Appendix C

Marine Traffic Impact Assessment Report

Agreement No. CE 79/2023 (GE)

Underground Quarrying at Tsing Yi North – Investigation, Design and Construction

Marine Traffic Impact Assessment Report (Final)
(Ref. B20d-04)

Table of Contents

Tables

Figures

Appendices

1 Introduction

1.1 Background and Purpose

1.1.1 Rock, principally as aggregates in concrete, is the most predominately used construction material for buildings and infrastructure developments in Hong Kong. Local quarries, where rock is sourced for such uses, are strategically important to the construction industry in Hong Kong. Apart from the extraction of virgin rock, surplus rock generated from local construction projects can be processed and recycled at quarries for beneficial reuse. In addition, the quarries are suitable sites for housing manufacturing plants of rock-derived construction materials such as ready-mixed concrete and asphalt. Historically, rock has been quarried in Hong Kong by way of surface quarrying – open/pit extraction at the ground surface. By doing this, the quarries have been operating as self-financing business entities rather than government-funded facilities.

1.1.2 Currently, Lam Tei Quarry (LTQ) at Tuen Mun is the only active local quarry, for which the current quarry contract is scheduled for completion in 2025. Recognising the importance of local quarries in minimizing the risk of irregularities in the supply of imported rock, the Government has been searching for suitable sites to set up new surface quarries in order to maintain local rock supply, with a view to have at least one new quarry to dovetail with the closure of Lam Tei Quarry.

1.1.3 Apart from rock materials, Hong Kong is also desperately in need of developable land to meet socio-economic needs. Creating spaces in underground rock caverns is one of the solutions in boosting land supply in the medium to long term. To create land in this manner, the cavern formation will not only generate a large amount of good quality rock, but this process is also a source of rock materials which could be an integral part of the local rock supply in future. This is the underlying concept of the initiative of underground quarry-cum-cavern development, which is unprecedented in Hong Kong. There are, nevertheless, successful examples of this approach in other countries, e.g. Switzerland, Norway and the United States of America, where the entire operation combining quarrying and subsequent uses of the cavern spaces created (e.g. cold storage, data centres, warehousing and recreational complexes) is confirmed to be commercially viable.

1.1.4 Preliminary reviews under the Strategic Cavern Study identified the prospect of this concept and thereby proposed it as one of the initiatives under the long-term strategy for cavern developments in Hong Kong. Accordingly, in November 2018, when formulating the local quarry strategy for maintaining the local rock supply, the Government also recognized this initiative as a potential long-term solution that is complementary to new surface quarries. In other words, underground quarrying in Hong Kong is being pursued as a dual-benefit policy initiative contributing to enhanced land supply and sustainable use of local rock resources.

1.1.5 In 2017, the Civil Engineering and Development Department (CEDD) commissioned the Underground Quarry Study to evaluate the feasibility of this initiative, covering various aspects including technical acceptability, statutory and regulatory requirements, business model analyses and implementation mechanisms. Based on the results of a systematic territory-wide site search, the hillside at Tsing Yi North, which is one of the 48 Strategic Cavern Areas (SCVAs) as delineated in the Cavern Master Plan (CMP) jointly promulgated by CEDD and PlanD in 2017, was recommended to be taken forward.

1.1.6 In 2019, the CEDD and PlanD jointly commissioned the Pilot Planning and Engineering Study on Development of Selected Strategic Cavern Areas – Feasibility Study (“Pilot Study”) to enable the Government to earmark sites for cavern development and to facilitate the implementation of cavern development. The study findings concluded that it is worthwhile launching a scheme of underground quarrying at Tsing Yi North. It is envisioned as an integral part of the long-term local quarry strategy. Shortage of rock imports from Mainland China due to lockdown arising from the COVID-19 outbreak in early 2020 caused substantial impacts across the construction industry in Hong Kong, heightening the importance of local quarries in the supply chain. To enhance crisis preparedness, it is timely to proceed with the scheme, along with other quarry-related initiatives to maintain the local rock supply.

1.1.7 Following the commencement of the IDC assignment for developing and designing the pilot underground quarry at Lam Tei, Tuen Mun in 2021, CEDD launched an IDC assignment for developing a new underground quarry at Tsing Yi North in 2023.

1.1.8 To implement the proposed underground quarry-cum-cavern development at Tsing Yi North, it is necessary to conduct a site-specific investigation and design for the scheme, building on the work completed under the Underground Quarry Study and the pilot study.

1.1.9 This Assignment aims to complete all the tasks necessary and sufficient to undertake the assignments including statutory procedures, public consultation, detailed technical assessments, broad design for potential facilities, formulation of implementation arrangement etc. at the investigation, design and early construction stages, in order to enable commencement of the underground quarrying tentatively targeted at 2027. These include various impact assessments, reference design of caverns and the underground quarrying-related activities (e.g. the materials processing/manufacturing plants and their operations) coordinated or implemented by the Government, business case analyses, implementation strategy and procurement arrangements. Consultation within the Government and with public and relevant stakeholders/industry players will also be carried out.

1.1.10 This Assignment will also look into any works potentially required by the quarry operators during the operation stage of the proposed underground quarrying. Given its pilot nature, the underground quarrying operation will be subject to the prevailing and/or new implementation mechanisms such as contract form, site supervision and any independent audits required. These will be examined and tailor-designed under this Assignment. Depending on the findings, it may call for works or tasks for which the Government may procure consultancy services separately during the operation stage.

1.1.11 The construction works for the Underground Quarrying at Tsing Yi North (TYNUQ) are scheduled to commence in 2027, and the operation of the TYNUQ is expected to commence in 2028.

1.1.12 AECOM Asia Co. Ltd has been commissioned by the CEDD on 13 June 2024 to undertake the “Agreement No. CE 79/2023 (GE) Underground Quarrying at Tsing Yi North – Investigation, Design and Construction” (hereinafter referred to as “the Project”).

1.1.13 Recognizing the potential marine traffic issues that may arise from the project, AECOM has engaged Maritime Planning Solutions limited (MPS) to conduct a Marine Traffic Impact Assessment (MTIA) to assess any marine impacts generated from the Underground Quarrying project at Tsing Yi North. It includes identifying a suitable location for the barging points and exploring its potential impacts on marine traffic while using the barge. The associated traffic generated by the development and operation of the barging points will be assessed in this study, and corresponding mitigation measures will be developed if required.

1.2 Project Works

1.2.1 The boundary of the Study Area, the two proposed site areas at Ngau Kok Wan (NKW) and Wok Tai Wan (WTW) for the Project, are illustrated in **Figure 1-1**. The Study Area covers the key marine-based facilities and waterways in the vicinity of the proposed site areas within Hong Kong waters.

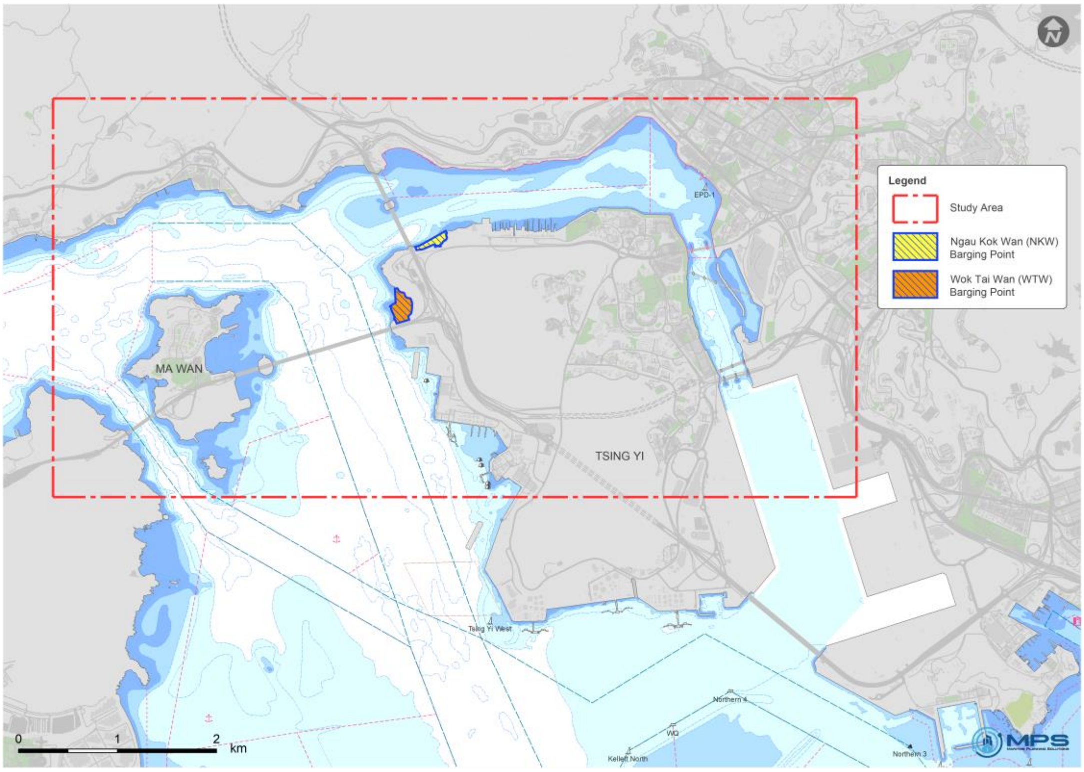

Figure 1-1 Proposed Site Barging Points and MTIA Study Area

1.3 Objectives

1.3.1 The main goal of this report is to review the potential marine traffic impacts brought about by the marine transportation activities generated due to the Project. In addressing the key issues, the MTIA is framed around the following aspects:

Marine Feasibility

What is the existing marine traffic level, and does the barging location present any navigation constraints?

What marine activities may be affected due to the proposed vessel's movements in the Project?

Marine Traffic data is collected from the Marine Department (MD) to review the current marine traffic pattern in waters along the travelled routes; the data will be used to identify any potential impacts due to the proposed transporting activities and recommend risk control measures as required.

Marine Operation

What do the operations involve?

Vessel deployment arrangements and the scheduled barge frequencies are outlined. Marine routes are proposed from the potential origins to the TYNUQ site area.

Marine Safety

What can be done to minimise impact?

Practical mitigation measures are recommended to minimise the potential impact generated by the transporting activities.

1.4 Scope of Works

1.4.1 This Report on Marine Traffic Impact Assessment is one of the deliverables of B20 as described in Section 6.15 of the Scope. The scope of the MTIA includes the following tasks:

1.4.2 Review and study any potential impact on marine traffic during the development and operation of the quarry. Existing information available from relevant studies/surveys regarding the assessment area shall be reviewed. Based on the review results, the assessment shall identify data gaps and determine if there is any need for field surveys. If field surveys are considered necessary, the assessment shall include sufficient site surveys carried out at different strategic locations within or outside the site. The requirements of the survey for the MTIA shall be agreed upon with the MD.

1.4.3 Collect relevant data, including consultation with marine facilities and ship operators on existing and future size and draft of ships and frequency of calls, and project the marine traffic volume, density and flow pattern before, during and after the quarry development;

1.4.4 The traffic model design and its inherent assumptions shall be agreed upon with the MD prior to entry of data into the model for determining the marine traffic risk.

1.4.5 Based on 1.4.2 – 1.4.4 above, evaluate and quantify the existing and future marine traffic situation and navigation risk levels associated with the quarry development;

1.4.6 Based on 1.4.5 above, recommend, if necessary, mitigation measures to minimise the possible impacts to an acceptable level;

1.4.7 Assess the possible cumulative marine traffic and transport impacts, taking into consideration the other proposed developments/works within and near the site; and

1.4.8 Assess the impacts on existing and future vessel traffic during and after the quarry development, and recommend, if necessary, mitigation measures to maintain an unhindered and safe passage and access to marine-based facilities.

1.5 Study Methodology

1.5.1 The MTIA has been developed in accordance with the Formal Safety Assessment (FSA) methodology adopted by the International Maritime Organization (IMO) as a structured approach to the assessment of marine risks and the effectiveness of control mechanisms. The steps are illustrated in **Figure 1-2** and may be summarized as follows:

1.5.2 **Step 1** – Hazard Identification: a list of all relevant accident scenarios with potential causes and outcomes;

1.5.3 **Step 2** – Risk Assessment: estimation of the likelihood and consequences of the potential accident scenarios;

1.5.4 **Step 3** – Risk Control Options: identify potential measures to reduce the likelihood of occurrence of the identified risks or limit their consequences should they occur, and estimate their effect on reducing the risk; and

1.5.5 **Step 4** – Recommendations: the produced information about hazards, risks, and risk control options is gathered and summarized as input for recommendations for decision-making.

Figure 1-2 Formal Safety Assessment (FSA) Methodology

1.5.6 To support the different steps of risk assessment and estimate the effectiveness of mitigating measures, the International Association of Lighthouse Authorities (IALA) suggests the use of several supportive tools. These tools are characterised as quantitative when they result in numeric risk figures or qualitative when the tool produces results in terms of acceptability.

1.5.7 To determine the marine traffic risk that may arise from the Project, two tools from the IALA toolbox will be used for quantitative and qualitative risk assessment, namely a) IALA Waterway Risk Assessment Program (IWRAP) and ii) Simplified IALA Risk Assessment Method (SIRA).

The IALA Waterway Risk Assessment Program (IWRAP)

1.5.8 IWRAP MK II, a quantitative risk assessment tool, is a frequency analysis program that models the marine traffic environment to predict risk levels of ship collisions, allisions and groundings. It quantifies marine traffic risk levels and determines the probability of collision of a predefined traffic route by applying AIS and radar data sourced from the Marine Department (MD).

1.5.9 IWRAP MK II supports steps 1 to 3 of the FSA process. The hazards that can be identified include groundings, allisions, and collisions. The calculated likelihood of these accidents is presented as a "heat map" on an Electronic Nautical Chart (ENC) to reveal "hotspots" in an area where the traffic density distribution leads to relatively high-risk levels. The resulting change in risk level and risk distribution due to changes in the traffic layout (possibly due to mitigating measures) is clearly shown.

The Simplified IALA Risk Assessment Method (SIRA)

1.5.10 SIRA, a qualitative risk assessment tool, uses a structured approach to identify hazards and undesirable incidents and assess their likelihood and consequences. It evaluates the risk level for each incident with and without risk control measures. In this way, SIRA covers FSA steps 1 to 4. Risk control options are recommended primarily based on perceived effectiveness in mitigating risk to acceptable levels.

1.6 Structure of the Report

1.6.1 This report contains the following sections:

Section 1 **Introduction:** outlines the project background, study objectives, and study area.

Section 2 **Proposed Marine Transportation Activities:** identifies and describes the elements of barging operation, vessel deployment and generated traffic;

Section 3 **Marine Environment:** outlines the marine environment of the MTIA Study Area, including the existing marine-based and port-related facilities, and other ongoing and planned developments, metocean conditions, aids to navigation, and constraints;

Section 4 **Marine Traffic Activities Review:** presents the existing, construction and operation marine traffic situation of the Study Area, taking into consideration other proposed developments within the Study Area;

Section 5 **Marine Traffic Risk Assessment:** presents the methodology of marine traffic risk modelling, summarizes the overall risk assessment results, and details the findings of SIRA;

Section 6 **Risk Control Measures:** proposes risk control and mitigation measures to minimise any potential marine impacts;

Section 7 **Conclusions & Recommendations:** summarises the findings, conclusions and recommendations of this MTIA.

1.7 Nomenclature and Abbreviations

1.7.1 **Table 1-1** lists out the abbreviated titles of government bureaus, departments, offices, statutory bodies and public organizations mentioned in this Study.

Table 1-1 Abbreviations for Government Bodies

Abbreviations	Full title
CEDD	Civil Engineering and Development Department
HKO	Hong Kong Observatory
MD	Marine Department
PlanD	Planning Department
VTS	Vessel Traffic Services

1.7.2 **Table 1-2** lists out the meanings of abbreviations for expressions adopted in this Report.

Table 1-2 Abbreviations Adopted in this Report

Abbreviations	Full title
3RS	Three-Runway System
AECOM	AECOM Asia Company Ltd
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
CMP	Cavern Master Plan
CMPs	Contaminated Mud Pits
ENC	Electronic Nautical Chart
FF	Fast Ferry
FL	Fast Launch
FSA	Formal Safety Assessment
HK	Hong Kong
HKP 2030	Hong Kong Port 2030
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organization
I·PARK1	Integrated Waste Management Facilities Phase 1
I·PARK2	Integrated Waste Management Facilities Phase 2
IWRAP	IALA Waterway Risk Assessment Program
KSMF	Kap Shui Mun Fairway
LF	Local Ferry
LTQ	Lam Tei Quarry
mCD	Meters below the Chart Datum
MPS	Maritime Planning Solutions Limited
MTIA	Marine Traffic Impact Assessment
MWF	Ma Wan Fairway
NKW	Ngau Kok Wan
NWNT	Northwest New Territories
OG	Oceangoing
PRD	Pearl River Delta

Abbreviations	Full title
RT	River Trade
SC	Small Craft
SCVAs	Strategic Cavern Areas
SIRA	Simplified IALA Risk Assessment
TCNTE	Tung Chung New Town Extension
TMB	Tuen Mun Bypass
TM-CLKL	Tuen Mun – Chek Lap Kok Link
TT	Tug and Tow
TYLL	Tsing Yi – Lantau Link
TYNUQ	Underground Quarry at Tsing Yi North
UKC	Under Keel Clearance
WENTX	West New Territories Landfill Extension
WTW	Wok Tai Wan

2 Proposed Marine Transportation Activities

2.1 Introduction

2.1.1 This section outlines the proposed marine transportation activities associated with the TYNUQ Project. It presents the site areas of the Project and summarises the key marine construction and operational activities of the Project.

2.2 Site Areas

2.2.1 Two site areas are proposed along the northern and southern coastline of Tsing Yi:

- **Ngau Kok Wan (NKW)**: designated primarily for the receive and delivery of rock, as well as for receiving raw materials from suppliers to facilitate ancillary operations at NKW.
- **Wok Tai Wan (WTW)**: serves as the stockpile area for the Project. The site will function as a temporary storage location for construction materials during the construction phase, and for excavated and processed rock from NKW or other projects during the operation phase.

2.2.2 The layouts of the proposed NKW and WTW site areas are shown in **Figure 2-1**. Barging points will be set up at both locations to facilitate marine loading and unloading operations.

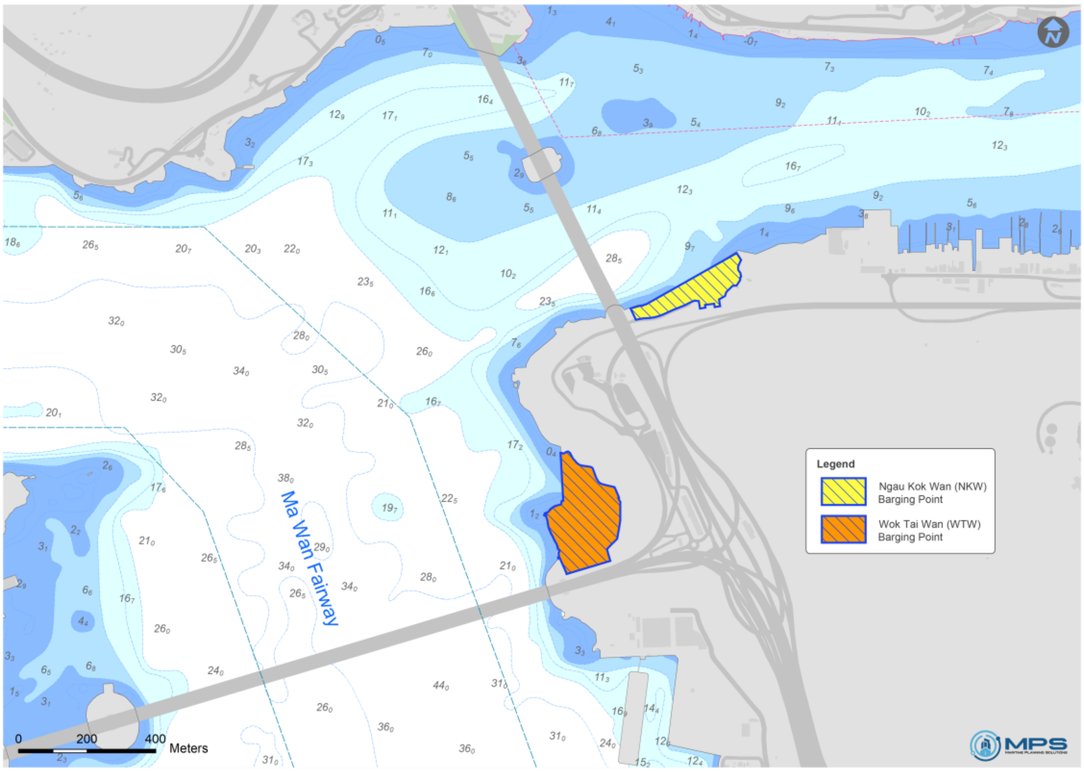

Figure 2-1 Site Areas of the Project

2.3 Marine Activities During the Construction Phase

2.3.1 The construction phase for the Project is scheduled to commence in 2027. Marine traffic during this period will primarily be generated by the transportation of construction materials, plant, equipment, and rock stockpiles to and from the designated site areas.

2.3.2 Construction materials are expected to be delivered from several locations to the NKW and WTW site areas. **Table 2-1** and **Table 2-2** present the estimated peak number of vessel movements by the delivery routes to the NKW and WTW site areas, respectively.

Table 2-1 Estimated Daily Vessel Movements to NKW Site Area during Construction Phase (2027)

Phase	Marine Activities	From	To	Round Trip per day
Construction	Delivery of Construction Materials, Plants, and Equipment	Tuen Mun Public Cargo Working Area	NKW	0.33
		the New Yau Ma Tei Public Cargo Working Area		0.33
		Mainland China		0.34
Total				**1**

Table 2-2 Estimated Daily Vessel Movements to WTW Site Area during Construction Phase (2027)

Phase	Marine Activities	From	To	Round Trip per day
Construction	Delivery of Construction Materials, Plants, and Equipment	Tuen Mun Public Cargo Working Area	WTW	0.25
		the New Yau Ma Tei Public Cargo Working Area		0.25
		Mainland China		0.25
		NKW		0.25
Total				**1**

2.3.3 The typical construction vessels anticipated to be deployed are summarised in **Table 2-3**.

Table 2-3 Typical Vessels Deployed During the Construction Phase

Phase	Marine Activities	Vessel Type	LOA (m)	Beam (m)	Draft (m)	Airdraft (m)
Construction	Delivery of Construction Materials, Plants, and Equipment	Tug and Tow	~100*	~20	~4	~20
		Delivery Barge	~75	~23	~5	~20

Note (*): The overall length of the Tug & Tow is estimated to be 100m, which includes the length of the barge (50m), tugboat (20m), and the length of the tow line 30m).

2.3.4 The indicative marine traffic routes during the construction phase of the Project are illustrated in **Figure 2-2**.

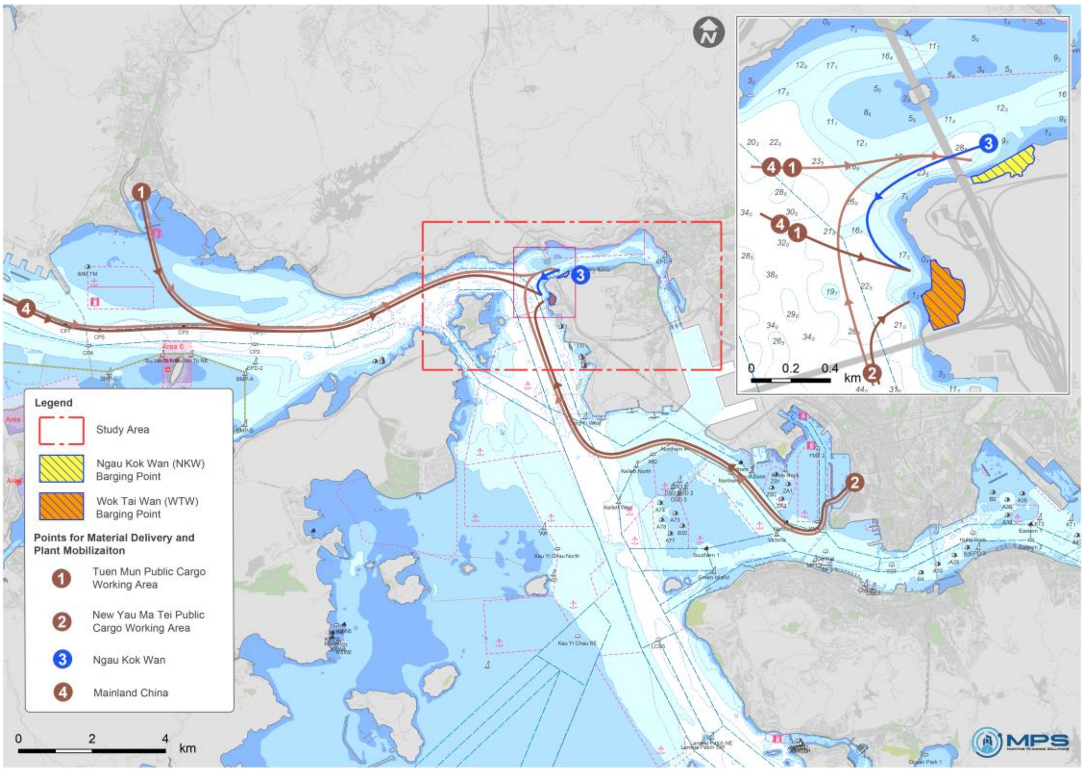

Figure 2-2 Indicative Marine Traffic Routes (Construction Phase)

2.4 Marine Activities During the Operation Phase

2.4.1 The operation phase of the TYNUQ is expected to commence in 2028. During operation, the concrete batching and asphalt production facilities will require marine delivery of raw materials (e.g. aggregates and cement etc.) from the Mainland suppliers to the NKW site area.

2.4.2 An internal marine transfer between WTW and NKW will be established for the transport of stockpiled rock. This includes the delivery of excavated or processed rock from NKW to WTW for storage, and the transfer of stockpiled rock from WTW to NKW for further processing.

2.4.3 **Table 2-4** and **Table 2-5** present the estimated number of vessel movements categorized by the delivery routes to NKW and WTW site areas during the operation phase, respectively.

Table 2-4 Estimated Daily Vessel Movements to NTW Site Area during Operation Phase (2028)

Phase	Marine Activities	From(2)	To	Round Trip per day
Operation	Material Supply	Western waters of HK *(Primary)*	NKW	7.2(2)
		Eastern waters of HK *(Alternative)*		0.8(2)
Total				**8 (16 movements)(1)**

Notes:

(1) *Based on production capacity and the typical loading capacity of delivery barges, approximately 8 round trips (16 movements) per day are expected.*

(2) *Due to supplier uncertainty at this stage,* ***two marine routes*** *are proposed* ***via the western*** *and* ***eastern waters of Hong Kong****. For a conservative assessment, the western route is assumed as the primary route handling about 90% of vessel traffic (approximately 7.2 round trips per day),* *while the eastern route serves as an alternative handling about 10% (approximately 0.8 round trips per day.)*

Table 2-5 Estimated Daily Vessel Movements to WTW Site Area during Operation Phase (2028)

Phase	Marine Activities	From	To	Round Trip per day
Operation	Rock Delivery	NKW	WTW	2
Total				**2 (4 movements)**

2.4.4 The types of vessels expected to be deployed during operations, along with their typical dimensions and carrying capacities, are summarized in **Table 2-6**.

Table 2-6 Typical Vessels Deployed During the Operation Phase

Phase	Marine Activities	Vessel Type	LOA (m)	Beam (m)	Draft (m)	Airdraft (m)	Capacity (ton)
Operation	Material Supply/ Rock Delivery	Pelican Barge	~75	~20	~5	~22	~3,000
		Delivery Barge	~75	~23	~5	~20	~1,500

2.4.5 The indicative marine traffic routes during the operation phase of the Project are illustrated in **Figure 2-3.** Marine transport operations will take place daily between 07:00 and 19:00.

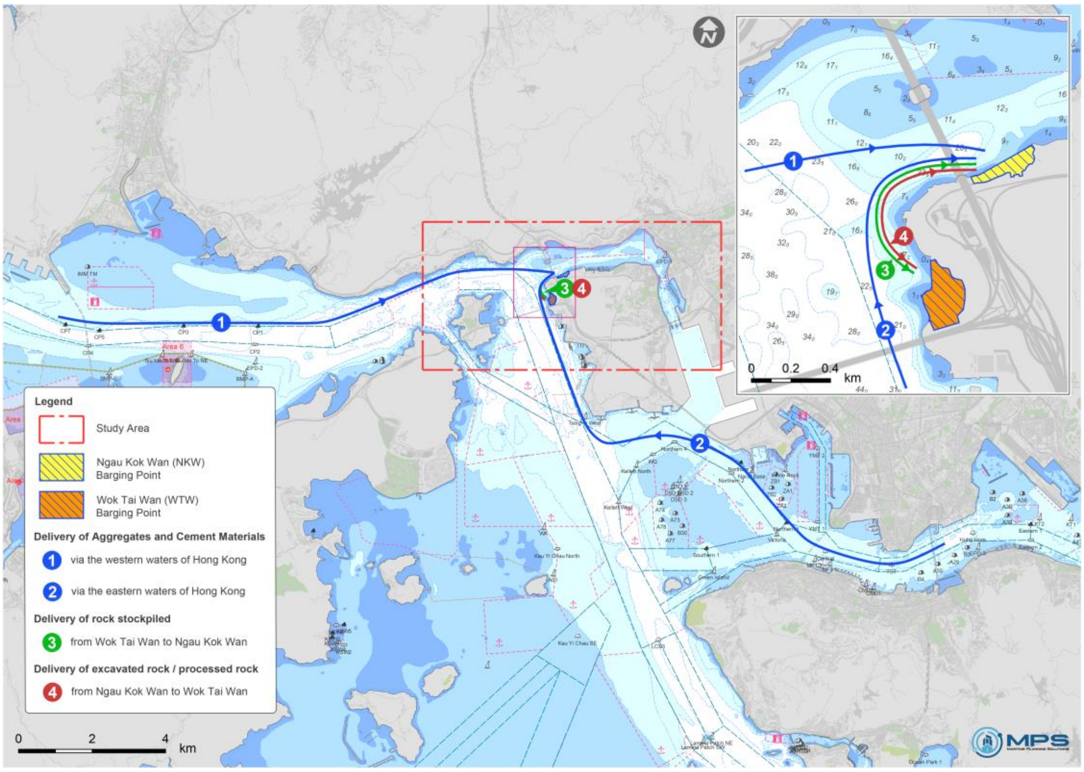

Figure 2-3 Indicative Marine Traffic Routes (Operation Phase)

2.4.6 The typical vessel dimensions and estimated daily round trips outlined in this section have been adopted in the marine traffic risk assessment to quantify the associated risk levels (refer to **Section 5**). Detailed marine traffic information will be provided by the Contractor and will be further assessed in the Construction Marine Traffic Impact Assessment (CMTIA).

2.5 Summary

2.5.1 An overview of the proposed marine transportation activities and the deployed vessels for the TYNUQ Project during both the construction and operational phases has been reviewed and identified. A detailed assessment of potential risks to existing and future marine traffic resulting from these activities is provided in a later section.

3 Marine Environment

3.1 Introduction

3.1.1 This section reviews the marine environment of the MTIA Study Area, comprising existing marine facilities, port operation arrangements, and any anticipated future developments. Existing navigation constraints within the MTIA Study Area are also identified.

3.2 Existing Marine Facilities and Proposed Development

3.2.1 **Figure 3-1** illustrates the existing marine-based facilities and proposed developments that may generate marine activities or have restrictions for vessel passage within the Study Area.

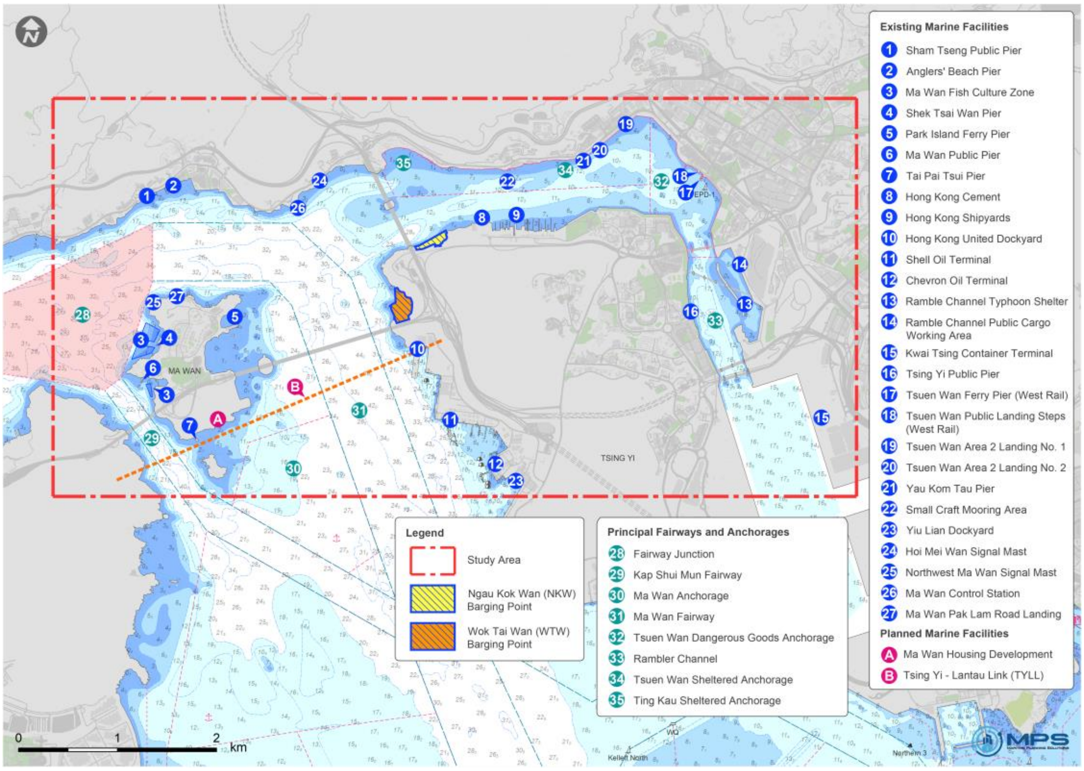

Figure 3-1 Marine Facilities within the Study Area

Existing Marine Facilities

1. **Sham Tseng Public Pier** – a pier maintained by the CEDD Pier/Landing Structure with No. NP091, the former Kaito ferry service linking Sham Tseng Public Pier to Ma Wan Public Pier, has been suspended; currently, no franchised, licensed or Kaito ferry services are berthing at Sham Tseng Public Pier.

2. **Angler's Beach Pier** – a pier maintained by the CEDD Pier/Landing Structure with No. NP161, the former Kaito ferry service linking Angler's Beach Pier to Ma Wan Public Pier, has been suspended; currently, no franchised, licensed or Kaito ferry services are berthing at Angler's Beach Pier.

3. **Ma Wan Fish Culture Zone** – located alongside Tam Shui Wan and Shek Tsai Wan on the west shore of Ma Wan. The rafts are used by fishermen to store fish before taking them to market.

4. **Shek Tsai Wan Pier** – one of the important landing points for local villagers and fishermen in Ma Wan. The existing Shek Tsai Wan Pier has only one berthing space and is mainly used by small fishing vessels.

5. **Park Island Ferry Pier** – a pier used by "Park Island – Tsuen Wan" and Park Island – Central", a licensed ferry service, operated by Park Island Transport Company Limited.

6. **Ma Wan Public Pier** – a pier formerly maintained by the Civil Engineering and Development Department (CEDD), the former Katio ferry service linking Ma Wan Public Pier to Sham Tseng Public Pier/Angler’s Beach Pier has been suspended; currently, no franchised, licensed or Kaito ferry services are berthing at Ma Wan Public Pier.

7. **Tai Pai Tsui Pier** – a pier maintained by the CEDD Pier/Landing Structure with No. IP075.

8. **Hong Kong Cement** – Hong Kong Cement Company Limited owns a private terminal for receiving aggregate and other raw materials for cement making.

9. **Hong Kong Shipyards** – is mainly engaged in ship repairing and maintenance services.

10. **Hong Kong United Dockyard** - is mainly engaged in tugboat, salvage services, ship repair, mechanical and electrical engineering and automobile services.

11. **Shell Oil Terminal** - a storage and distribution depot of Shell’s, the facility is to providing a safe and efficient supply of oil products to Hong Kong and Macau.

12. **Chevron Oil Terminal** – Chevron’s Tsing Yi fuel terminal, the facility is responsible for receiving, delivering and housing Chevron Hong Kong's fuel supply.

13. **Rambler Channel Typhoon Shelter** – used for sheltered berthing and mooring of ~13ha for vessels with a length overall not exceeding 50m.

14. **Rambler Channel Public Cargo Working Area** – inside the Rambler Channel Typhoon Shelter for ships to perform loading and unloading cargo operation.

15. **Kwai Tsing Container Terminal** – Kwai Tsing Port possess 9 container terminals that are financed and owned by 5 private operators. It generates frequent trips of container vessels arriving and departing the basin daily.

16. **Tsing Yi Public Pier** – a pier maintained by the CEDD Pier/Landing Structure with No. NP123, currently no franchised, licensed or kaito ferry services berthing at Tsing Yi Public Pier.

17. **Tsuen Wan Ferry Pier (West Rail)** – a pier maintained by the CEDD Pier/Landing Structure with No. KP092, used by “Tsuen Wan – Park Island”, is a licensed ferry service operated by Park Island Transport Company Limited.

18. **Tsuen Wan Public Landing Steps (West Rail)** – a landing step maintained by the CEDD Pier/Landing Structure with No. KP093.

19. **Tsuen Wan Area 2 Landing No. 1** – a landing step maintained by CEDD Pier/Landing Structure with No. NP040.

20. **Tsuen Wan Area 2 Landing No. 2** – a landing step maintained by the CEDD Pier/Landing Structure with No. NP041.

21. **Yau Kom Tau Pier** – a pier maintained by the CEDD Pier/Landing Structure with No. NP125.

22. **Small Craft Mooring Area** – a designated zone where small vessels can moor.

23. **Yiu Lian Dockyard** – mainly engaged in tugboat, salvage services, and ship repair.

24. **Hoi Mei Wan Signal Mast** – signal masts erected at the end of the Ma Wan Fairway to give warnings of restricted movement through the area; the signal mast at Hoi Mei Wan provides a warning to vessels approaching from the east and the south.

25. **Northwest Ma Wan Signal Mast** – signal masts erected at the end of the Ma Wan Fairway to give warnings of restricted movement through the area; signal mast at the northwest of Ma Wan Island provides a warning to vessels approaching from the west.

26. **Ma Wan Control Station** – active vessel traffic management and control scheme to maintain the safe transit of vessels around Ma Wan.

27. **Ma Wan Pak Lam Road Landing** – a landing step maintained by the CEDD Pier/Landing Structure with No. IP121.

Principal Fairway and Anchorages

28. **Fairway Junction** – It joins the Ma Wan Fairway, the Kap Shui Mun Fairway, and the Ha Pang Fairway.

29. **Kap Shui Mun Fairway** – it is designated as a Principal Fairway by the Marine Department with an objective of improving navigation safety in the area, where traffic movement is restricted, with one-way traffic arrangement that restricts vessels exceeding 10 meters to sail through the channel in a southeasterly direction only; fairway is cross by Kap Shui Mun Bridge, with a height limit of 41 meters clearance.

30. **Ma Wan Anchorage** – a mooring area for vessels with length overall less than 320 meters and draught less than 12.6 meters to berth.

31. **Ma Wan Fairway** – it is designated as a Principal Fairway by the Marine Department with an objective of improving navigation safety in the area, where traffic movement is restricted, with North-South direction fairway with the Tsing Ma Bridge overhead is a main navigation channel for container ships to/from Kwai Tsing Container Terminal and other cargo vessels, passenger ferries and oil tankers to/from Hong Kong and ports in the PRD; The height restriction for all vessels approaching Tsing Ma Bridge Area is 57 meters above sea level. Vessels with a height exceeding 54.6 metres above sea level, but not exceeding 57 metres above sea level, can enter or pass through the Tsing Ma Bridge Area during the hours specified by the Highways Department.

32. **Tsuen Wan Dangerous Goods Anchorage** – is one of eight gazetted Dangerous Goods Anchorages in Hong Kong designated for vessels carrying or handling dangerous goods, it accommodates 70 private moorings used primarily by local oil carriers.

33. **Rambler Channel** – a passageway approximately 900 meters at its widest point separates Tsing Yi Island from Tsuen Wan. The majority of vessels' activities involve River Trade vessels to/from Kwai Chung Terminal and Rambler Channel Typhoon Shelter, and local vessels to/from shipyards and small craft moorings.

34. **Tsuen Wan Sheltered Anchorage –** provides 3.7 hectares of sheltered water area primarily for working vessels.

35. **Tin Kau Sheltered Anchorage –** provides 0.7 hectares of sheltered water area primarily for pleasure vessels.

Proposed Developments

A. **Ma Wan Housing Development –** CEDD has conducted a feasibility study for the Private Housing Development in Ma Wan South and finished in September 2024. The report suggests that the implementation of the Ma Wan Housing Development Program is subject to review; hence, the first intake year of the private development is yet to be affirmative.

B. **Tsing Yi – Lantau Link (TYLL) –** construction of dual 3-lane carriageway between Northeast Lantau and Tsing Yi, in the form of cable-supported bridges with connections to/from the proposed Tsing Lung Bridge and the existing North Lantau Highway in both directions at Northeast Lantau Interchange and to/from Tsing Shan Highway in both directions at Tsing Yi. This TYLL will potentially bring constraints to the future vessel movements to/from TYNUQ. However, the study of TYLL is still underway.

3.3 Metocean Environment

3.3.1 The following metocean parameters and conditions within the MTIA Study Area were reviewed to identify any potential impacts during the construction and operation phases of the Project:

- Tidal levels
- Current
- Wind
- Wave Height
- Adverse Weather, including strong monsoons, tropical cyclones, rainstorm warnings, and reduced visibility.

Tidal Levels

3.3.2 Tidal data at Ma Wan Station has been chosen to demonstrate the typical tidal patterns, as it is the nearest tidal station to the TYNUQ. Tidal details are shown **Table 3-1** where the levels of “Mean Lower Low Water” and “Mean Higher High Water” encompass the range of normal tidal variation.

3.3.3 The mean tidal range of about 1.48m is considered to be low, and the change of tidal levels is not considered to have a significant impact on vessels deployed for marine works for the construction and operation of the TYNUQ.

Table 3-1 Tidal Levels at Ma Wan (height in meters above Chart Datum)

Mean Sea Level	Mean Higher High Water Level	Mean Lower Low Water Level	Highest Astronomical Tide
1.48	2.06	0.84	2.89

Note: The Chart Datum is 0.15m below the Hong Kong Principal Datum.
Source: ‘Charts for Local Vessels 2025’, Hong Kong Waters' by Hydrographic Office, Marine Department

Current

3.3.4 To review the tidal current environment in proximity to the Site Area, one year of tidal stream prediction data from 05 Oct 2023 to 04 Oct 2024, sourced from the Marine Department Hydrographic Office, was obtained for analysis. Data points are set in the vicinity of the site area, as illustrated in **Figure 3-2**.

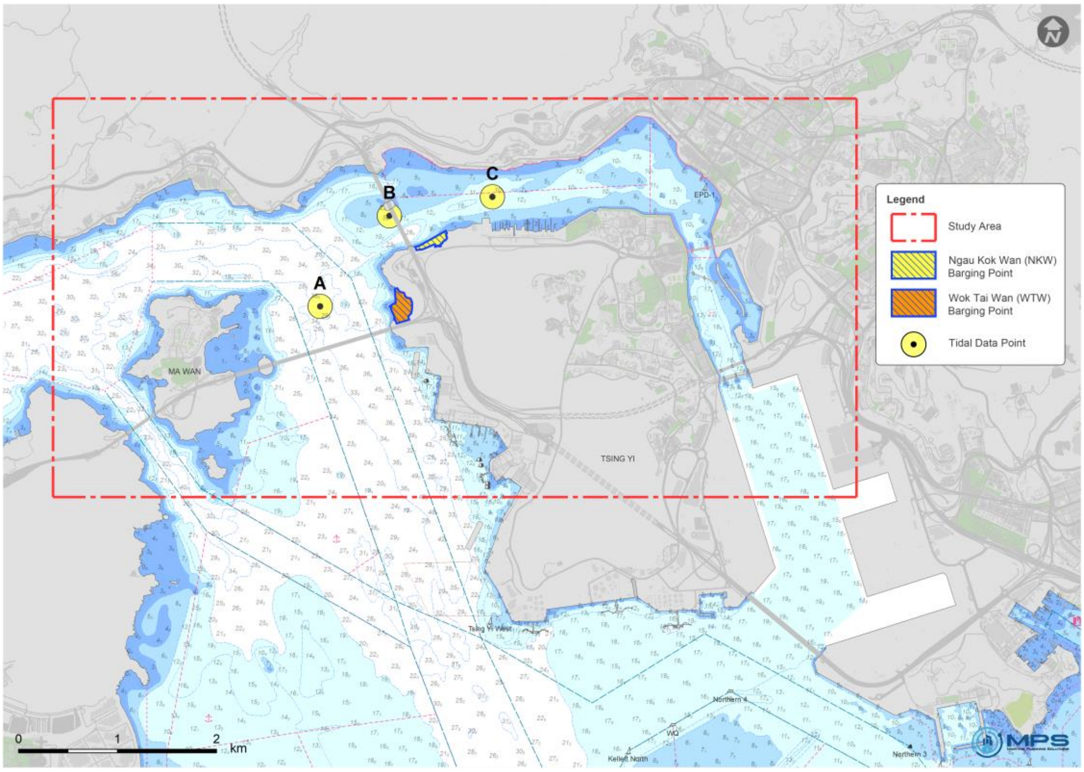

Figure 3-2 Locations of Currents Data Prediction Points

3.3.5 Current speeds and directions are graphically depicted in a “current rose” for the specified locations, as shown in **Figure 3-3**. The longest “bar” on the rose indicates the most frequently occurring direction as a percentage. The “bar” colour bands indicate different current speeds in knots.

3.3.6 It is identified that the strongest tidal currents were recorded at Point A, with maximum speeds of 4.39 knots. Point C with a speed up to 2.16 knots and Point B with a speed up to 1.5 knots, respectively.

3.3.7 Point A is located in the middle of the Ma Wan Fairway and is relatively distant from the barging location. Therefore, the relatively high current speed at this point is not expected to significantly impact the barging operation. The current speeds at Points B and C are considered low to moderate compared to other locations in Hong Kong and are not expected to have a significant impact on the marine works of the Project.

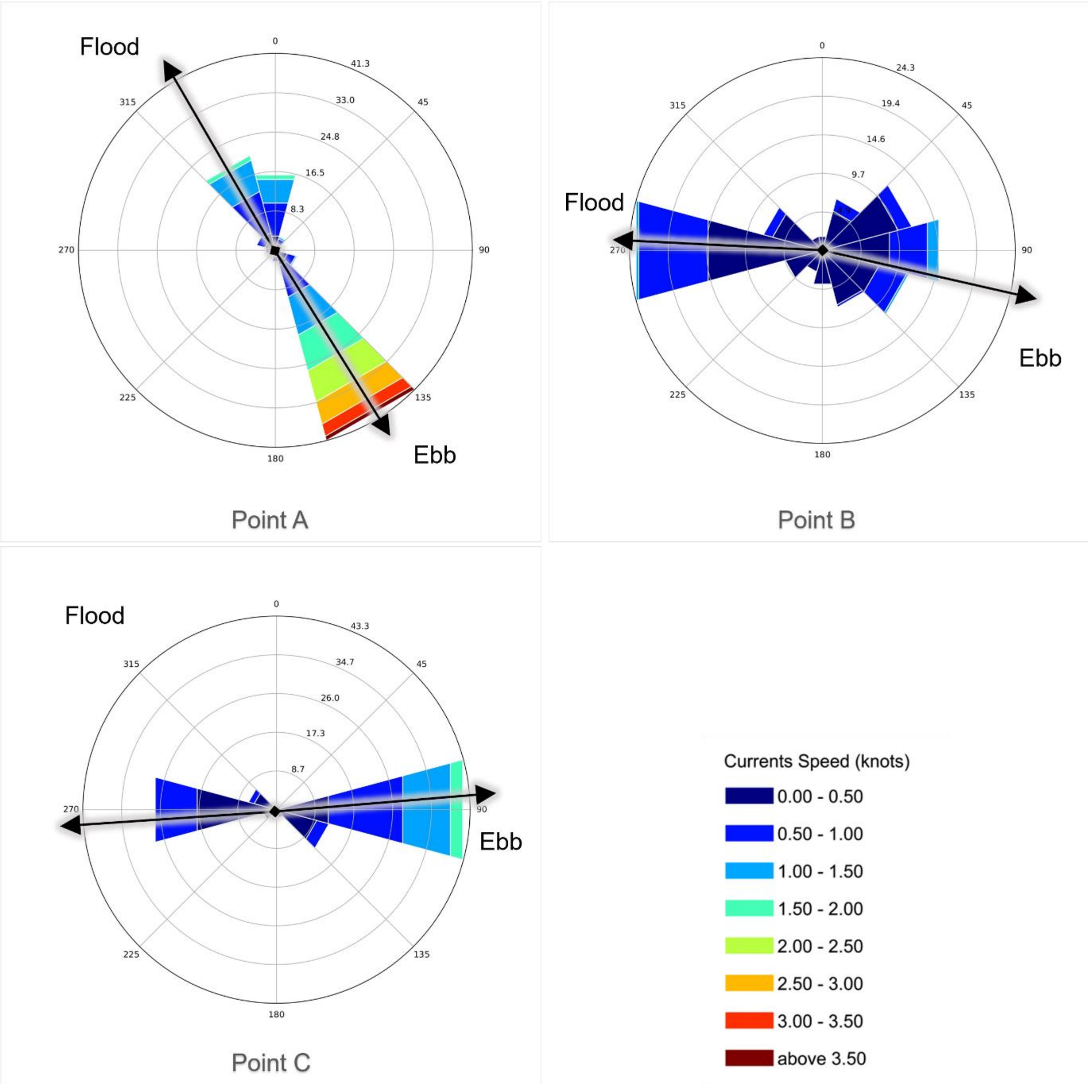

Figure 3-3 Flood / Ebb Tide Direction and Speed

Wind

3.3.8 The wind environment within the Study Area is referenced from data sourced from the automatic weather stations at Shell Oil Depot. The annual wind rose in 2024 is shown in **Figure 3-4**. The most dominant wind direction at Shell Oil Depot has been identified from the Southeast, with a wind force of Beaufort Scale 3 – 4.

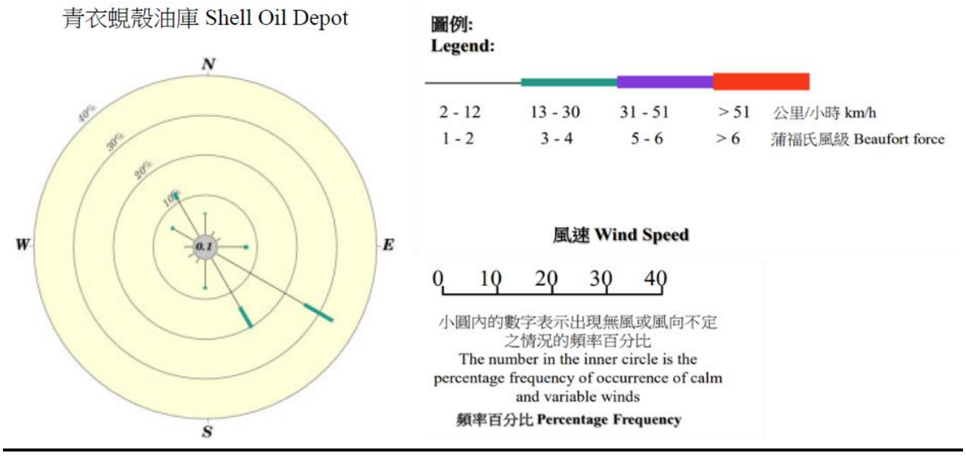

Figure 3-4 Annual Wind Rose at Shell Oil Depot Automatic Weather Station (2024)

Source: Summary of Meteorological and Tidal Observations in Hong Kong 2024, Hong Kong Observatory

3.3.9 **Table 3-2** summarized the prevailing wind direction and mean wind speed recorded in 2024, sourced from the automatic weather station at Shell Oil Depot of the Hong Kong Observatory (HKO). A predominantly south-easterly prevailing wind is observed for the majority of months, as indicated by the direction of 120 to 140 degrees azimuth. The wind speeds during these months vary, with the lowest mean speed observed in November at approximately 6.4 km per hour and the highest in April at about 12.0 km per hour. It is not anticipated that the wind conditions will adversely impact the marine works.

Table 3-2 Prevailing Wind Direction and Mean Wind Speed at Shell Oil Depot, 2024

Month	Shell Oil Depot Automatic Weather Station (2024)	
	Prevailing Direction (degrees)	Mean Speed (km/hour)
Jan	120	7.7
Feb	120	8.5
Mar	120	8.6
Apr	140	12.0
May	120	9.5
Jun	140	10.8
Jul	120	9.1
Aug	130	6.6
Sept	120	6.5
Oct	120	8.3
Nov	320	6.4
Dec	320	6.9

Source: 'https://www.hko.gov.hk/tc/publica/smo/files/SMO2024.pdf' Climatological Information Services, HKO

Wave Height

3.3.10 The Port Works Division of the CEDD operates a long-term wave monitoring program, with stations positioned near Kau Yi Chau and at the West Lamma Channel in Hong Kong. The data collected over the last 10 years indicate that the prevailing wave directions at the measurement locations are predominantly from the south and southeast. It is important to note that extreme wave heights are generally observed in conjunction with tropical cyclone events. A summary of the measurements of wave height at Kau Yi Chau is provided below for reference.

Table 3-3 Wave Measurement at Kau Yi Chau Tide Station

Year	Calm Period (%) (H_{mo}<0.3m)	Maximum Recorded H_{max} (m)
2015	11	2.96
2016	70	1.55
2017	65	2.13
2018	54	6.80
2019	63	2.11
2020	26	2.47
2021	7	2.28
2022	10	3.83
2023	11	3.29
2024	11	2.44

Where: Hmo: Spectral significant wave height, Hmax: Maximum recorded wave height Source: *https://www.cedd.gov.hk/eng/about-us/core-business/port/wave-measurement/index.html, Port Works Division, CEDD*

Increment Weather Review

3.3.11 The following adverse weather conditions are reviewed to identify any potential hazards during the construction and operation of this TYNUQ Project.

- Strong Monsoons
- Tropical Cyclones
- Rainstorm Warnings
- Reduced Visibility

Strong Monsoons

3.3.12 A 10-year record from 2015 to 2024 of strong monsoon signals issued by HKO was reviewed, and the average number of strong monsoons each month is summarized in the table below.

Table 3-4 Monthly Average Number of Strong Monsoon Signals (2015 – 2024)

Monthly Average	Number
Jan	2
Feb	2
Mar	2
Apr	1
May	1
Jun	0
Jul	1
Aug	0
Sept	1
Oct	3
Nov	2
Dec	2

Monthly Average	Number
Total (Annual Average)	**17**

Source: https://www.hko.gov.hk/en/wxinfo/climat/warndb/warndb2.shtml

Tropical Cyclones

3.3.13 A 10-year record from 2015 to 2024 of Tropical Cyclone Warning Signals issued by HKO was reviewed, and the average number of tropical cyclone signals hoisted each month is summarized in the table below.

Table 3-5 Monthly Average Number of Tropical Cyclone Warning Signals (2015 - 2024)

Monthly Average	T3	T8	T9 or above	Total
Jan	0.0	0.0	0.0	**0.0**
Feb	0.0	0.0	0.0	**0.0**
Mar	0.0	0.0	0.0	**0.0**
Apr	0.0	0.0	0.0	**0.0**
May	0.2	0.0	0.0	**0.2**
Jun	0.5	0.3	0.0	**0.8**
Jul	1.2	0.6	0.0	**1.8**
Aug	1.5	0.9	0.2	**2.6**
Sept	0.8	0.5	0.2	**1.5**
Oct	1.8	0.8	0.1	**2.7**
Nov	0.5	0.4	0.0	**0.9**
Dec	0.0	0.0	0.0	**0.0**
Total (Annual Average)	**6.5**	**3.5**	**0.5**	**10.5**

Source: https://www.hko.gov.hk/en/wxinfo/climat/warndb/warndb1.shtml

Rainstorm Warnings

3.3.14 A 10-year record from 2015 to 2024 of Rainstorm Warnings issued by HKO was reviewed, and the average of rainstorm warnings issued each month is summarized in the table below.

Table 3-6 Monthly Average Number of Rainstorm Warnings (2015 - 2024)

Monthly Average	Amber	Red	Black	Total
Jan	0.1	0.0	0.0	**0.1**
Feb	0.2	0.0	0.0	**0.2**
Mar	0.3	0.1	0.1	**0.5**
Apr	2.0	0.1	0.0	**2.1**
May	5.1	1.3	0.2	**6.6**
Jun	6.4	1.2	0.2	**7.8**
Jul	4.0	0.3	0.0	**4.3**
Aug	6.2	0.8	0.0	**7.0**
Sept	4.2	0.9	0.2	**5.3**
Oct	1.8	0.8	0.3	**2.9**

Monthly Average	Amber	Red	Black	Total
Nov	0.1	0.0	0.0	**0.1**
Dec	0.0	0.0	0.0	**0.0**
Total (Annual Average)	**30.4**	**5.5**	**1.0**	**36.9**

Source: https://www.hko.gov.hk/en/wxinfo/climat/warndb/warndb3.shtml

Reduced Visibility

3.3.15 A 10-year record (from 2015 to 2024) of Reduced Visibility recorded at the Hong Kong Observatory (HKO) was received. The average monthly frequency of reduced visibility, at less than 3km (~1.6 nautical miles) under all weather conditions, is summarized in **Figure 3-5** below. Typically, marine operations are suspended when visibility falls below 2 nautical miles.

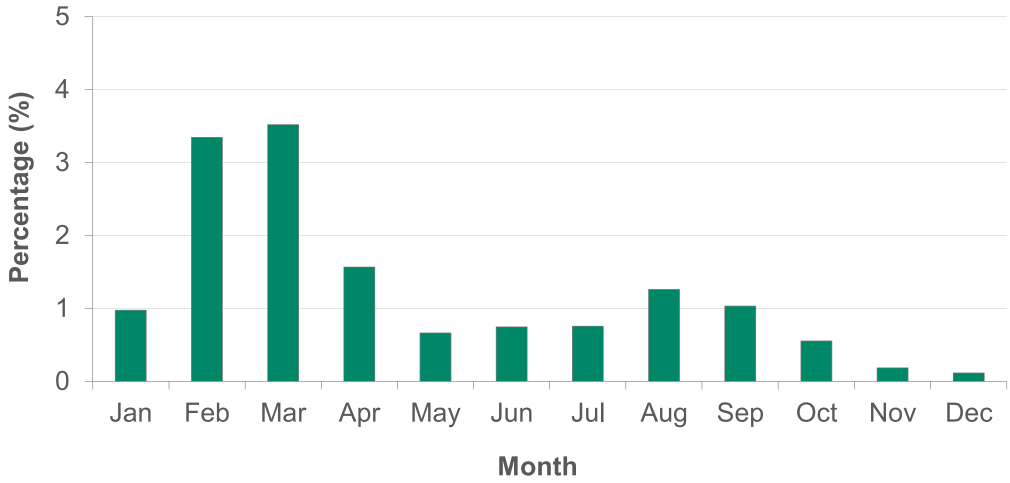

Figure 3-5 The Average Monthly Percentage Frequency of Visibility Below 3km (All Weather Conditions)

Source: Summary of Meteorological and Tidal Observations in Hong Kong, Hong Kong Observatory (2015-2024)

3.4 Water Depth

3.4.1 **Figure 3-6** illustrates the water depths within the Study Area. At NKW site, shoreline depths are generally around -9.1m below Chart Datum (mCD) over a strech of approximately 115m, while both ends of the site exhibit shallower depths of approximately -1.4 mCD. At the WTW site, most of the shoreline is relatively shallow, ranging from -0.4 mCD to -1.42 mCD, with a central section of about 20m reaching depths between -5.1 mCD and -10 mCD.

3.4.2 The relatively shallow waters at WTW may pose a potential grounding risk for vessels with drafts exceeding the available depth. Subject to the type of vessels that the Contractor proposed, adjustment in the payload of vessels may therefore be required to ensure sufficient navigational clearance for vessels. When necessary, the Contractor shall carry out a hydrographic survey prior to deployment of vessels to confirm that the water depths are adequate for the proposed vessels.

3.4.3 To ensure safe navigation, vessels should not exceed the available water depth with their maximum operating draft, and a sufficient under-keel clearance (UKC) of 10 to 15% of the vessel's deepest draught should be considered for safe navigation.

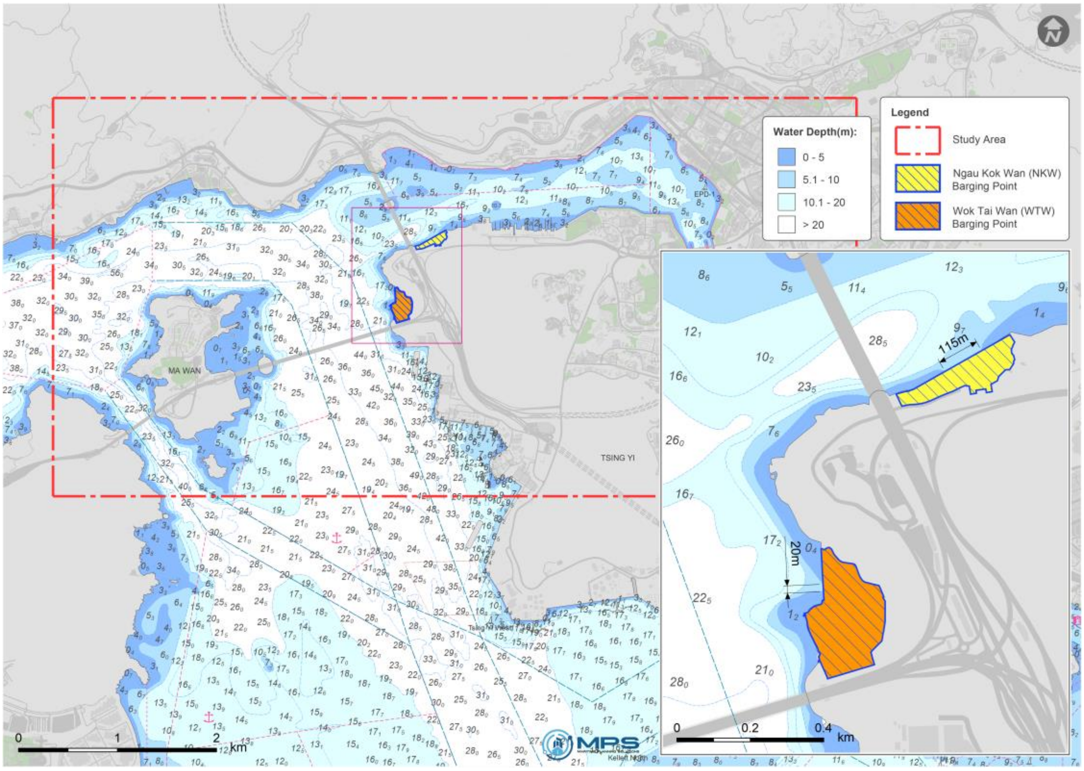

Figure 3-6 Water Depths in the vicinity of Underground Quarrying at Tsing Yi North

Source: 'Charts for Local Vessels 2025' by Hydrographic Office, Marine Department

3.5 Existing Marine Navigation Constraints and Risk Control Measures

3.5.1 Vessels transiting with the Study Area are subject to existing navigation constraints and risk control measures, including 1) Bridge Height Restricted Areas and Special Areas, 2) Ma Wan Transit Window, 3) Ma Wan Marine Traffic Control System and 4) Compulsory Pilotage.

Bridge Areas and Special Areas

3.5.2 **Figure 3-7** summarizes the existing constraints of the Tsing Ma Bridge Area, Kap Shui Mun Bridge Area, Kap Shui Mun Special Area, Ting Kau Bridge, Tsing Tsuen and Tsing Yi Bridge Area in accordance with Shipping and Port Control Regulations (Cap. 313A). The WTW site is located within the Kap Shui Mun Bridge area, where vessels are required to have an air draught of less than 35m. It is not anticipated that this height restriction will impact the construction or operation of the Project.

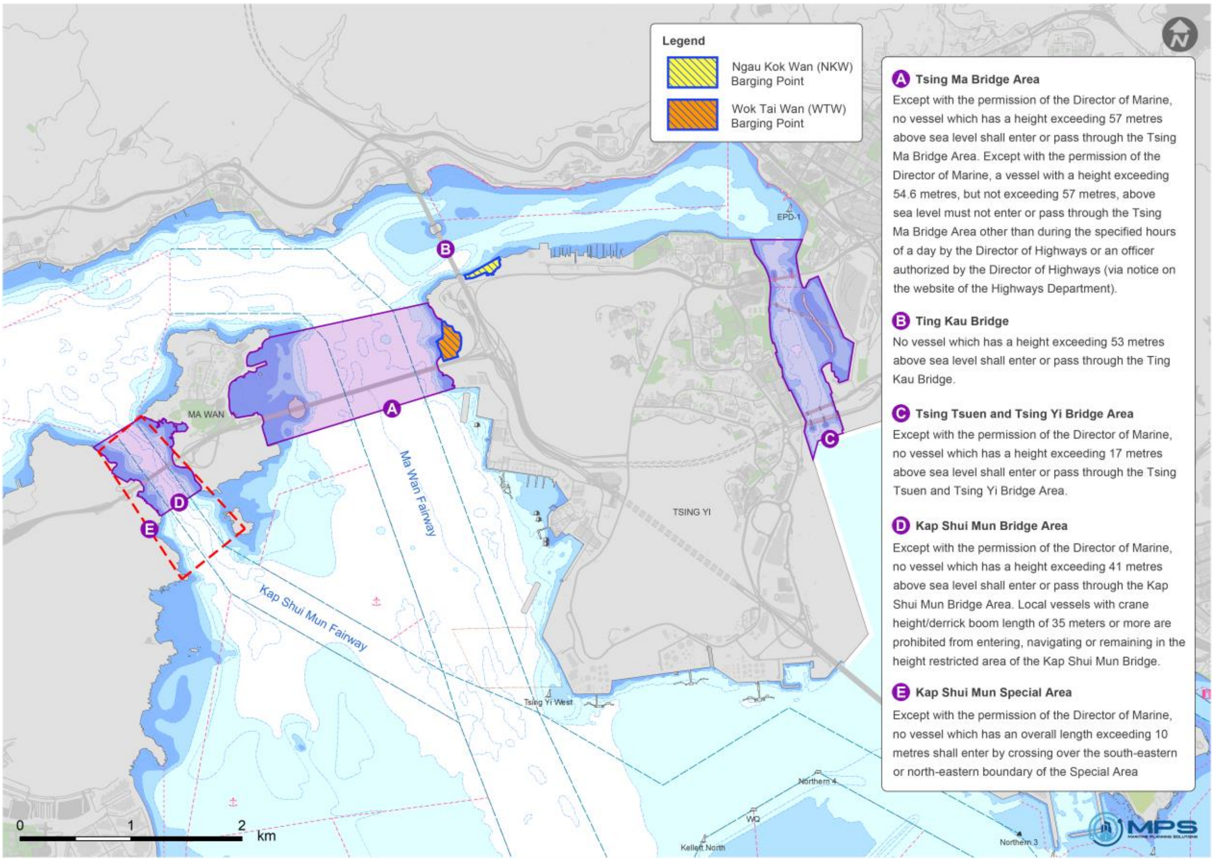

Figure 3-7 Bridge Areas and Special Areas Constraints

Ma Wan Transit Window

3.5.3 Vessels transiting through Ma Wan Fairway are restricted by transit window, considering the type and size of the vessels and the corresponding tidal prediction. Transits through Ma Wan Fairway shall refer to the Ma Wan Transit Window published by the Hydrographic Office of the Marine Department.

3.5.4 **Table 3-7** summarizes the general restrictions for the Ma Wan transit window.

Table 3-7 Ma Wan Transit Tidal Window Restrictions

Bulker and Tanker (All vessels other than passenger & container ships)				
LOA	Draught	Restriction in Tidal Current at Ma Wan (knots)		Other Restriction
		Against	With	
≤230m	≤12.5m	>2.5	>1.5	
	>12.5m - ≤13.0m	>2.5	>1.5	Daylight Transit Only
>230m - ≤255m	≤15m	>2.0	>1.0	Daylight Transit Only
>255m - ≤290m	≤16.8m	>1.5	>0.5	Daylight Transit Only
>290m	≤16.8m	>1.0	>0.5	Daylight Transit Only

Container Ship				
LOA	Draught	Restriction in Tidal Current at Ma Wan (knots)		Other Restriction
		Against	With	
≤400m	≤14.5m	>3.0	>2.0	
	>14.5m - ≤15.0m	>2.5	>1.5	
	>15.0m - ≤15.5m	>2.0	>1.0	
	>15.5m - ≤16.0m	>2.0	>1.0	Daylight Transit Only
Passenger Ship (Conventional)				
LOA	Draught	Restriction in Tidal Current at Ma Wan (knots)		Other Restriction
		Against	With	
≤400m	≤11.0m	>3.0	>2.0	
Passenger Ship (Highly Manoeuvrable)				
LOA	Draught	Restriction in Tidal Current at Ma Wan (knots)		Other Restriction
		Against	With	
≤400m	≤11.0m	>3.5	>2.5	

Notes: Highly maneuverable passenger ships should meet the following requirements:
(a) Bow thrusters of total power ≥ 8000HP
(b) Equipped with azipods.

Ma Wan Marine Traffic Control System

3.5.5 The Ma Wan Marine Traffic Control System facilitates the safe transit of vessels around Ma Wan through an active vessel traffic management and control scheme to monitor the movements of ocean-going vessels and small craft in the area.

3.5.6 Movements of local craft and river trade vessels are temporarily restricted through signal lights, VHF communications and the patrol launch at the scene when large vessels, deep-draught vessels, hampered vessels, vessels carrying specified categories of dangerous goods or other special craft are about to transit the area.

3.5.7 3 signal masts at the 2 ends of the Ma Wan Fairway give warnings of restricted movement through the area:

- Signal masts at Ha Pang and the northwest of Ma Wan Island provide warning to vessels approaching from the west; and
- Signal mast at Hoi Mei Wan provides a warning to vessels approaching from the east and the south.

3.5.8 When the appropriate signal mast(s) show the warning signal, which is three red lights in a vertical line occulting every 8 seconds (5 seconds on and 3 seconds off), vessels that are restricted for movement should wait in the designated Waiting Area(s) shown in **Figure 3-8** until the warning signal is turned off.

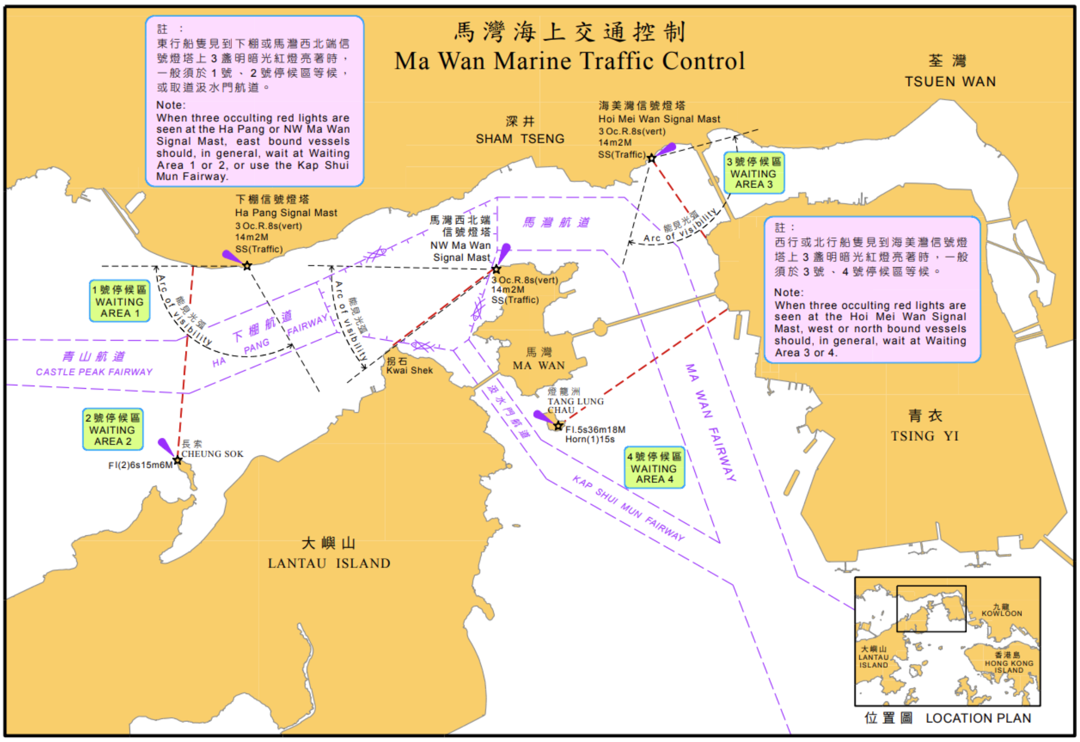

Figure 3-8 Ma Wan Marine Traffic Control

Compulsory Pilotage

3.5.9 Compulsory pilotage in Hong Kong applies to all vessels exceeding 3,000 gross tonages (GT), as well as certain vessels between 1,000 and 3,000 GT under specific conditions. Pilotage is regulated by the Director of Marine and provided 24 hours a day by licensed pilots from the Hong Kong Pilots Association.

3.5.10 In general, vessels of 3,000 GT or above are required to engage a licensed pilot when navigating within Hong Kong waters. Vessels of 1,000 GT or above are also subject to compulsory pilotage if they are carrying dangerous goods, operating as gas carriers (regardless of size), or navigating to designated container terminals, wharves, or government mooring buoys. In addition, vessels with restricted maneuverability are likewise required to take on a licensed pilot.

3.5.11 The Pilotage Ordinance (Cap. 84) provides further details on the compulsory pilotage requirements in Hong Kong. It is not anticipated that vessels deployed for this Project will require pilotage services.

3.6 Summary

3.6.1 This section provides a review of the existing marine-based facilities, anticipated developments, and metocean conditions which may impact or be impacted by the TYNUQ development. Potential marine traffic impacts and interface with existing marine-based facilities and planned developments arising from the TYNUQ, and proposed mitigation measures are assessed in the following sections.

4 Marine Traffic Activities Review

4.1 Introduction

4.1.1 This section presents an overview of the existing marine traffic situation within the MTIA as well as the future marine traffic situation, which includes marine traffic activity anticipated to be generated within the Study Area.

4.2 Vessel Classification

4.2.1 Vessels were categorized into seven classes for analysis and summarized in **Table 4-1**.

Table 4-1 Vessel Classes for Marine Traffic Analysis

Vessel Class	Photos of typical vessels	Description
Oceangoing (OG)		cargo vessels, including container vessels, bulk carriers, tankers, cruise liners, etc., with a length overall over 100m, and cruise ships
River Trade (RT)		cargo vessels, including container vessels, bulk carriers, tankers, fishing/fish processing vessels, local lighter/barge/cargo junk, local bunker vessels, etc, with length overall between 20 to 100m
Tug and Tow (TT)		tugboat with towage, with the total length of tow including the barge and tug/tow vessel length overall between 110m to 140m
Fast Ferry (FF)		cross-boundary passenger ferries with a length overall between 29m to 47m
Local Ferry (LF)		domestic passenger ferries of lengths overall up to 22m

Fast Launch (FL)		government vessels comprised of patrol boats and fire service speedboats, as well as pilot boats of length overall up to 14m
Small Craft (SC)		single tugboat without towage, fishing vessels, pleasure vessels (mostly of auxiliary powered yachts and cruisers), work boats, etc., of length overall up to 20m

4.3 Baseline Marine Traffic Environment

4.3.1 This section reviews the existing marine traffic activity within the MTIA Study Area and describes the present marine traffic levels and patterns. The baseline marine traffic was reviewed based on the following sources of data:

- A one-month marine traffic survey to capture marine traffic in the vicinity of the TYNUQ site;
- One month (September 2024) of Automatic Identification System (AIS) and radar data sourced from the Marine Department;
- Latest timetable schedules of franchised and licensed ferry services within the Study Area; and
- Historical record of marine incidents in Hong Kong waters from 2015 to 2024 sourced from the MD.

Review of Marine Traffic Survey Data

4.3.2 To ascertain the existing marine traffic passing through the Study Area, a marine traffic survey was carried out in accordance with the *Requirements for Marine Traffic Surveys in Marine Traffic Impact Assessment*.

4.3.3 Video footage was recorded for a period of 30 consecutive calendar days (from 27 September 2024 to 26 October 2024) to collect real-time data on marine activities within the Study Area.

4.3.4 Vessel counting was carried out for 12 days randomly selected from recorded video footage during daylight hours (7:00 to 19:00). The survey methodology and viewpoints were agreed upon with the Marine Department before carrying out the survey. The study will be based on the most up-to-date marine traffic data available to assess the current situation.

4.3.5 The following marine traffic gates and proposed viewpoints, as presented in **Figure 4-1** have been adopted for assessment:

- **Gate A**: A camera positioned to the east of Ma Wan, capturing marine traffic movements **along the Ma Wan Fairway**.
- **Gate B**: A camera positioned to the east of Ma Wan, capturing marine traffic movements **across the Ting Kau Bridge**.

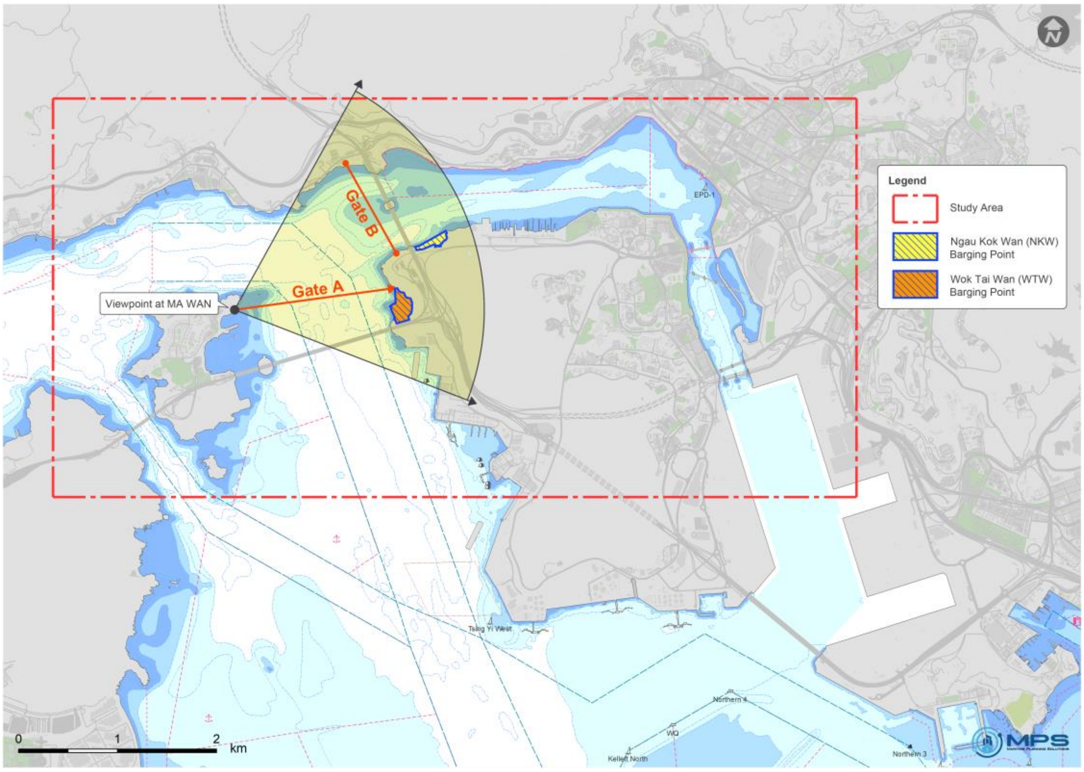

Figure 4-1 Visual Survey Gates

4.3.6 The traffic volume during daylight hours (07:00-19:00) across the marked gates is summarised in **Table 4-2**.

4.3.7 It has been identified from the marine traffic survey data that the marine traffic activity along the Ma Wan Fairway is primarily dominated by Small Craft vessels, followed by River Trade and Fast Ferry vessels, and less frequent traffic activity from Oceangoing and other vessel types. While the marine traffic activity across the Ting Kau Bridge is dominated by Small Craft vessel movements, followed by River Trade vessels, with occasional transits by other vessel types. Ma Wan Fairway has a greater overall average daily daylight traffic volume than Ting Kau Bridge, with 127 traffic movements.

Table 4-2 Average Daily Daylight (07:00 - 19:00) Traffic Movements (Marine Traffic Survey from Sep 2024 to Nov 2024)

Data Source	Vessel Class							Total
	OG	RT	TT	FF	LF	FL	SC	
Marine Traffic Survey	Gate A – Traffic along Ma Wan Fairway							
	25	53	8	24	8	4	141	263
	10%	20%	3%	9%	3%	1%	54%	100%
	Gate B – Traffic across the Ting Kau Bridge							
	0	48	1	0	22	3	62	136
	0%	35%	1%	0%	16%	2%	46%	100%

Note: OG – Oceangoing, RT – Rivertrade, TT – Tug and Tow, FF – Fast Ferry, LF – Local Ferry, FL – Fast Launch, SC – Small Craft; Traffic volumes include northbound and southbound traffic at Ma Wan Fairway.

Review of AIS and Radar Data

4.3.8 One month of AIS and radar data of the Study Area from **September 2024** has been provided by the Marine Department for the purpose of this Study.

4.3.9 AIS and radar data are sourced from the MD system used to provide vessel traffic service to vessels visiting Hong Kong. AIS and radar data provide 24-hour vessel tracking information (including vessel positions, speed, timing, approximate length, and beam) that, when analysed, provides key marine traffic information: traffic volume, route structure, and speed profile.

4.3.10 However, many vessels within Hong Kong waters (particularly fishing vessels and recreational craft) do not carry AIS transponders. Tracking information on these vessels was instead sourced from radar data, although not all vessels could be detected by radar. Radar data does not contain vessel type information, and size and speed information are less consistent than AIS data, as they are based on the interpretation of radar reflections.

4.3.11 In order to review existing traffic patterns and allow cross-referencing with the marine traffic survey findings, marked gates have been created across the same traffic gates as defined in the marine traffic survey. Vessel tracks for one day (24 hours), AIS and radar data of typical vessel activity within the Study Area are presented in **Figure 4-2**.

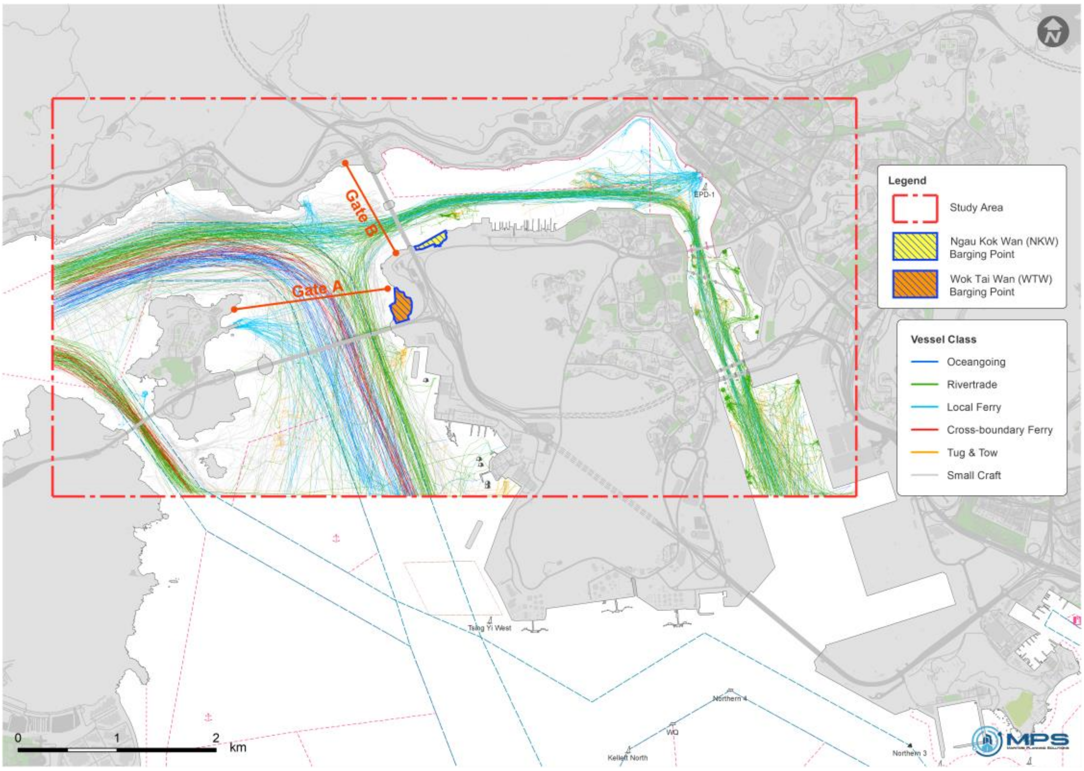

Figure 4-2 Vessel Tracks within MTIA Study Area (A Typical Day in September 2024)

4.3.12 **Table 4-2** presents the average number of transits during a **24-hour** day identified from the AIS and radar data at the traffic gates.

Table 4-3 Average Daily (24-Hour) Traffic Volume (September 2024 AIS and Radar Data)

Data Source	Vessel Class							Total
	OG	RT	TT	FF	LF	FL	SC	
AIS and Radar Data	Gate A – Marine Traffic along Ma Wan Fairway							
	44	97	2	25	13	4	148	333
	13%	29%	1%	8%	4%	1%	44%	100%
	Gate B – Marine Traffic across the Ting Kau Bridge							
	0	71	2	0	36	2	100	211
	0%	34%	1%	0%	17%	1%	47%	100%

Note: OG – Oceangoing, RT – Rivertrade, TT – Tug and Tow, FF – Fast Ferry, LF – Local Ferry, FL – Fast Launch, SC – Small Craft; Traffic volumes include northbound and southbound traffic at Ma Wan Fairway.

4.3.13 It has been identified from the AIS and Radar data that average daily marine traffic activity along the Ma Wan Fairway is dominated by Small Craft, followed by River Trade vessels and Oceangoing vessels, with occasional transits by other vessel types. The marine traffic activity across the Ting Kau Bridge consists predominately of Small Craft, and River Trade vessels, followed by Local Ferries. Ma Wan Fairway has a greater overall average daily daylight traffic volume than Ting Kau Bridge, with 122 traffic movements.

Local Ferry and Cross-Boundary Ferry Route and Schedule

4.3.14 In the Study Area, ferry routes and operators connecting Central to Ma Wan (Park Island) and Hong Kong to the Greater Bay Area via Ma Wan Fairway and Kap Shui Mun Fairway have been identified. The indicative scheduled ferry routes are illustrated in **Figure 4-3**. The details on routes and operators are summarised in **Table 4-4**.

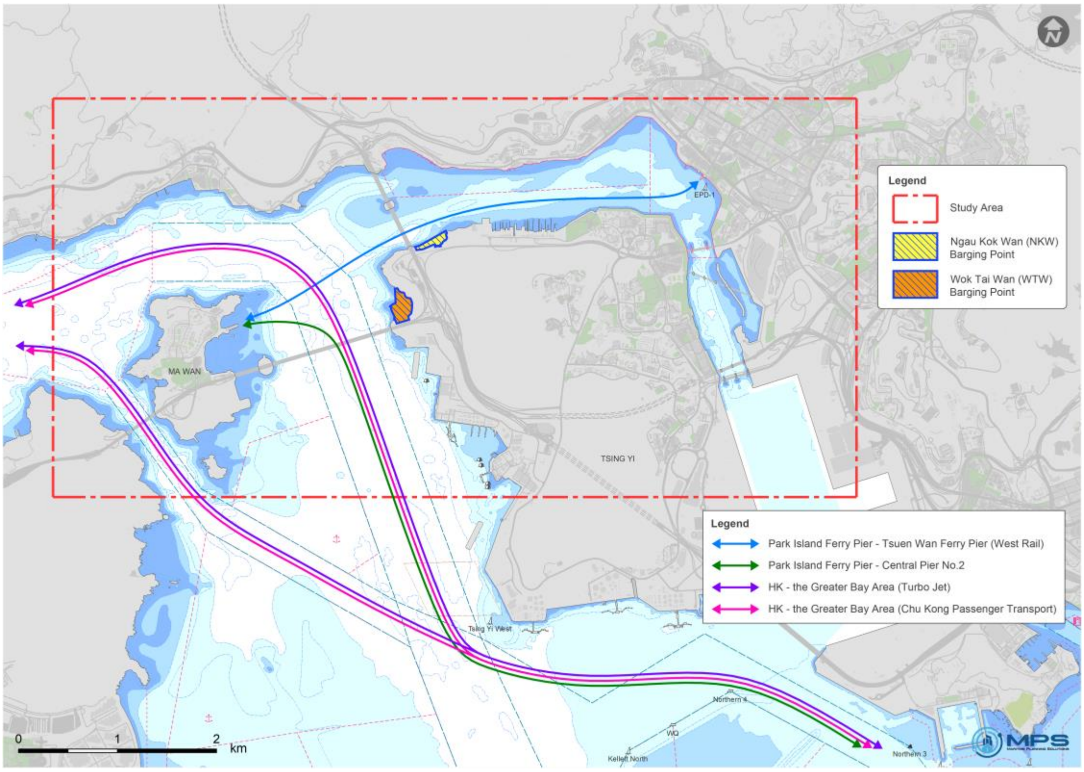

Figure 4-3 Local Ferry and Cross-Boundary Services Route Map

Table 4-4 Daily Scheduled Ferries within the MTIA Study Area

Ferry Operators	Outlying Island Ferry Service	No. of Daily Traffic
Park Island Transport Company Ltd.(1)	Ma Wan (Park Island) ⇔ Central	56 moves (Monday to Friday) 34 moves (Saturday, Sunday and Public Holidays)
	Ma Wan (Park Island) ⇔ Tsuen Wan	6 moves
	Cross-Boundary Fast Ferry Service	
Turbojet(2)	Macau Ferry Terminal / China Ferry Terminal ⇔ Zhuhai	16 moves
Chu Kong Shipping (CKS)(3)	Macau Ferry Terminal ⇔ Shenzhen	10 moves

	China Ferry Terminal ⇔ Nan Sha	4 moves
	China Ferry Terminal ⇔ Zhong Shan	14 moves

Updated as of Jun 2025
Source:
(1)http://www.pitcl.com.hk/en/ferry_service.php
(2)https://www.turbojet.com.hk/en/routing-sailing-schedule/hkkln-zhuhai/sailing-schedule-fares.aspx
(3)https://www.cksp.com.hk/#/main/shipline/ship1

4.3.15 The local ferry and cross-boundary ferry movements have been found in consistent with the AIS and radar data records. Hence, the AIS and radar data records for local ferry and cross-boundary ferry traffic have been adopted as the baseline traffic data.

Baseline Traffic Levels

4.3.16 **Table 4-3** presents a comparison of the average daily daylight traffic volumes identified from the marine traffic survey with the AIS and radar data to ensure accurate identification of traffic volume and vessel distribution within the Study Area.

Table 4-5 Comparison of Average Daily Daylight (07:00 – 19:00) Traffic Volume from Marine Traffic Survey and AIS, and Radar Data

Data Source	Vessel Class							Total
	OG	RT	TT	FF	LF	FL	SC	
Gate A – Marine Traffic along Ma Wan Fairway								
AIS and Radar Data (a)	24	60	1	22	12	3	112	234
Marine Traffic Survey (b)	25	53	8	24	8	4	141	263
Difference (a-b)	-1	7	-7	-2	4	-1	-29	-29
Gate B – Marine Traffic across the Ting Kau Bridge								
AIS and Radar Data (a)	0	46	1	0	29	1	78	155
Marine Traffic Survey (b)	0	48	1	0	22	2	62	136
Difference (a-b)	0	-2	0	0	7	-1	16	20

Note: OG – Oceangoing, RT – Rivertrade, TT – Tug and Tow, FF – Fast Ferry, LF – Local Ferry, FL – Fast Launch, SC – Small Craft; Traffic volumes include northbound and southbound traffic at Ma Wan Fairway.

4.3.17 The result shows that there is reasonable agreement between the traffic structures captured from the visual survey and the analysis of AIS and radar data for larger vessels, except for the number of Small Craft. It is observed that the marine traffic survey data captured greater volumes of Small Craft vessel movements along the Ma Wan Fairway. This may be due to the small size of Small Craft vessels, the wood hull of vessels not being captured by radar, or the vessels not equipped with an AIS transponder.

4.3.18 The Baseline Traffic Model is developed based on the higher average daily daylight traffic volume for each vessel class identified between the two data sets, and the volumes would be adjusted based on the ratios of daylight to night traffic volumes identified from AIS and radar data for each vessel class to develop the 24-hour traffic volumes.

4.3.19 **Table 4-6** summarizes the baseline traffic levels of the vessel classes to be adopted as the Baseline Marine Traffic Model for risk assessment in this MTIA Study.

Table 4-6 Baseline Marine Traffic Model

Gate	Vessel Class							Total
	OG	RT	TT	FF	LF	FL	SC	
Gate A Ma Wan Fairway	25	60	8	24	12	4	141	274
% of total	9%	22%	3%	9%	4%	1%	51%	100%
Gate B Ting Kau Bridge	0	48	1	0	29	2	78	158
% of total	0%	30%	1%	0%	18%	1%	49%	100%

Note: OG – Oceangoing, RT – Rivertrade, TT – Tug and Tow, FF – Fast Ferry, LF – Local Ferry, FL – Fast Launch, SC – Small Craft; Traffic volumes include northbound and southbound traffic at Ma Wan Fairway.

4.4 Future Marine Traffic Environment

4.4.1 This section presents an overview of the future marine traffic activities within the MTIA Study Area, including:

- Future marine traffic activity from other proposed developments; and
- Future baseline marine traffic activities.

4.4.2 Relevant sources and growth trends based on the best available information at the time of this Study have been reviewed to project the future traffic situation within the MTIA Study Area.

Future Marine Traffic Activity from Concurrent Developments

4.4.3 A number of proposed developments under planning may generate marine traffic within the MTIA Study Area and have a potential interface with the Project, including:

1) West New Territories Landfill Extension (WENTX) Operation;
2) Sunny Bay Reclamation;
3) Tsing Lung Bridge – Route 11 (Section between Yuen Long and North Lantau);
4) Road P1 (Tai Ho – Sunny Bay Section);
5) Tsing Yi – Lantau Link (TYLL);
6) Lung Kwu Tan and Tuen Mun West Reclamation;
7) Tuen Mun Bypass (TMB);
8) Integrated Waste Management Facilities Phase 1 & 2 (I·PARK1 & I·PARK2) Operation;
9) Contaminated Sediment Disposal Facility to the West of Lamma Island and
10) Ma Wan Housing Development

4.4.4 These projects may increase the cumulative marine traffic risk level within the MTIA Study Area and should be considered in the marine traffic risk assessments.

1) West New Territories Landfill Extension (WENTX) Operation

4.4.5 The operation stage of WENTX is expected to begin in 2026 and reach its design capacity in the late 2040s or early 2050s. WENTX has a landfill capacity of approximately 76 million cubic meters, with an average yearly filling capacity of 3.17 million cubic meters. Assuming the operation of WENTX remains the same as existing operations at WENT Landfill, it is estimated that around 7,000 tonnes of solid waste per day will be received and disposed of at the WENTX. Based on typical capacity of delivery barges (about 1,000 tons per transit), an average of 14 round trips (or 28 vessel movements) per day to and from WENTX can be estimated through the Ma Wan Fairway or Kap Shui Mun Fairway to and from the refuse transfer stations[1].

2) Sunny Bay Reclamation

4.4.6 The Sunny Bay reclamation development could be carried out concurrently with the Project. There is no information from the Sunny Bay Reclamation development on construction traffic yet; an assumption will be made based on a similar reclamation project area in recent Hong Kong development, i.e. Tung Chung New Town Extension (TCNTE).

4.4.7 The construction marine traffic activity for TCNTE reclamation, with an extent of about 129ha[2], was estimated to be 32 round trips per day during the peak construction period. Given that the Sunny Bay Reclamation is around two-thirds the scale of the TCNTE reclamation[3], 20 round trips (or 40 vessel movements) would be adopted as the peak traffic activity arising from the Sunny Bay Reclamation. Half of the 40 vessel movements are assumed to transit through the MTIA study area, travelling to and from the southern waters of Hong Kong to reach the Sunny Bay reclamation work site. The remaining half of the vessel movements are expected to originate from the western waters of Hong Kong.

3) Tsing Lung Bridge – Route 11 (Section between Yuen Long and North Lantau)

4.4.8 Tsing Lung Bridge under Route 11 development is one of the major infrastructure developments in Hong Kong. This roadwork development is expected to be carried out in 2026. According to the project brief for the Route 11 development, Tsing Lung Bridge will be in the form of a suspension bridge, and the alignment is proposed to be constructed across the Ha Pang Fairway with the potential reclamation of approximately 2.7 ha for the construction of bridge towers[4]. A similar assumption in using the TCNTE marine traffic volume would be used.

4.4.9 According to the current construction planning, the number of construction vessels, either from tug boat or the barge, would be limited to 4, 1 and 6 round trips per day for the barging facilities at To Kau Wan, San Po Tsui, and Tsing Lung Tau respectively.

4.4.10 Half of the 22 vessel movements are assumed to transit through the MTIA study area, travelling to and from the southern waters of Hong Kong to reach the Route 11 minor reclamation work site and barging operation. The remaining half of the vessel movements are expected to originate from the western waters of Hong Kong.

4) Road P1 (Tai Ho – Sunny Bay Section)

4.4.11 Road P1 (Tai Ho – Sunny Bay Section) is identified as part of the Priority Transport Network in the Lantau Tomorrow Vision. This roadwork development could also be carried out concurrently with the Project. According to the project brief for Road P1, Road P1 will be comprised of land after reclamation and marine viaducts, and the alignment is proposed to be constructed with the potential reclamation of approximately 15 ha for the construction[5].

4.4.12 Considering that the required reclamation for the Road P1 development is approximately 15 ha, conservatively, it is anticipated that 6 round trips (or 12 vessel movements) would be adopted as the peak traffic activity arising from this reclamation and marine viaduct works. Half of the 12 vessel movements are assumed to transit through the MTIA study area, travelling to and from the southern waters of Hong Kong to reach the Road P1 reclamation and the marine viaduct work site. The remaining half of the vessel movements are expected to originate from the western waters of Hong Kong.

5) Tsing Yi Lantau Link (TYLL)

4.4.13 Tsing Yi-Lantau Link (TYLL) is to provide a new road connecting Route 11 on Lantau Island and Tsing Sha Highway at Tsing Yi, serving as an alternative route to Lantau Link for vehicles commuting between the Northwest New Territories (NWNT) and urban areas. This roadwork development could also be carried out concurrently with the Project. According to the project brief for the TYLL development, TYLL will be in the form of cable-supported bridges, and the alignment is proposed to be constructed across the Ma Wan Fairway (MWF) and Kap Shui

Mun Fairway (KSMF) with the potential reclamation of approximately 5 ha for the construction of bridge towers and anchorages[6].

4.4.14 Considering that the required reclamation for the TYLL development is approximately 5 ha, conservatively, it is anticipated that 10 round trips (or 20 vessel movements) would be adopted as the peak traffic activity arising from these minor reclamation works and construction materials delivery in support of the bridge construction. 20 vessel movements are assumed to transit through the MTIA study area, travelling to and from the western waters and southern waters of Hong Kong to reach the TYLL minor reclamation work site.

6) Lung Kwu Tan Reclamation Development and the Re-planning of Tuen Mun West

4.4.15 The Lung Kwu Tan reclamation development and the re-planning of Tuen Mun West is expected to be carried out in 2027. There is no information from the Lung Kwu Tan Reclamation development on construction traffic yet; an assumption will be made based on a similar reclamation project area in recent Hong Kong development, i.e. Tung Chung New Town Extension (TCNTE).

4.4.16 The construction marine traffic activity for TCNTE reclamation, with an extent of about 129ha, was estimated to be 32 round trips per day during the peak construction period. Given that the Lung Kwu Tan Reclamation is around 145ha and Tuen Mun West Reclamation is around 45ha[7], 48 round trips (or 96 vessel movements) would be adopted as the peak traffic activity arising from the Lung Kwu Tan Reclamation. Half of the 96 vessel movements are assumed to transit through the MTIA study area, travelling to and from the southern waters of Hong Kong to reach the Lung Kwu Tan reclamation work site. The remaining half of the vessel movements are expected to originate from the western waters of Hong Kong.

7) Tuen Mun Bypass (TMB)

4.4.17 Tuen Mun Bypass will be 3 barging points and 1 delivery point established for the project at the Tuen Mun – Chek Lap Kok Link (TM-CLKL) Northern Landfall. Only the 3 barging points would be responsible for the spoil transportation and the delivery point would only involve delivery of equipment and construction materials. According to the current construction planning, the number of construction vessels, either from tug boat or the barge, would be limited to 3 trips per day for each barging point and delivery point[8].

8) Integrated Waste Management Facilities Phase 1 & 2 (I·PARK1 & I·PARK2)

4.4.18 The Integrated Waste Management Facilities Phase 1 (I·PARK1) will have a treatment capacity of 3,000 tonnes each day. It is expected to commence operation in 2025 and the contract includes a 15-year operation period. Municipal Solid Waste (MSW) and ash would be delivered by marine vessels from the existing refuse transfer stations including Island East Transfer Station, Island West Transfer Station and West Kowloon Transfer Station to WENT Landfill and the adjoining the Tsang Tsui Ash Lagoons site. It is assumed that up to 8 daily vessel movements to transit through the MTIA study area[9].

4.4.19 Construction works for Integrated Waste Management Facilities Phase 2 (I·PARK2) are scheduled to commence in 2026, however construction related marine activity is not expected to pass through the MTIA study area.

9) Contaminated Sediment Disposal Facility to the West of Lamma Island

4.4.20 The operation of the contaminated sediment disposal facility to the west of Lamma Island is scheduled to commence in 2025/2026 and is expected to have a service lifetime of up to 20 years. Based on the conservative estimate, up to 172 vessel movements per day could arise from backfilling, dredging and capping works of three contaminated mud pits (CMPs) in 2027 and it is estimated that there will be approximately 34 vessel trips per day for capping of the last CMP from 2036 onward[10]. It is estimated that 68 vessel movements will pass through the MTIA study area.

10) Ma Wan Housing Development

4.4.21 According to the latest report of Private Housing Development in Ma Wan South released by CEDD in September 2024, there are no marine works proposed under the Ma Wan Housing Development; therefore, no direct marine traffic impact is anticipated[11].

4.4.22 **Table 4-7** summarizes the estimated daily marine traffic generated by concurrent developments that are expected to transit through the MTIA Study Area in 2027 and 2028.

Table 4-7 Summary of Estimated Marine Traffic Generated by Concurrent Developments within the MTIA Study Area

ID	Concurrent Project	Estimated Daily Vessel Movements within MTIA Study Area (2027 and 2028)
1	WENTX Operation	28
2	Sunny Bay Reclamation	20
3	Tsing Lung Bridge – Route 11	11
4	Road P1	6
5	Tsing Yi – Lantau Link (TYLL)	20
6	Lung Kwu Tan & Tuen Mun West Reclamation	48
7	Tuen Mun Bypass (TMB)	12
8	I·PARK1 & I·PARK2 Operations	8
9	West Lamma Contaminated Sediment Disposal Facility	68
10	Ma Wan Housing Development	Not anticipated
Total		**221**

4.4.23 **Figure 4-4** presents the distribution of estimated marine traffic generated from proposed developments currently in the planning stage, which may potentially interact with the marine traffic of the Project.

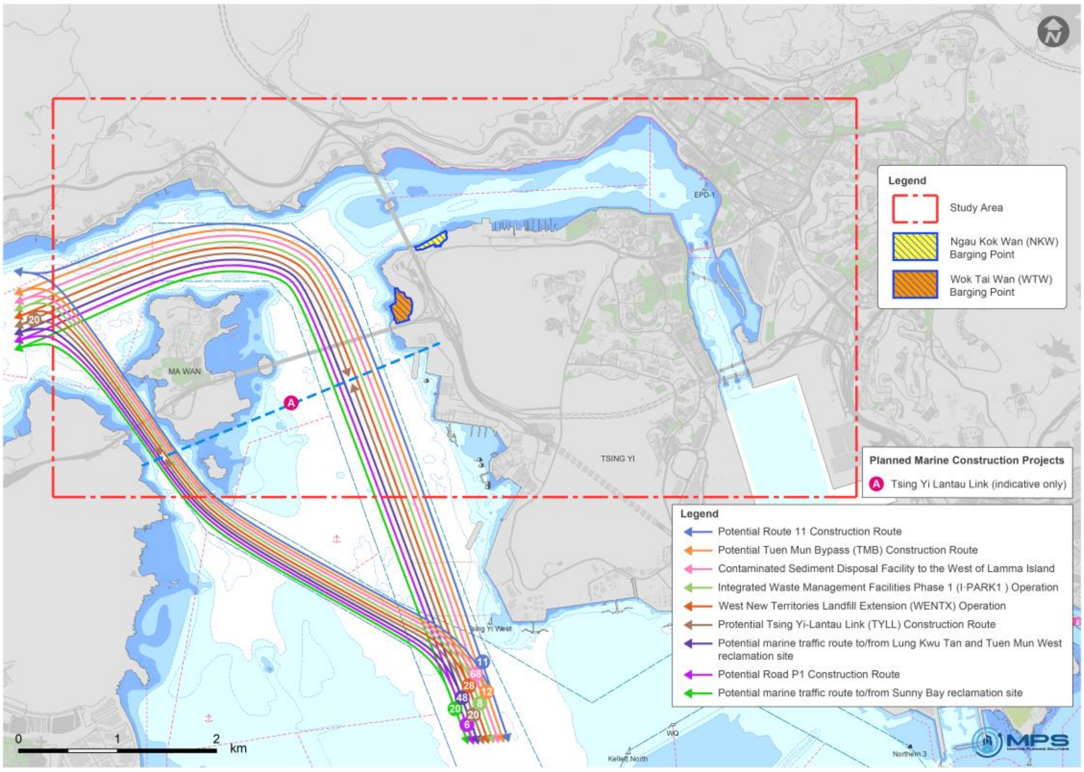

Figure 4-4 Indicative Marine Traffic Routes Generated by Concurrent Developments in 2027 and 2028

(1) Legislative Council of the Hong Kong Special Administrative Region, Item for Public Works Subcommittee of Finance Committee

(2) Marine Department, Local Vessels Advisory Committee, Tung Chung New Town Extension

(3) Environmental Protection Department, Sunny Bay Development Project Profile, Environmental Impact Assessment
(4) Environmental Protection Department, Route 11 (Section between Yuen Long and North Lantau), Environmental Impact Assessment Executive Summary
(5) Environmental Protection Department, Road P1 (Tai Ho – Sunny Bay Section), Lantau, Project Profile, Environmental Impact Assessment
(6) Environmental Protection Department, Tsing Yi – Lantau Link Project Profile, Environmental Impact Assessment
(7) Environmental Protection Department, Reclamation at Lung Kwu Tan, Project Profile, Environmental Impact Assessment
(8) Environmental Protection Department, Tuen Mun Bypass, Project Profile, Environmental Impact Assessment
(9) Environmental Protection Department, Problems & Solutions, Integrated Waste Management Facilities
(10) Marine Department, PAC Paper No. 9/2022, Dredging, Management and Capping of Contaminated Sediment Disposal Facility at West of Lamma Island
(11) Civil Engineering and Development Department, Agreement No. CE 50/2021 (CE) Private Housing Development in Ma Wan South – Feasibility Study

Future Baseline Marine Traffic Activities

4.4.24 Relevant sources and growth trends have been reviewed to project the future traffic situation within the MTIA Study Area to be adopted for the marine traffic risk assessment from the baseline year up to the horizon year 2028, which is the commencement year of operations.

4.4.25 The following sources were reviewed:

- Executive Summary of "*Study on the Strategic Development Plan for Hong Kong Port 2030 (HKP 2030)*" published by the Hong Kong Maritime and Port Board forms the foundation of the oceangoing and river trade cargo traffic forecasts as they take into account macro and local economic drivers;
- "*Port of Hong Kong Statistical Tables*" from 2015 to 2024 (i.e. 10-year records) by the Marine Department provides the historical data records for vessel arrivals in Hong Kong, including general cargo, cross-boundary ferries, as well as government fleet statistics;
- "*Monthly Traffic and Transport Digest*" from 2015 to 2024 (10 years) by the Transport Department provides the historical data records to be referred to for domestic passenger ferry traffic forecasts; and
- Executive Summary of "A*ssessment of Typhoon Shelter Space Requirement 2022 – 2035*" by the Marine Department provides the principal reference for local vessels.

4.4.26 The forecast methodology is illustrated in **Figure 4-5** below. Historical trends were adopted if there was no forecast data available and extrapolated.

Figure 4-5 Marine Traffic Forecast Methodology

4.4.27 As described in **Table 4-1**, vessels are grouped into 7 classes (i.e. oceangoing, river trade, tug and tow, fast ferry, local ferry, fast launch and small craft) for analysis and **Appendix A** presents the traffic projections for each vessel class based on historical trends and expected annual growth rates to be adopted for marine traffic risk assessment.

4.4.28 The forecast average annual rate of growth by vessel type, and the forecast rate of vessel traffic growth from existing traffic levels for the key vessel types at different time horizons to be adopted for assessments, are summarized in **Table 4-8**. The construction peak in 2027 and the operation of TYNUQ in 2028 have been adopted and reviewed as part of the future traffic baseline.

Table 4-8 Summary of Forecast Rate of Vessel Traffic Growth (2024 - 2027 & 2024 - 2028)

Vessel Type	OG	RT	TT	FF	LF	FL	SC
Forecast Growth in 2027	-3%	-4%	-4%	0%	0%	7%	4%
Forecast Growth in 2028	-4%	-5%	-5%	0%	0%	9%	6%

Note: OG – Oceangoing, RT – Rivertrade, TT – Tug and Tow, FF – Fast Ferry, LF – Local Ferry, FL – Fast Launch, SC – Small Craft; Traffic volumes include northbound and southbound traffic at Ma Wan Fairway.

4.5 Summary

4.5.1 A review of AIS and Radar data and visual survey records has been conducted to identify the existing marine traffic situation and patterns within the Study Area.

4.5.2 Marine traffic in the Ma Wan Fairway and its adjacent inshore traffic zones is dominated by river trade vessels and small crafts. Other vessel types, including oceangoing vessels, contribute approximately 9% of the total average daily movements. Ting Kau Bridge is dominated by river trade vessels and small craft, followed by local ferries, with occasional transits by other vessel types.

4.5.3 Relevant sources and growth trends have been reviewed to forecast the future traffic situation for different vessel types, including traffic activity generated by proposed developments within the MTIA Study Area up to the construction year of 2027 and the operation year of 2028 for TYNUQ.

5 Marine Traffic Risk Assessment

5.1 Introduction

5.1.1 This section presents the methodology and results of the marine traffic risk assessment to evaluate the risk level brought by both the construction and operation phases of the Project.

5.1.2 The existing and future marine traffic volumes and patterns within the MTIA Study Area identified in the previous sections were used to develop the marine traffic risk model. The baseline and future risk environments were assessed by examining the spatial distribution of incidents within the MTIA Study Area.

5.1.3 Risk assessment tools, including both quantitative and qualitative analysis suggested by the International Association of Lighthouse Authorities (IALA) toolbox, were adopted to support the different steps of risk assessment and estimating the effectiveness of mitigating measures.

5.2 Marine Traffic Quantitative Risk Assessment

Approach

5.2.1 The IALA Risk Management Tool, IWRAP MK II, a desktop risk assessment program that is aimed at the calculation of probabilities of ship collisions, allisions, and groundings, is adopted to develop a marine traffic risk model to predict risk levels arising from the proposed marine works.

Collision Risk

5.2.2 IWRAP MK II quantifies marine traffic risk levels and determines the probability of collision of a predefined traffic route by applying MD's AIS and radar data. Collisions were divided into two types: i) collisions along the route segment, i.e. overtaking or head-on collisions, and ii) collisions when two routes cross each other, merge, or intersect each other in a turn.

5.2.3 The applied model for calculating the frequency of collision accidents involves the use of a causation probability that is multiplied by a theoretically obtained number of collision accidents. The causation factor models the probability of a vessel failing to react in time given that it is on a collision course with another vessel.

5.2.4 The collision analysis procedures are as follows:

1) Define the navigational area, including traffic composition along all navigational routes and all grounds in the vicinity of the route.
2) Estimate the geometrical probability distribution function of each traffic route based on the defined annual traffic volume per vessel type.
3) Given how the traffic routes meet or overlap with each other and their estimated geometrical probability distribution functions, calculate the collision risk.
4) Multiply the collision risk with a causation probability that two vessels will fail to avoid a collision when they meet.
5) Sum up the collision risk from all traffic routes in the defined navigational area to obtain the final collision frequency per year.

Grounding/Allision Risk Assessment Approach

5.2.5 There are two basic types of grounding/allision risk:

- Type 1 – Grounding/allision by powered vessels, going aground with operational speed, mainly due to human errors (e.g. fail to turn and correct the ship heading);
- Type 2 – Grounding/allision by drifting vessel with power down, going aground with drifting speed, and possible mitigation measures (e.g. repair, anchor drop) failed.

5.2.6 The grounding and allision risk analysis procedures are as follows:

1) Define the major traffic routes (geometry and daily traffic volume)
2) Define the land area that vessels would go aground;
3) Measure the distance between routes and land area in the vicinity;
4) Prepare wind information (direction and speed occurrence %) and setup drifting speed based on input vessel type

5.2.7 The inputs above are used to calculate the grounding and allision risk based on the following formulas for the risk evaluation:

Type 1 - Grounding by powered vessels

$$P_{ground-1} = N \cdot P_C \cdot P_G \cdot e^{-d/a}$$

Type 2 - Grounding by drifting vessel

$$P_{ground-2} = N \cdot P_{wind} \cdot P_{breakdown} \cdot P_{no\_repair} \cdot P_{no\_anchor}$$

Overall Grounding Risk

$$P_{ground\_all} = P_{ground-1} + P_{ground-2}$$

Annotations:

N : traffic volume;

P_C : causation probability, the probability of human error;

P_G : geometric probability, the accumulative distribution of traffic density where may overlay on the land

d: distance from the bending section of the route to the land shape (d =0 when straight route section)

a: distance between position checks by the crew

P_{wind} : probability of wind, which in such direction that will push the vessel to the land

$P_{breakdown}$: probability of vessel losing power or failure of propulsion system

P_{no_repair} : probability of not being able to repair the machine failure

P_{no_anchor} : probability of not using anchor or failure of using anchor

5.3 Modelling Scenarios

5.3.1 The following marine traffic risk modelling scenarios have been developed to compare the baseline traffic risk levels with the cumulative risk levels arising from both the construction and operation phases of the Project, as well as future traffic growth.

Table 5-1 Summary of IWRAP Marine Traffic Risk Modelling Scenarios

Scenario A	2024 Baseline Traffic
	Existing marine traffic conditions **without** implementing the Project. This scenario models the current traffic environment by adopting traffic levels identified from collected data. The predicted traffic risk level provides a baseline for comparison with other scenarios.
Scenario B1	**2027 Future Traffic without TYNUQ Construction**
	Future traffic **without** the construction works of the Project. Evaluates the cumulative risk level, considering future traffic growth and the estimated peak traffic of other proposed developments.
Scenario B2	**2027 Future Traffic with TYNUQ Construction**
	Future traffic **with** the construction works of the Project. Evaluate the cumulative risk level, considering future traffic growth, the generated peak construction traffic of the project in 2027, and the estimated peak traffic of other proposed developments.
Scenario C1	**2028 Future Traffic without TYNUQ Operation**
	Future traffic **without** the implementation of the Project. Evaluate the cumulative risk level, considering future traffic growth and the estimated peak traffic of other proposed developments at the planned commissioning year in 2028.
Scenario C2	**2028 Future Traffic with TYNUQ Operation**
	Future traffic **with** the implementation of the Project. Evaluate the cumulative risk level, considering future traffic growth and the estimated peak traffic of other proposed developments at the planned commissioning year in 2028.

5.3.2 The marine traffic risk modelling scenarios are summarized in **Figure 5-1**.

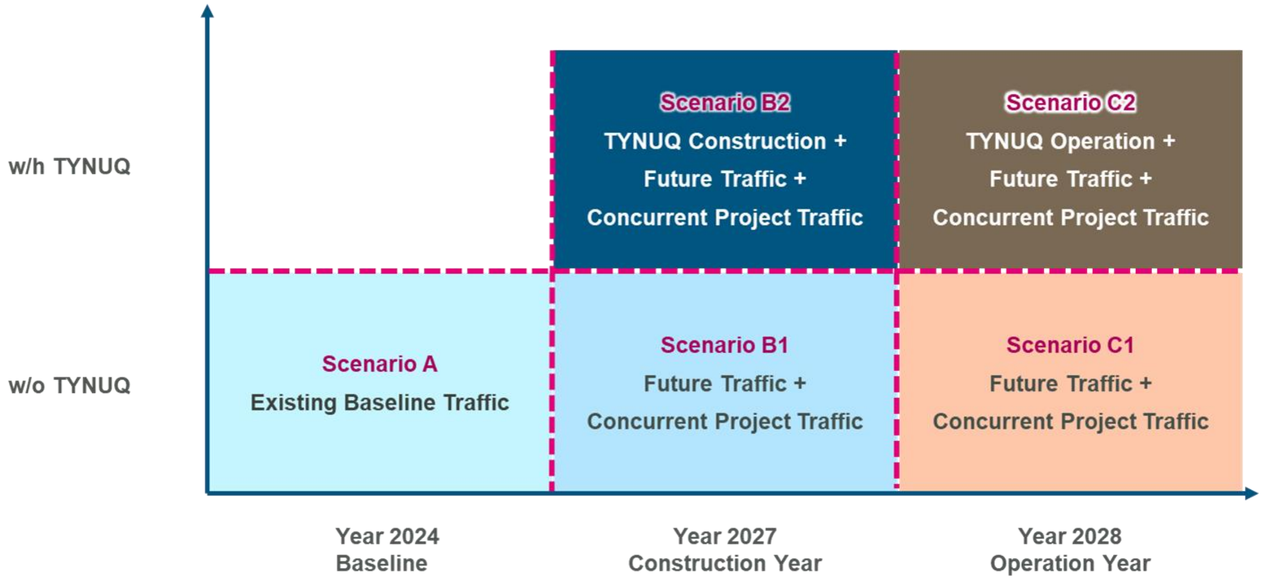

Figure 5-1 IWRAP Marine Traffic Risk Modelling Scenarios

5.4 Risk Model Area

5.4.1 Given that the Project will not generate any marine traffic to the west of the site area, and in order to concentrate the risk assessment effectively near the TYNUQ barging points, a designated "Model Area" with reference to the collision incidents grid has been established for marine traffic risk analysis. This focused assessment area is illustrated in **Figure 5-2**.

5.4.2 It is projected that both existing and future marine activities, as well as the associated levels of collision risk within the “Model Area”, may be influenced by the construction and operation of the Project. However, beyond the boundaries of the "Model Area," the Project’s construction and implementation are not expected to induce substantial changes in prevailing marine traffic patterns or navigational behaviour that would consequently alter the existing risk levels.

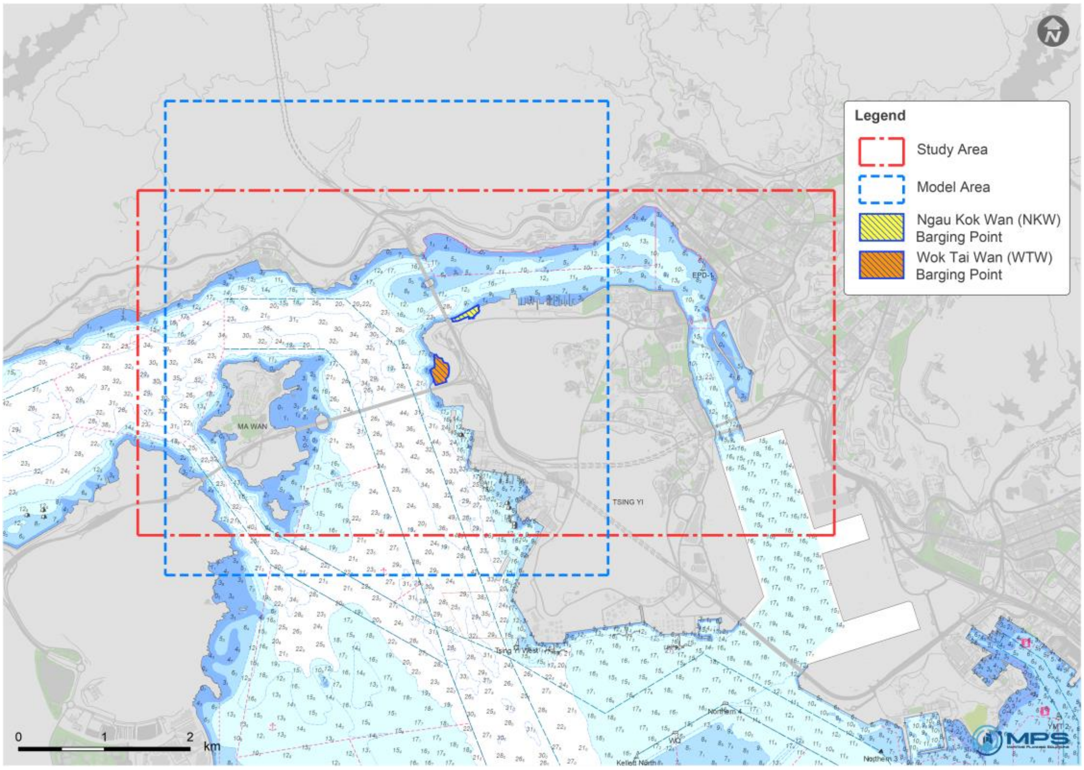

Figure 5-2 Model Area for Marine Traffic Risk Assessment

5.5 Marine Risk Model

Route

5.5.1 The existing vessel traffic routes identified from AIS and radar data, adopted for the marine traffic risk model, are illustrated in **Figure 5-3**.

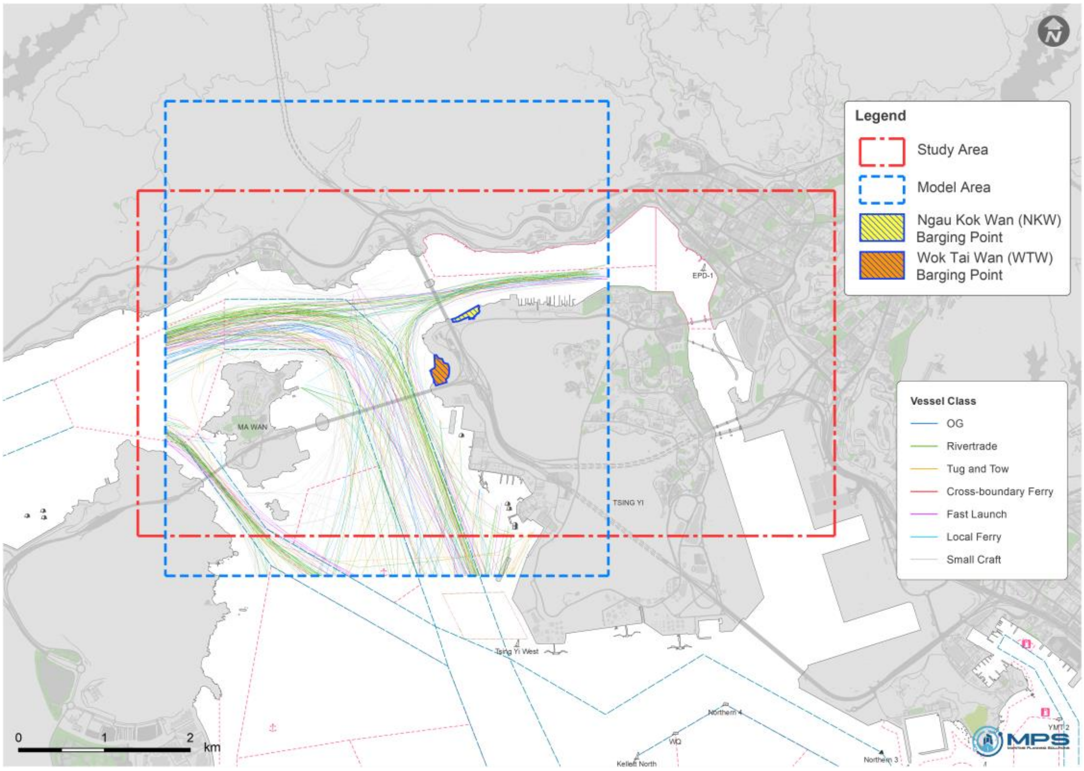

Figure 5-3 Marine Traffic Risk Model Vessel Route

Model Calibration

5.5.2 Collision incident records from 2015 to 2024 provided by the Hong Kong Marine Department within the MTIA Study area have been reviewed and assessed. As shown in **Figure 5-4**, the total average annual collision incident frequency in the Study Area is 10.0 per year from 2015 to 2024. The average collision incident frequency within the Model Area is approximately 3.9 incidents per year.

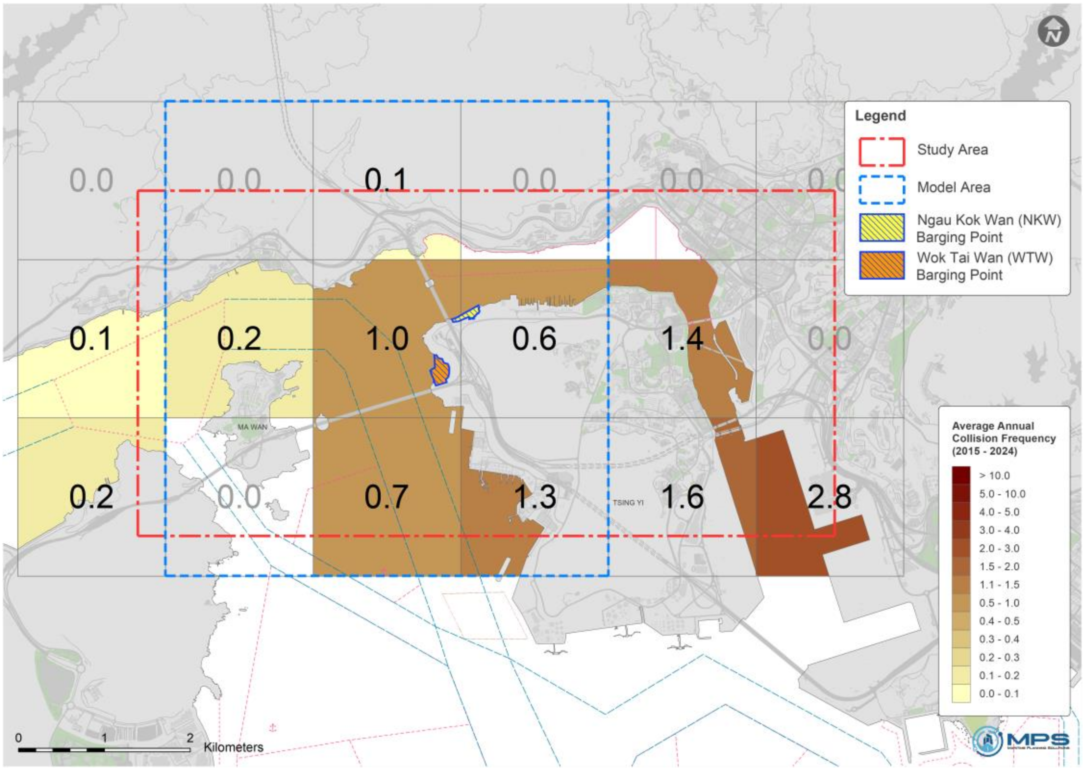

Figure 5-4 Historical Average Annual Collision Incidents (2015 - 2024)

5.5.3 Grounding incident records from 2015 to 2024 provided by the Hong Kong Marine Department within the MTIA Study area have been reviewed. As shown in **Figure 5-5**, the total average grounding incident frequency in the Study Area was 1.8 per year during the period from 2015 to 2024. The average grounding incident frequency within the Model Area is approximately 0.7 incidents per year.

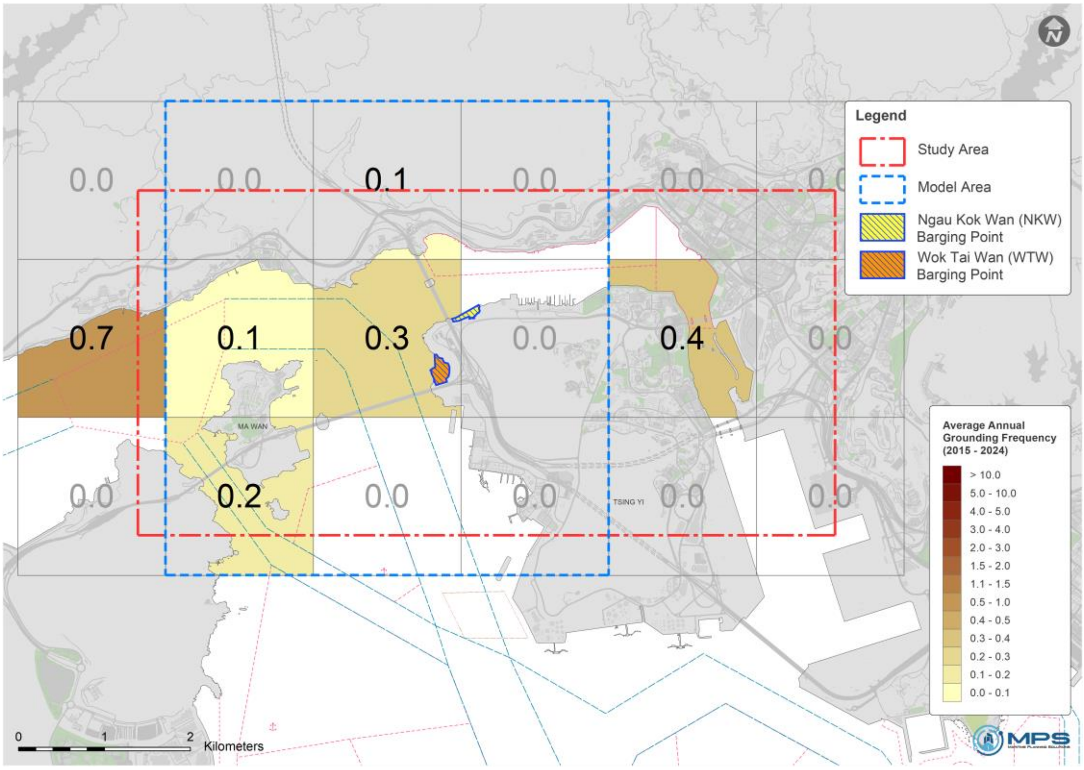

Figure 5-5 Historical Average Annual Grounding Incidents (2015 - 2024)

5.6 Collision Risk Modelling Results

Scenario A - 2024 Baseline Traffic

5.6.1 The baseline marine traffic risk model has been calibrated to the existing marine traffic risk level identified. **Figure 5-6** illustrates the average annual distribution of collision incident rates of 3.90 within the Model Area.

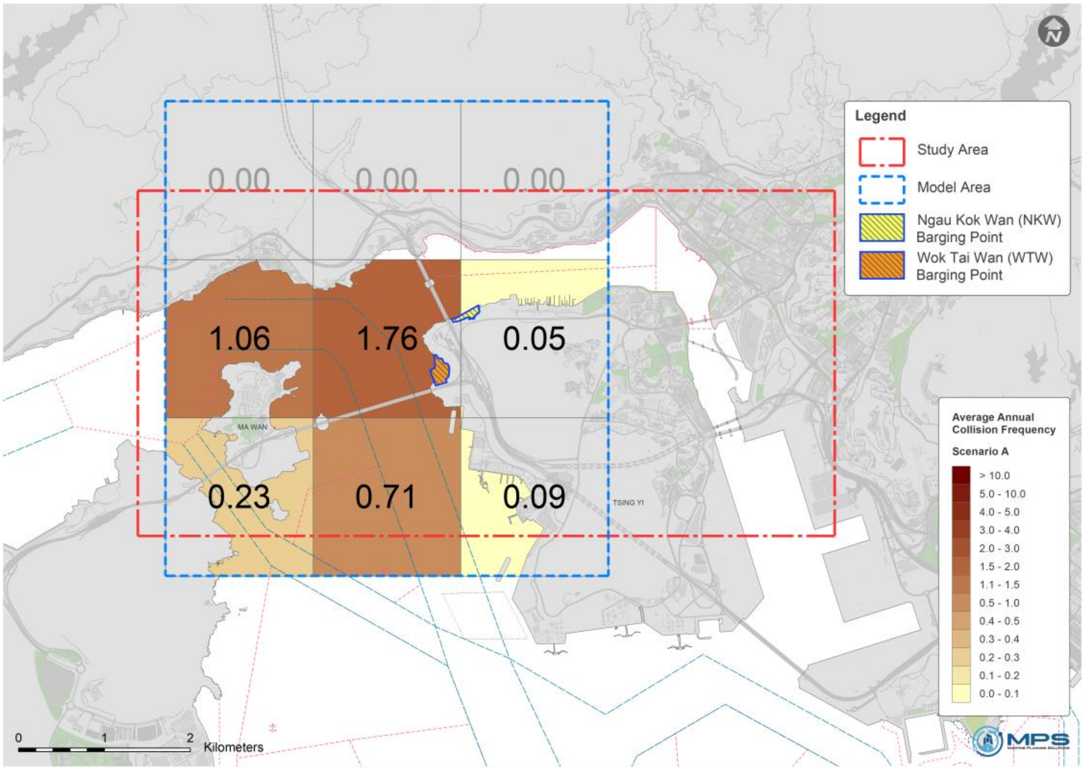

Figure 5-6 Scenario A – Average Annual Collisions of Baseline Traffic 2024

Scenario B1 – 2027 Future Traffic without TYNUQ Construction

5.6.2 **Figure 5-7** identifies the annual collision frequency in the Risk Modelling Area, considering future traffic without the peak construction traffic of TYNUQ in 2027. An average annual collision incident rate of 5.86 has been identified within the Model Area.

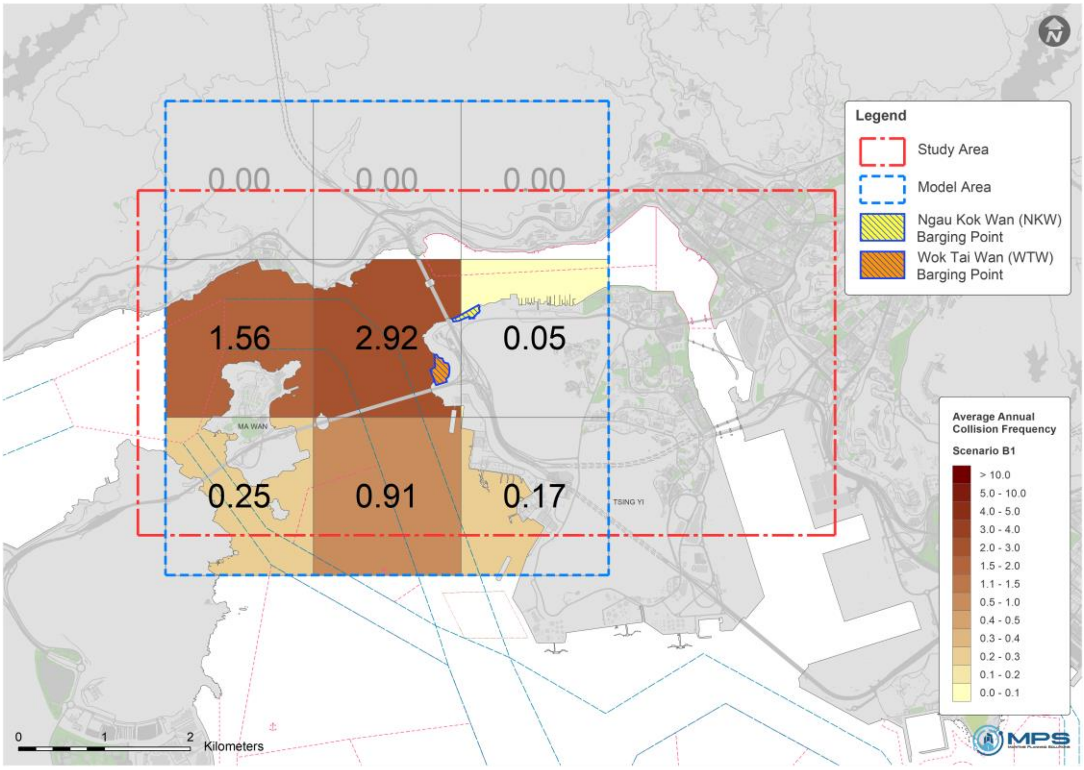

Figure 5-7 Scenario B1 – Average Annual Collisions of Future Traffic 2027 without TYNUQ Construction

5.6.3 The risk model predicted that future traffic growth up to the year 2027 along with concurrent traffic generated by other proposed developments without the peak construction traffic of TYNUQ in 2027 would increase average annual collision incidents by about 1.96 incidents (~50% increase) within the Model Area from existing levels (i.e. Scenario B1 – Scenario A).

Scenario B2 – 2027 Future Traffic with TYNUQ Construction

5.6.4 **Figure 5-8** illustrates the distribution of average annual collision incidents considering future traffic growth and the estimated peak traffic of other proposed developments, with the peak construction traffic of TYNUQ in 2027. An average annual collision incident rate of 5.91 has been identified within the Model Area.

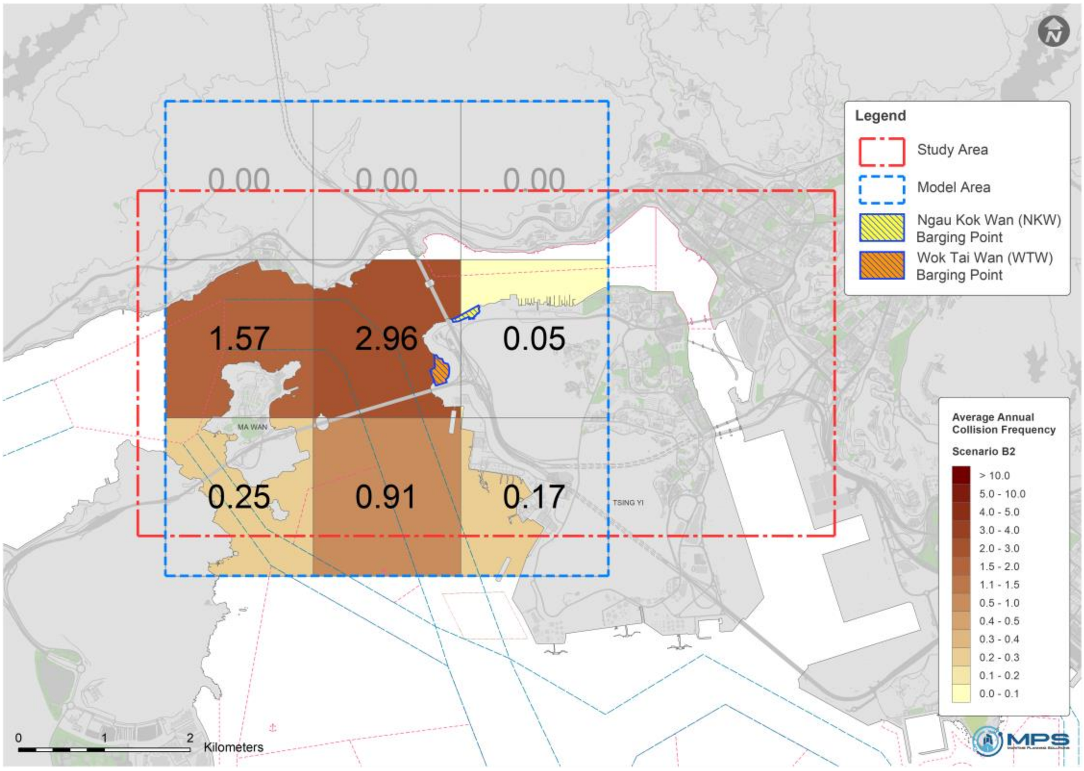

Figure 5-8 Scenario B2 – Average Annual Collisions of Future Traffic 2027 with TYNUQ Construction

5.6.5 The risk model predicted that future traffic growth up to the year 2027 along with concurrent traffic generated by other proposed developments with the peak construction traffic of TYNUQ in 2027 would increase average annual collision incidents by about 0.05 incidents (~1% increase) within the Model Area from existing levels (i.e. Scenario B2 – Scenario B1).

Scenario C1 – 2028 Future Traffic without TYNUQ Operation

5.6.6 **Figure 5-9** illustrates the distribution of average annual collision incidents considering future traffic growth and the estimated peak traffic of other proposed developments at the planned commissioning year in 2028, without the implementation of TYNUQ. An average annual collision incident rate of 5.82 has been identified within the Model Area.

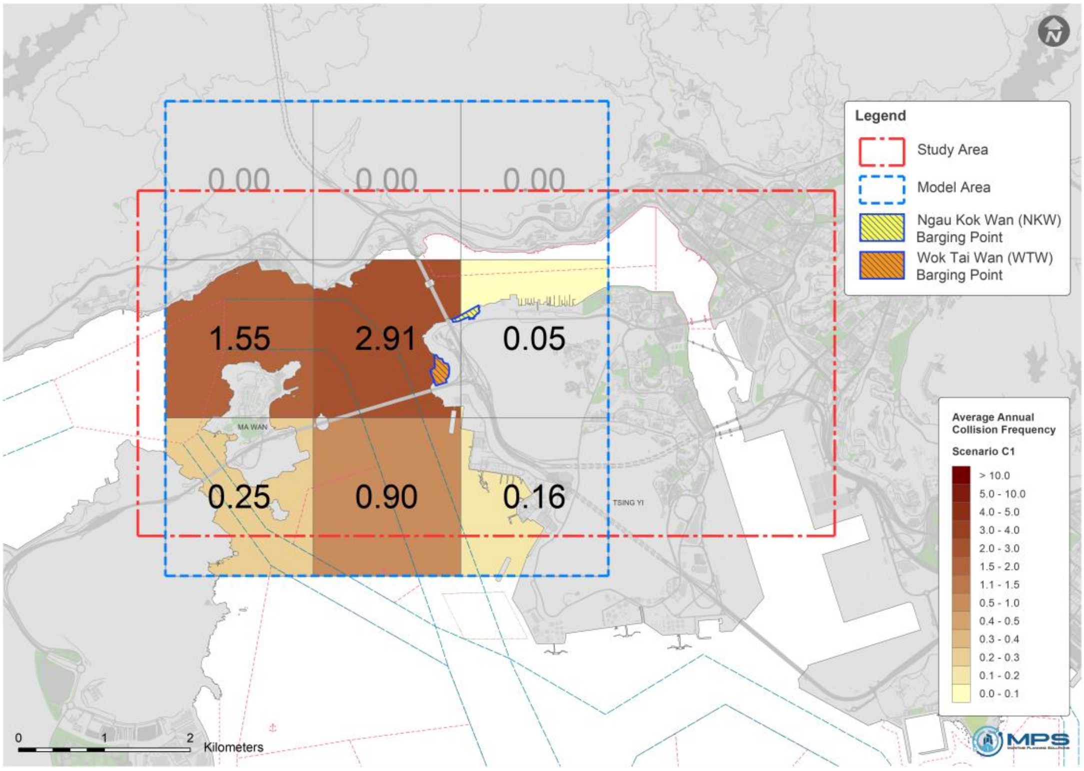

Figure 5-9 Scenario C1 – Average Annual Collisions of Future Traffic 2028 without TYNUQ Operation

5.6.7 The risk model predicted that future traffic growth up to the year 2028 considering the estimated peak traffic of other proposed developments at the planned commissioning year in 2028 without the implementation of TYNUQ would increase average annual collision incidents by about 1.92 incidents (~49% increase) within the Model Area from existing levels (i.e. Scenario C1 – Scenario A).

Scenario C2 – 2028 Future Traffic with TYNUQ Operation

5.6.8 **Figure 5-10** illustrates the distribution of average annual collision incidents considering future traffic growth and the estimated peak traffic of other proposed developments at the planned commissioning year in 2028, with the implementation of TYNUQ. An average annual collision incident rate of 6.02 has been identified within the Model Area.

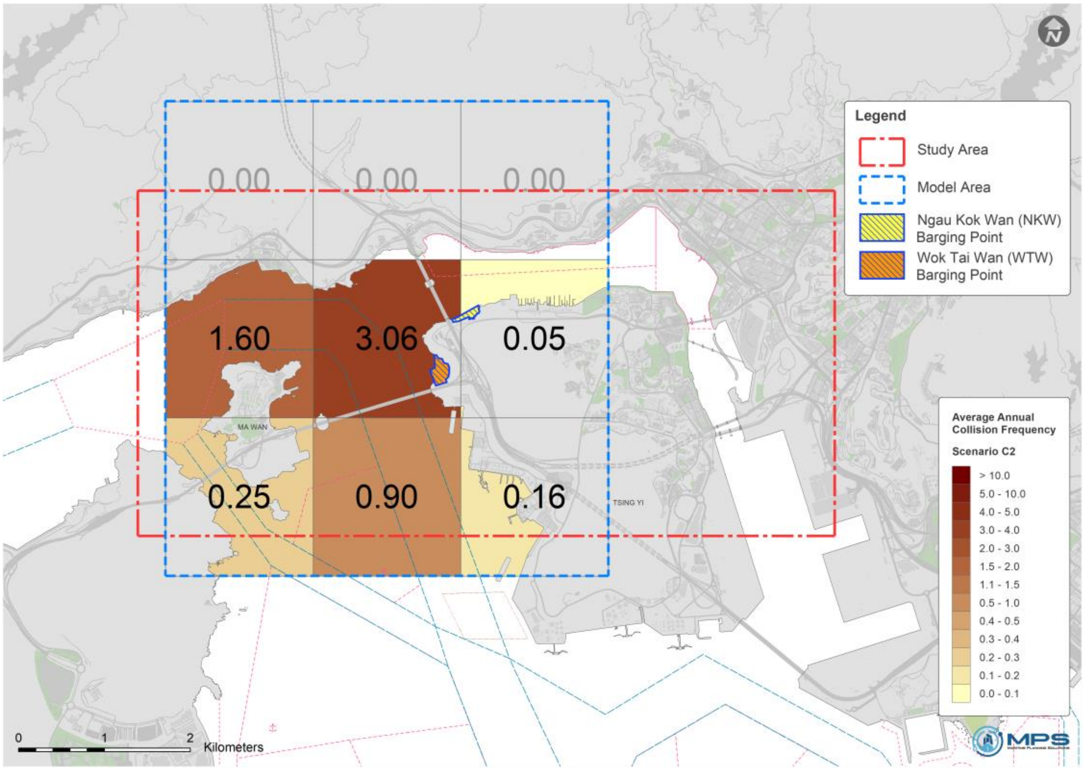

Figure 5-10 Scenario C2 – Average Annual Collisions of Future Traffic 2028 with TYNUQ Operation

5.6.9 The risk model predicted that future traffic growth up to the year 2028 considering the estimated peak traffic of other proposed developments at the planned commissioning year in 2028 with the implementation of TYNUQ would increase average annual collision incidents by about 0.2 incidents (~3% increase) within the Model Area from existing levels (i.e. Scenario C2 – Scenario C1).

Collision Risk Assessment Summary

5.6.10 **Table 5-2** presents a summary of the IWRAP collision risk assessment results and a comparison of the impact on risk levels anticipated within the Model Area in the existing and future traffic environments, with and without the implementation of the TYNUQ.

Table 5-2 IWRAP Collision Risk Assessment Summary

Scenario	Descriptions	Average Annual Collision Frequency	Percentage Increase in Risk Level
A	2024 Baseline Traffic	3.90	2024 Baseline Risk
B1	2027 Future Traffic + Concurrent Project Traffic	5.86	~50% up on Scenario A
B2	2027 Future Traffic with TYNUQ Construction Traffic + Concurrent Project Traffic	5.91	~51% up on Scenario A; ~1% up on Scenario B1
C1	2028 Future Traffic + Concurrent Project Traffic	5.82	~49% up on Scenario A
C2	2028 Future Traffic with TYNUQ Operation + Concurrent Project Traffic	6.02	~54% up on Scenario A ; ~3% up on Scenario C1

5.6.11 Comparing Scenario B1 and Scenario C1 with Scenario A, it is identified that the average annual collision incident level in the Model Area could potentially increase by ~50% in 2027 and ~49% in 2028, even without the implementation of the TYNUQ due to the forecast marine traffic growth and concurrent traffic from other proposed developments. The ~50% and ~49% increase primarily attributable to concurrent projects, which are expected to generate approximately 221 daily vessel movements (refer to **Table 4-7**) on top of the existing 274 background movements at Gate A (refer to **Table 4-6**). This increase in total traffic volume accounts for the projected rise in collision risk.

5.6.12 Comparing Scenario B2 with Scenario A, it is identified that the cumulative impact arising from the construction of TYNUQ along with concurrent traffic from other proposed developments, could potentially increase the average annual collision incident level within the Model Area by ~51%. Comparing Scenario B2 with Scenario B1, the TYNUQ Project itself contributes only 16 vessel movements in 2027 (refer to **Table 2-4**), which is negligible compared with the traffic generated by concurrent developments and existing background movements. This limited contribution results in only ~1% incremental collision risk in 2021.

5.6.13 Comparing Scenario C2 with Scenario A, it is identified that that the implementation of TYNUQ along with concurrent traffic from other proposed developments, could potentially increase the average annual collision incident level within the Model Area by ~54%. Comparing Scenario C2 with Scenario C1, the TYNUQ Project itself contributes only 4 movements in 2028 (refer to **Table 2-5**), which is negligible relative to the traffic generated by concurrent developments and existing background movements. This limited contribution results in only ~3% incremental collision risk in 2028.

5.6.14 It can be concluded that the increase in risk level arising from the construction and implementation of TYNUQ is significantly less than the increase in risk level anticipated from future traffic growth and concurrent traffic of other proposed developments in the years 2027 and 2028 without the implementation of the TYNUQ. Accordingly, the TYNUQ Project is not expected to result in adverse collision impacts on future marine traffic in 2027 and 2028.

5.7 Grounding and Allision Risk Modelling Results

Scenario A - 2024 Baseline Traffic

5.7.1 The baseline marine traffic risk model has been calibrated to the existing marine traffic risk level identified. **Figure 5-11** illustrates the average annual distribution of grounding and allision incidents rate of 0.70 within the Model Area.

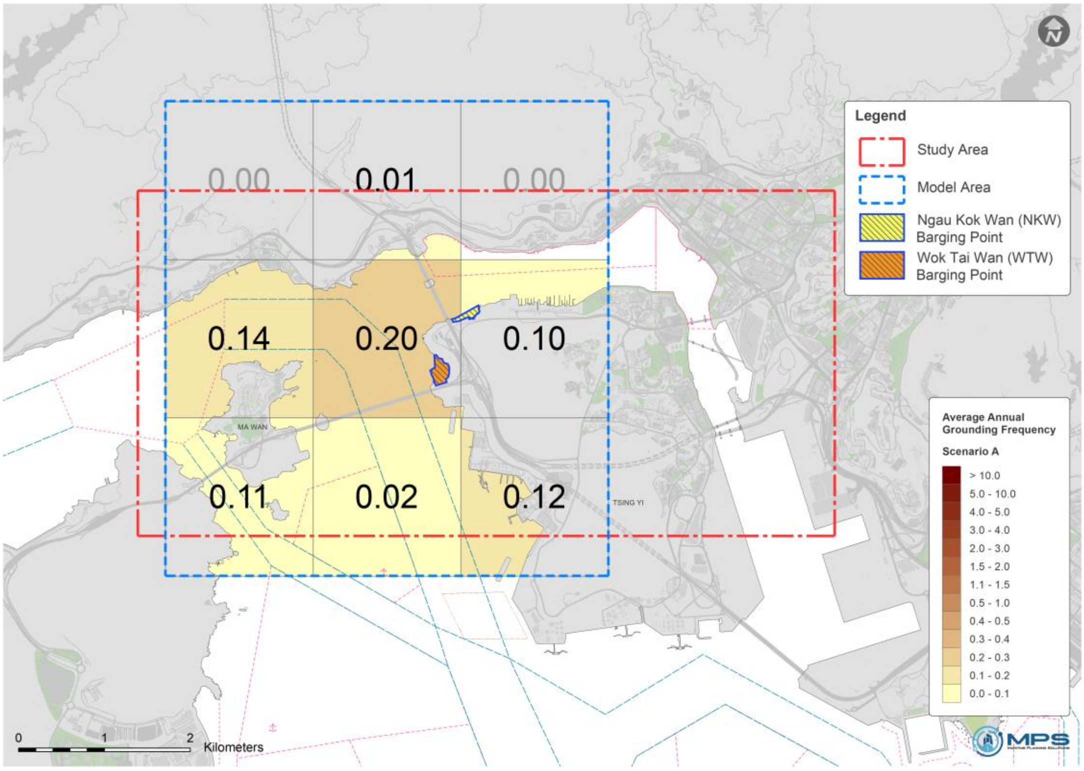

Figure 5-11 Scenario A – Average Annual Grounding and Allision of Baseline Traffic 2024

Scenario B1 – 2027 Future Traffic without TYNUQ Construction

5.7.2 **Figure 5-12** illustrates the distribution of average annual grounding and allision incidents considering future traffic growth and the estimated peak traffic of other proposed developments without the peak construction traffic of TYNUQ in 2027. An average annual grounding and allision incident rate of 4.11 has been identified within the Model Area.

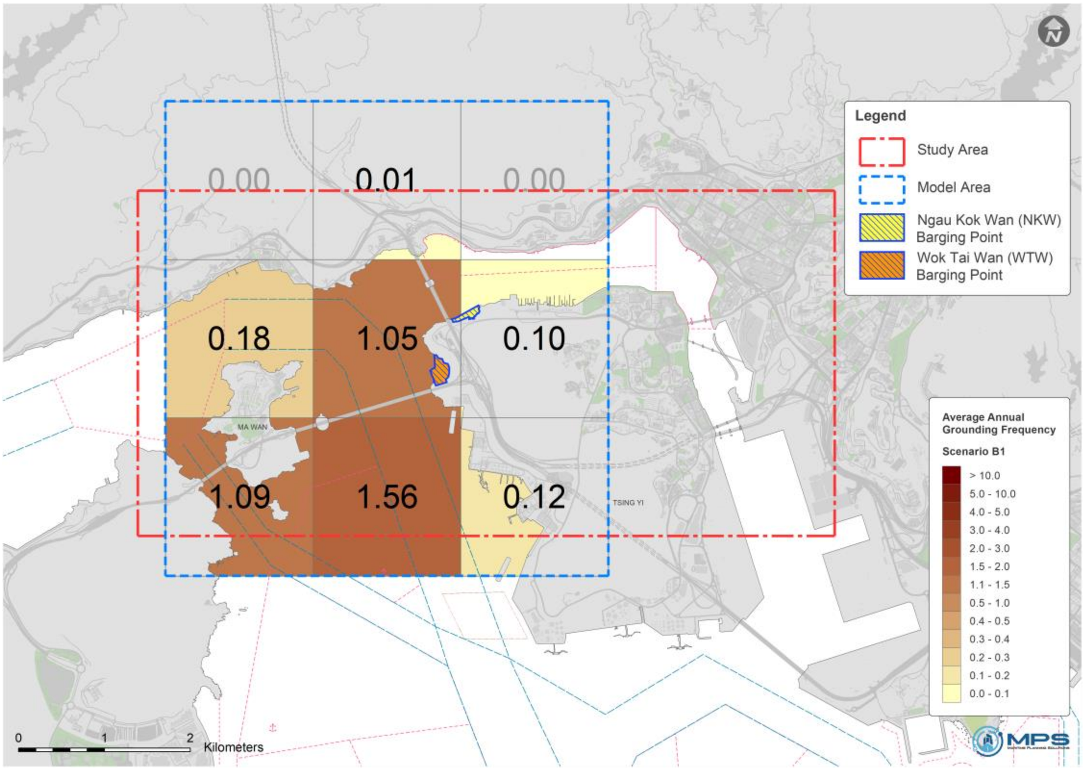

Figure 5-12 Scenario B1 – Average Annual Grounding and Allision of Future Traffic 2027 without TYNUQ Construction

5.7.3 The risk model predicted that future traffic growth up to the year 2027 along with concurrent traffic generated by other proposed developments without the peak construction traffic of TYNUQ in 2027 would increase average annual grounding and allision incidents by about 3.41 incidents (~487% increase) within the MTIA Study Area from existing levels (i.e. Scenario B1 – Scenario A).

Scenario B2 – 2027 Future Traffic with TYNUQ Construction

5.7.4 **Figure 5-13** illustrates the distribution of average annual grounding and allision incidents considering future traffic growth and the estimated peak traffic of other proposed developments with the peak construction traffic of TYNUQ in 2027. An average annual grounding and allision incident rate of 4.13 has been identified within the Model Area.

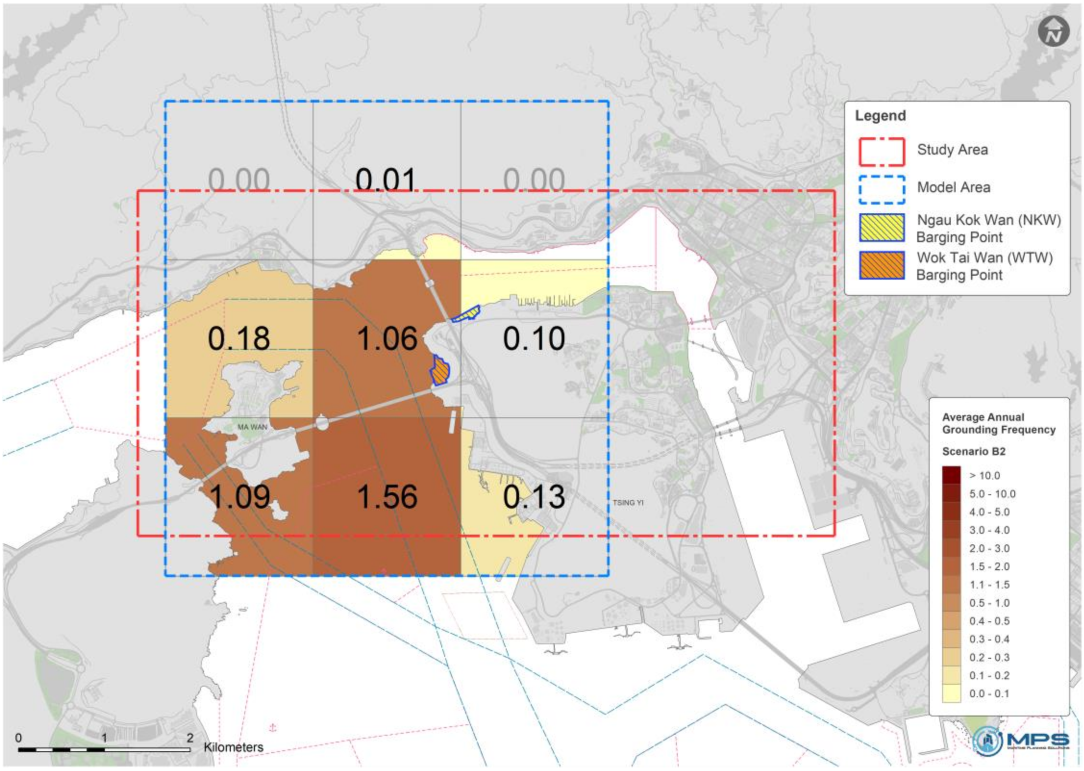

Figure 5-13 Scenario B2 – Average Annual Grounding and Allision of Future Traffic 2027 with TYNUQ Construction

5.7.5 The risk model predicted that future traffic growth up to the year 2027 along with concurrent traffic generated by other proposed developments with the peak construction traffic of TYNUQ in 2027 would increase average annual grounding and allision incidents by about 0.02 incidents (~0.5 % increase) within the Model Area from existing levels (i.e. Scenario B2 – Scenario B1).

Scenario C1 – 2028 Future Traffic without TYNUQ Operation

5.7.6 **Figure 5-14** illustrates the distribution of average annual grounding and allision incidents considering future traffic growth and the estimated peak traffic of other proposed developments at the planned commissioning year in 2028, without the implementation of TYNUQ. An average annual grounding and allision incident rate of 4.16 has been identified within the Model Area.

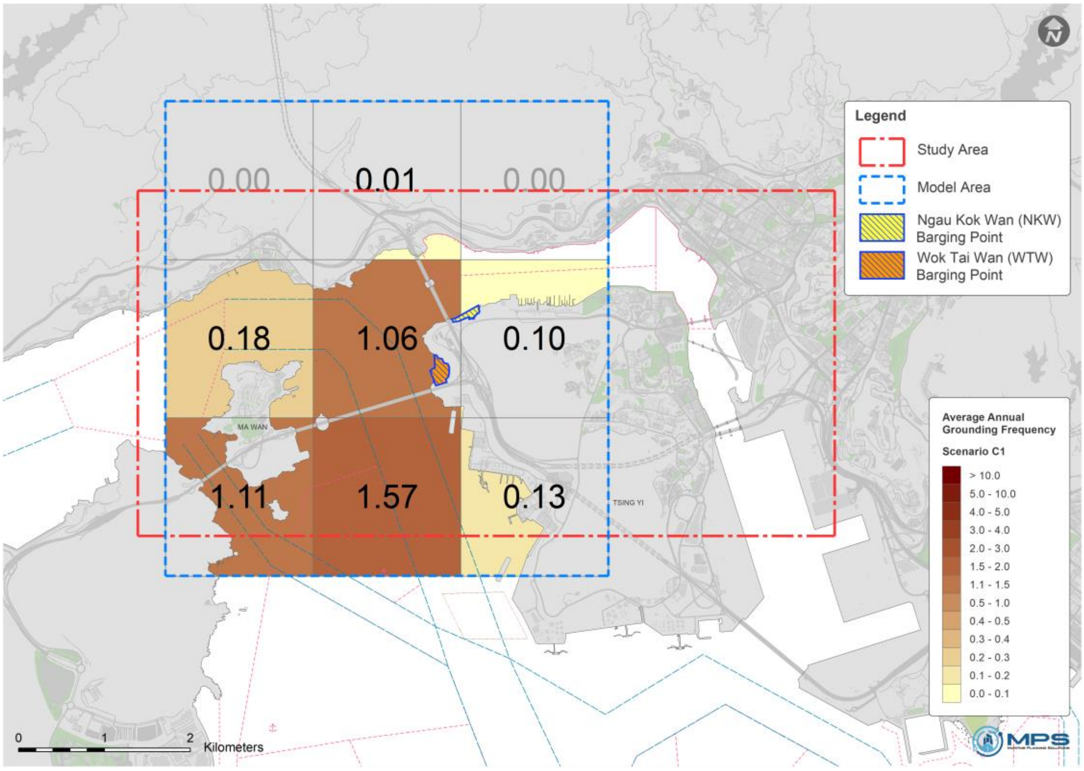

Figure 5-14 Scenario C1 – Average Annual Grounding and Allision of Future Traffic 2028 without TYNUQ Operation

5.7.7 The risk model predicted that future traffic growth up to the year 2028 considering the estimated peak traffic of other proposed developments at the planned commissioning year in 2028 without the implementation of TYNUQ would increase average annual grounding and allision incidents by about 3.46 incidents (~494% increase) within the Model Area from existing levels (i.e. Scenario C1 – Scenario A).

Scenario C2 – 2028 Future Traffic without TYNUQ Operation

5.7.8 **Figure 5-15** illustrates the distribution of average annual collision incidents considering future traffic growth and the estimated peak traffic of other proposed developments at the planned commissioning year in 2028, with the implementation of TYNUQ. An average annual grounding and allision incident rate of 4.20 has been identified within the Model Area.

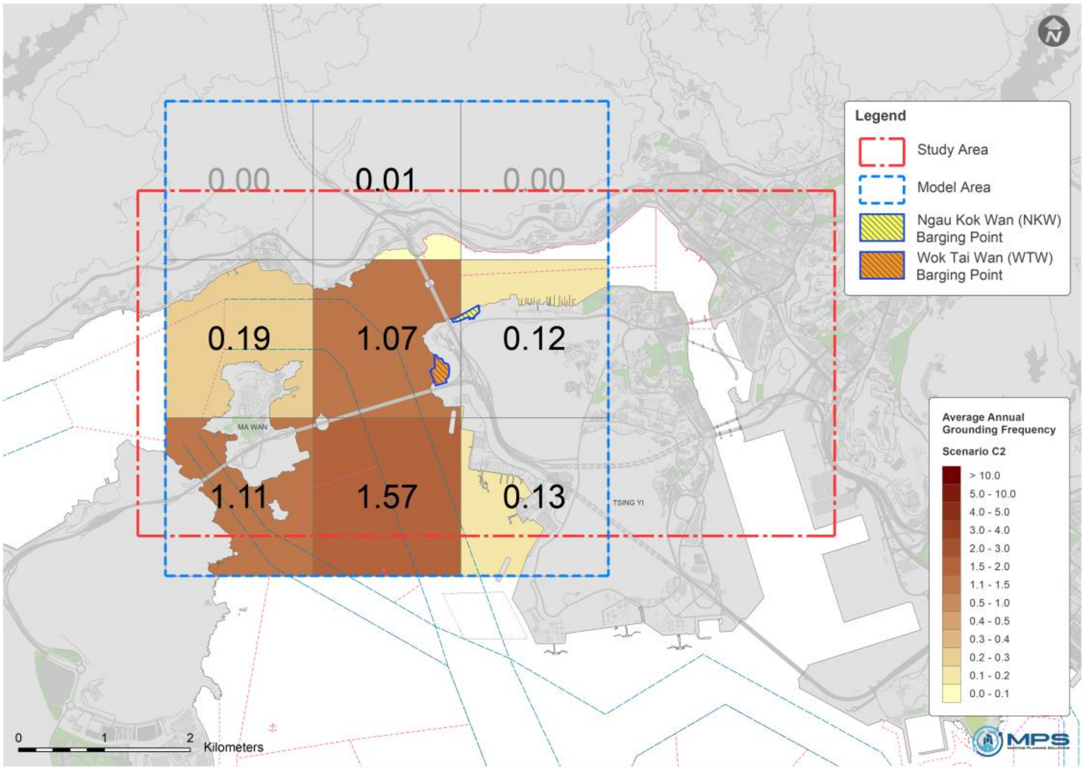

Figure 5-15 Scenario C2 – Average Annual Grounding and Allision of Future Traffic 2028 with TYNUQ Operation

5.7.9 The risk model predicted that future traffic growth up to the year 2028 considering the estimated peak traffic of other proposed developments at the planned commissioning year in 2028 with the implementation of TYNUQ would increase average annual grounding and allision incidents by about 0.04 incidents (~1% increase) within the Model Area from existing levels (i.e. Scenario C2 – Scenario C1).

Ground and Allison Risk Assessment Summary

5.7.11 Ground and Allison Risk Assessment Summary **Table 5-3** presents a summary of the IWRAP grounding, and allision risk assessment results and a comparison of the impact on risk levels anticipated within the Risk Model Area in the existing and future traffic environments, with and without the implementation of the TYNUQ.

Table 5-3 IWRAP Ground and Allison Risk Assessment Summary

Scenario	Descriptions	Average Annual Collision Frequency	Percentage Increase in Risk Level
A	2024 Baseline Traffic	0.70	2024 Baseline Risk
B1	2027 Future Traffic + Concurrent Project Traffic	4.11	~487% up on Scenario A
B2	2027 Future Traffic with TYNUQ Construction Traffic + Concurrent Project Traffic	4.13	~490% up on Scenario A ; ~0.5% up on Scenario B1
C1	2028 Future Traffic + Concurrent Project Traffic	4.16	~494% up on Scenario A
C2	2028 Future Traffic with TYNUQ Implementation + Concurrent Project Traffic	4.20	~500% up on Scenario A ; ~1% up on Scenario C1

5.7.12 Comparing Scenario B1 and Scenario C1 with Scenario A, it is identified that the average annual grounding and allision incident level in the Model Area could potentially significantly increase by ~487% in 2027 and ~494% in 2028, even without the implementation of TYNUQ. This increase is primarily attributable to concurrent projects, which are expected to generate approximately 221 daily vessel movements (refer to **Table 4-7**) on top of the existing 274 background movements at Gate A (refer to **Table 4-6**).

5.7.13 Comparing Scenario B2 with Sneario A , it is identified that the cumulative impact arising from the construction of TYNUQ, along with concurrent traffic from other proposed developments, could potentially increase the average annual grounding and allision incident level within the Model Area by ~490%. Comparing Scenario B2 with Sneario B1, the TYNUQ Project itself contributes only 16 movements in 2027 (**refer to Table 2-4**), which is negligible relative to the traffic generated by concurrent developments and existing background movements. As such, it results in only ~0.5% incremental grounding and allision risk in 2027.

5.7.14 Comparing Scenario C2 with Sneario A, it is identified that the implementation of TYNUQ, along with concurrent traffic from other proposed developments, could potentially increase the average annual grounding and allision incident level within the Model Area by ~500%. Comparing Scenario C2 with Sneario C1, theTYNUQ Project itself contributes only 4 movements in 2028 (refer to **Table 2-5**), which is negligible relative to the traffic generated by concurrent developments and existing background movements. As such, it results in only ~3% incremental grounding and allision risk in 2028.

5.7.15 It can be concluded that the increase in grounding and allision risk arising from the construction and implementation of TYNUQ is significantly lower than the increase anticipated from future traffic growth and concurrent developments in 2027 and 2028 without TYNUQ. Accordingly, the TYNUQ Project is not expected to result in adverse grounding and allision impacts on future marine traffic in 2027 and 2028.

5.9 Marine Traffic Qualitative Risk Assessment

Approach

5.9.1 The IALA Risk Management Tool, SIRA, has been adopted for qualitative risk review. It provides a structured method for developing a risk matrix that identifies relevant hazards and undesirable events, and assesses the effectiveness of risk control options.

5.9.2 The identification of hazards is based on available information such as traffic data, adequate nautical charts, publications, etc. Based on the identified hazards, possible undesirable scenarios are identified. SIRA addresses each undesirable scenario in turn, and the likelihood of the occurrence of each undesirable scenario is estimated, as well as its potential consequences, in the immediate and long term. The SIRA process is illustrated as:

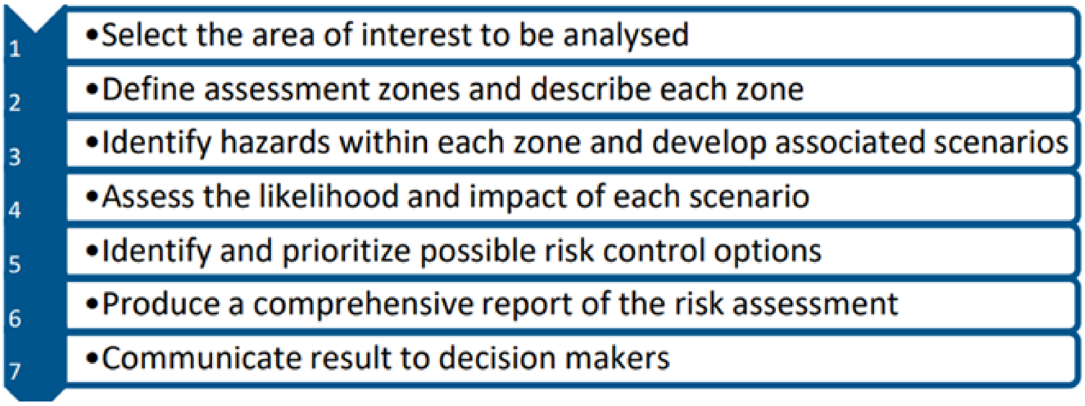

Figure 5-16 SIRA Process

Source: IALA GUIDELINE G1138 THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)

5.9.3 The SIRA process involves five levels of likelihood as presented in **Table 5-4** and five levels of impact as presented in **Table 5-5** for each undesirable scenario. These levels are used to calculate a risk value by multiplying the likelihood and impact scores. Historical data may be used to adjust the likelihood scale based on known frequencies of undesirable scenarios. Additionally, an impact scale is provided for various categories such as service disruption and human impact. The highest score across these categories, when combined with the likelihood score, determines the risk value.

Table 5-4 Description of Likelihood

Classification	Socre	Probability
Very rare	1	Very rare or unlikely, will occur only in exceptional circumstances and not more than once in 20 years
Rare	2	Rare, may occur every 2–20 years
Occasional	3	Occasional, may occur every 2 months to 2 years
Frequrent	4	Frequent, may occur once every weekly to every 2 months
Very frequent	5	Very frequent, may occur at least once every week

Source: IALA GUIDELINE G1138 THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)

Table 5-5 Description of Impact Categories

Category	Score	Service Disruption	Human Impact
Insignificant	1	No service disruption apart from some delays or nuisance.	No injury to humans, perhaps significant nuisance.
Minor	2	Some nonpermanent loss of services such as the closure of a port or waterway for up to 4 hours.	Minor injury to one or more individuals who may require hospitalization.
Severe / Moderate	3	Sustained disruption to services such as the closure of a port or waterway for 4-24 hours	Injuries to several individuals requiring hospitalization.
Major	4	Sustained disruption to services such as the closure of a major port or waterway for 1-30 days or permanent or irreversible loss of services	Severe injuries to many individuals or loss of life.
Catastrophic	5	Sustained disruption to services such as the closure of a major port or waterway for months or years	Severe injuries to numerous individuals and/or loss of several lives.

Source: IALA GUIDELINE G1138 THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)

5.9.4 The risk value for each identified scenario is calculated by multiplying the likelihood and impact scores. The risk value is calculated in accordance with the matrix in **Table 5-6**.

Table 5-6 Risk Value Matrix

		PROBABILITY (LIKELYHOOD)				
		Very Rare 1	Rare 2	Occasional 3	Frequent 4	Very frequent 5
CONSEQUENCE (IMPACT)	Catastrophic 5	5	10	15	20	25
	Major 4	4	8	12	16	20
	Severe 3	3	6	9	12	15
	Minor 2	2	4	6	8	10
	Insignificant 1	1	2	3	4	5

Source: IALA GUIDELINE G1138 THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)

5.9.5 To determine whether those risks are acceptable or not, SIRA specifies four colour-banded levels of risk. These are shown in the **Table 5-7**.

Table 5-7 Action Required for Risk Categories

Risk Value	Risk Category	Action Required
1 – 4	Green	**Low risk** not requiring additional risk control options unless they can be implemented at low cost in terms of time, money and effort.
5 – 8	Yellow	**Moderate risk must be reduced to the ALARP level**, through the implementation of additional risk control options that are likely to require additional funding.
9 –12	Amber	**High risk** for which substantial and urgent efforts **must be made to reduce it to ALARP levels** within a defined period. Significant funding is likely to be required and services may need to be suspended or restricted until risk control options have been actioned.
15 – 25	Red	**Very high and unacceptable risk** for which substantial and immediate improvements are necessary. Major funding may be required, and ports and waterways are likely to be forced to close until the risk has been reduced to an acceptable level.

Source: IALA GUIDELINE G1138 THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)

5.9.6 The FSA methodology requires that any risks that are intolerable (i.e., in the red category in SIRA) should be identified and improved immediately. For those risks in the green category, the level of risk is considered acceptable. For those risks lying in between these upper and lower bounds (i.e., yellow and amber), they should be appraised to understand how the risks can be reduced to a level "as low as reasonably practicable" ALARP.

Table 5-8 Illustration to show FSA-defined ALARP regions in SIRA Matrix

		PROBABILITY/(LIKELIHOOD)				
		Very Rare (1)	Rare (2)	Occasional (3)	Frequent (4)	Very frequent (5)
CONSEQUENCE (IMPACT)	Catastrophic (5)	5	10	15	20	25
	Major (4)	4	8	12	16	20
	Severe (3)	3	6	9	12	15
	Minor (2)	2	4	6	8	10
	Insignificant (1)	1	2	3	4	[illegible]

"Intolerable"
Risks to be ALARP
"Tolerable"

Source: IALA GUIDELINE G1138 THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)

5.10 Hazard Identification

5.10.1 The hazards identified in the IALA Guideline G1138 are categorized into seven groups: 1) Natural Hazards; 2) Economic Hazards; 3) Technical Hazards; 4) Human Hazards; 5) Operational Hazards; 6) Spatial Planning Conflicts; and 7) Waterway Complexity.

5.10.2 The hazards identified may lead to one or more undesirable scenarios within the Study Area at the construction and operation phases were identified and summarized in **Table 5-9**.

Table 5-9 Hazards identified for the MTIA Study Area

Hazard	Description	Remark
1. Natural	Shallow water	Shallow water observations at the shore end of the barging points in NKW and WTW.
	Low Visibility	Vessels transiting in the waters between Ting Kau and Tsing Yi North may not be able to see marine works vessels during low visibility.
2. Economic	This hazard is unrelated to the vessels involved in TYNUQ construction and operation. Economics is not be covered in the marine traffic impact assessment, which focuses on physical impact.	
3. Technical	Mechanical failures	The TYNUQ construction and operation will require the deployment of marine works vessels. If the contractor and operator choose to employ marine works vessels without ensuring proper management and maintenance, it could result in the loss of vessel control due to mechanical failures during work.
4. Human	Crew competency and distraction	Insufficient communication and action are being taken by the skipper associated with the marine work vessels when navigating to and from the works area.
5. Operational	Impact of vessels	Other vessels are unable to identify the marine work vessels deployed for the TYNUQ construction and operation.
6. Spatial planning conflicts	The existence of wrecks and new dangers	Marine work vessels transiting in Tsing Yi North have not taken into account the height restrictions and marine viaduct structures of the Tsing Ma Bridge and Ting Kau Bridge.
7. Waterway complexity	This hazard is unrelated to the vessels involved in TYNUQ construction and operation. No waterway complexity has been identified in the vicinity of the works area.	

5.11 Identify Undesirable Scenarios

5.11.1 The hazards identified may lead to several different undesirable scenarios. The possible scenarios that these hazards may cause are identified and summarised in **Table 5-10**.

Table 5-10 Possible Undesirable Scenarios Identified for Construction and Operation Phases

Hazard	Scenario	Remark
1. Natural		
Safe minimum depth (m)	Grounding (Construction Phase)	Shallow water observations at the shore end of the barging points in NKW and WTW.
Minimum visibility (NM)	Collision (Construction & Operation Phase)	Vessels transiting in the waters between Ting Kau and Tsing Yi North may not be able to see marine works vessels during low visibility.
2. Economic		
This hazard is unrelated to the vessels involved in TYNUQ construction and operation. Economics is not be covered in the marine traffic impact assessment, which focuses on physical impact.		
3. Technical		
Loss of vessel control due to mechanical failure	Collision (Construction & Operation Phase)	Unexpected operational breakdowns on marine works vessels could result in collisions with other vessels.
4. Human		
Crew competency	Collision (Construction & Operation Phase)	Miscommunication or action being taken with other vessels when there is a foreseeable risk of collision with marine works vessels.
5. Operational		
Impact of vessels	Collision (Construction Phase)	Other vessels are unable to identify the marine work vessels deployed for the TYNUQ construction.
Impact of vessels	Collision (Operation Phase)	Other vessels are unable to identify the marine work vessels deployed for the TYNUQ operation.
6. Spatial planning conflicts		
The existence of wrecks and new dangers	Allision (Construction Phase)	TYNUQ construction vessels may strike the Tsing Ma Bridge and Ting Kau Bridge marine viaduct structures when navigating into and out of the proposed working area.
7. Waterway complexity		
This hazard is unrelated to the vessels involved in TYNUQ construction and operation. No waterway complexity has been identified in the vicinity of the works area.		

5.12 Risk Scores of Undesirable Scenarios (without Risk Control Measures)

5.12.1 For each undesirable scenario, a risk score is given considering the probability of the incident happening and its potential impact. The likelihood and impact scores were determined based on findings from the IWRAP assessment and historical incidents in the Study Area. **Table 5-11** presents the risk scores for the scenarios under the existing situations without implementing a risk control option, and a detailed development of the risk values is presented in **Appendix C**.

Table 5-11 Risk Scores of Undesirable Scenarios

Ref	Scenario & Description	Likelihood (A)	Impact (B)	Risk Value (A * B)
1. Natural				
1.1	<u>Grounding (Construction Phase)</u> Marine works vessels may go aground in shallow waters at the shore end of the barging points in NKW and WTW..	3	2	6
1.5	<u>Collision (Construction & Operation Phase)</u> Marine works vessels may not be able to see other vessels on the same course during low visibility, potentially leading to collisions.	4	4	16
2. Economic				
This hazard is unrelated to the vessels involved in TYNUQ construction and operation. Economics is not be covered in the marine traffic impact assessment, which focuses on physical impact.				
3. Technical				
3.3	<u>Collision (Construction & Operation Phase)</u> Unexpected operational breakdowns on marine works vessels could result in collisions with other vessels.	2	4	8
4. Human				
4.1	<u>Collision (Construction & Operation Phase)</u> Miscommunication or action being taken with other vessels when there is a foreseeable risk of collision with marine works vessels.	2	4	8
5. Operational				
5.1	<u>Collision (Construction Phase)</u> Other vessels are unable to identify the vessels deployed for the TYNUQ.	3	4	12
5.2	<u>Collision (Operation Phase)</u> Other vessels are unable to identify the vessels deployed for the TYNUQ.	4	4	16
6. Spatial planning conflicts				
6.1	<u>Allision (Construction Phase)</u> TYNUQ construction vessels may strike the Tsing Ma Bridge and Ting Kau marine viaduct structures when navigating into and out of the proposed working area.	3	2	6
7. Waterway complexity				
This hazard is unrelated to the vessels involved in TYNUQ construction and operation. No waterway complexity has been identified in the vicinity of the works area.				

5.13 Risk Scores of Undesirable Scenarios (with Risk Control Measures)

5.13.1 It has been identified that the risk values for all undesirable scenarios are within the ALARP region based on the current situation. In order to ensure risks can be further minimized to ALARP, further risk control measures are recommended. **Table 5-12** provides a summary of the proposed risk control measures for each scenario and their resulting risk values and a detailed development of control measures is presented in **Appendix C**.

Table 5-12 Risk Scores of Undesirable Scenarios (with Risk Control Measures)

Ref	Scenario & Description	Risk Control Measures	Likelihood (A)	Impact (B)	Risk Value (A * B)
1. Natural					
1.1	<u>Grounding (Construction Phase)</u> Marine works vessels may go aground in shallow waters at the shore end of Tsing Yi North.	A hydrographic survey covering the waters within the barging area shall be carried out before deployment of vessels. Temporary Marine Traffic Management (TMTM) Plan should be prepared during the construction phase, which may include a mooring plan, designated routing (to avoid shallow waters), designated anchoring area (if necessary), and contingency plan in case of grounding incidents.	2	1	2
1.5	<u>Collision (Construction & Operation Phase)</u> Marine works vessels may not be able to see other vessels on the same course during low visibility, potentially leading to collisions.	The marine operations shall be suspended at times of poor visibility of 2.0 nautical miles or below, all marine works shall be suspended, and regular bell swings/gong strikes will be carried out to warn approach vessels. Sound signals for vessels in restricted visibility shall strictly comply with the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Rule 35.	3	3	9
2. Economic					
This hazard is unrelated to the vessels involved in TYNUQ construction and operation. Economics should not be covered in the marine traffic impact assessment, which focuses on physical impact.					
3. Technical					
3.3	<u>Collision (Construction & Operation Phase)</u> Unexpected operational breakdowns on marine works vessels could result in collisions with other vessels.	All vessels deployed for the marine works must be properly licensed locally in Hong Kong and operated by a licensed operator. Should the suspension of navigation be required and confirmed, the marine launch will pick up all onboard site staff and transport them to land. Tug(s) would be summoned for the towing of the vessel to a safe location.	1	3	3

Ref	Scenario & Description	Risk Control Measures	Likelihood (A)	Impact (B)	Risk Value (A * B)
4. Human					
4.1	Collision (Construction & Operation Phase) Miscommunication or action being taken with other vessels when there is a foreseeable risk of collision with marine works vessels.	Contractor and operator shall provide a daily briefing to coxswains on guard boats and remind them that it is vital that the guard boat must NOT sail beyond the Works Area and intrude into the navigation passage. The skipper and crew will receive periodic training sessions to familiarize them with the waterspace and restrictions in the vicinity of the works area.	1	3	3
5. Operational					
5.1	Collision (Construction Phase) Other vessels are unable to identify the vessels deployed for the TYNUQ.	The Temporary Marine Traffic Management (TMTM) Plan should be developed by the contractor. Promulgation of the Marine Department Notice (MDN) on the works carried out. A stakeholder meeting, such as the Marine Management Liaison Group (MMLG), is recommended to address marine traffic issues. The Marine Traffic Management Team (MTMT) Plan should be developed by the contractor. Deployment of yellow marker buoys fitted with yellow flashing lights and radar reflectors, and AIS transmitters to mark the positions of the anchors extending from the work barges. Work barges equipped with an AIS transponder and VHF.	2	3	6
5.2	Collision (Operation Phase) Other vessels are unable to identify the vessels deployed for the TYNUQ.	The Marine Traffic Management Team (MTMT) Plan should be developed by the contractor. Deployment of yellow marker buoys fitted with yellow flashing lights and radar reflectors, and AIS transmitters to mark the positions of the anchors extending from the work barges. Work barges equipped with an AIS transponder and VHF.	3	3	9

Ref	Scenario & Description	Risk Control Measures	Likelihood (A)	Impact (B)	Risk Value (A * B)
6. Spatial planning conflicts					
6.1	<u>Allision (Construction Phase)</u> TYNUQ construction vessels may strike the Tsing Ma Bridge and Ting Kau marine viaduct structures when navigating into and out of the proposed working area.	Temporary Marine Traffic Management (TMTM) Plan should be prepared during the construction phase, which may include a designated routing (to be aware of the Vessels Height Restrictions of Tsing Ma Bridge and Ting Kau Bridge) and contingency plan in case of allision incidents. Promulgation of the MDN on the works carried out. A stakeholder meeting, such as the Marine Management Liaison Group (MMLG), is recommended to address marine traffic issues.	2	1	2
7. Waterway complexity					
This hazard is unrelated to the vessels involved in TYNUQ construction and operation. No waterway complexity has been identified in the vicinity of the works area.					

5.14 Qualitative Risk Assessment Findings

5.14.1 The SIRA assessment was conducted to identify the potential hazards and undesirable scenarios arising from the construction and operation of the Project. A risk value was calculated based on likelihood and impact. In order to ensure risks are minimized and managed, further risk control measures were recommended, and a new risk value was calculated to evaluate the effectiveness of the proposed risk control measures. The assessment record, in the form of a matrix, is included in **Appendix C**. It is identified that the recommended risk control measures have further reduced risk values. The details on risk control measures are presented in the next section of this Report.

5.15 Summary

5.15.1 A comprehensive risk assessment was conducted using IWRAP and SIRA to assess the quantitative and qualitative risks within the study area. It is not anticipated that the Project, during the construction phase and operation phase, with the proposed risk control measures, will pose significant hazards to existing and future marine traffic.

6 Risk Control Measures

6.1 Introduction

6.1.1 As reviewed in the previous sections, it is anticipated that the construction works and operation of the TYNUQ will impact the local marine traffic environment during the construction and operation phase. To minimise any potential marine traffic risk, general marine traffic management measures are recommended.

6.1.2 This section summarises the proposed risk control measures that shall be implemented for the construction works and operation of the TYNUQ to mitigate any potential marine traffic risk.

6.1.3 As mentioned in Section 2.3 and 2.4, the primary marine activity during construction and operation phases is transporation of material. There is no marine construction works proposed under this Project. If the contractor plans to carry out any marine construction works to suit for their need, the contractor shall submit to the Marine Department for promulgation of a Marine Department Notice (MDN) together with the necessary supporting information. The following section outlined the requirement of the supporting information in the event that they are triggered.

6.2 General Marine Traffic Management Measures During Construction

Pre-Construction Site Survey

6.2.1 Prior to the commencement of marine construction works, a hydrographic survey covering the waters within the construction works area, where necessary, shall be carried out to ensure adequate water depth for safe navigation for construction vessels.

Temporary Marine Traffic Management Plan (TMTM)

6.2.2 To identify and minimise potential construction marine traffic impacts, the appointed contractor of the Project shall employ a marine traffic consultant with relevant experience to develop a Temporary Marine Traffic Management (TMTM) plan for the proposed marine construction works. The TMTM plan shall identify the potential hazards and propose adequate mitigation measures to minimize any potential impacts of the proposed construction works, including but not limited to:

- Review of key marine facilities, existing marine traffic activity and the metocean environment in the vicinity of the works area;
- Identify the work activities, deployed vessel list, required working area and works-related marine traffic arising from the construction works;
- Temporary marine traffic arrangements and re-provisioning arrangements to ensure that adequate access to existing marine facilities is maintained during the construction works;
- Proposed marine traffic routes and recommended control measures for management and monitoring of vessel movements;
- Evaluate the effect of establishing temporary navigation aids or any other appropriate measures to maintain navigation safety; and
- Recommendations on tackling all marine safety issues, including typhoon evacuation, emergency and inclement weather.

6.2.3 A detailed TMTM plan would be carried out at the construction phase when details of the construction method and vessel deployment for the marine works are further developed by the appointed contractor and would be submitted for review and approval before submission for the promulgation of MDN for the construction works. The potential marine traffic impacts and proposed mitigation measures for marine works shall consider impacts on vessels within the principal fairways as well as the waters outside the principal fairways.

Marine Department Notice

6.2.4 At least one month before the commencement of the construction works, an application shall be submitted to the Marine Department for promulgation of a MDN in advance to provide detailed information on the proposed marine works and temporary traffic arrangement with reference to the latest Marine Department Notice on Promulgation of Marine Department

Notices (i.e., MDN No. 23/2020 at time of this Study). To comply with statutory requirements for the notification and control of marine works, Section 70 of the Shipping and Port Control Regulation (Cap. 313A) should be referred to.

6.3 Marine Traffic Control

Pre-Deployment Site Survey

6.3.1 Prior to the deployment of vessels, a hydrographic survey covering the waters within the barging areas, where necessary, shall be carried out to ensure adequate water depth for safe navigation for vessels.

Vessel Deployment

6.3.2 All vessels deployed for marine works and operations must be properly licensed locally in Hong Kong and manned under the Merchant Shipping (Local Vessels) Ordinance (Cap. 548) and its sub-legislation. The Certificate of Ownership (COO) and Operating License (OL) shall be obtained prior to operating a vessel in the waters of Hong Kong. With regards to the particulars of the employed local vessels (such as their length overall and extreme breadth, vessel type, conditions, etc.), their OL and Certificate of Survey shall prevail.

6.3.3 All works vessels shall be equipped with an AIS transponder that is in good operational order and VHF equipment that shall be operated by licensed Marine Radio Officers on board. The guard boats and escort boats shall be on continuous listening watch on VHF Channel 11 to assist piloted vessels passing the works area on request by the pilots on board. All works vessels shall maintain a listening watch on the relevant VHF Channel of VTC. The barge shall be on continuous listening watch on marine VHF (Channel 14) for VTC's instruction, as well as facilitate communication with HPS and other vessels.

6.3.4 All work vessels deployed for the construction and operation works shall be:

- Equipped with a Global Positioning System (GPS) or equivalent with AIS for real-time tracking and monitoring;
- Equipped with a marine band VHF radio operating on specified channels to facilitate communication with the Vessel Traffic Centre (VTC) and Harbour Patrol Section (HPS) of the Marine Department, as well as other vessels, and shall only be operated by a licensed operator;
- Properly licensed and manned under Cap. 548 Merchant Shipping (Local Vessels) Ordinance;
- To ensure safe navigation, the maximum operating draft of the works barges should not exceed the available water depth, and adequate under-keel clearance (UKC) should be allowed. In general, the UKC is 15% of the vessel's deepest draft; and
- Yellow marker buoys fitted with yellow flashing lights and radar reflectors, and AIS transmitters shall be laid to mark the positions of the anchors extending from the works barges deployed for marine works. The positions of the anchors would be laid according to the agreed plan.
- Appropriate illumination shall be installed on any marine platforms to indicate their location at night.
- Properly licensed locally in Hong Kong and operated by a licensed operator.

6.3.5 Should the suspension of navigation be required and confirmed, the marine launch will pick up all onboard site staff and transport them to land. Tug(s) would be summoned for the towing of the vessel to a safe location.

6.3.6 The contractor and operator shall provide a daily briefing to coxswains on guard boats and remind them that it is vital that the guard boat must NOT sail beyond the Works Area and intrude into the navigation passage.

6.3.7 The skipper and crew will receive periodic training sessions to familiarize them with the waterspace and restrictions in the vicinity of the works area.

Marine Traffic Management Team (MTMT)

6.3.8 During the construction and operation phase, the appointed contractor and operator shall establish an MTMT and be responsible for monitoring marine traffic movements of all marine construction and operation works. The MTMT will closely monitor daily work to ensure the implementation of work is as planned and ensure that works are carried out to fulfil compliances.

6.3.9 The MTMT shall be organised and managed by a Marine Coordination Manager with relevant qualifications and supported by a Marine Traffic Superintendent and Supervisor (on-site) for the management of the overall interfacing and communication duties with other relevant stakeholders, as well as management of vessel activities during the construction and operation phase.

6.3.10 The following outlines the general workflow for monitoring marine traffic movement:

- Marine Traffic Superintendent and Supervisor shall regularly report to the Marine Coordination Manager on daily marine works and weekly work plans.
- All information on working vessels, works area, and works duration shall be provided to the Marine Coordination Manager before commencement of works.
- The relevant information of each working vessel shall be maintained and updated by the MTMT.
- The MTMT shall monitor all working vessels on-site and communicate with the working vessels via mobile phone.
- The MTMT shall maintain lines of communication with the Vessel Traffic Centre (VTC) of the Marine Department and other relevant stakeholders at all times.

Marine Management Liaison Group (MMLG)

6.3.11 The appointed contractor shall liaise closely with the requirements of the Marine Department in all marine traffic matters concerned with the execution of the Project. It is proposed that a Marine Management Liaison Group (MMLG) should be established to review the planning of the key phases of the Works and provide a forum for key stakeholder engagement, including the local marine users and contractors of marine construction works near the works site. The purpose of the MMLG is to:

- Provide a forum for the sharing of marine traffic management requirements between the contractor(s), concerned stakeholders, and concerned government/bureaux to assist in planning construction works;
- To evaluate the implementation of marine traffic risk control measures to optimise the safety and efficiency of construction and port operations;
- To advise on the phasing of construction operations and
- To resolve conflicts that may arise from the construction works.

6.3.12 Key stakeholders shall include, but not be limited to, representatives from:

- Marine Department;
- Civil Engineering and Development Department ;
- Contractor(s);
- Resident Site Staff;
- Key stakeholders of affected marine facilities;
- Representatives from relevant government departments;
- Hong Kong Pilots Association (on an as-needed basis);
- Hong Kong Police Force and Fire Services Department (on an as-needed basis) and
- Ferry Operators

6.3.13 The frequency of the meetings should be based on the frequency and schedule of work.

6.3.14 As part of the active risk control measures, any interface issues with the concurrent construction activities could be resolved by the contractor by maintaining close liaison with marine stakeholders and concurrent projects. Ad-hoc liaisons should be arranged for any work that may impact individual stakeholders. A representative shall be assigned by the Contractor to take an active role in liaising and regularly communicating with the MD and relevant authorities, as well as interface with concurrent projects and marine stakeholders, to resolve any marine issues.

6.4 Contingency Plan for Adverse Weather and Emergency Conditions

6.4.1 The following emergency and adverse weather risk control measures and procedures shall be implemented by vessels carrying out the construction works and operation of the TYNUQ.

Safety Measures for Poor Visibility

6.4.2 During conditions when visibility is poor due to fog, mist, heavy rainstorms, or any other similar causes and found to be less than 2.0 nautical miles (3,704m), all marine works shall be suspended, and regular bell swing/gong strike will be carried out to warn approach vessels. Sound signals for vessels in restricted visibility shall strictly comply with the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Rule 35.

6.4.3 The appointed contractor of the works and operator shall refer to the latest Marine Department Notice (i.e. MDN No. 20/2025 at the time of this Study) for safe navigation in poor visibility about safety practices at times during conditions of restricted visibility.

Safety Measures for Typhoon Evacuation

6.4.4 The appointed contractor and operator shall ensure that all vessels deployed for marine works are properly licensed locally and stipulated on the local license, the intended location for the vessel to take shelter during adverse weather conditions. A Typhoon Evacuation Plan (TEP) shall be submitted to outline the vessel's evacuation arrangement, and if in case the sheltering location is outside HK waters, the TEP should also consider the maneuverability of any special-purpose working vessel and the time required to leave the works area and to navigate to the intended sheltering location.

6.4.5 When the Hong Kong Observatory (HKO) announces that Tropical Cyclone Warning Signal No.1 will be or has been hoisted, vessel masters shall review the weather forecast regularly to monitor the latest situation and make necessary preparations to evacuate in case a higher tropical cyclone warning signal is forecasted.

6.4.6 When the HKO announces that Tropical Cyclone Signal No.3 will be, or has been hoisted, no journey for disposal operation shall commence, all marine works shall be suspended, and vessels shall commence preparations to proceed to the nearest appropriate typhoon shelter. Any vessels with a length overall greater than 50m but less than 75m shall seek shelter at Hei Ling Chau Typhoon Shelter only. All construction vessels exceeding LOA 75m, or as required by the conditions of their operating licenses, should take early action and navigate on their own power to evacuate forthwith towards sheltered waters outside Hong Kong before Signal No.3 is hoisted. The indicative location(s) outside Hong Kong waters and safety measures for typhoon evacuation shall be further updated by the appointed contractor once the vessel deployment for construction works is confirmed.

6.4.7 Vessel masters shall maintain a continuous listening watch on the VHF radio channel appropriate to the VHF sector in which the vessel is located and shall have sufficient crew to man the barge and carry out duties to ensure the safety of the vessel during the passage of the typhoon.

Safety Measures for Monsoon

6.4.8 If the Strong Monsoon Signal warning is forecasted to be issued by the HKO, all works shall be suspended. The following safety measures shall be implemented for works vessels remaining within the works area at a time under strong monsoon conditions:

- Sufficient tugboat(s) shall be arranged on-site to provide assistance in case of emergency;
- Keep a proper lookout and anchor watch to monitor the vessel's position. Take appropriate actions to rectify any dragging of anchors and

- Continuous listening and watch on marine VHF (Channel 14) for VTC's instructions and to report the status of vessels at regular intervals.

Safety Measures for Emergency Evacuation

6.4.9 The appointed contractor and operator shall prepare for the evacuation of the works vessels in case of emergencies such as engine breakdown, fire on board, grounding, or oil spillage. Tug(s) would be summoned for the towing of the works vessel to a safe location if necessary. In the event of a need for emergency evacuation, the incident and evacuation time needed to leave the working area shall be reported to the MD VTC immediately.

6.5 Summary

6.5.1 The marine works associated with the construction and operation of the TYNUQ are not anticipated to impact the navigation of existing traffic within the MTIA Study Area.

6.5.2 To establish general principles for managing marine traffic, ensuring the effective and safe passage of vessels in the area during the construction phase, the appointed contractor will conduct a detailed risk assessment, develop associated mitigation measures, and prepare a Temporary Marine Traffic Management (TMTM) plan. This plan will undergo further review at the construction phase, aligning with the detailed design and construction methods.

6.5.3 Marine traffic risk control measures have been proposed to minimise any potential impacts arising from the construction and operation of the TYNUQ. In addition, contingency measures are established to mitigate the risks associated with the construction and operation of the TYNUQ in emergency events and adverse weather.

7 Summary

7.1 Introduction

7.1.1 A Marine Traffic Impact Assessment has been conducted to assess and evaluate potential marine traffic impacts and cumulative effects arising from the TYNUQ within the Study Area during the construction and operation of the Project. Marine traffic impact mitigation and operational risk control measures were recommended.

7.1.2 Upon contract commencement, the details of the proposed marine activities shall be provided by the contractor, including but not limited to, the size of the vessels deployed, frequencies, mooring methods, layout of the mooring/berthing for a comprehensive MTIA. The contractor shall prepare and submit a MTIA for construction and operation phases to MD when the latest details are available.

7.1.3 The primary marine activity during construction and operation phases is transporation of material. There is no marine construction works proposed under this Project. If the contractor plans to carry out any marine construction works to suit for their need, the contractor shall submit to the Maine Department for promulgation of a Marine Department Notice (MDN) together with the necessary supporting information.

7.2 Proposed Marine Transportation Activities

7.2.1 The construction and operation of the TYNUQ have been reviewed with the development of proposed marine work vessels.

7.2.2 The construction of the TYNUQ would require the delivery of construction machinery, equipment and ancillary facilities to the NKW and WTW barging points, with 1 round trip per day for each location.

7.2.3 The operation of the TYNUQ would require the delivery of raw production material (e.g. aggregates and cement etc.) to the NKW barging point, 8 round trips per day. In addition, the delivery of rock stockpiled from WTW to NKW, as well as the transport of excavated rock / processed rock from NKW to WTW, will involve 2 round trips per day.

7.3 Marine Environment

7.3.1 A review of the marine environment of the MTIA Study Area has been conducted to identify the existing marine facilities, metocean conditions, and restrictions in the vicinity. It is not anticipated that the TYNUQ construction and operation will be impacted by metocean conditions or have a significant interface with any existing or planned marine facilities.

7.4 Marine Traffic Activities Review

7.4.1 Following the identification of hazards or key marine features and navigation constraints. A review of AIS and Radar data and visual survey records has been conducted to identify the existing marine traffic situation and patterns within the Study Area.

7.4.2 It was identified that the marine traffic across the waters between Tsing Yi North and Ting Kau Study Area is dominated by river trade vessels and small crafts, with limited local ferry and other vessel types.

7.4.3 Relevant sources and growth trends have been reviewed to forecast the future traffic situation for different vessel types, including traffic activity generated by proposed developments within the MTIA Study Area up to the horizon year 2028.

7.4.4 It is anticipated that the TYNUQ construction and operation will generate a certain level of marine construction traffic from the marine works vessels across the waters between Tsing Yi North and Ting Kau could potentially impact the navigation safety of existing marine traffic.

7.5 Marine Traffic Risk Assessment

IWRAP Assessment

7.5.1 Marine traffic risk assessment considering the following scenarios:

- Current marine traffic;
- Future peak marine traffic without TYNUQ construction
- Future peak marine traffic with TYNUQ construction
- Future peak marine traffic without TYNUQ operation
- Future peak marine traffic with TYNUQ operation

7.5.2 It is identified that the annual collision and grounding incident level or risk level would not significantly increase with the implementation of the construction and operation of the TYNUQ.

SIRA Assessment

7.5.3 The SIRA assessment was conducted to identify the potential hazards and undesirable scenarios due to the TYNUQ's marine works and operation. A risk value was calculated based on likelihood and impact. It was identified that the risk values for all undesirable scenarios are within the as low as reasonably practicable (ALARP) region. To ensure risks are minimised and managed, further risk control measures were recommended, and a new risk value was calculated to evaluate the effectiveness of the proposed risk control measures. It was identified that the recommended risk control measures have further reduced risk values.

7.6 Risk Control Measures

7.6.1 Risk mitigation measures have been proposed to assist in the development of a safety management plan for the TYNUQ construction. Recommendations have been made about the following aspects:

- Pre-Construction Site Survey
- General Marine Traffic Management Measures
- Marine Traffic Control
- Contingency Plan for Adverse Weather and Emergency Conditions

7.6.2 Risk mitigation measures have also been proposed to assist in the development of a safety management plan for the TYNUQ operation. Recommendations have been made about the following aspects:

- Pre-Deployment Site Survey
- Marine Traffic Control
- Contingency Plan for Adverse Weather and Emergency Conditions

Appendix A

Marine Traffic Forecast

A1. Forecast Oceangoing Vessel Traffic Activity

1.1.1 Oceangoing vessel traffic within the MTIA Study Area is primarily associated with container vessels calling to and from the Hong Kong Port (HKP), including the Kwai Tsing Container Terminals and other major cargo-handling facilities. Accordingly, the forecast of oceangoing vessel activity is derived based on the projected container throughput of the HKP, which serves as the key indicator of overall vessel movement trends in Hong Kong waters.

1.1.2 In recent years, Hong Kong's container throughput has shown a gradual decline. However, this downward trend is projected to slow and stabilize as Hong Kong benefits from integration within the Guangdong–Hong Kong–Macao Greater Bay Area (GBA) such import/export opportunities benefit from enhanced interconnectivity, cargo sharing, and coordinated regional planning to offset part of the loss from standard container traffic.

1.1.3 Three forecast scenarios have been developed in order to capture the possible future trends:

- **Scenario1 - Declining Trend Case**: Represents a continuation of the historical declining trend in HKP container throughput based on past record data (2015–2024).
- **Scenario2 - Strategic Growth Case**: Reflects gradual stabilization and recovery in container throughput, aligned with government port development strategies, GBA integration and market diversification.
- **Scenario3 – Midpoint Projection Case**: Represents the arithmetic mid-point between Scenarios 1 and 2, providing a moderate projection between potential decline and recovery.

<u>**Scenario1 - Declining Trend Case**</u>

1.1.4 Historical data on seaborne container throughput of the HKP by Kwai Tsing Container Terminals and other cargo handling locations is reviewed with reference to Port of Hong Kong Statistical Tables (2015 – 2024). The historical data shown in **Figure A-1** indicate a downward trend, primarily driven by competition from Shenzhen and Guangzhou ports.

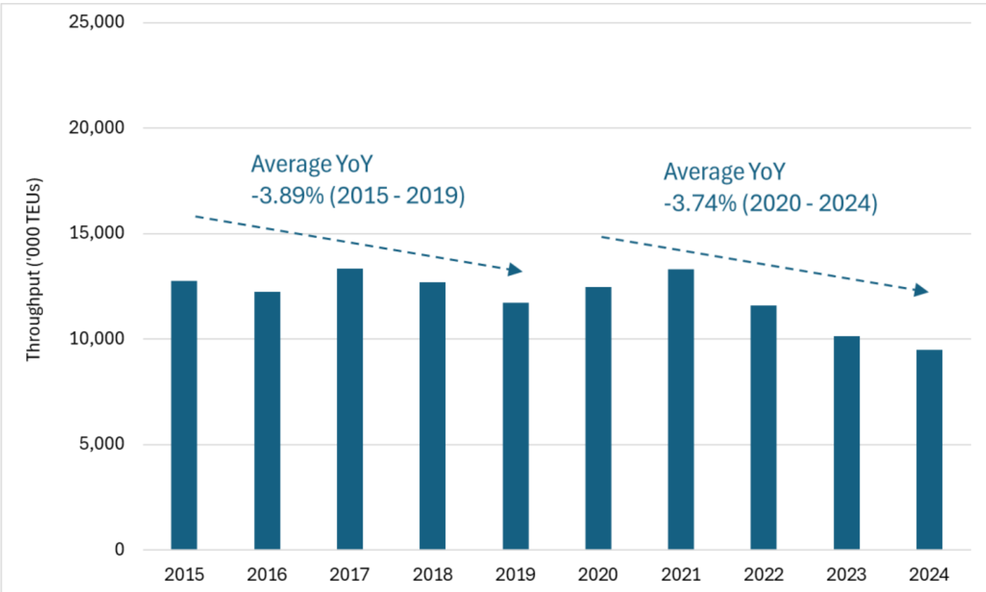

Figure A-1 Hong Kong Port Seaborne Container Throughput (2015 - 2024)

Source: Marine Department, Port of Hong Kong Statistical Tables, "Port Container Throughput by Main Cargo Handling Location", 2015 -2024

1.1.5 Between 2015 and 2019, the average year-on-year (YoY) reduction in throughput was –3.89%, and between 2020 and 2024, the average YoY reduction was –3.74%. The mean of these two periods, –3.82% per annum, is adopted as the annual growth rate for the Declining Trend Case (Scenario 1).

Scenario2 - Strategic Growth Case

1.1.6 Hong Kong's throughput is expected to gradually stabilize under the Strategic Growth Case supported by GBA integration, enhanced cargo sharing, and improved regional connectivity. Key strategic measures supporting this trend include:

1) **Expansion of Inland Cargo Sources** - HKP is strengthening its connections through the New Western Land–Sea Corridor via Guangxi, which achieved a 47.4% YoY increase in container throughput in Q4 2024, reaching approximately 59,600 TEUs.[1]

2) **Market Diversification -** HKP is expanding into emerging markets such as Central and South America and Oceania, while reinforcing its role in maritime finance, digital logistics, and green shipping initiatives, in line with Hong Kong's position as an international maritime centre.[1]

3) **Strengthening of Transshipment Hub Role** - Hong Kong remains one of the world's foremost transshipment hubs, handling about 24 million TEUs annually, connecting with over 550 ports worldwide and accommodating nearly 200,000 vessel calls per year, creates a cluster effect that continues to attract shipping lines seeking efficient, multi-port connectivity.[2]

1.1.7 Taken into consideration of above positive growth opportunities, a reference per annum growth rate of 1.5% from is adopted making reference to the Study on the Strategic Development Plan for Hong Kong Port 2030 (Transport and Logistics Bureau, 2014) which forecasted that the total container throughputs of oceangoing is projected to grow at a rate of 1.5% per annum from 2015 to 2030.

Scenario3 – Midpoint Projection Case

1.1.8 For modelling purposes, Scenario 3 represents a midpoint projection between historical decline and potential recovery. The overall growth rate is calculated as below:

$$\text{Overall Growth Rate} = \frac{(1+R_1)^t + (1+R_2)^t}{2} - 1$$

Where:

R_1 =-3.82% (Scenario 1 - Declining Trend Case)

R_2 =+1.5% (Scenario 2 - Strategic Growth Case)

1.1.9 Applying the above formula,

- For 2024 - 2027, overall growth rate = $[(1 – 3.82\%)^3 + (1 + 1.5\%)^3]/2 – 1$ = **–3.2%**
- For 2024 - 2028, overall growth rate = $[(1 – 3.82\%)^4 + (1 + 1.5\%)^4]/2 – 1$ = **–4.1%**

[1] *Reference: Multiple Strategies for New Chapter in Maritime and Port Industry - https://www.tlb.gov.hk/eng/blog/20250329.html*
[2] *Reference: The world's leading cargo transshipment hub - https://www.hongkongmaritimehub.com/the-hub-3/the-worlds-leading-cargo-transshipment-hub/*

Adopted Forecast Growth Rate

1.1.10 In summary, the predicted growth rate calculated from the various scenarios are presented in **Table A-1** and **Figure A-2**.

Table A-1 Summary of Adopted Forecast Annual Growth Rates for Oceangoing Vessels

	Growth Rate per annum
Scenario1 - Declining Trend Case	–3.82%
Scenario2 - Strategic Growth Case	+1.5%
Scenario3 – Midpoint Projection Case	-3.2% (2024 – 2027) - 4.1 % (2024 – 2028)

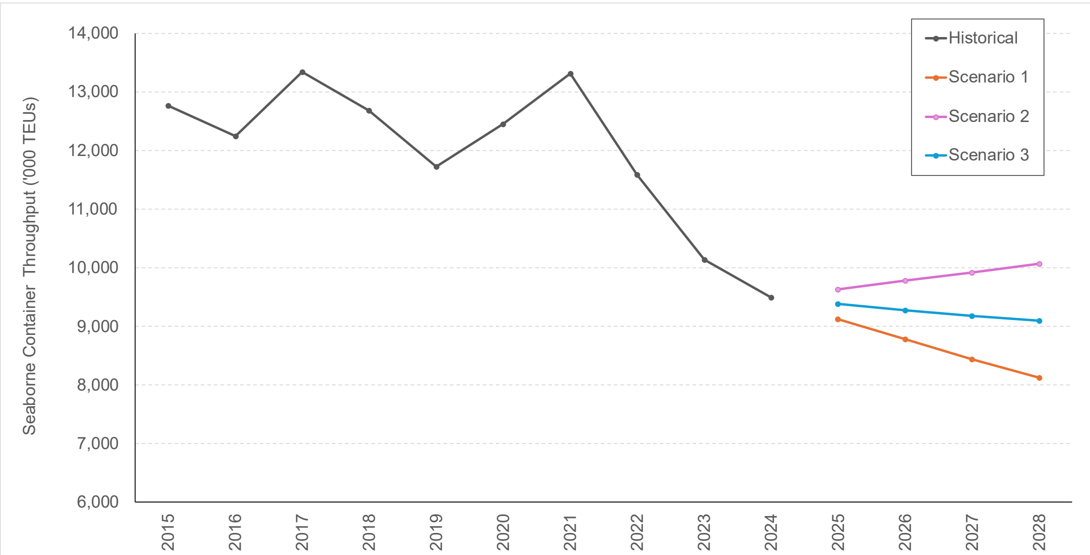

Figure A-2 Forecast of Hong Kong Port Seaborne Container Throughput (2024–2028)

1.1.11 In view of uncertainties about the current competitive environment and positive future outlook, the Study would adopt findings from Scenario 3 as the forecast annual growth rates for modelling future oceangoing vessel traffic within the Study Area.

1.2 A2. Forecast River Trade Vessel Traffic Activity

1.2.1 The forecast of river trade vessel activity within the MTIA Study Area follows the same methodological approach as the oceangoing vessel traffic forecast. River trade traffic are mostly related to cargo or container vessels (see **Figure A-4**), and the forecast adopts the same scenarios to capture potential growth:

- **Scenario 1 – Declining Trend Case**: Based on historical river trade container throughput, representing a continuation of the recent downward trend.
- **Scenario 2 – Strategic Growth Case**: Based on the Hong Kong Port 2030 Study, assuming recovery and growth in river trade throughput driven by regional economic integration, infrastructure enhancements, and port development initiatives.
- **Scenario 3 – Midpoint Projection Case**: Represents the mid-point between Scenarios 1 and 2, providing a moderate projection for river trade vessel traffic.

Scenario 1 – Declining Trend Case

1.2.2 Historical trend on river trade container throughput with reference to the Port of Hong Kong Statistical Tables (2015 – 2024) is presented in **Figure A-3** and it is identified that river trade container throughput in Hong Kong have gradually decreased over the past decade with a significant decline in 2020.

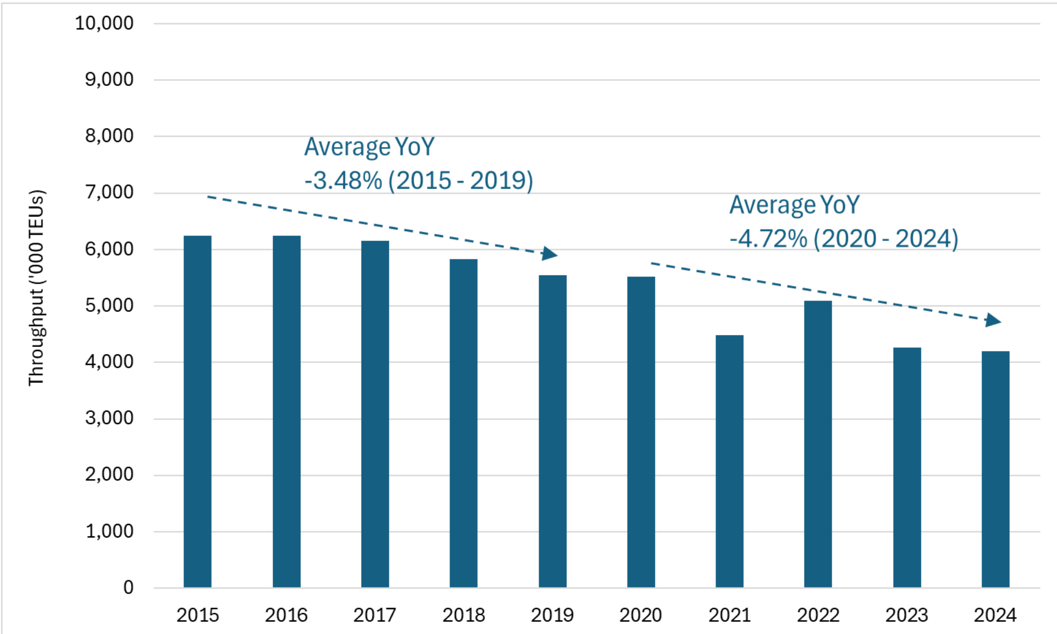

Figure A-3 River Trade Container Throughput in Hong Kong (2015 - 2024)

Source: Source: Marine Department, Port of Hong Kong Statistical Tables, "Port Cargo Throughput by River", 2015 -2024

1.2.3 The historical analysis shows that the average YoY decline between 2015 and 2019 was approximately –3.48% and approximately –4.72% between 2020 and 2024. The mean of these two periods, –4.10% per annum, is adopted as the annual growth rate for the Declining Trend Case (Scenario 1).

Scenario 2 – Strategic Growth Case

1.2.4 Although historical trends indicate a decline, the Strategic Growth Case assumes that river trade throughput will recover, supported by:

i. Policy and government initiatives enhancing port operations and connectivity,

ii. Diversification of cargo sources, and

iii. Continued integration within the GBA, supporting transshipment and regional trade flows.

1.2.5 Analysis of vessel arrivals indicates that approximately 80% of river trade vessel arrivals are associated with container traffic (conventional, fully cellular, or semi-container vessels), as shown in **Figure A-4**.

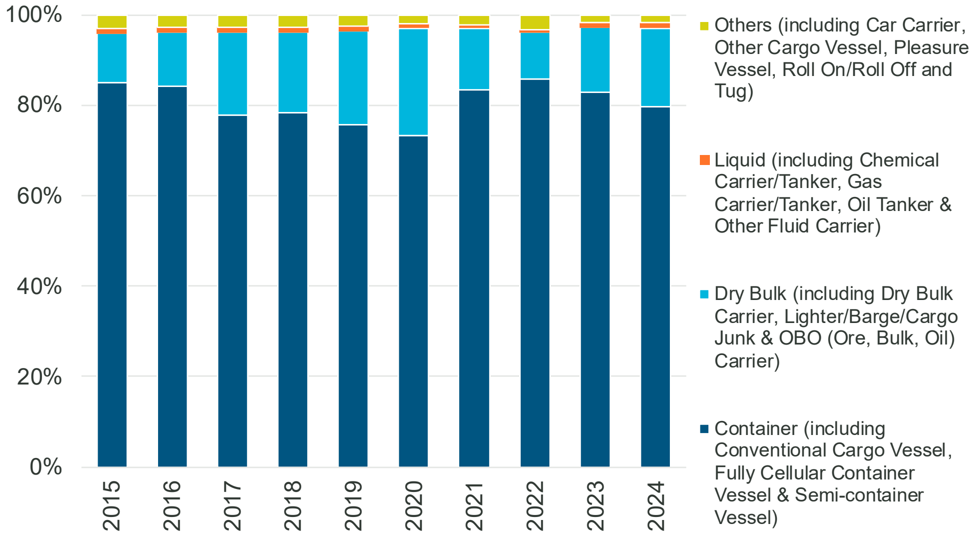

Figure A-4 River Trade Vessel - Cargo Type Breakdown (2015 - 2024)

Source: Marine Department, Port of Hong Kong Statistical Tables, "Vessel Arrivals by Ship Type" 2015 – 2024

1.2.6 Taken into consideration of above positive growth opportunities, a reference per annum growth rate of 1.5% from is adopted making reference to The Study on the Strategic Development Plan for Hong Kong Port 2030 (Transport and Logistics Bureau, 2014) which forecasted that the total container throughputs of river trade vessel is projected to grow at a rate of 1.5% per annum from 2015 to 2030.

Scenario3 – Midpoint Projection Case

1.2.7 For modelling purposes, Scenario 3 represents a balanced projection between historical decline and potential recovery. The overall growth rate is calculated as below:

$$\text{Overall Growth Rate} = \frac{(1+R_1)^t + (1+R_2)^t}{2} - 1$$

Where:

R_1 = −4.10% (Scenario 1 - Declining Trend Case)

R_2 = +1.5% (Scenario 2 - Strategic Growth Case)

1.2.8 Applying the above formula,

- For 2024 - 2027, overall growth rate = $[(1 - 4.10\%)^3 + (1 + 1.5\%)^3]/2 - 1$ = **–3.6%**
- For 2024 - 2028, overall growth rate = $[(1 - 4.10\%)^4 + (1 + 1.5\%)^4]/2 - 1$ = **–4.6%**

Adopted Forecast Growth Rate

1.2.9 In summary, the predicted growth rate calculated from the various scenarios are presented in **Table A-2** and **Figure A-5**.

Table A-2 Summary of Adopted Forecast Annual Growth Rates for River Trade Vessels

	Growth Rate per annum
Scenario1 - Declining Trend Case	–4.10%
Scenario2 - Strategic Growth Case	+1.5%
Scenario3 – Midpoint Projection Case	-3.6% (2024 – 2027) - 4.6 % (2024 – 2028)

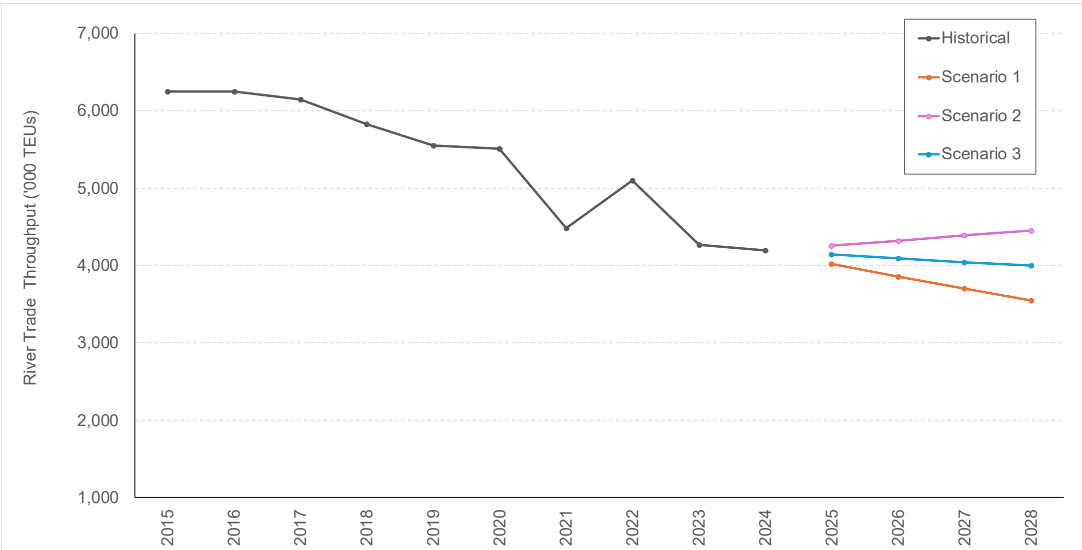

Figure A-5 Forecast of Hong Kong Port River Trade Container Throughput (2024–2028)

1.2.10 In view of uncertainties about the current competitive environment and positive future outlook, the Study would adopt findings from Scenario 3 as the forecast annual growth rates for modelling future oceangoing vessel traffic within the Study Area.

1.3 A3.Forecast Fast Ferry Vessel Traffic Activity

1.3.1 Historical data on vessel arrivals and departures at cross-boundary ferry terminals were reviewed with reference to Port of Hong Kong Statistical Tables (2015 – 2024) and **Figure A-5** presents the historical trend. A significant decline observed in 2020, associated with the COVID-19 pandemic, is excluded as it may not be representative of the typical existing cross-boundary ferry traffic activity. However, a declining rate of 8.5% is still identified for the CAGR between 2015 to 2024.

1.3.2 For a conservative assessment, it is assumed that the future fast ferry vessel traffic in the MTIA Study Area up to 2027 and 2028 will remain the same as existing levels.

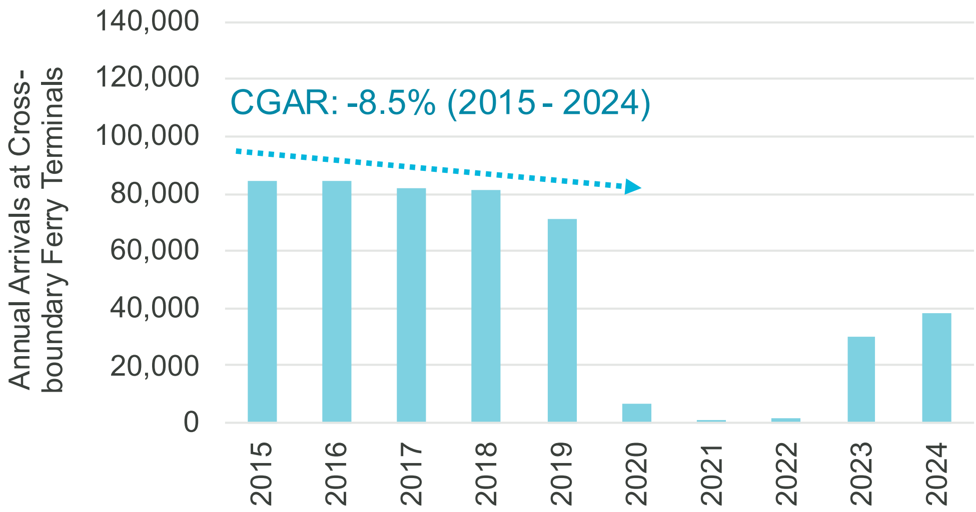

Figure A-6 Vessel Arrivals at Cross-Boundary Ferry Terminals (2015 - 2024)

Source: Marine Department, Port of Hong Kong Statistical Tables, “Statistics on Vessel Arrivals and Departures at Cross-Boundary Ferry Terminals” 2015 – 2024

1.4 A4. Forecast Local Ferry Vessel Traffic Activity

1.4.1 Historical trends on the average daily passenger journeys by domestic licensed and franchised ferries were reviewed from the Monthly Traffic and Transport Digest (2014 – 2023). A significant decline observed in 2020, associated with the COVID-19 pandemic, is excluded as it may not be representative of the typical existing domestic ferry traffic activity. However, a declining rate of 1.8% is still identified for the CAGR between 2013 to 2019, and the historical trend is presented in **Figure A-6**.

1.4.2 For a conservative assessment, it is assumed that the future local ferry vessel traffic in the MTIA Study Area up to 2027 and 2028 will remain the same as existing levels.

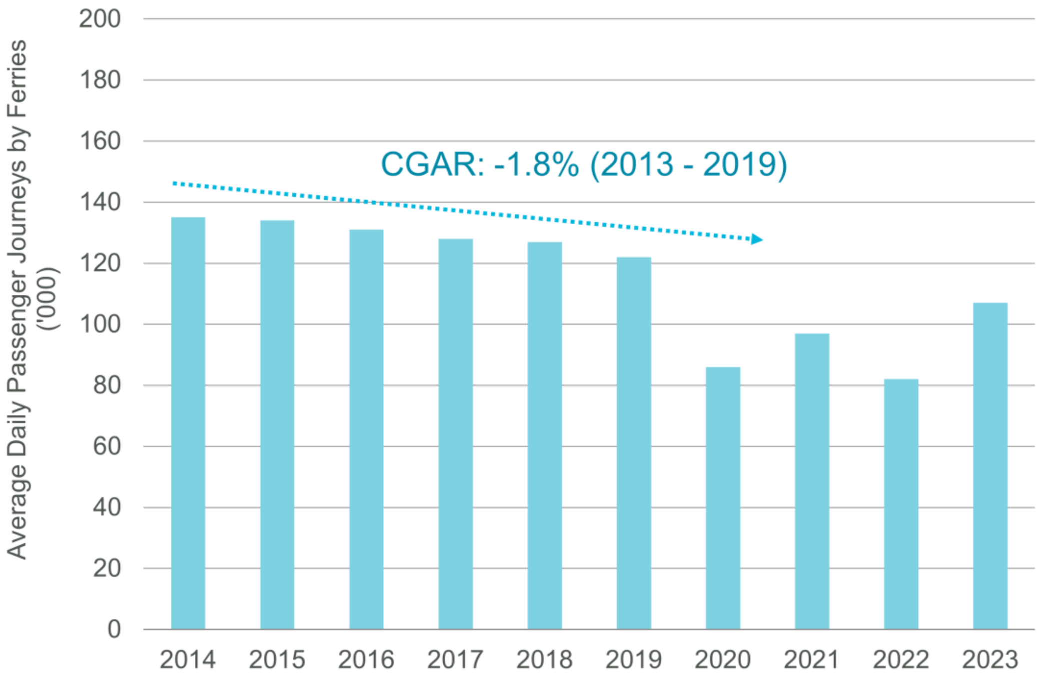

Figure A-7 Average Daily Passenger Journeys by Domestic Ferries (2014 - 2023)

Source: Monthly Traffic and Transport Digest (2014 – 2023) by the Transport Department, *https://www.td.gov.hk/mini_site/atd/2024//sc/5-2*

1.5 A5. Forecast Fast Launch Traffic Activity

1.5.1 Fast launch vessels adopted in the marine traffic model refer to government vessels comprised of powered vessels commonly found within the MTIA Study Area.

1.5.2 Historical data from the Port of Hong Kong Statistic Tables (2015-2024) on the supply of local government vessels were reviewed and the historical trend is presented in **Figure A-7**.

1.5.3 A linear projection using an average historical CAGR of 2.2% identified between 2015 and 2024 is adopted for forecasting an overall growth rate of 6.7% from 2024 to 2027 and 9.1% from 2024 to 2028.

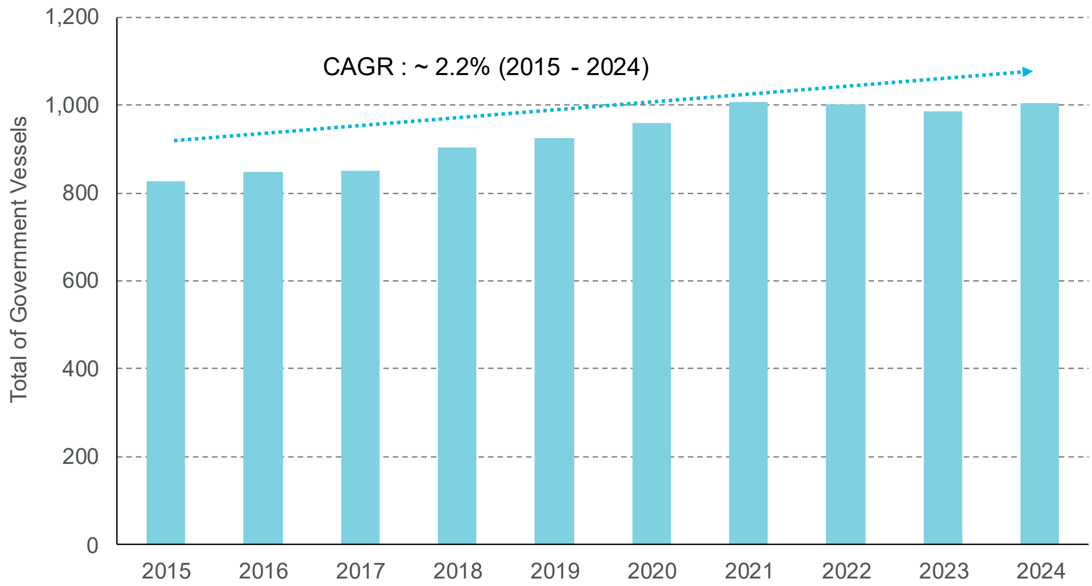

Figure A-8 Total Number of Government Vessels (2015 - 2024)

Source: Department, Port of Hong Kong Statistic Tables (2015 – 2024), Table of Departmental Ownership and Availabilities of Government Vessels

1.6 A6. Forecast Small Craft Traffic Activity

1.6.1 Small craft vessels adopted in the marine traffic model are best represented by:

- Class III vessels (i.e. Fishing Vessel: Fish Carrier, Fishing Sampan, Fishing Vessel, Outboard Open Sampan); and
- Class IV vessels (i.e. Pleasure Craft: Auxiliary Powered Yacht, Cruiser, Open Cruiser) as defined in the Port of Hong Kong Statistical Tables by MD.

1.6.2 Historical records on vessel numbers of locally licensed Class III and Class IV were reviewed and the historical trend from 2015 to 2024 is illustrated in **Figure A-8**.

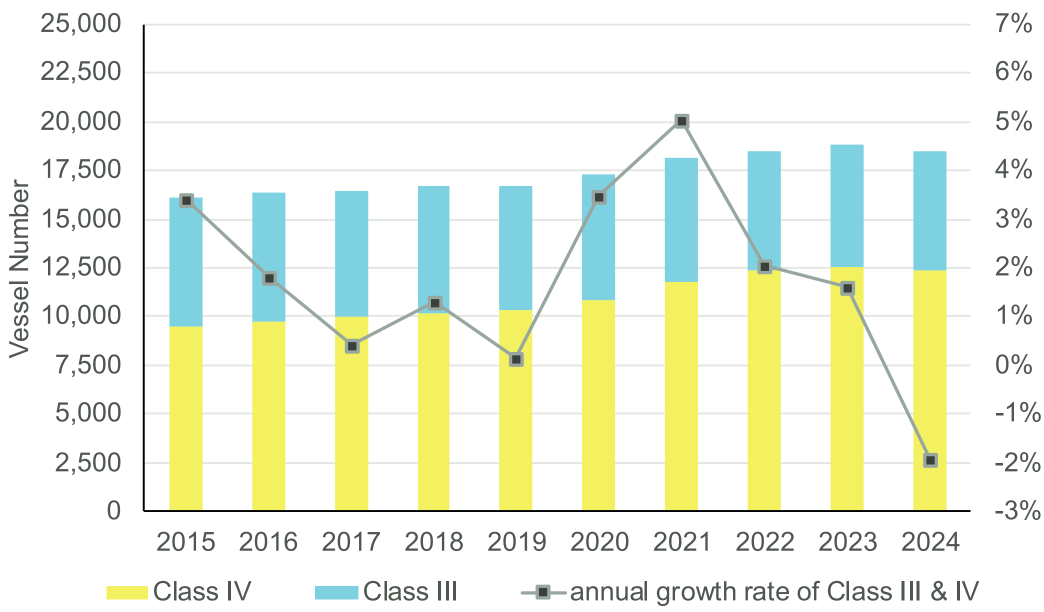

Figure A-9 Historical Trend for Hong Kong Licensed Vessels (Class III & IV) (2015 - 2024)

Source: Marine Department, Port of Hong Kong Statistic Tables, "Hong Kong Licensed Vessels by Tonnage Classification" 2015 – 2024

1.6.3 Growth in Class III & IV licensed vessel numbers have generally increased with a peak of around 5% in 2021, although it decreased around 2% in 2024. However, the 'Assessment of Typhoon Shelter Space Requirements 2022 – 2035' projects an average annual rate of change of around 0.4% and 1.9% for locally licensed vessels Class III and Class IV, respectively from 2021 to 2035. From 2024 to 2027, these growth rates are conservatively adopted up to 2027 which corresponds to an overall growth rate of 1.2% for Class III and 5.8% for Class IV, respectively. From 2024 to 2028, these growth rates are conservatively adopted up to 2028 which corresponds to an overall growth rate of 1.6% for Class III and 7.8% for Class IV, respectively.

1.6.4 The vessel distribution for "Small Craft" comprising Class III and Class IV vessels adopted is calculated based on the existing vessel distribution of locally licensed vessels. Port of Hong Kong Statistical Tables of 2024 identified a total of 20,604 local vessels and Class III (6,125) represents 30% of the total while Class IV represents (12,325) 60% of the total. The forecast future traffic would adopt a Small Craft vessel distribution of 33% [30/90] and 67% [60/90] for Class III and Class IV respectively.

1.6.5 For forecasting future Small Craft traffic activity, a weighted percentage of overall traffic growth of 4.3% = [1.2% x 33% + 5.8% x 67%] is adopted from 2024 to 2027, and another weighted percentage of overall traffic growth of 5.8% = [1.6% x 33% + 7.8% x 67%] is adopted from 2024 to 2028.

1.7 Summary

1.7.1 The following table summaries the predicted growth rate:

Vessel Type	Growth Rate (2024 – 2027)	Growth Rate (2024 – 2028)
Oceangoing	-3.2%	-4.1%
River Trade	-3.6%	-4.6%
Fast Ferry	0%	0%
Local Ferry	0%	0%
Fast Launch	6.7%	9.1%
Small Craft	4.3%	5.8%

Appendix B

IALA Training Certificate

The IALA World-Wide Academy

IALA

hidrográfico
marinha · portugal

certifies that

[redacted]

has completed the

IALA World-Wide Academy training course on the Use of the IALA Risk Management Toolbox

course on

27th June 2025

Assinado por: **Filipe Alexandre Reis Vieira**

Rear Admiral Vincent Denamur
Dean of the
IALA World-Wide Academy

Ms Latifa Oumouzoune
Education and Training Manager
IALA World-Wide Academy

Filipe Alexandre Reis Vieira
Capitão-de-fragata / CDR (OF-4)
Chefe da Divisão de Navegação
Instituto Hidrográfico – Marinha Portuguesa

This certificate is awarded in accordance with IALA Recommendation R0141 and IALA Model Course L1.3. Serial number: Lisbon2025_4

Appendix C

SIRA Risk Assessment Matrix

Simplified IALA Risk Assessment (SIRA)

REF	Hazard	Review Results	Scenario	Description of Scenario / Incident	Root Cause(s)	Existing Risk Control Measures	Reasoning behind Probability Score	Reasoning behind Consequence Score (short term and long term)	Without Control Measures			Control Measures which could reduce either probability or consequence	After Control Measures		
									Probability Score (1 - 5)	Consequence Score (1 - 5)	Risk Value		Probability Score (1 - 5)	Consequence Score (1 - 5)	Risk Value
1. Natural															
1.1	Safe minimum depth (m)	Shallow water is identified as the shore end of the bargingin point in Ngau Kok Wan (NKW) and Wok Tai Wan (WTW) (See **Figure 3-6**). Marine works vessels may be exposed to grounding risk, particularly during low tide periods.	Grounding	Marine works vessels may go aground in shallow waters at the barging facility in NKW and WTW.	Poor planning of mooring location	N.A.	According to the MD incident record (2015-2024), the average annual grounding rate per year is around 0.7 in the Model Area, which is considered occasional (i.e. occur every 2 months to 2 years according to G1138 IALA standard).	Onstie tugboat will be summoned immediately to untangle the grounding problem. Grounding may cause some minor injuries. No public service or the waterway traffic would be interrupted. No significant environmental or economic impact is anticipated.	3	2	6	Refer to Section 6.2 in the MTIA report A hydrographic survey covering the waters within the construction works area shall be carried out before the construction works. Temporary Marine Traffic Management (TMTM) Plan should be prepared during the construction stage, which may include a mooring plan, designated routing (to avoid shallow waters), designated anchoring area (if necessary), and contingency plan in case of grounding incidents.	2	1	2
1.2	Proximity of danger (NM)	By reviewing the sea chart, the nearest 'Obstruction' marking is identified approximately 670 meters away from the TYNUQ barging point.													
1.3	Tide, wind, wave, and current effect	The tide, wind, wave, and current effects are reviewed in Section 3.3. It is not anticipated that the metocean conditions will pose significant impacts on the TYNUQ construction and operation.													
1.4	Ice conditions	This hazard is unrelated to the vessels involved in this project. The chance of ice conditions in Hong Kong is rare.													
1.5	Minimum visibility (NM)	By reviewing "*Summary of Meteorological and Tidal Observations in Hong Kong" (2014-2023)* , it is noted that reduced visibility under 3km (1.6 nautical miles) under all weather conditions is between 2% to 4% during February to April and less than 1% during other months. Generally speaking, the visibility is fair enough for marine users.	A collision between marine works vessels and other vessels due to low visibility	Marine works vessels may not be able to see other vessels on the same course during low visibility, potentially leading to collisions.	Low visibility	Under MDN No. 20/2025	Based on the IWRAP modelling result of the construction and operation stage of peak year with concurrent projects traffic where the anticipated collision per year is around 5.91-6.02 within the Risk Model Area, which is considered frequent (i.e. occur once weekly to every 2 months according to G1138 IALA standard).	Collision incidents within the waters between Ting Kau and Tsing Yi North could cause sustained disruption to services such as the closur a port or waterway for 4-24 hours, and severe injuries to many individuals or loss of life. No significant environmental or economic impact is anticipated.	4	4	16	Refer to Section 6.4 in the MTIA report The marine operations shall be suspended at times of poor visibility of 2.0 nautical miles or below, all marine works shall be suspended, and regular bell swings/gong strikes will be carried out to warn approach vessels. Sound signals for vessels in restricted visibility shall strictly comply with the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Rule 35.	3	3	9
1.6	Low sun issues	This hazard is unrelated to the vessels involved in this project. The chance of low sun issues in Hong Kong is rare.													
1.7	Background lighting	This hazard is unlikely to have an impact on the vessels associated with the project. The waters from Ting Kau to Tsing Yi North is remote to the populated downtown area. Background lighting is a less critical factor affecting the crew's watch.													
1.8	Loss of PNT (geographical obstruction)	This hazard is unlikely to have an impact on the vessels associated with the project. The geographical location of Hong Kong is within the Ionosphere regions with high frequency.													
1.9	Earthquake and tsunami	This hazard is unrelated to the vessels involved in this project. The chance of earthquakes and tsunamis in Hong Kong is rare.													
2. Economic															
2.1	Legal action problems	This hazard is unrelated to the vessels involved in this project. Legal action problems should not be covered within the MTIA.													
2.2	Insufficient AtoN funding issues	This hazard is unrelated to the vessels involved in this project. Insufficient AtoN funding issues should not be covered within the MTIA.													
3. Technical															
3.1	Shipborne nav-aid failure	This hazard is unlikely to have an impact on the vessels associated with the project. A tugboat will be depolyed with the marine works vessels to provide assistance during the TYNUQ construction and operation. Continuous communication between the skipper and contractor/operator will be maintained during transit to and from the work site. Monitoring of the marine works vessels will be overseen by the contractor and operator. In the event of shipborne nav-aid failure and requiring immediate assistance, the skipper should signal appropriate international and Hong Kong port signals, and effectively manage the situation using their seamanship skills. Skippers and ship owners should ensure that charts and navigational information are up to date. Before sailing, develop a thorough passage plan that includes waypoints, navigational aids, and potential hazards.													
3.2	Quality and validity of charted information	This hazard is unrelated to the vessels involved in this project. Contractor will use the latest charted information for the opeartion.													

Simplified IALA Risk Assessment (SIRA)

3.3	Loss of vessel control due to mechanical failure	The proposed marine works will require the deployment of various marine works vessels. If the contractor and operator choose to employ marine works vessels without ensuring proper management and maintenance, it could result in the loss of vessel control due to mechanical failures during works.	A collision between marine works vessels and other vessels due to mechanical failure (Construction and Operation stage)	Unexpected operational breakdowns on marine works vessels could result in collisions with other vessels.	Mechanical failures leading to loss of vessel control can be caused by wear and tear, lack of maintenance, malfunctioning systems, and environmental factors.	N.A.	(1) Ship inspection shall be carried out before the marine works. The possibility of the vessel having a malfunction is relatively small. (2) Due to the works area being closer to the land, the possibility of losing the network and thus losing communication is relatively small.	Collision incidents within the waters between Ting Kau and Tsing Yi North could cause sustained disruption to services such as the closur a port or waterway for 4-24 hours, and severe injuries to many individuals or loss of life. No significant environmental or economic impact is anticipated.	2	4	8	Refer to Section 6.3 in the MTIA report All vessels deployed for the marine works must be properly licensed locally in Hong Kong and operated by a licensed operator. Should the suspension of navigation be required and confirmed, the marine launch will pick up all onboard site staff and transport them to land. Tug(s) would be summoned for the towing of the vessel to a safe location.	1	3	3
3.4	Loss of communications	This hazard is unlikely to have an impact on the vessels associated with the project. A tugboat will be depolyed with the marine works vessels to provide assistance during the TYNUQ construction and operation. Continuous communication between the skipper and contractor/operator will be maintained during transit to and from the work site. Monitoring of the marine works vessels will be overseen by the contractor and operator. In the event of loss of communication and requiring immediate assistance, the skipper should signal appropriate international and Hong Kong port signals, and effectively manage the situation using their seamanship skills. Skippers and ship owners should stay updated with the latest navigational techniques, technologies, and best practices to effectively handle any adverse situations.												
3.5	Loss of connectivity	This hazard is unlikely to have an impact on the vessels associated with the project. A tugboat will be depolyed with the marine works vessels to provide assistance during the TYNUQ construction and operation. Continuous communication between the skipper and contractor/operator will be maintained during transit to and from the work site. Monitoring of the marine works vessels will be overseen by the contractor and operator. In the event of loss of communication and requiring immediate assistance, the skipper should signal appropriate international and Hong Kong port signals, and effectively manage the situation using their seamanship skills. Skippers and ship owners should stay updated with the latest navigational techniques, technologies, and best practices to effectively handle any adverse situations.												
3.6	Cyber interference	This hazard is unlikely to have an impact on the vessels associated with the project. A tugboat will be depolyed with the marine works vessels to provide assistance during the TYNUQ construction and operation. Continuous communication between the skipper and contractor/operator will be maintained during transit to and from the work site. Monitoring of the marine works vessels will be overseen by the contractor and operator. In the event of loss of communication and requiring immediate assistance, the skipper should signal appropriate international and Hong Kong port signals, and effectively manage the situation using their seamanship skills. Skippers and ship owners should stay updated with the latest navigational techniques, technologies, and best practices to effectively handle any adverse situations.												
3.7	AtoN failure	This hazard is unlikely to have an impact on the vessels associated with the project. A tugboat will be depolyed with the marine works vessels to provide assistance during theTYNUQ construction and operation. Continuous communication between the skipper and contractor/operator will be maintained during transit to and from the work site. Monitoring of the marine works vessels will be overseen by the contractor and operator. In the event of loss of communication and requiring immediate assistance, the skipper should signal appropriate international and Hong Kong port signals, and effectively manage the situation using their seamanship skills. Skippers and ship owners should stay updated with the latest navigational techniques, technologies, and best practices to effectively handle any adverse situations.												

Simplified IALA Risk Assessment (SIRA)

3.8	Loss of PNT	This hazard is unlikely to have an impact on the vessels associated with the project. A tugboat will be depolyed with the marine works vessels to provide assistance during the TYNUQ construction and operation. Continuous communication between the skipper and contractor/operator will be maintained during transit to and from the work site. Monitoring of the marine works vessels will be overseen by the contractor and operator. In the event of loss of communication and requiring immediate assistance, the skipper should signal appropriate international and Hong Kong port signals, and effectively manage the situation using their seamanship skills. Skippers and ship owners should stay updated with the latest navigational techniques, technologies, and best practices to effectively handle any adverse situations.													
3.9	Substandard ships	Ensure ship capability, Update vessel survey will be conducted and supplemented in the Marine Department Notice (MDN) application.													
4. Human															
4.1	Crew competency	Insufficient communication and action being taken by the operator of TYNUQ associated marine work vessels when working.	A collision between marine works vessels and other vessels due to a communication error (Construction and Operation stage)	Miscommunication or action being taken with other vessels when there is a foreseeable risk of collision.	The operator of vessels may lack the ability to identify the risk of collisions with other vessels, coupled with weak communication and uncertainty about the necessary actions to be taken. Also, the operator may be distracted or lack sufficient training when facing the risk of collisions.	N.A.	The operator of vessels may be distracted or lack sufficient training when facing the risk of collisions.	Collision incidents within the waters between Ting Kau and Tsing Yi North could cause sustained disruption to services such as the closur a port or waterway for 4-24 hours, and severe injuries to many individuals or loss of life. No significant environmental or economic impact is anticipated.	2	4	8	Refer to Section 6.3 in the MTIA report Contractor and operator shall provide a daily briefing to coxswains on guard boats and remind them that is vital that the guard boat must NOT sail beyond the Works Area and intrude into the navigation passage. The skipper and crew will receive periodic training sessions to familiarize them with the waterspace and restrictions in the vicinity of the works area.	1	3	3
4.2	Fatigue	The likelihood of this hazard affecting the vessels associated with the project is low. However, the health issues of the crews need to be overseen and managed by the Person in Charge (PIC) of each vessel.													
4.3	Safety culture	The likelihood of this hazard affecting the vessels associated with the project is low. However, the safety culture of the crews needs to be overseen and managed by the contractor and the Person in Charge (PIC) of each vessel.													
4.4	Influence of alcohol and/or drugs	The likelihood of this hazard affecting the vessels associated with the project is low. However, the influence of alcohol and/or drugs on the crews needs to be overseen and managed by the contractor and the Person in Charge (PIC) of each vessel.													
4.5	Availability and competency of VTS	This hazard is unrelated to the vessels involved in this project.													
4.6	Competency of other AtoN provider	This hazard is unrelated to the vessels involved in this project.													
4.7	Availability and competency of pilotage	This hazard is unrelated to the vessels involved in this project.													
4.8	Piracy/terrorism	This hazard is unrelated to the vessels involved in this project. Piracy/terrorism is rare to occur in Hong Kong waters.													
4.9	Political issues	This hazard is unrelated to the vessels involved in this project. Poiltical issues should not be covered within the MTIA.													
4.10	Culture and language issues	Refer to REF 4.1.													
4.11	Crew medical issues	The likelihood of this hazard affecting the vessels associated with the project is low. However, the crew's medical issues need to be overseen and managed by the contractor and the Person in Charge (PIC) of each vessel.													
4.12	Crew distractions	Refer to REF 4.1.													

Simplified IALA Risk Assessment (SIRA)

5. Operational															
5.1	Impact of vessels	Collision during TYNUQ construction	A collision between marine works vessels and other vessels due to a communication error	Other vessels are unable to identify the vessels deployed for TYNUQ marine works.	(1) Moderate traffic volume within the waters between Ting Kau and Tsing Yi North near the TYNUQ by Rivertrade, Small Craft and Local Ferry vessels within the Study Area. (2) Additional traffic movements generated by the construction of the Project. (3) The TYNUQ construction route would pose a new temporary obstruction for vessels navigating within the waters between Ting Kau and Tsing Yi North and vessels may need to deviate from their existing routes. (4) Marine users are not aware of or do not take into consideration the construction works of the Project when planning their passage within the Study Area.	HKVTS COLREGs	Based on the IWRAP modelling result of the construction stage of peak year with concurrent projects traffic where the anticipated collision per year is around 5.91 within the Risk Model Area, which is considered frequent (i.e. occur once every 2 months to 2 years according to G1138 IALA standard).	Collision incidents within the waters between Ting Kau and Tsing Yi North could cause sustained disruption to services such as the closur a port or waterway for 4-24 hours, and severe injuries to many individuals or loss of life. No significant environmental or economic impact is anticipated.	3	4	12	Refer to Section 6.2 & 6.3 in the MTIA report The Temporary Marine Traffic Management (TMTM) Plan should be developed by the contractor. Promulgation of the Marine Department Notice (MDN) on the works carried out. A stakeholder meeting, such as the Marine Management Liaison Group (MMLG), is recommended to address marine traffic issues. Deployment of yellow marker buoys fitted with yellow flashing lights and radar reflectors, and AIS transmitters to mark the positions of the anchors extending from the work barges. Work barges equipped with an AIS transponder and VHF.	2	3	6
5.2	Impact of vessels	Collision during TYNUQ operation	A collision between marine works vessels and other vessels due to a communication error	Other vessels are unable to identify the vessels deployed for TYNUQ marine works.	(1) Moderate traffic volume within the waters between Ting Kau and Tsing Yi North near the TYNUQ by Rivertrade, Small Craft and Local Ferry vessels within the Study Area. (2) Additional traffic movements generated by the operation of the Project. (3) The TYNUQ operation route would pose a new temporary obstruction for vessels navigating within the waters between Ting Kau and Tsing Yi North and vessels may need to deviate from their existing routes. (4) Marine users are not aware of or do not take into consideration the operation works of the Project when planning their passage within the Study Area.	HKVTS COLREGs	Based on the IWRAP modelling result of the operation stage of peak year with concurrent projects traffic where the anticipated collision per year is around 6.02 within the Risk Model Area, which is considered frequent (i.e. occur once weekly to every 2 months according to G1138 IALA standard).	Collision incidents within the waters between Ting Kau and Tsing Yi North could cause sustained disruption to services such as the closur a port or waterway for 4-24 hours, and severe injuries to many individuals or loss of life. No significant environmental or economic impact is anticipated.	4	4	16	Refer to Section 6.3 in the MTIA report The Marine Traffic Management Team (MTMT) Plan should be developed by the contractor. Deployment of yellow marker buoys fitted with yellow flashing lights and radar reflectors, and AIS transmitters to mark the positions of the anchors extending from the work barges. Work barges equipped with an AIS transponder and VHF.	3	3	9
5.3	Fishing activities	This hazard is unrelated to the vessels involved in this project. No significant fishing activiteis have been identified in the vinicity of the propsoed works area.													
5.4	Seasonal activities	This hazard is unrelated to the vessels involved in this project. No significant seasonal activities have been identified in the vinicity of the propsoed works area.													
5.5	Poor passage planning	Refer to REF 5.1 & 5.2.													
5.6	Inadequate routeing guidance	Refer to REF 5.1 & 5.2.													
5.7	Poor route monitoring	Refer to REF 5.1 & 5.2.													
5.8	Poor response to marking of new danger	This hazard is unrelated to the vessels involved in this project. No new dangers have been identified in the vicinity of the proposoed works area.													
5.9	Poor promulgation of maritime safety information (MSI)	The likelihood of this hazard affecting the vessels associated with the project is low. Marine Department Notice (MDN) shall be applied for the marine works of the TYNUQ.													
6. Spatial planning conflicts															
6.1	The existence of wrecks and new dangers	Allision to Tsing Ma Bridge and Ting Kau Bridge marine viaduct structures during the TYNUQ construction.	Allision to Tsing Ma Bridge and Ting Kau Bridge marine viaduct structures during construction stage	TYNUQ construction vessels may strike the Tsing Ma Bridge and Ting Kau Bridge marine viaduct structures when navigating into and out of the proposed working area.	Poor planning when TYNUQ construction vessels navigating into and out of the proposed barging facility.	Tsing Ma Bridge and Ting Kau Bridge Height Restricted Areas	Based on the IWRAP modelling result of the construction stage of peak year with concurrent projects traffic where the anticipated grounding and allision per year is around 4.13 within the Risk Model Area, which is considered occasional (i.e. occur once every 2 months to 2 years according to G1138 IALA standard).	The allision may cause some minor injuries. Some non-permanent loss of highway services. No significant environmental or economic impact is anticipated.	3	2	6	Refer to Section 6.2 & 6.3 in the MTIA report Temporary Marine Traffic Management (TMTM) Plan should be prepared during the construction stage, which may include a designated routing (to be aware of the Vessels Height Restrictions of Tsing Ma Bridge and Ting Kau Bridge) and contingency plan in case of allision incidents. Promulgation of the Marine Department Notice (MDN) on the works carried out. A stakeholder meeting, such as the Marine Management Liaison Group (MMLG), is recommended to address marine traffic issues.	2	1	2
6.2	Crowded waterway issues	Refer to REF 5.1 & 5.2.													
6.3	The existence of restricted areas (e.g., spoil grounds, fish farms)	This hazard is unrelated to the vessels involved in the construction and operation of the TYNUQ. No spatial planning conflicts have been identified in the vicinity of the works area.													
7. Waterway complexity															
7.1	New or existing obstructions	This hazard is unrelated to the vessels involved in this project. No new or existing obstructions have been identified in the vicinity of the proposed works area.													

7.2	Sharp bends	This hazard is unrelated to the vessels involved in this project. No sharp bends navigation channel have been identified in the vicinity of the proposed works area.													
7.3	Narrow fairway	This hazard is unrelated to the vessels involved in this project. No narrow fairway have been identified in the vicinity of the proposed works area.													
7.4	Manoeuvering space	This hazard is unrelated to the vessels involved in this project. No confined waterspace have been identified in the vicinity of the proposed works area.													
7.5	Traffic considerations	Referring to REF 5.1 & 5.2, there is a moderate level of existing marine traffic that will traverse with the proposed TYNUQ area, particularly navigating into and out of the waters between Ting Kau and Tsing Yi North.													
7.6	Limited available depth of water	Refer to REF 1.1.													
7.7	Mobile seabed	This hazard is unrelated to the vessels involved in this project. No Mobile have been identified in the vicinity of the proposed works area.													
7.8	Channel siltation	This hazard is unrelated to the vessels involved in this project. No siltation has been identified in the vicinity of the proposed works area.													