessel type collision scenario (head-on, merging, etc) can be viewed in **Annex B**.

Table 8: Overall Probability Analysis

Hazard	Saint Helena Assessment
Total Groundings	1 in 427 years
Total Collisions	1 in 504,900 years

6.2. COLLISION PROBABILITY

Figure 44 shows the probability of collision events for vessels of all types on each leg of the IWRAP model. The colour gradient scheme used spans from yellow to dark blue, with yellow indicating a leg with a lower probability score for all types of collision and dark blue indicating the highest probability relative to the other legs in the model. A leg with a red or dark blue colouring does not indicate an unacceptable level of hazard probability, it merely indicates that the leg has a higher probability in comparison to other legs included in the model.

The leg returning the highest probability for a collision event occurrence is the leg closest to Jamestown. Vessel traffic frequency is high in this area (relative to other areas in the model) and navigation becomes increasingly constrained as several routes diverge, this means vessels are navigating in proximity and therefore the risk of a collision event occurring is increased.

The other legs returning a high probability for a collision event are the main routes identified in **Section 4.5**, these are the main tanker, cargo, and passenger routes with relative high vessel traffic frequency in comparison to other legs included within the Saint Helena assessment area.

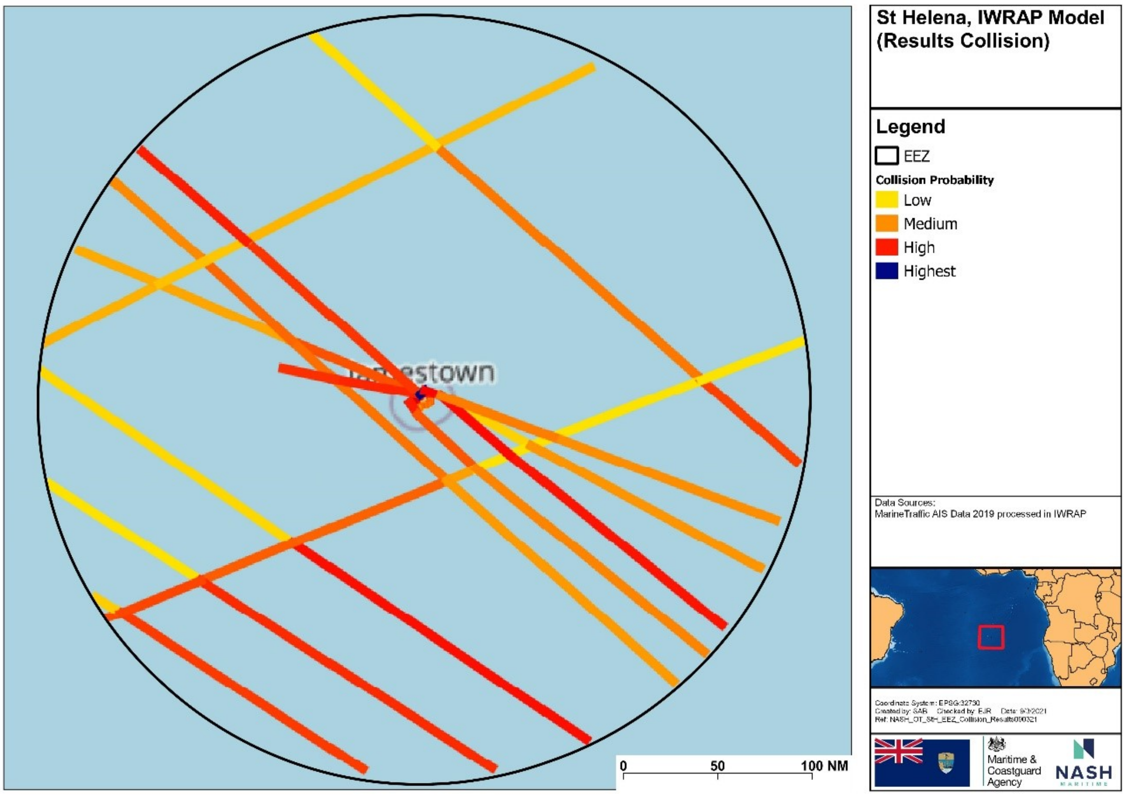


Figure 44: Collision Probability.

6.3. COLLISION PROBABILITY BY VESSEL TYPE

Table 9 gives a summary (by vessel type) of the collision probability for all collision evets (head on, merging, crossing, bend) occuring within the model area (defined as the EEZ and excluding internal and port waters).

The table shows the probability that a vessel of a given type is struck by another vessel or stikes another vessel. The table also shows the probability that a vessel of a given type is involved in a collision incident (be that being stuck by another vessl or striking another vessel) Collision probability is influenced by two key parameters, the number of transits made by vessels within the model area (vessel traffic frequency) and the areas in which vessels are frequently navigating which dicates the proximity of vessel interaction.

Table 9: Overall Collision Probability by Vessel Types.

	Struck by another Vessel	Strikes another Vessel	Total Collisions
Tanker	1in 2,853,577 years	1in 1,523,941 years	1in 993,413 years
Cargo	1in 1,057,110 years	1in 1,020,709 years	1in 519,295 years
Passenger	1in 73,920,211 years	1in 35,675,934 years	1in 24,062,640 years
Tug & Service	1in 13,155,039 years	1in 14,946,812 years	1in 6,996,902 years
Fishing	1in 14,412,212 years	1in 22,768,152 years	1in 8,825,611 years
Recreational	1in 1,904,410 years	1in 4,861,945 years	1in 1,368,408 years

Figure 45, shows the number of hours vessel navigated within the study assessment area, the total hours presented in **Figure 45** have then been broken down by hours navigated within EEZ waters (**Figure 46**) and Territorial Waters (**Figure 47**).

Generally speaking the greater the number of hours spent navigating in the study assessment area the greater the probabiity of vessels of that category being invoved in a colllions event. For example, cargo vessels navigated within the assessment are for the most significant amount of time and are consequently the most likely to be involved in a collision event. In contrast passenger vessels account for the least amount of time navigated by any vessel category within the assessment area, consequently passenger vessels are the least likely to be involved in a collision incident.

Collision probability is not solely dependant on vessel traffic frequency but a combination of frequency and geographic disposition of where vessels are navigating and the resulting proximity of vessel interaction. For exmaple recreational vessels navigate within the assessment area for almost double the amount of time that tanker vessels are more likely to be involvd in a collision event. This because tanker vessels (along with lareg vessels such as cargo vessels) are more likely to follow key shipping routes through the assessment area, this means tanker transits are concentrated in certain areas. In contrast recreational vessel tracks are spread over the assessment area and therefore the geographic distubution of tracks is not concentrated along certain routes, therefore for recreational craft the proximity of vessel interaction is less close and the probabilty of involvement in a collision event is reduced.

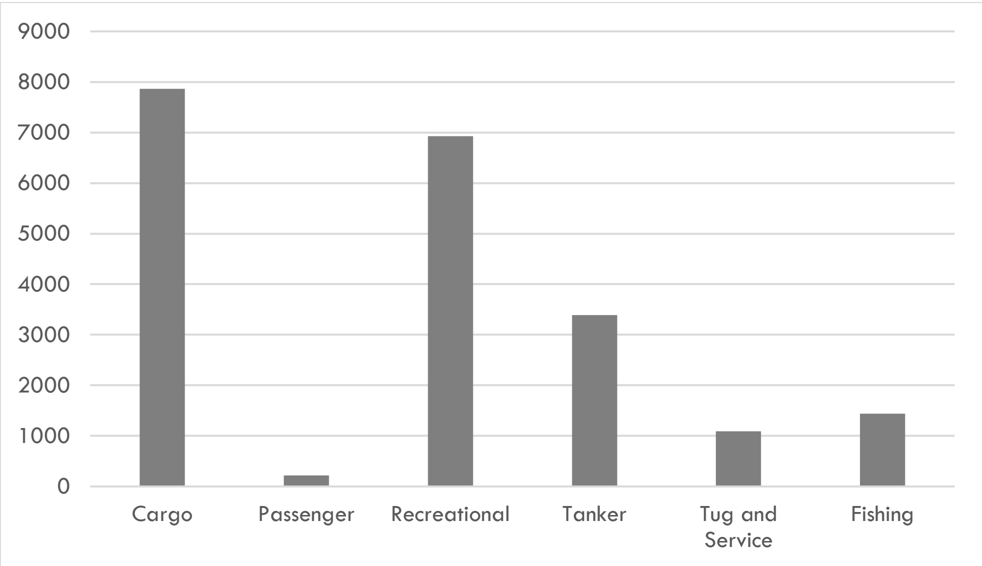


Figure 45: Hours Navigating within Assessment Area by Vessel Category(AIS Data 2019).

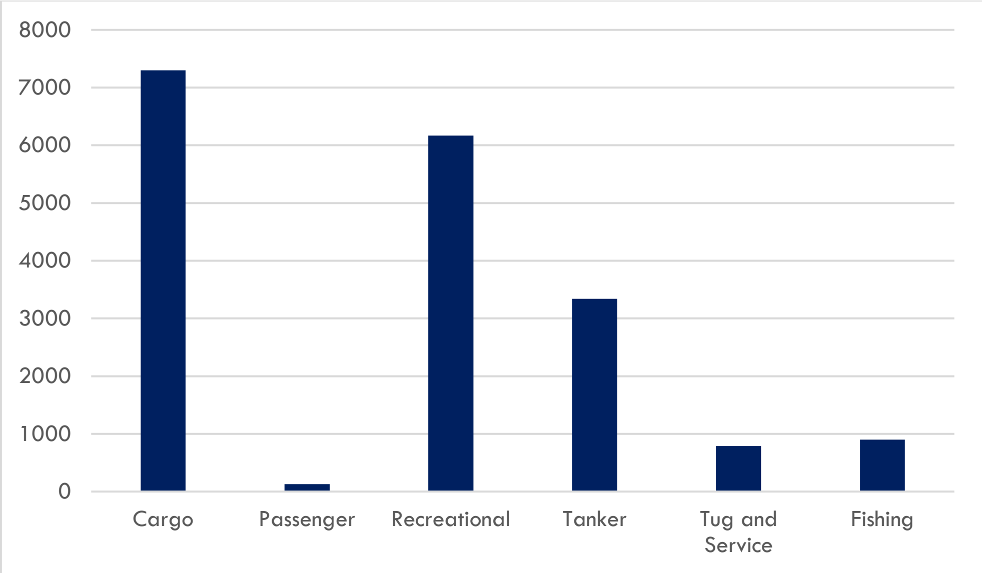


Figure 46: Hours Navigated in EEZ waters by Vessel Category (AIS Data 2019).

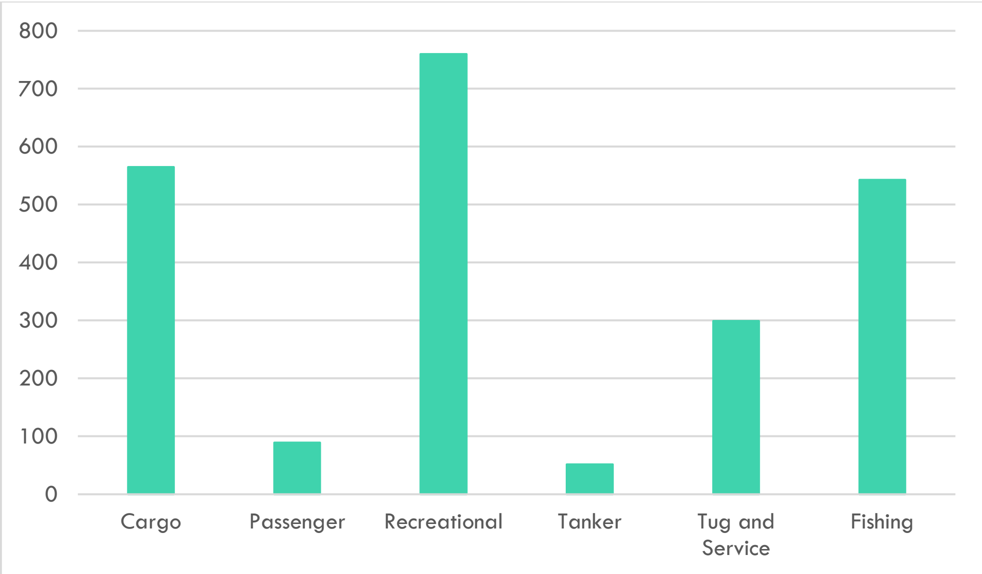


Figure 47: Hours Navigated in Territorial Waters by Vessel Category (AIS Data 2019).

6.4. GROUNDING PROBABILITY

Figure 48 shows the areas where grounding probability is highest. The inshore areas see a high volume of vessel transits in areas where depth is limited. As a result, the inshore areas are shown to have a higher grounding probability when compared to areas further offshore.

The most significant area of grounding probability is highlighted by the area shaded dark blue on the eastern coast of Saint Helena. Grounding probability is also shown to be high on the northern side of Saint Helena, this corresponds with the increased vessel traffic to this side of the island as vessel arrive and depart Jamestown.

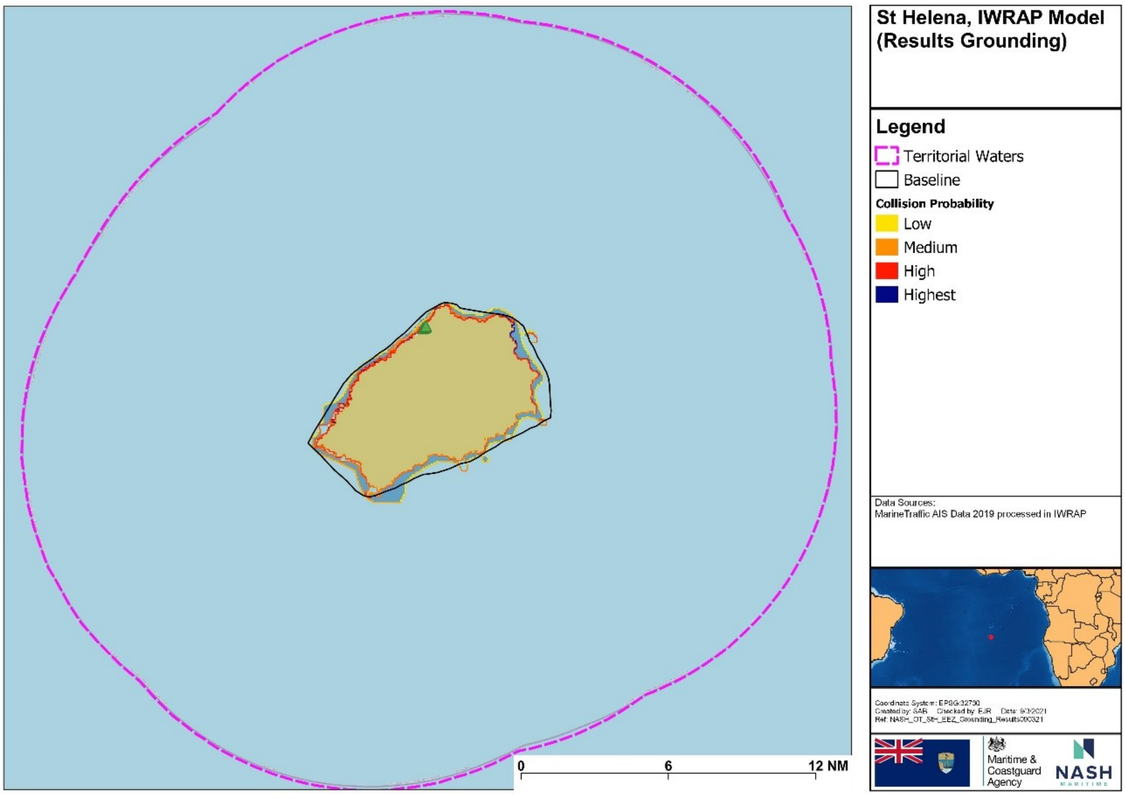


Figure 48: Grounding Probability Saint Helena.

6.5. GROUNDING PROBABILITY BY VESSEL LENGTH

Table 10 shows the overall grounding (powered and drifting) probability for vessels navigating within the model area. It should be noted that the model area used to determine these probability scores does not include internal or port waters if the model were to include these waters grounding probabilities would likely be much increased.

In general, smaller vessels are likely to return a higher probability of grounding as vessels of this type (e.g., recreational craft) are more likely to navigate in waters with restricted depths, this is true of the Saint Helena assessment area with craft 0-50m loa most likely to be involved in a grounding event.

Grounding probability can also be attributed to vessel draught.

For example, vessels of 100m to 150m loa are significantly less likely to be involved in a grounding incident than vessels 150-200m despite a greater number of transits made to Jamestown by vessels between 100m-150m. This is because nearly all transits to Jamestown by vessels within the 100m -150m loa bracket are by the cargo vessel *mv Helena* (101m loa and draught 4.9m), other than *mv Helena* there are very few vessels within this length bracket navigating within proximity to Saint Helena, this is reflected in the probability of grounding occurrence. In comparison vessels in the 150m to 200m category navigating to and from Jamestown are of significantly deeper draught, vessels within this loa category had a draught between 8.9 and 11m.

Similarly, the grounding probability for vessels within the 200m -250m loa category is less significant because transits made to Jamestown were made by passenger vessels (*Albatross, Boudicca*) with a much shallower draughts between 7.2m and 7.5m.

Vessels of 250m to >300m make relatively few visits to Jamestown and tend to navigate well clear of Saint Helena. However, those that do navigate to Jamestown are deep draught e.g., *Arafura* (tanker with a draught in excess of 15m).

Table 10:Grounding Probability by Vessel Length.

Vessel Length (m)	Grounding Incidents
0-50	506
50-100	6,091
100-150	244,124
150-200	15,665
200-250	165,143
250-300	7,931
>300	7,895

6.6. SUMMARY

In summary:

- The probability analysis was performed for a model area that does not include internal or port waters. If these areas were included in the model, grounding and collision probability would likely be significantly higher;
- Collision probability is influenced by vessel transit numbers. For example, cargo vessels navigated within the assessment are for the most significant amount of time and are consequently the most likely to be involved in a collision event;
- Collision probability is also influenced by the areas in which vessels frequently navigate. For example, Although, tug and service vessels navigated within the assessment area for a greater number of hours, recreational craft are more likely to be involved in a collision event; and
- Grounding events are more likely for smaller craft 0-100m loa and larger deep draught vessels that navigate to and from Jamestown. Cargo and passenger ships with limited draught are amongst the least likely vessels to be involved in a grounding event.

7. IWRAP RESULTS BENCHMARK

7.1. INTRODUCTION

The results presented in **Section 6** are useful in that they allow for an understanding of the geographic areas within the Saint Helena model area where hazard probability is higher as well as an understanding of the type of vessels more likely to be involved in a grounding or collision events. However, in terms of acceptability of navigational risk within the model area, they are of limited use without understanding the threshold of navigation risk acceptability.

A process of benchmarking is therefore applied to determine acceptability of navigation risk and identify whether it is necessary to introduce certain SOLAS (risk mitigation) measures, namely: Routeing, Reporting, VTS or AtoN. It is difficult to conduct a fully quantitative benchmarking exercise because of an absence of available vessel traffic and risk probability statistics presented in support of previous applications to introduce risk mitigation measures. However, there are reports available via the IMO's document storage portal[4] that have examined the need to introduce certain risk mitigation measures, with some of these reports using IWRAP in a similar way to this study, such that requirements for implementation of measures can be ascertained.

. A review and examination of these documents also reveals a number of common themes that lead to contracting governments applying to the IMO to introduce either; Reporting, Routeing, VTS or AtoN measures.

Finally, it is also possible to use publicly available AIS data sets to gain an understanding of vessel transits in a particular area. In the case of this assessment anonymised AIS vessel transit data for 2017 is available for UK waters and is made available by the Marine Management Organisation (MMO) and used to determine vessel traffic frequency in IMO adopted routing measures.

In order to benchmark the results presented in **Section 6** a qualitative and quantitative benchmarking assessment has been undertaken using data and information as outlined above.

7.2. QUALITATIVE BENCHMARKING METHODOLOGY

An examination of applications for Routeing, Reporting, VTS and AtoN measures submitted to the IMO reveals several consistent themes that lead to contracting governments seeking to implement such risk measures. The list is by no means exhaustive but is a comprehensive summary of the factors that lead contracting governments to consider such measures, examples are also referenced below:

- Proof of a sustained increase in vessel traffic within contracting governments EFZ/Territorial Waters, e.g. request by the Government of Portugal to introduce a mandatory ship reporting system in response to a sustained increase in vessel transit numbers;[5]
- Significant navigational hazards;

[4] https://docs.imo.org/

[5] NAV 54/3/4, Implementation of a Mandatory Ship Reporting System "Off the Coast of Portugal –COPREP", 27-Mar-2008.

- Recent major incidents and resulting recommendations, e.g. request by the Government of the United Kingdom to implement a TSS and precautionary area in response to a number of factors including recent maritime incidents;[6]
- A change in the navigational disposition or foreseeable changes in the traffic pattern resulting from port or offshore terminal developments, e.g. application by the Government of Brazil for the establishment of an ATBA in response to a 50% increase in offshore oil related activity;[7]
- Adequacy of existing aids to navigation, reporting measures, charts and hydrographic surveys;
- A lack of existing control measures, e.g. application by the Government of Kuwait for a routeing and reporting scheme in a sensitive area with no existing risk mitigation measures in place; and[8]
- Maritime Spatial Panning resulting in new restrictions to navigation.

When ascertaining whether the introduction of one of the four assessment mitigation measures within the Saint Helena is necessary the above listed factors are considered.

7.3. QUALATITIVE BENCHMAKRING RESULTS

Table 11 summarises the results of the qualitative assessment carried out in accordance with the methodology outlined in **7.2.**

Table 11: Summary of Qualitative Assessment Findings.

Factor	Applicable to FI Model Area (Yes/ Possible/No).	Justification
Sustained increase in vessel traffic.	No	No evidence has been provided but conversations with the Saint Helena project team have indicated that there has been no substantial increase in vessel traffic within the assessment area.
A foreseeable change in traffic patterns.	No	No evidence has been provided to suggest that there will be any foreseeable change to the existing traffic pattern and navigational disposition.
Significant unmitigated navigational hazards.	No	No significant unmitigated navigational hazards have been identified within the assessment area. Note this does not include port or internal waters.
Recent major incidents and resulting recommendations	No	No incident data has been provided but conversations with the Saint Helena project team indicate that there have been no incidents of note in recent years.

[6] NAV 46/3/7, Traffic Separation Schemes in the Approaches to the River Humber, 4 May 2000

[7] NCSR 7/INF.10, Information on the proposal for the establishment of an area to be avoided off the Brazilian southeast coast, 8 November 2019.

[8] NAV 50/3/7, Establishment of new recommended traffic separation schemes, ship reporting system, new anchorage areas and pilot boarding positions, 2 April 2004.

Factor	Applicable to FI Model Area (Yes/ Possible/No).	Justification
Inadequate existing aids to navigation, reporting measures, charts and hydrographic surveys	No	There are currently no SOLAS Chapter V risk mitigation measures in place. The United Kingdom Hydrographic Office (UKHO) is due to issue revised charts based on recent hydrographic surveys.
Maritime Spatial Panning resulting in new restrictions to navigation	No	There is no current Marine Spatial Planning activity that is likely alter the current navigational pattern/disposition.

It is understood that vessel traffic activity within the model area is unlikely to change within the immediate future because of any offshore development, environmental protection measures or Marine Spatial Planning activity currently being undertaken. It is also understood that a significant year on year increases in vessel traffic within the model area is not anticipated and a sustained increase in vessel traffic over recent years is not apparent.

No historical incident data was provided to the project team and the Saint Helena project team are not aware of any incidents and resulting recommendations of note.

Saint Helena has no AtoN outside internal and port waters and no IMO routeing, reporting or VTS measures in place.

7.4. QUANTITATIVE BENCHMARKING METHODOLOGY

It is possible to carryout quantitative benchmarking to consider whether routeing and reporting schemes should be introduced, this quantitative benchmarking has been carried out in combination with the qualitative approach outlined above.

IMO directions dictate that the introduction of SOLAS (risk mitigation) measures should be based on a review of "volume of traffic" and "degree of risk". It is therefore prudent to benchmark Saint Helena vessel traffic frequency and degree of risk against other comparable assessments.

Previous IWRAP assessments have been conducted in instances when contracting governments have been considering the introduction of routeing or reporting schemes within their waters. It is, therefore, possible to compare the results of these previous assessments, as well as vessel traffic frequency figures from the same studies, with the results from this IWRAP assessment to inform a benchmarking exercise of volume of traffic and degree of risk. There are two reports available to this study one focussing on the introduction of a number of TSS and commissioned by the Danish and Swedish Governments to review proposals for TSS in Kattegat and off the west coast of Denmark.[9] The second is a report commissioned by the Government of Indonesia to support an

[9] NCSR 5/INF. 3, Report on the sea traffic and consequence analysis and IWRAP Mk2 analysis related to proposals for new routeing measures in the vicinity of Kattegat between Denmark and Sweden, 7 November 2017.

application for a new TSS in the Lombok Strait.[10] The IWRAP results for these two assessments are summarised in **Table 12.**

The project team have recently conducted IWRAP assessments for seven other Overseas Territories. Vessel traffic frequency and degree of risk for Saint Helena Territorial Waters and EEZ can also be benchmarked against these assessments.

In addition, to further support a quantitative benchmarking assessment it is possible to compare vessel transit frequency within the Saint Helena Territorial Waters and EEZ with vessel traffic passing through already established routeing schemes. To support this element of the benchmarking assessment, vessel traffic frequency figures through a range of routeing measures in UK waters have been extracted using UK Marine Management Organisation (MMO) AIS Data sets.

7.5. QUANTATIVE BENCHMARKING RESULTS

Table 12 compares the overall risk probability determined by IWRAP for the Saint Helena model against the risk probability returns identified as part of the Kattegat and Lombok assessments and the recent assessment carried out by NASH Maritime Ltd for the other Overseas Territories.

Table 12: Benchmarking of Saint Helena IWRAP Assessment Results Against Previous Studies.

	Incidents / Years (1 incident in xxx years)											
Hazard	Anguilla	Cayman	BVI	FLK	Bermuda	St.Helena	Montserrat	TCI	Kattegat Assessment		Lombok Assessment	
									Model with no TSS	Model with TSS	Model with no TSS	Model with TSS
Grounding	1211	106	218	43	124	427	118	54	3 per year	2.7 per year		
Collision	32800	700	14580	15550	9382	504900	9021	7659	2	2.18	2	4.1

In terms of degree of risk, the probability of collision and grounding events within the Saint Helena model area are significantly less than the Kattegat and Lombok assessments. The IWRAP assessments for the Lombok and Kattegat areas were used to support applications to the IMO for the introduction of Traffic Separation Schemes, the probabilities returned in the Saint Helena assessment are far less significant than the probabilities returned by these two assessments. In comparison to the other Overseas Territories assessments carried out by NASH Maritime the probabilities for collision and grounding events within the Saint Helena assessment area are less significant.

When examining degree of risk, it is useful to understand risk probability in relation to the number of vessels navigating in the area. To do this we calculate the exposure of vessels and correlate this to the probability of

10 NCSR 6/3/4, Establishment of a new traffic separation scheme and associated routeing measures in Lombok Strait, Indonesia, 12 October 2018.

hazard occurrence as predicted by IWRAP. **Table 13:** shows the probability of collision/grounding events per vessel transit year for the Saint Helena model area in comparison to the other Overseas Territory assessments. The information summarised in **Table 10** is presented graphically in **Figure 49** and **Figure 50**.

Table 13: Collision/Grounding Probability per Vessel Transit Year.

	Bermuda	BVI	FLK	Cayman	St. Helena	Anguilla	Montserrat	TCI
	Probability (Vessel Transit Year)							
Total Groundings	0.000594	0.000725	0.000752	0.000495	0.000980	0.000229	0.003616	0.002441
Total Collisions	0.000008	0.000011	0.000002	0.000075	0.000001	0.000008	0.000047	0.000017

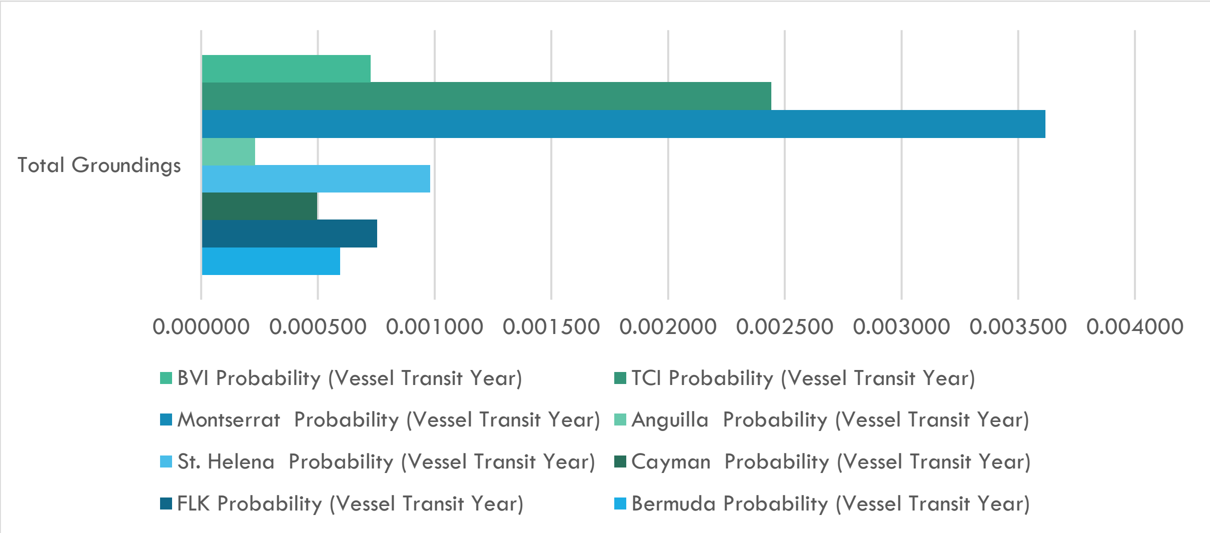


Figure 49: Probability of Grounding per Vessel Transit Year

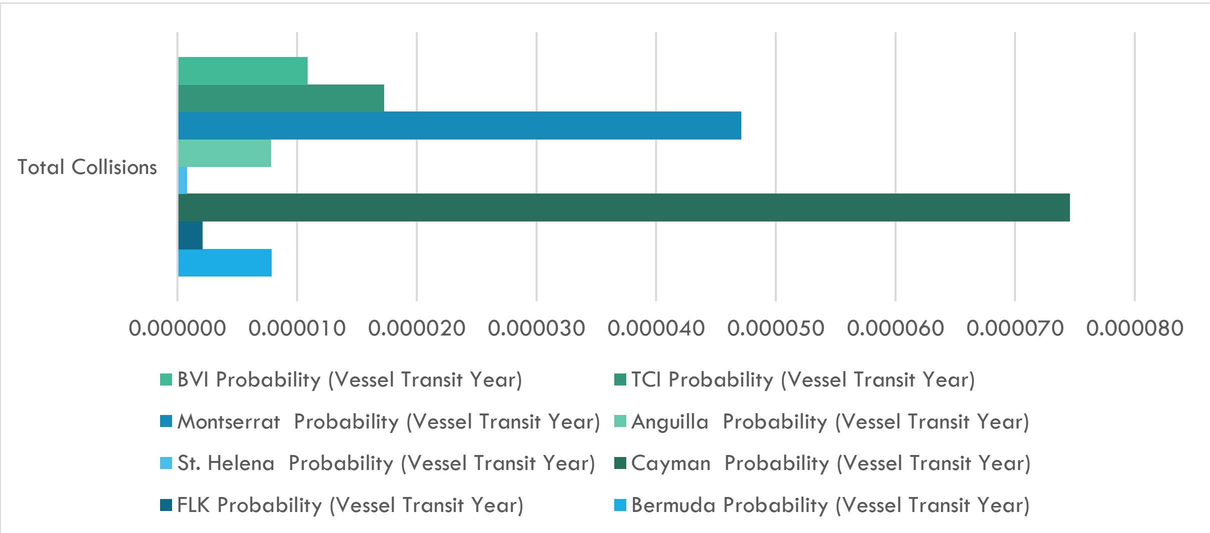


Figure 50: Probability of Collision per Vessel Transit Year

The IWRAP assessment scores are useful in benchmarking degree of risk but is important to also develop an understanding of vessel traffic frequency.

Lombok and Kattegat IWRAP assessments, along with the studies recently produced by NASH Maritime used AIS data to determine the extent of vessel traffic frequency within the chosen study areas. In the case of the Kattegat assessment there were between 7,500 and 12,500 annual transits across the individual legs drawn in the IWRAP model. The Indonesia study of the Lombok Strait identified 36,773 unique vessel transits identified as passing through the Archipelagic Sea Lane (ASL) II (the focus of the assessment). For the Lombok Strait example this equates to 101 ships a day, in comparison the most frequently used shipping lane within Saint Helena model area was utilised approximately less than once a day.

In addition, to further support a quantitative benchmarking assessment of vessel traffic frequency it is possible to compare vessel transit frequency passing along the main shipping routes identified within the Saint Helena model area with vessel traffic passing f already established UK routeing schemes, the vessel frequencies recorded by the Kattegat and Lombok straits assessments as well as vessel traffic frequency figures identified as utilising the highest frequency routes in the other Overseas Territory assessment areas. To support this element of the benchmarking assessment, vessel traffic frequency figures from a range of routeing measures in UK waters have been extracted using MMO AIS data sets and benchmarked against the vessel traffic frequency numbers identified in the studies above as well as the numbers recorded as part of this assessment, see **Figure 51**.

Note that the MMO data only gives figures for tanker, cargo, and passenger vessels, therefore figures for fishing, recreational and tug and service vessels have not been included in the analysis.

In comparison to vessel traffic frequency through routeing schemes in UK waters, vessel traffic frequency was significantly lower, the most frequently transited route in the Saint Helena assessment area was transited just 177 times i.e. less than 1 transit a day. In comparison to vessel traffic volumes identified as part of the Bermuda, Falkland Islands, Cayman Islands and BVI assessments vessel traffic frequency within the Saint Helena model area was comparatively low.

A comparison of vessel traffic frequency utilising the main shipping routes within the model area is useful to aid an understanding of vessel traffic in the busiest parts of the model. However it does not necessarily give a full understanding of vessel traffic across the whole assessment area, for instance traffic can be widely distributed across the full model area in some instances rather than concentrated in specific areas. To give a fuller understanding of vessel traffic frequency across the model area the number of hours navigated (vessel exposure) within the Saint Helena assessment area can be benchmarked against the exposure data identified as part of the other Overseas Territories assessments (See Error! Reference source not found.**).**

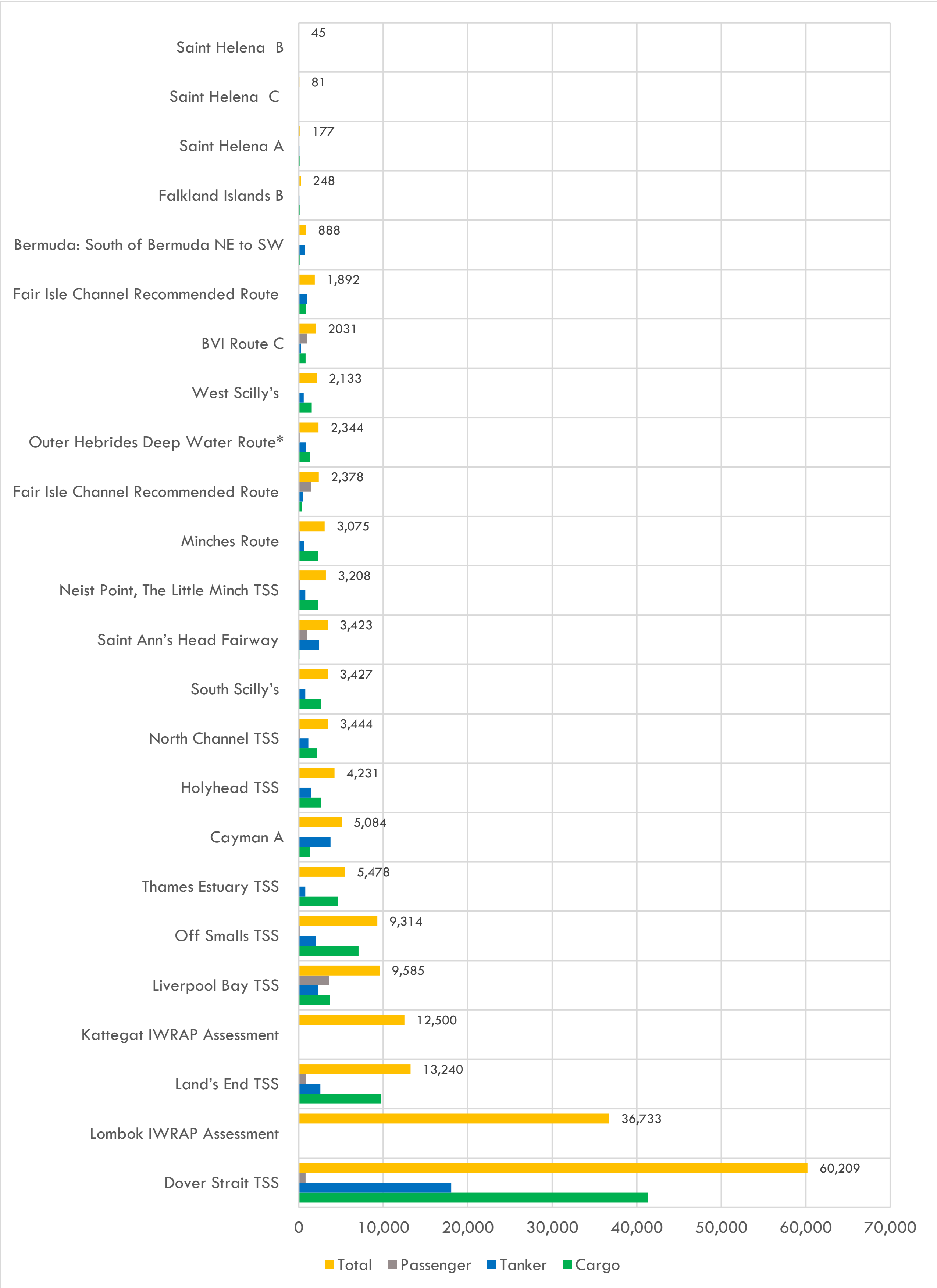


Figure 51:Comparison of Traffic Volumes.

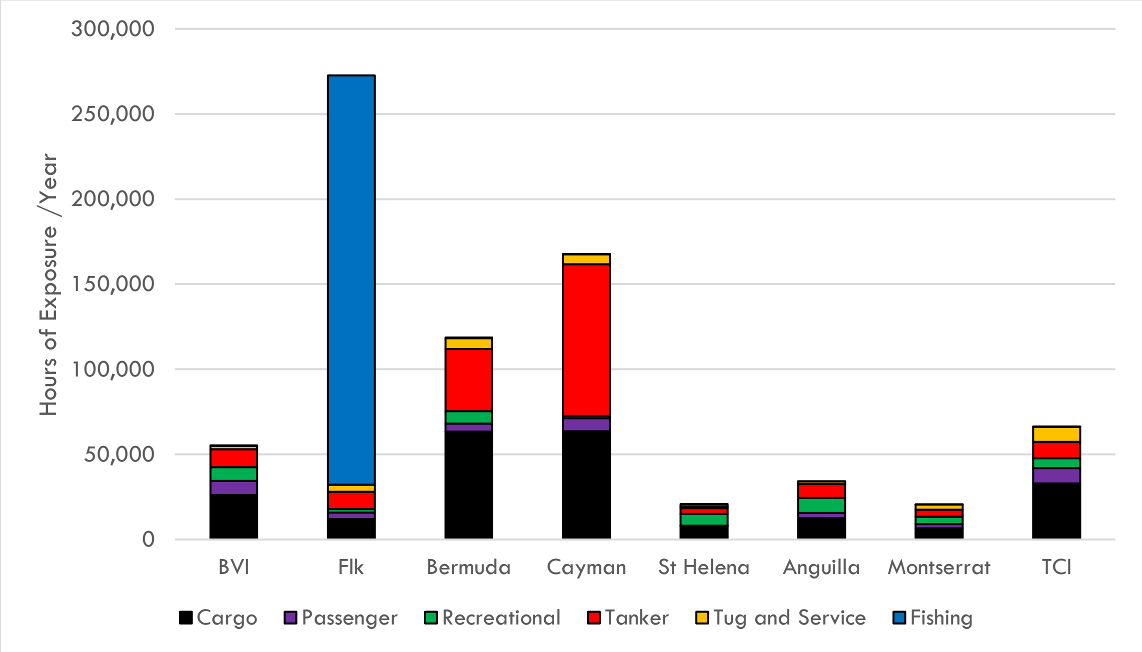


Figure 52: Comparison of Overseas Territories Exposure Data by Vessel Category.

7.6. SUMMARY

In summary a qualitative and quantitative benchmarking assessment of vessel traffic density and risk frequency has established:

- None of the factors that have historically motivated contracting government to apply to the IMO to introduce additional SOLAS risk mitigation measures apply to the Saint Helena model area;
- When compared to similar assessments where risk mitigation measures were introduced (in the form of the Kattegat and Lombok IWRAP assessments) the degree of risk assigned to collision and grounding incidents is significantly lower in the Saint Helena assessment area;
- In comparison to similar assessments of Bermuda, BVI, Cayman Islands and Falkland Islands waters conducted by NASH Maritime, probability of collision events occurring is significantly less;
- Grounding probability within the Saint Helena model area is significantly less than the other Overseas Territories with the exception of Anguilla; and
- Vessel traffic frequency within the Saint Helena model area is significantly lower than traffic passing through UK routeing schemes, the vessel traffic numbers identified as part of the Lombok and Kattegat assessments and the other Overseas Territory assessments carried out by Nash Maritime.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. CONCLUSIONS

An assessment of volume of traffic and degree of risk has been undertaken for Saint Helena Territorial Waters and EEZ waters. The assessment was based on:

- A review of the current legislation, navigational features and existing risk control measures in place;
- An examination of vessel traffic disposition within the Saint Helena Territorial Waters and EEZ;
- Analysis of vessel traffic frequency within the Saint Helena Territorial Waters and EEZ;
- IWRAP Modelling to define the degree of risk within Saint Helena Territorial Waters and EEZ;
- A review of recent applications made by contracting governments to the IMO and associated qualitative benchmarking exercise;
- A quantitative exercise to benchmark degree of risk and vessel traffic frequency against available datasets and reports; and
- A review of the findings by the project team to determine suitable recommendations.

The assessment has revealed that additional SOLAS risk mitigation measures are not necessary within the model area assessed this is summarised in **Table 15.**

Table 14: Summary of Necessary SOLAS Risk Mitigation Measures

SOLAS Chapter V Risk Mitigation Measure	Required / Not Required
Routeing Measures – Regulation 10	Based on the results of this assessment **no recommendations** for implementing routeing measures are made in Saint Helena.
Reporting Measures – Regulation 11	Based on the results of this **no recommendations** for implementing reporting measures are made in Saint Helena.
Vessel Traffic Services (VTS) – Regulation 12	Based on the results of this assessment **no recommendations** for implementing VTS measures are made in Saint Helena.
Aids to Navigation (AtoN) – Regulation 13	Based on the results of this assessment **no recommendations** are made for additional AtoN in Saint Helena.

8.2. RECOMMENDATIONS

Although additional risk mitigation measures are not considered to be necessary within the study area, there are opportunities to improve the monitoring of vessel traffic within the EEZ and Territorial Waters as well as improving capability and capacity, and determine of risk within port / internal waters. Recommendations in this regards are split into the following categories:

- To risk assess navigation within internal and waters effectively; and
- Build capacity to address:
  - Training needs of personnel including capability, capacity, and training;
  - Requirements for updated equipment/for collection of evidence base/data; and
  - Implementation of necessary policies, procedures, and processes to enable effective management of navigational risk.

Table 15 summarises the recommendations made and proposes actions that could be taken in order to address the recommendations outlined.

8.2.1. RECOMMENDATION TO EFFECTIVELY ASSESS NAVIGATIONAL RISK WITHIN INTERNAL/PORT WATERS

- The scope of this assessment has not considered internal or port waters. However, vessel traffic frequency and degree of risk are generally highest in these areas. Measures should therefore be taken to conduct appropriate risk assessments of internal and port waters to determine the level of risk and ensure appropriate risk mitigation measures, policies and procedures are appropriate and in place. Whilst not a requirement of SOLAS this is a requirement of domestic legislation. Consideration could be made for introduction of a Port and Internal Marine Safety Code (or equivalent) to provide a defined standard for marine safety that aims to enhance and manage marine risk and safety.

8.2.2. RECOMMENDATIONS TO IMPROVE CAPABILITY AND CAPACITY

- Requirements for updated equipment:
  - The IMO mandates that contracting governments should conduct a review every 5 years, to ascertain that the effectiveness of the SOLAS Chapter V measures are adequate. If future applications to the IMO are needed, then they will need to be based on an assessment of degree of risk and vessel traffic frequency and should be benchmarked to other quantitative data sets. To achieve this then member states should ensure that data and information is collected to allow evidenced based reviews. Saint Helena currently does not collect vessel traffic data (in the form of AIS data and vessel reporting logs) it is recommended that a suitable system be introduced; and
  - For the data to be useful and to enable quantitative and statistical analysis of vessel traffic (as presented in this report) it is recommended the government of Saint Helena develops vessel traffic analysis capability. Initially this should be in presenting vessel traffic information through a GIS type system – this can be undertaken at low cost using open source and freely available applications – although a degree of GIS capability and expertise will be required. In due course Saint Helena should also consider the need to use risk models such as IWRAP (as provided by IALA) and may consider using the IALA Risk Management Tool Kit to support assessment of marine navigation.
- Training needs of personnel:
  - Staff should be given adequate training and appropriate equipment to enable them to fulfil their responsibilities;
  - To effectively utilise GIS systems and IWRAP risk modelling software, staff will need to be trained to an appropriate level of knowledge. This may range from developing a full capability (‘advanced user’ in house) to contracted outsourced work to specialist users (or a hybrid model). At a minimum level, and if this scope is contracted, a ‘basic user’ level of internal understanding

is recommended to enable local staff to define appropriate requirements of contracted work and also interpret and act on findings;

- IALA Worldwide Academy (WWA) provides advice and training on compliance with IMO and IALA Standards – focused on AtoN and VTS provision. Saint Helena as an IALA member is entitled can make use of this capacity building; and
- Working with external providers to provide training, alongside the provision of further work, will ensure key recommendations are delivered but will also build capacity in an 'On The Job' (OJT) training environment. Options could include staff secondments to specialist user organisations, parallel working on defined tasks to pursue mutual points of interest or bespoke training packages provided by experts.

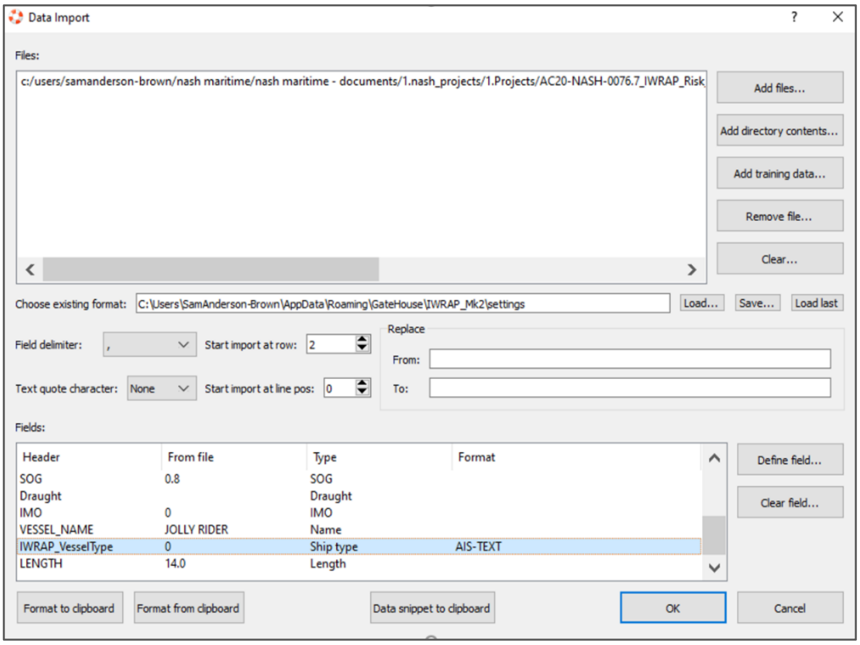
- Implementation of necessary procedures to enable effective management of navigational risk:
  - Steps should be taken to ensure that the necessary procedures are in place to effectively implement risk mitigation measures and external guidance/resource should be sought if required; and
  - Consideration could be made for introduction of a Port and Internal Waters Marine Safety Code (or equivalent) to provide a defined standard for marine safety that aims to enhance and manage marine risk and safety within internal waters.

Table 15: Summary of Recommendations.

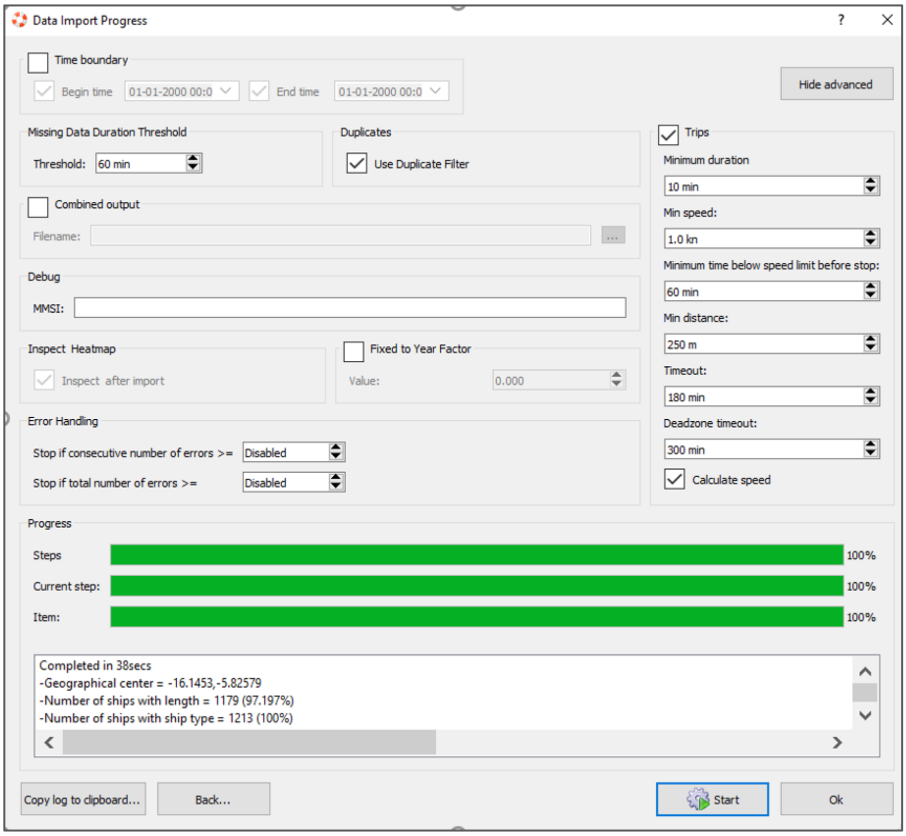
			Capacity Building Required		
			Personnel	Equipment	Implement Procedures
ID	**Recommendation**	**Proposed Action**			
1	**Assess navigational risk within internal waters and port waters and implement any necessary risk controls.**	Conduct an appropriate risk assessment for port and internal waters and implement any required risk control measures / procedures e.g., Marine Safety Code.	Ensure staff are appropriately trained to conduct risk assessments for port /internal water or outsource to an appropriately qualified expert.		Implement any risk control measures resulting from risk assessment findings. e.g., Marine Safety Management System. Outsource to expert if internal expertise is not sufficient.
2	**Conduct a review of SOLAS Chapter V measures every 5 years and ensure effective monitoring of Territorial Waters and EEZ to enable evidence-based reviews.**	Ensure that data and information is collected to allow evidenced based reviews as well as considering the use of risk models such as IWRAP to define "degree of risk".	Train staff appropriately so that vessel traffic analysis/risk modelling can be conducted or outsource to appropriate expert.	If conducting internally, ensure access to regularly updated AIS data and GIS analysis tools is available as well as risk modelling software.	

ANNEX A – IWRAP MODEL SETTINGS

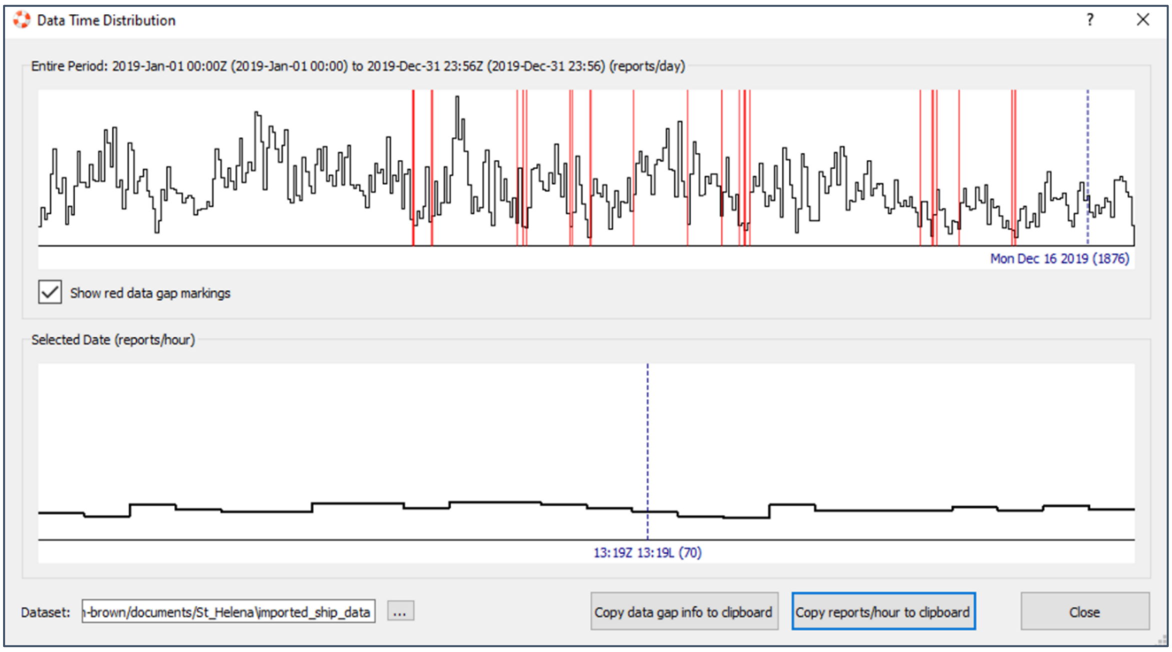
1. AIS data input fields



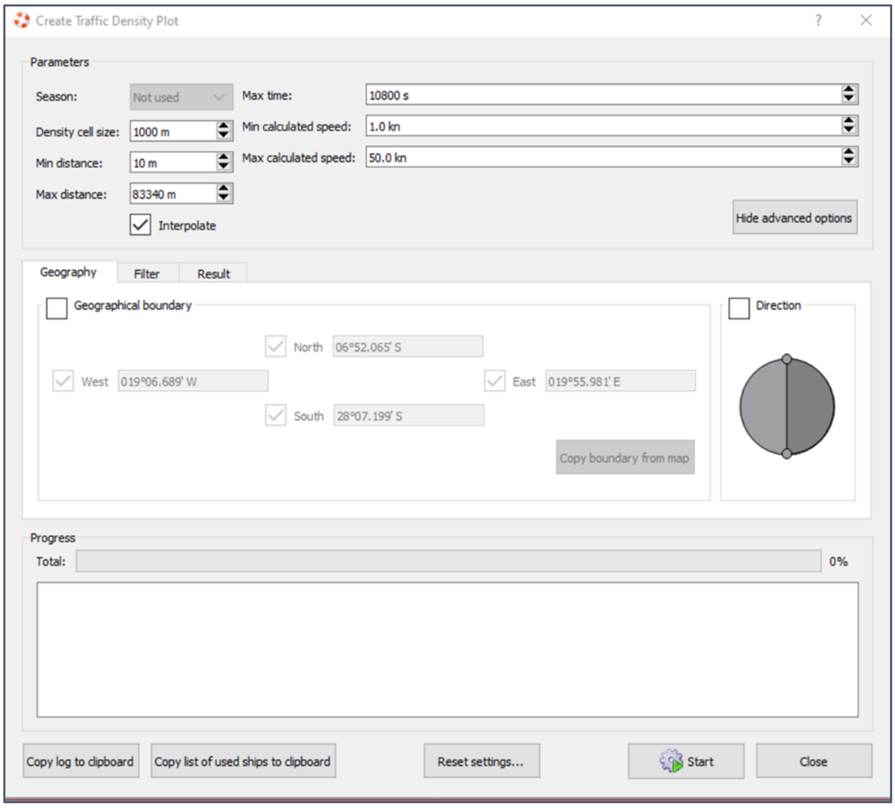
2. AIS data input settings



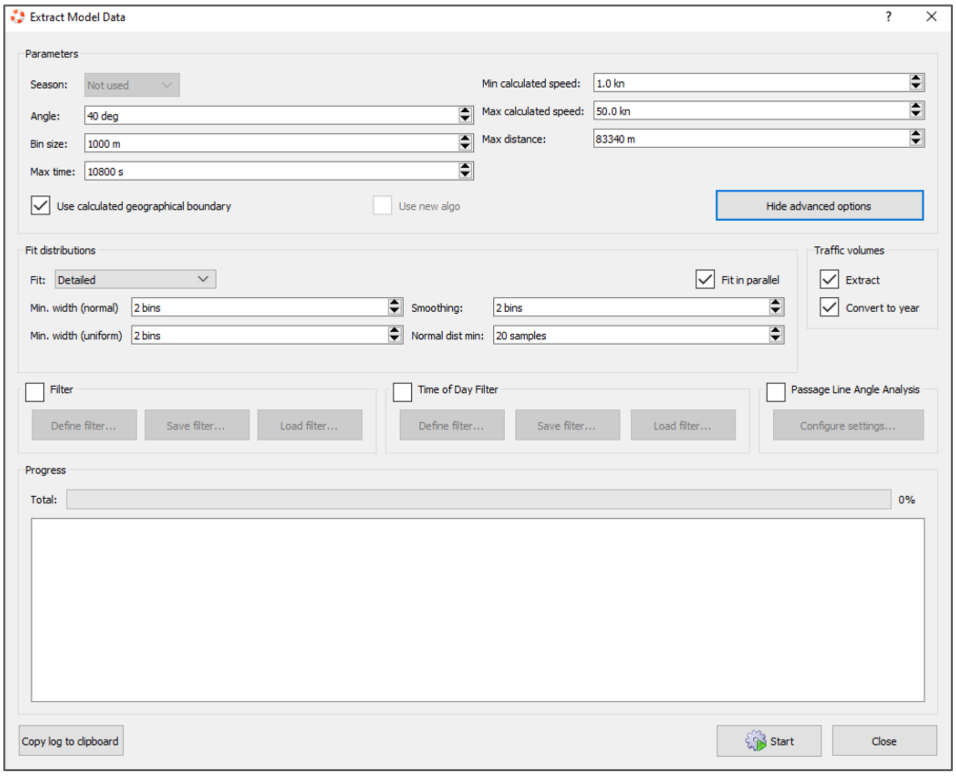
3. Data gap graphic



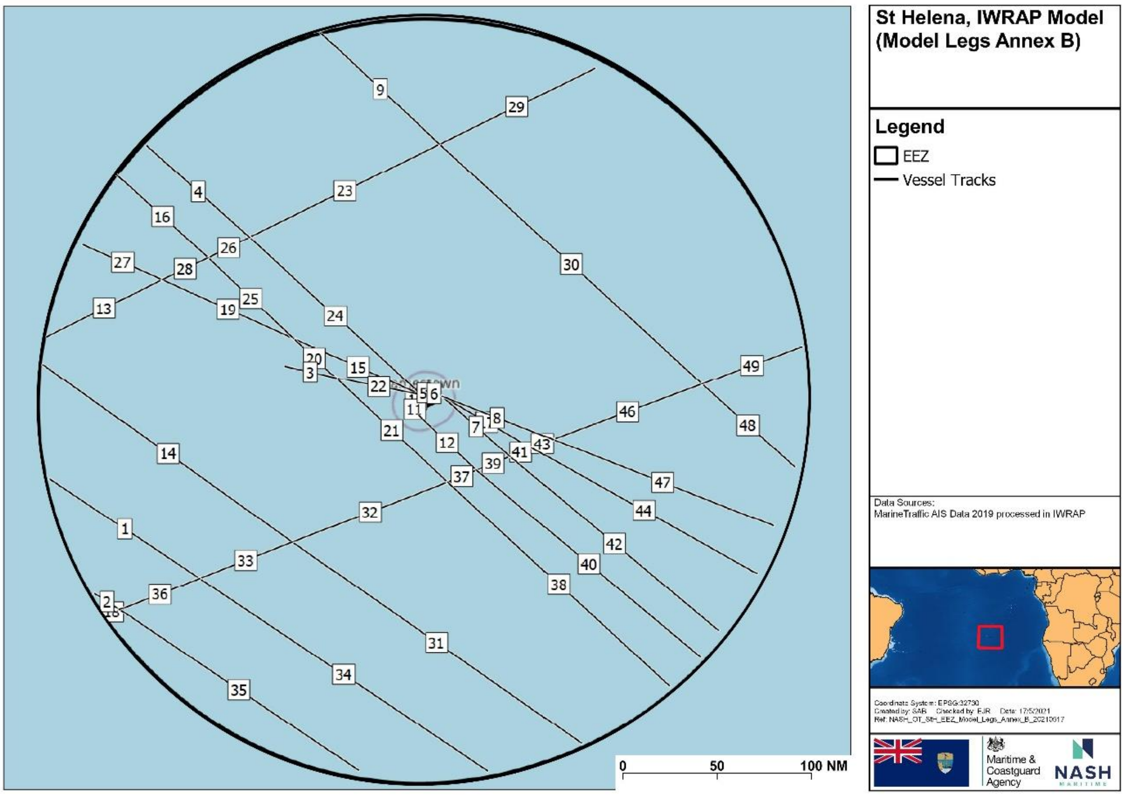
4. Density plot settings



5. Model extraction settings



ANNEX B – IWRAP VESSEL TRAFFIC FREQUENCY BY LEG



Leg	Direction	Total traffic	Tanker	Cargo	Passenger	Tug & Service	Fishing	Recreational
1	East	43	12	31	0	0	0	0
1	West	10	4	6	0	0	0	0
2	East	36	24	12	0	0	0	0
2	West	11	5	5	0	0	0	1
3	West	22	1	0	0	2	11	8
3	East	11	0	0	0	0	11	0
4	West	24	0	8	2	0	1	13
4	East	9	0	4	2	1	0	2
5	West	50	0	2	3	2	0	43
5	East	8	0	0	0	3	2	3
6	East	6	1	0	2	2	0	1
6	West	67	0	0	4	1	0	62
7	East	3	2	0	0	1	0	0
7	West	49	0	12	0	0	0	37
8	West	11	0	0	4	0	0	7
8	East	2	0	1	0	1	0	0

Leg	Direction	Total traffic	Tanker	Cargo	Passenger	Tug & Service	Fishing	Recreational
9	West	24	7	16	0	0	0	1
9	East	5	1	3	0	1	0	0
10	West	30	1	10	0	4	12	3
10	East	31	0	0	0	7	15	9
11	South	39	0	10	0	1	28	0
11	North	23	0	0	0	1	17	5
12	West	14	1	4	0	0	0	9
12	East	15	1	13	0	0	0	1
13	West	13	5	7	0	0	0	1
13	East	1	1	0	0	0	0	0
14	East	26	9	17	0	0	0	0
14	West	15	5	10	0	0	0	0
15	West	20	1	1	1	0	0	17
15	East	1	0	0	0	0	1	0
16	East	6	0	5	0	0	1	0
16	West	13	1	10	0	0	0	2
17	West	18	0	1	0	0	0	17
17	East	0	0	0	0	0	0	0
18	West	22	2	20	0	0	0	0
18	East	1	0	1	0	0	0	0
19	West	14	1	1	1	1	0	10
19	East	3	0	2	0	0	1	0
20	East	8	1	7	0	0	0	0
20	West	17	3	12	0	0	0	2
21	East	8	1	7	0	0	0	0
21	West	16	4	12	0	0	0	0
22	West	23	1	0	0	2	8	12
22	East	11	0	0	0	0	11	0
23	West	14	6	8	0	0	0	0
23	East	1	1	0	0	0	0	0
24	West	33	0	8	2	0	1	22
24	East	11	0	5	2	1	0	3
25	East	8	1	7	0	0	0	0
25	West	19	3	12	0	0	0	4
26	West	14	6	8	0	0	0	0
26	East	1	1	0	0	0	0	0
27	West	9	2	1	0	1	0	5
27	East	2	0	2	0	0	0	0
28	West	12	5	7	0	0	0	0

Leg	Direction	Total traffic	Tanker	Cargo	Passenger	Tug & Service	Fishing	Recreational
28	East	1	1	0	0	0	0	0
29	West	14	6	8	0	0	0	0
29	East	1	1	0	0	0	0	0
30	West	23	6	16	0	0	0	1
30	East	8	2	4	0	2	0	0
31	West	20	5	14	0	1	0	0
31	East	17	5	12	0	0	0	0
32	West	24	2	22	0	0	0	0
32	East	0	0	0	0	0	0	0
33	West	23	2	21	0	0	0	0
33	East	1	0	1	0	0	0	0
34	West	9	4	5	0	0	0	0
34	East	47	16	31	0	0	0	0
35	East	30	19	11	0	0	0	0
35	West	8	6	2	0	0	0	0
36	West	23	2	21	0	0	0	0
36	East	1	0	1	0	0	0	0
37	West	21	2	19	0	0	0	0
37	East	0	0	0	0	0	0	0
38	West	15	2	11	0	1	0	1
38	East	4	0	4	0	0	0	0
39	East	0	0	0	0	0	0	0
39	West	19	3	16	0	0	0	0
40	West	3	0	2	0	0	0	1
40	East	14	1	13	0	0	0	0
41	East	0	0	0	0	0	0	0
41	West	19	3	16	0	0	0	0
42	East	5	3	1	0	1	0	0
42	West	38	0	20	0	0	0	18
43	East	0	0	0	0	0	0	0
43	West	19	2	17	0	0	0	0
44	West	17	1	2	0	0	0	14
44	East	2	0	2	0	0	0	0
46	East	0	0	0	0	0	0	0
46	West	18	2	16	0	0	0	0
47	West	16	0	1	4	0	0	11
47	East	4	0	1	2	1	0	0
48	East	6	2	2	0	2	0	0
48	West	28	9	18	0	0	1	0

Leg	Direction	Total traffic	Tanker	Cargo	Passenger	Tug & Service	Fishing	Recreational
49	East	0	0	0	0	0	0	0
49	West	16	1	15	0	0	0	0