Port Planning Consultancy for the Conceptual Master Plan of the Proposed Westports Expansion

Updated Marine Traffic Risk Assessment (MTRA) Report

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Updated Marine Traffic Risk Assessment (MTRA) Report

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1 Background

1.1 Introduction

Port Klang is one of Malaysia's prominent ports. Its position off the Strait of Malacca, a major shipping route, has historically made it an important port of call for traders. In addition to its maritime importance, it is centrally located in West Malaysia, close to the economic hub of Kuala Lumpur and connected to the rest of the peninsula by well-developed land and rail links.

Westports is a major container terminal operator at Port Klang, and BMT was commissioned to conduct a series studies to address the overall planning of Westports future development of Expansion, including assessments on physical/field conditions, market dynamics, operational efficiency, business outlook and engineering design, so as to achieve the optimal design options and to balance the related construction costs.

Following the Workshop with Port Klang Authority in April 2019, a revised layout plan has been developed and an update of the marine traffic risk assessment is required to be conducted to re-assess marine traffic risk due to the revised layout plan based on the updated South Channel layout and forecast marine traffic volume.

1.2 This Report – MTRA Update

This update Marine Traffic Risk Assessment (MTRA) is conducted to evaluate the potential marine traffic risk imposed by the final layout plan considering the identification and assessment of marine traffic conflicts, traffic pattern and risk levels to the design year; and based on the findings recommend mitigation measures to limit the marine risk.

This MTRA Report is structured as follows:

Section 1: this Introduction

Section 2: outlines the existing marine facilities and marine-based facilities, presents the update port layout plan and reviews the MTRA Study Area;

Section 3: presents the existing traffic activities and future traffic levels;

Section 4: develops the baseline risk environment of the Study Area by examining the spatial distribution of encounters and a risk assessment of future marine traffic impact for the Westport Phase 2 development is conducted;

Section 5: recommends marine access and safety management; and

Section 6: presents a summary of the report.

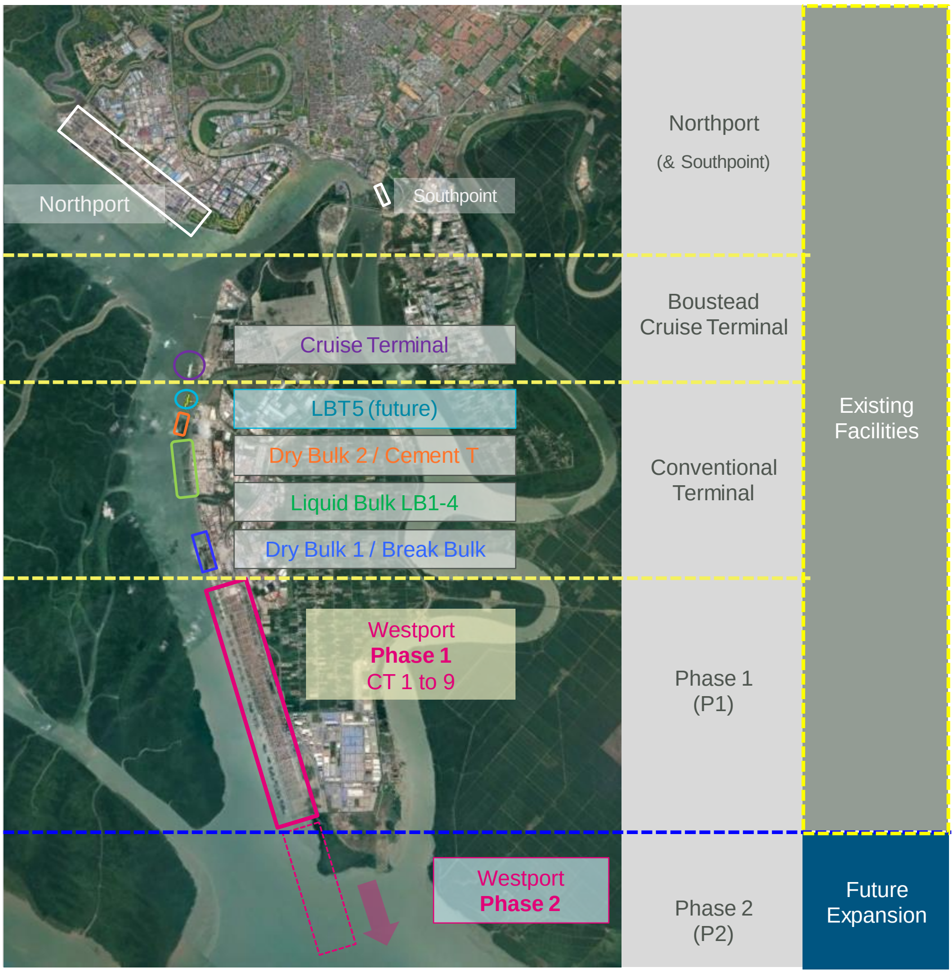
2 Study Area

2.1 Existing Port Facilities and Westport Expansion

The key port and marine-based facilities adopted for marine traffic risk assessment are illustrated in Figure 2-1 considering:

- Existing Facilities at Westport includes Westport CT1 to CT9; Conventional Terminal of Westport comprising of Dry Bulk Terminal 1 (Bulk) and Terminal 2 (Cement) and Liquid Bulk Terminal 1 to 4 (LB 1-4);
- Other existing port facilities includes Boustead Cruise Terminal and facilities at Northport (& Southpoint);
- Future Westport Expansion (Westport Phase 2) considers expansion of container terminal to the southeast of existing Westport CTs; and
- Future development at Conventional Terminal considers introduction of one additional liquid bulk terminal – LBT5.

Figure 2-1 Port & Marine-based Facility

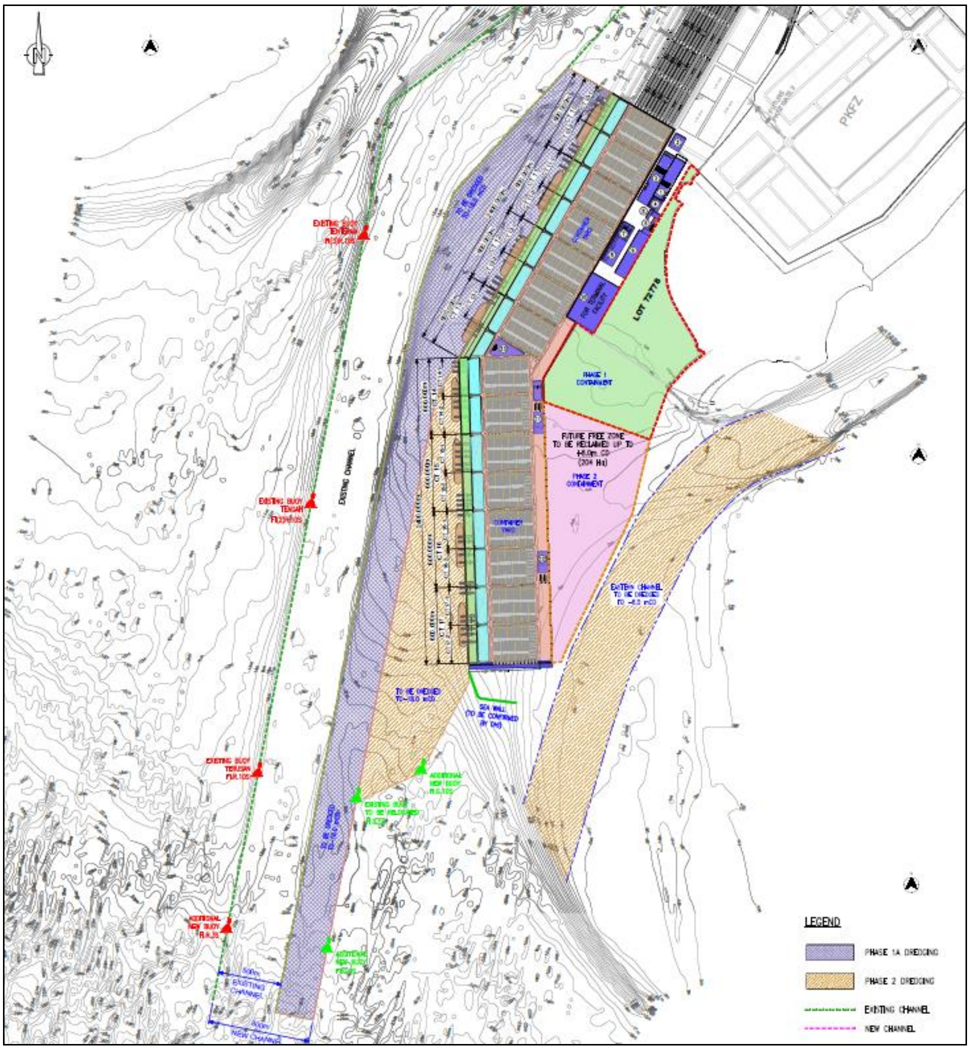


2.2 Final Layout Plan

The final layout plan for Westport Phase 2 Expansion is illustrated in Figure 2-2. The expansion considers 8 additional terminals namely Container Terminal CT10 to CT17 where each Terminal has a quay length of up to 600m and a total of 15 berths are introduced.

In view of marine navigation, the navigation width of the existing South Channel will be maintained at 500m and due to the implementation of CT10 to CT17 a new navigation channel of up to 800m with a dredged depth -18.0mCD is proposed.

Figure 2-2 Final Layout Plan

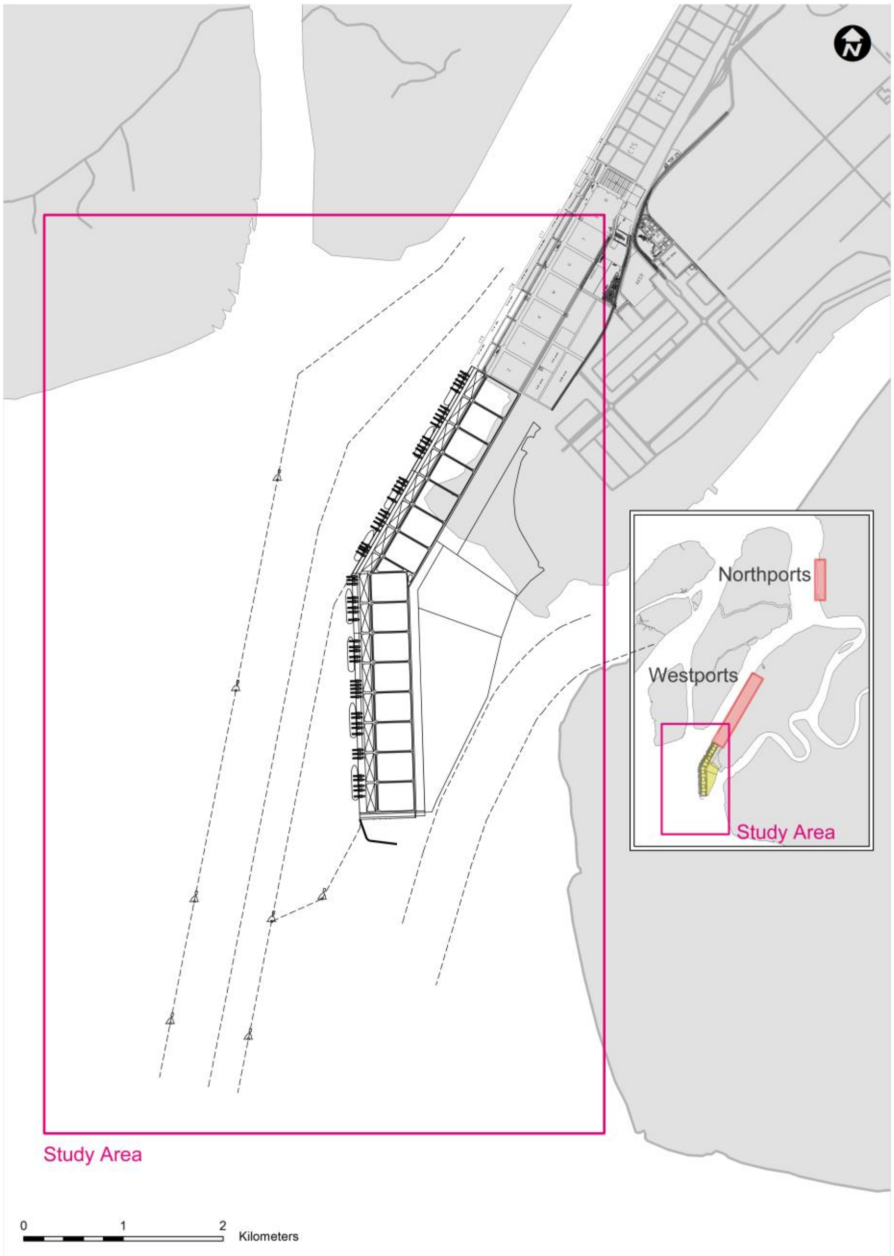


2.3 Marine Traffic Risk Assessment Study Area

In response to the marine traffic generated at existing port facilities and at future Westport expansion, the MTRA Study Area being adopted for analysis of marine risk considering waterspace along the South Channel is illustrated in Figure 2-3.

It is expected that the marine travel routes directed to the current port facilities will navigate at the NW end of the existing dredged South Channel and converge into the South Klang Strait and taken in consideration of future Westport expansion the marine travel routes directed to future CTs will navigate along the new dredged channel. Details on traffic activities in terms of vessel size, volume, navigation pattern and route alignment are discussed in the following section.

Figure 2-3 MTRA Study Area



3 Baseline & Future Traffic Activities

3.1 Introduction

This section includes a profile of present marine traffic within the Study Area and reviews the marine traffic comprising the future marine facilities due the implementation of future Westport expansion.

The following facilities are considered for assessment on Baseline and Future cases:

CASE	FACILITIES					
	Westport Phase 1	Westport Phase 2	Conventional Terminal	LBT 5	Cruise Terminal	Northport
Baseline	✓		✓		✓	✓
Future	✓	✓	✓	✓	✓	✓

In terms of timeframe, the Baseline Case is defined to represent the existing traffic conditions including ship calls at the newly implemented Westport CT9 up to March 2019 and the Future Case includes traffic growth at existing facilities, Westport Expansion Phase 2 and new berth(s) at LBT5.

This Section present the adopted traffic volume at the various marine facilities for the Baseline and Future cases.

3.2 Baseline Traffic Activities

Existing information on marine traffic activities within the Study Area has been collected from the following available sources:

- Review on latest ship call records for Container and Conventional vessels at Westport from April 2018 to March 2019;
- Cruise liner arrivals in 2019 (online access) at the Port Klang Cruise Terminal;
- General traffic arrival information provided by Westport;
- Port Klang Statistics by the Port Klang Authority (online access); and
- Automatic Identification System (AIS) & Radar data within the Study Area provided by the Marinetraffic.com

3.2.1 Westport Container Terminal

Historical records for April 2018 – March 2019 were obtained from Westport, the records include 7,146 ship calls data. The annual throughput was recorded at 9.8 million TEUs and details on vessel LOA and TEUs exchange are summarised in Table 3-1**.**

Table 3-1 Annual Arrivals at Westport Phase 1 (Apr 2018-Mar 2019)

Vessel LOA (m)	No. of Ship Calls		Throughput TEUs ('000)	
50 - 100	535	*7%*	112	*1%*
100 - 150	543	*8%*	309	*3%*
150 - 200	2345	*33%*	2,125	*22%*
200 - 250	662	*9%*	763	*8%*
250 - 300	2189	*31%*	3,713	*38%*
300 - 350	501	*7%*	1,162	*12%*
350 - 400	371	*5%*	1,638	*17%*
>400	0		0	
Total	**7,146**		**9,823**	

3.2.2 Westport Conventional Terminal

Historical records at Conventional Terminal for April 2018 – March 2019 were obtained from Westport, the records include 1,537 ship calls data are summarised in Table 3-2**.**

Table 3-2 Annual Arrivals at Conventional Terminal (Apr 2018-Mar 2019)

Vessel LOA (m)	No. of Ship Calls
50 - 100	182
100 - 150	600
150 - 200	679
200 - 250	69
250 - 300	1
300 - 350	6
350 - 400	0
>400	0
Total	**1,537**

3.2.3 Boustead Cruise Terminal

Cruise Liner

Cruise liner arrivals at Boustead Cruise Terminal is reviewed and the arrival schedule for 2019 is summarised below:

Table 3-3 Annual Arrival at Boustead Cruise Terminal (2019)

Month	No. of Ship Calls	Month	No. of Ship Calls
January	31	July	0
February	31	August	0
March	34	September	0
April	19	October	2
May	7	November	10
June	4	December	24
Total	162		

Source: http://crew-center.com/klang-malaysia-cruise-ship-schedule-2019

Naval Ship

Historical records on naval ship at Boustead Cruise Terminal is reviewed and it is identified from record provided by Westport that: Year 2017 – 7 Vessel Calls and Year 2018 – 10 Vessel Calls.

3.2.4 Northport

Existing port facilities at Northport include (i) Northport: Container Terminal, Bulk Cargo Terminal and Breakbulk Terminal (ii) Southpoint: Liquid Bulk, Dry Bulk and Break Bulk and the berth layout plan is illustrated in Figure 3-1 and Figure 3-2

Figure 3-1 Berth Layout Plans - Southpoint

Figure 3-2 Berth Layout Plans - Northport

Source: Port Klang Malaysia – Marine Information Handbook

The Ship Statistics by Port Klang Authority identifies the total ship arrival at Port Klang in 2018 and referring to ship statistics at Westport, the ship arrivals at Northport is calculated and summarised in Table 3-4.

Table 3-4 Ship Statistics (2018)

	Conventional			Container
Port Kang (i)	Dry Bulk	Liquid Bulk	General	Container
	435	1,306	1,430	10,347
Total	3,171			10,347
Westport (ii)	1,601			7,074
Northport	1,570			3,273

Source: (i) Port Klang Authority; Port Klang Performance – Port Klang Statistic 2018, Facilities include Northport (& South Point) and Westport
(ii) Westport, Ship Arrival Records from January 2018 to December 2018

3.2.5 Review on AIS Data and Traffic Activities

One-month AIS data was sourced from MarineTraffic.com for the period of August 2018. AIS data provides 24-hour tracking information (including vessel positions, speed, and timing) that when analysed, provides all necessary information on marine traffic pattern and route structure.

Traffic Pattern along South Channel

Vessel tracks were identified from the AIS data illustrated in Figure 3-3 considering the counting gate capturing traffic movements towards the Westport and Northport (and Southpoint) are adopted to form the baseline vessel route structure in the marine traffic model to characterize marine traffic activity within the Study Area.

Figure 3-3 AIS Vessel Tracks – 1 month of August 2018

<u>Port Facility (Container and Conventional Terminal) & Vessel Size Distribution</u>

AIS records provides information on vessel types; the level of traffic across the counting gate has been reviewed and each vessel types and size are grouped based on the designated facilities considering:

- Container Terminal: for container or cargo ships carrying containers, reefer/containership;
- Conventional Terminal:
  - *Liquid Cargo*: for Asphalt/Bitumen Tanker, Chemical Tanker, Crude Oil Tanker such as LPG Tanker, Oil Products Tanker and Oil/Chemical Tanker; and
  - *Dry Bulk, Break Bulk or General Cargo*: includes Bulk Carrier, Cargo, Cargo - Hazard A (Major), General Cargo, Heavy Lift Vessel, Heavy Load Carrier, Vehicles Carrier.

Vessel tracks of the key vessel types were identified from the AIS data and illustrated in the following figures.

Figure 3-4 AIS Vessel Tracks (Container Ship)

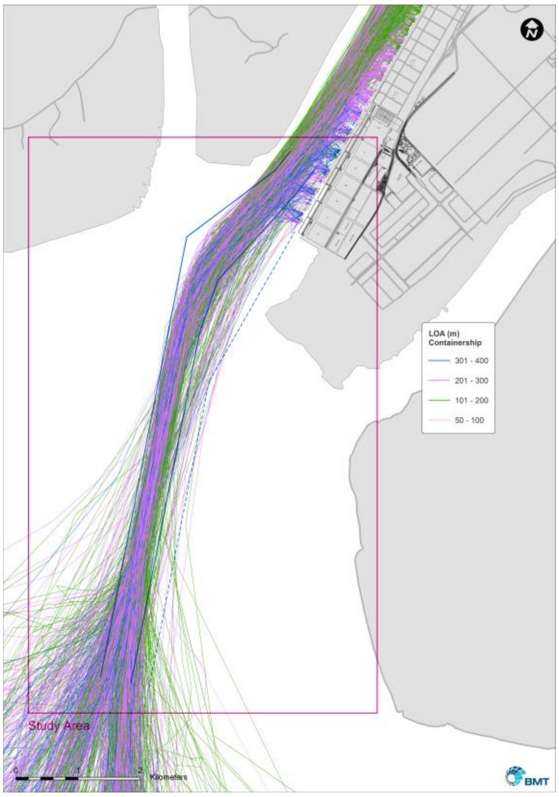


Figure 3-5 AIS Vessel Tracks (Bulk or General)

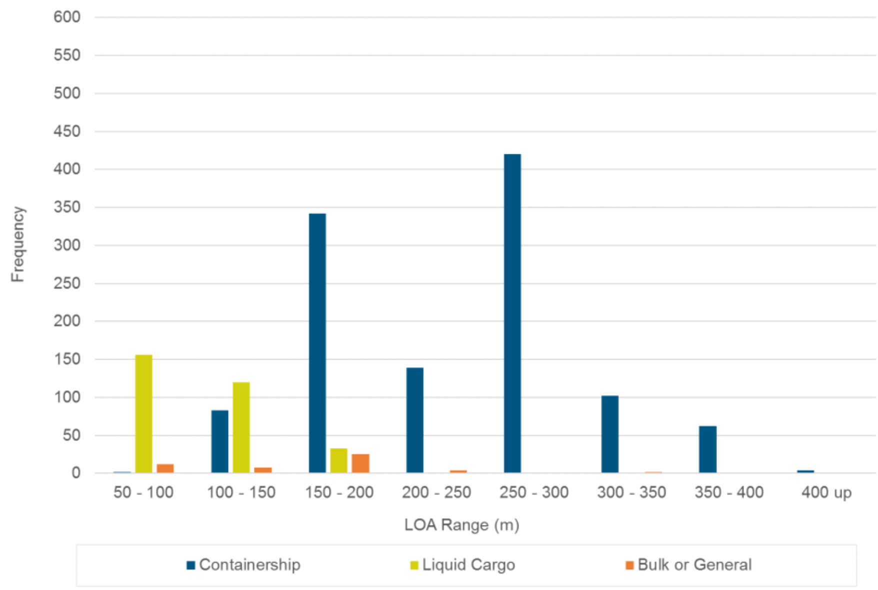
Figure 3-6 AIS Vessel Tracks (Liquid Cargo)

A summary of traffic volumes by vessel's types and LOA are presented in Table 3-5 and illustrated in Figure 3-7.

Table 3-5 Level of Traffic by LOA and Cargo Types (August 2018)

LOA Range (m)	Container Terminal	Conventional Terminal		Sub-total
		Liquid	Bulk/General	
50 – 100	2	156	12	170
100 - 200	425	153	33	611
200 - 300	559	0	4	563
300 - 400	164	0	2	166
> 400	4	0	0	4
Total	**1,154**	**309**	**51**	**1,514**

Figure 3-7 Level of Traffic by LOA Distribution (August 2018)



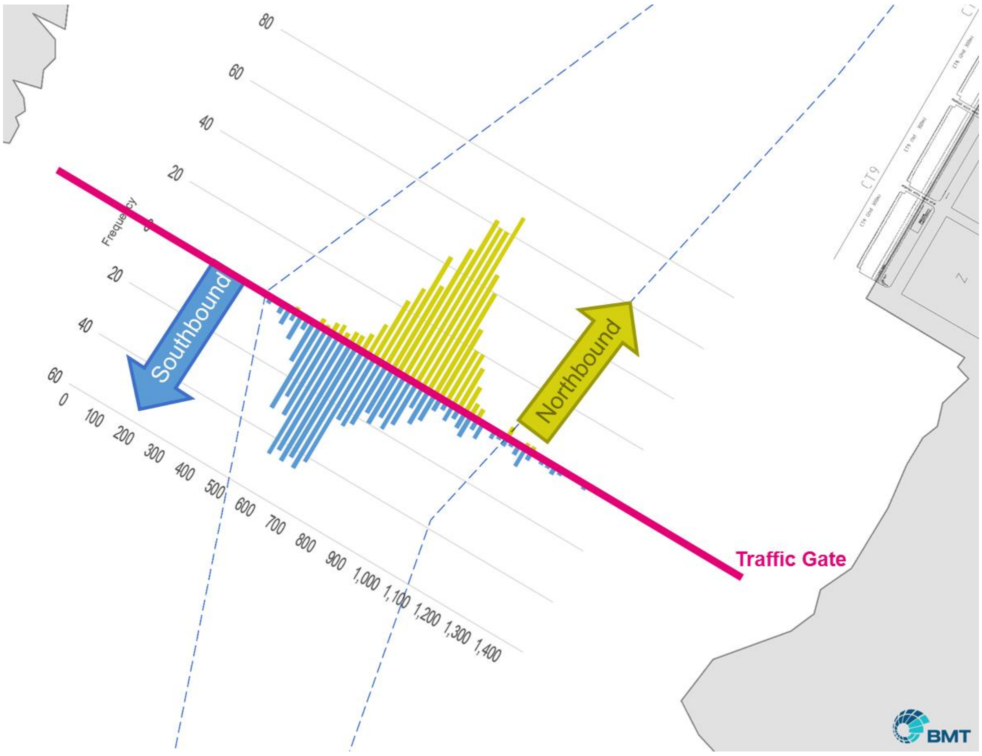
Based on a monthly record, an average daily transits of approximately 50 vessel's movements (1,514/31 vessels identified in Table 3-5) across the entrance of South Channel is identified; where 76% of total traffic are contributed by movements related to the Container Terminal and 24% to Conventional Terminal. In terms of ship size, over 70% of traffic related to the Container Terminal are vessel of LOA with the range 100m to 300m.

It is identified that up to 85% of Container Ship movements are in the range between 100 - 300m LOA and approximately 14% are Container Ship of LOA exceeding 300m.

Vessel's Route Characteristics

Traffic pattern of total vessel movements has been reviewed and findings are illustrated in Figure 3-8.

Figure 3-8 Route Width



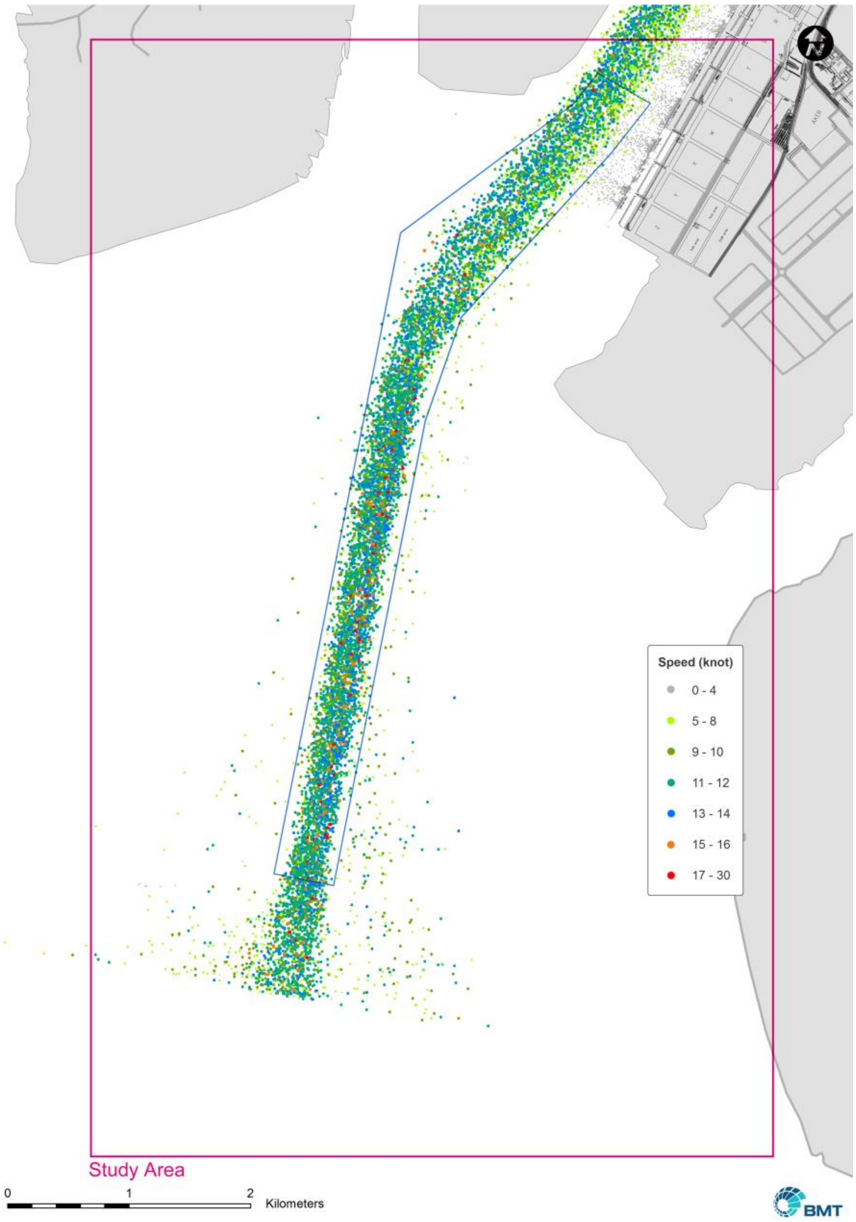
It has been identified from an analysis AIS data that:

- *Width of Navigation*: both northbound and southbound width of navigation is approximately 500m and set within the limitations of the existing channel;
- *Volumes*: comparable level of traffic are recorded for northbound and southbound movements, the average daily for each direction is approximately 22 to 23 movements. For modelling purposes, same traffic volume is adopted for northbound and southbound traffic stream;
- *North bound*: majority of the vessels transit in the middle of the channel; with a very small proportion navigate along the starboard side of the up channel and
- *South bound*: majority of the vessels transit closer to the port side of the up channel.

Vessel Speed

Vessel's travelling speed along the South Channel has been reviewed for understanding the vessel's manoeuvring behaviour and to be adopted for marine traffic simulation.

Figure 3-9 Speed in South Channel (1-month Oceangoing AIS Data)

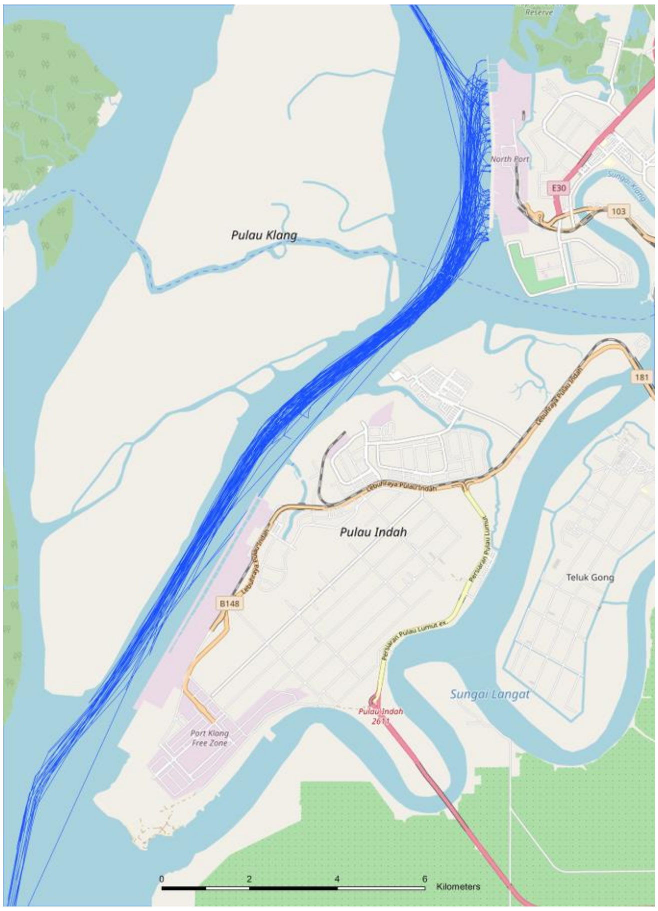


The average vessel's travelled speed along the South Channel is 10 to12 knots.

<u>Traffic Volume to/from Northport</u>

It is recognised that vessels navigate to/from the Northport via the South Channel and North Channel. Sample tracks is illustrated as:

Figure 3-10 Traffic Routes to Northport



In terms of volume distribution, it has been identified from the AIS records that up to 26% of total transits to Northport are via the North Channel and 74% of total transits are via the South Channel.

For modelling purposes, it is assumed that up to 74% of total arrivals at Northport will navigate along the South Channel.

The following is adopted for accounting traffic to/from the Northport for development of marine traffic model:

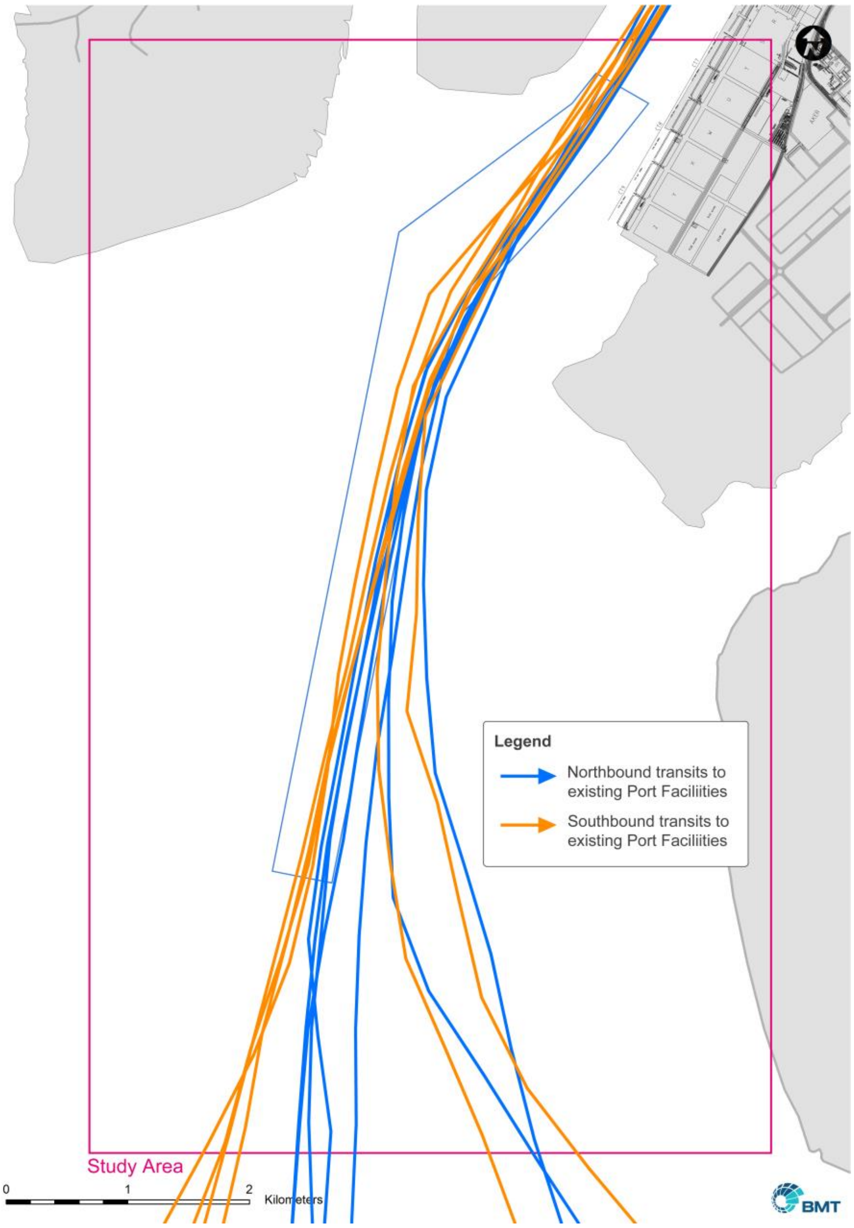
Total Annual Arrival Record (2018) at Northport Container + Conventional (Table 3-4 refers)	= 4,843
Daily Arrivals	= 4,843 / 365 = 13
Traffic Distribution along South Chanel	= 74%
Daily Traffic along South Channel	= 13 x 74% = 9.8

3.2.6 Baseline Marine Traffic Model

Modelled Route

Traffic pattern and route characterises have been reviewed from AIS data for preliminary review of route structure representing the existing traffic activities. The representative vessel tracks/route centrelines that portrays the current port activities are illustrated in Figure 3-11 and forms the backbone vessel route structure to characterize marine traffic activity within the Study Area.

Figure 3-11 Modelled Traffic Routes (Baseline Case)



Traffic Volume

The results of (i) review on current traffic activities based on up-to-date ship calls records and desktop review and (ii) AIS data analysis have been used to cross check each other and ensure the accurate identification vessel distribution and traffic patterns crossing the South Channel are captured, these checks contributing to the development of a representative traffic model for risk assessment purposes.

An average daily of approximately 50 vessel's movements (Table 3-5 refers) across the marked gate at the South Channel (as illustrated in Figure 3-3) has been identified from the AIS data and northbound and southbound movements is approximately 22 to 23 each direction; therefore an 25 average daily arrivals is determined.

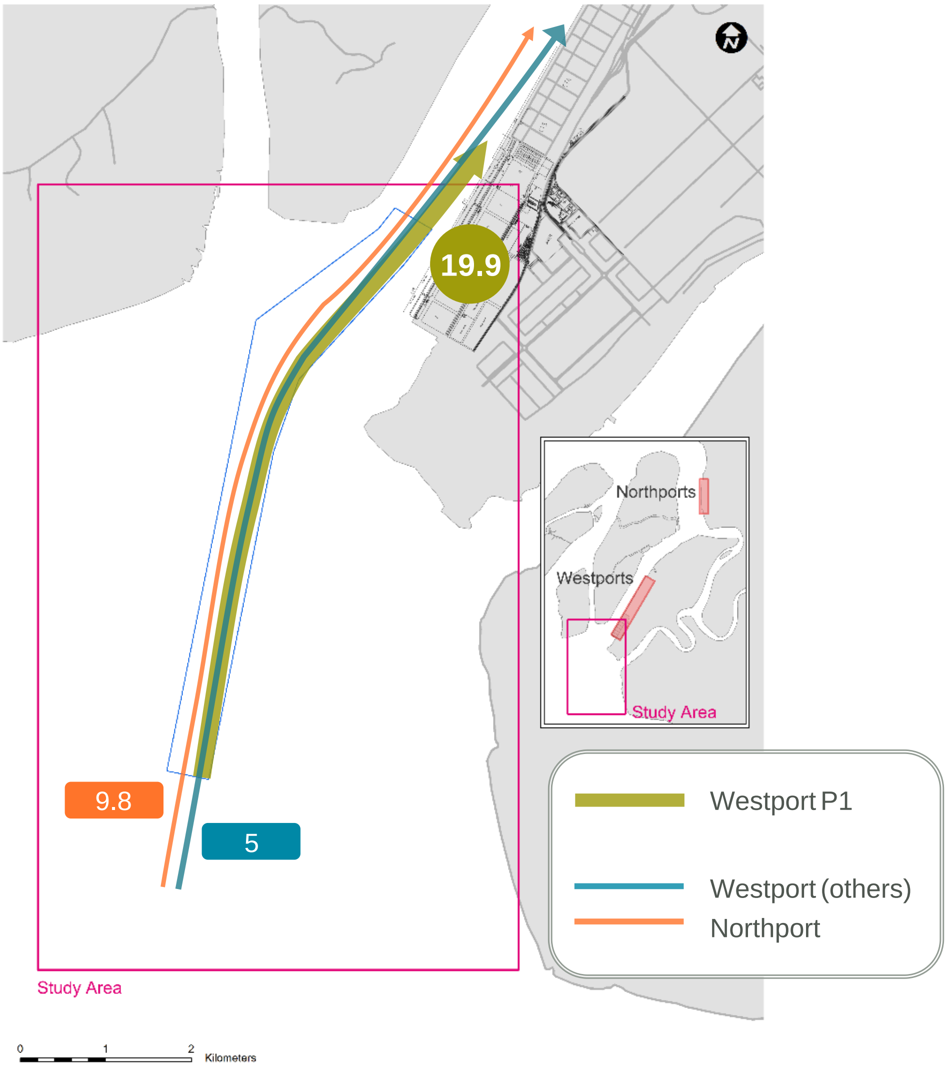
In view of up-to-date ship calls records and desktop review presented in Section 3.2 the average daily arrivals are summarised in Table 3-6 below. An 34.7 average daily arrivals is identified. For a conservative assessment, level of traffic based on ship calls records and desktop review is adopted.

Assuming 365 days operation in one year, the daily traffic adopted for development of baseline marine traffic model are summarised in Table 3-6 and illustrated in Figure 3-12.

Table 3-6 Baseline Marine Traffic Model

Facility	Daily Traffic	Assumptions
Westport Phase 1	19.9	Ship Arrival Records from April 2018 to March 2019 (Annual Arrival = 7,146) TEU exchange is established based on TEU by Vessel LOA Records from April 2018 to March 2019 (Annual Throughput = 9.8 TEUs)
Conventional Terminal	4.5	Ship Arrival Records from April 2018 to March 2019 (Annual Arrival = 1,537)
Cruise Terminal	0.5	Cruise Liner arrival schedule in 2019 (Annual Arrival = 162) Consider additional: 10 Naval Ship Annual Arrival
Northport	9.8	Total Arrival at Container & Conventional Terminal at Port Klang - Total Arrival at Container & Conventional Terminal at Westport (Annual Arrival = 4,843 x 74% transits via the South Channel)
Total Daily Arrival	**34.7**	

Figure 3-12 Baseline Marine Traffic (Daily Arrivals)



3.3 Future Traffic Activities

3.3.1 Westport Container Terminal Expansion

Port Layout & Throughput

The following assumptions are adopted for forecasting future traffic volume for the Future Case in the projected forecast year (2040).

Table 3-7 Model Assumptions for Future Case

Port Capacity	Terminal	Annual Throughput	Unit
Westport Phase 1	CT1 to CT9	15	Million TEU
Westport Phase 2	CT10 to CT17	12	Million TEU
Future Case	CT1 to CT17	27	Million TEU

Port Size	No. of Terminal	Quay Length	Unit
Westport Phase 1	9	5,800	m
Westport Phase 2	8	4,800	m

Container Terminal - Vessel Size & Throughput

It is assumed that TEUs exchange per vessel remains unchanged at existing level as summarised in Table 3-1. For future port planning and modelling purposes, it is expected the vessel size distribution at Westport Phase 1 will be similar to the current operation. The adopted traffic volume at Westport Phase 1 for future case is summarised in Table 3-8.

Table 3-8 Vessel LOA and TEUs (Future Case – Phase 1)

Vessel LOA (m)	*TEUs per exchange ('000)*	No. of Ship Calls (daily)	Annual Throughput ('000)
50 - 100	*209*	2	153
100 - 150	*569*	2	415
150 - 200	*906*	8	2646
200 - 250	*1,153*	8	3366
250 - 300	*1,696*	9	5572
300 - 350	*2,319*	2	1693
350 - 400	*4,416*	1	1612
>400	*5,500*	0	0
Total		**32**	**15,458**

It is assumed that TEUs exchange per vessel remains unchanged at existing level as summarised in Table 3-1. For future port planning and modelling purposes, it is expected that port facilities at Westport Phase 2 will receive vessel of LOA not less than 200m. The adopted traffic volume at Westport Phase 2 for future case is summarised in Table 3-9

Table 3-9 Vessel LOA and TEUs (Future Case – Phase 2)

Vessel LOA (m)	*TEUs per exchange ('000)*	No. of Ship Calls (daily)	Annual Throughput ('000)
50 - 100	*209*	0	0
100 - 150	*569*	0	0
150 - 200	*906*	0	0
200 - 250	*1,153*	7	2946
250 - 300	*1,696*	5	3096
300 - 350	*2,319*	3	2540
350 - 400	*4,416*	1	1612
>400	*5,500*	1	2008
Total		**17**	**12,200**

3.3.2 Westport Conventional Terminal

Existing Facilities

Conventional Terminal of Westport comprises Dry Bulk Terminal 1 (Bulk) and Terminal 2 (Cement) and Liquid Bulk Terminal 1 to 4 (LB 1-4); assuming no expansion on existing facility, for a conservative assessment a growth rate of 50% from 2018 to 2040 at existing capacity is adopted for forecasting future traffic.

Liquid Bulk Terminal 5 (LB5)

Information on future plan for development of Liquid Bulk Terminal 5 (LB5) is collected from Westport's operator and the expected future arrivals is summarised in Table 3-10.

Table 3-10 Vessel Arrivals at LB5

Item	LNG Vessel – Import (Q-MAX)	LNG Vessel - Export	LPG Vessel – Import (VLGC)	LPG Vessel - Export
Max Displacement Tonnage	145,000mt	25,000mt	80,000mt	9,000mt
Frequency of Calls Per Month	**2**	**7**	**2**	**30**

3.3.3 Boustead Cruise Terminal

Cruise Liners

According to the cruise schedule of 2019, the current usage at the cruise liner berth ranges from 0 to 31 arrivals each month and possible variation and growth may be expected in future years.

Assuming no expansion at existing facility, a growth rate of 100% from 2018 to 2040 at existing capacity is adopted for a conservative assessment. The average monthly arrival is calculated at 27 arrivals - a traffic level that has been demonstrated by historical record that the existing marine facilities in terms of Terminal and waterspace can accommodate.

Naval Ship

The usage for these vessels is expected to be relatively static and not anticipated to change significantly in the future. An arrival frequency similar at existing levels is adopted for future case model development.

3.3.4 Northport

A projection assuming a comparative growth rate at Westport is adopted for forecasting traffic at Northport. Taken into account that the targeted growth at Westport (Phase 1) is expected at 15M TEUs in 2040, a compound annual growth rate (CAGR) of 2.1% is calculated from 9.6M TEUs in 2018 or in terms of rate of change a forecast growth rate of 58% from 2018 to 2040 is identified.

In view of the movements of vessels along the South Channel considering the traffic activities to/from the Northport for a conservative assessment and taken in consideration of no significant expansion a 58% growth rate from 2018 to 2040 is adopted for total traffic generation at Northport.

3.3.5 Future Marine Traffic Model

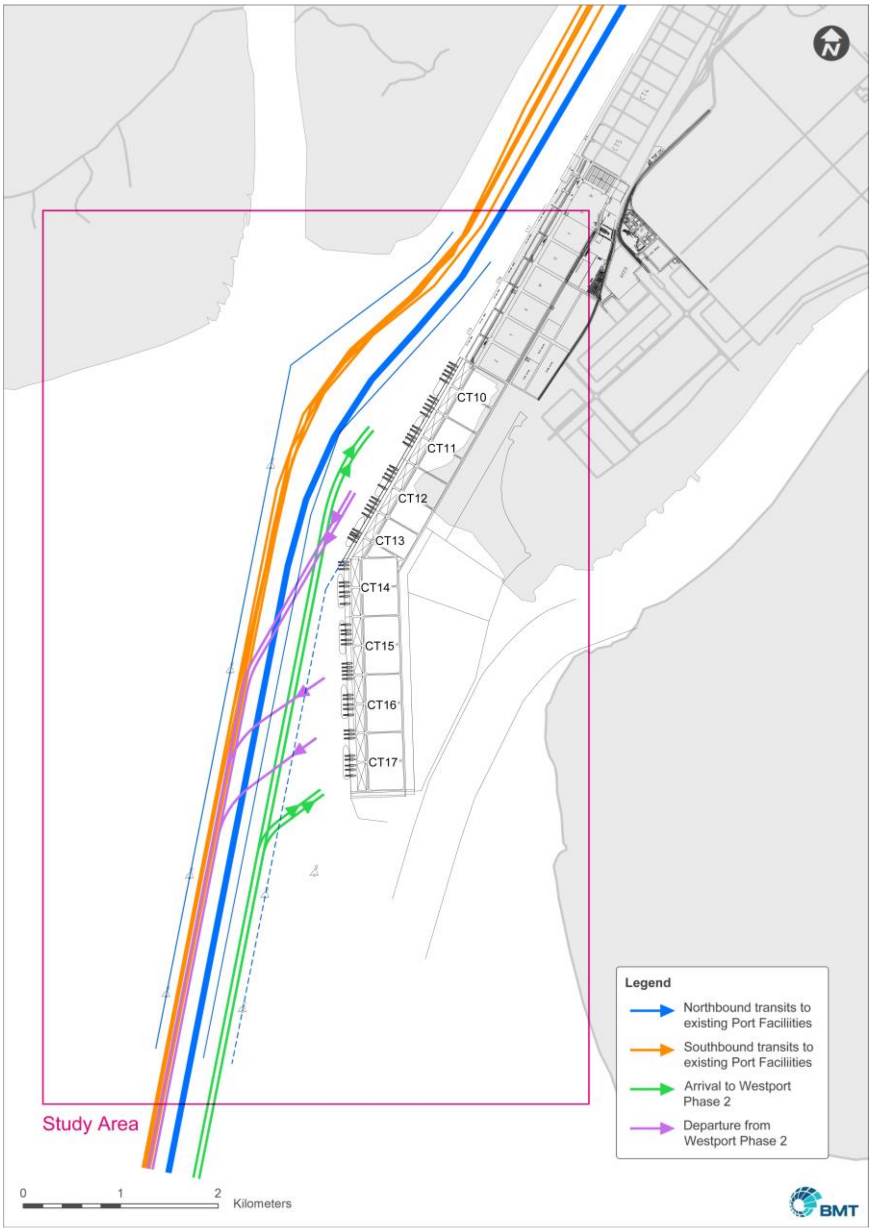
Modelled Route

As a result of widening of the existing South Channel, a clear traffic separation for northbound and southbound vessel movements at Westport and Northport is adopted.

The vessel's route alignment for traffic generated at Westport Phase 2 has been formulated following the findings from the Navigation Simulations; where approach movements are routed along the new channel and departure movements are routed along the existing South Channel following the southbound direction.

The representative vessel tracks/route centrelines that portrays the future port activities are illustrated in Figure 3-13 and forms the backbone vessel route structure to characterize marine traffic activity within the Study Area.

Figure 3-13 Modelled Traffic Routes (Future Case)



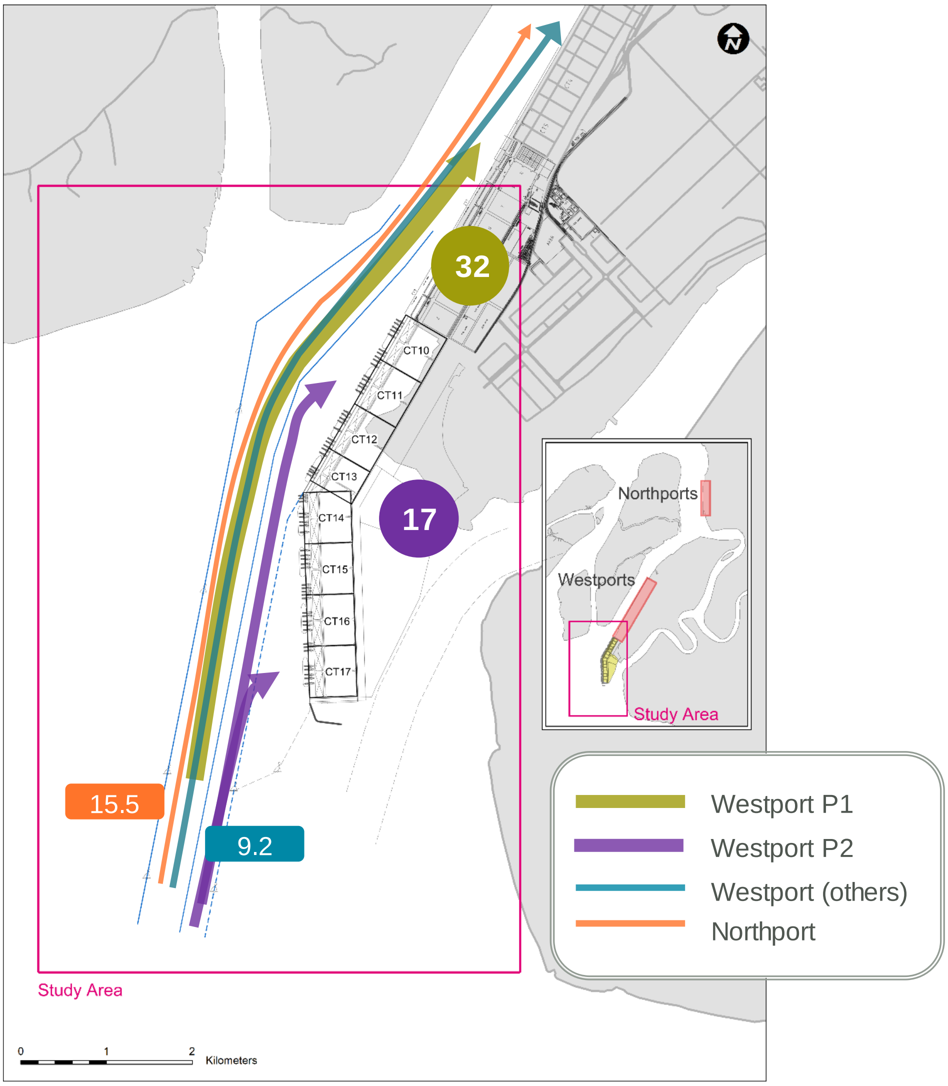
Traffic Volume

Based on up-to-date annual records presented in Section 3.3 and adopting an assumption for 365 days operation in one year, the daily traffic adopted for development of future marine traffic model are summarised in Table 3-11 and illustrated in Figure 3-14.

Table 3-11 Future Marine Traffic Model

Facility	Daily Traffic	Assumptions
Westport Phase 1	32	Annual Throughput = 15 TEUs
Westport Phase 2	17	Annual Throughput = 12 TEUs
Conventional Terminal	6.8	Assuming no expansion on existing facility, a growth rate of 50% from 2018 to 2040 at existing capacity is adopted
Liquid Bulk Terminal 5 (LB5)	1.5	Expected vessels consider: LNG Vessel – Import (Qmax) LNG Vessel - Export LPG Vessel – Import (VLGC) PG Vessel - Export Total Monthly Arrival = 41 *Information source: Westport Operator*
Cruise Terminal	0.9	Assuming no expansion on existing facility, a growth rate of 100% from 2018 to 2040 at existing capacity is adopted No significant change expected for Naval Ship arrivals
Northport	15.5	Assuming a similar growth rate at Westport is adopted for Northport, a growth rate of 58% from 2018 to 2040 at existing capacity is adopted
Total Daily Arrival	**73.7**	

Figure 3-14 Future Marine Traffic (Daily Arrivals)



3.4 Summary

This section has presented a review on existing marine traffic volume and patterns and summarised the projection of vessel activities for future forecast year.

AIS & Radar Data has been collected to provide a thorough characterisation of vessel types and volumes within the Study Area. The traffic movements along the South Channel is found to be dominated by Container Ships.

Projection of vessel activities at Westport for the future case has been established based on a capacity reaching 15M TEUs and 12M TEUs at CT1 to 9 and Westport Phase 2 respectively.

A baseline marine traffic model has been established based on vessel tracks as identified from AIS data and has adopted the traffic volume in 2018/19 and 2040 as baseline and future case respectively.

The marine impacts of the proposed Westport Phase 2 expansion associated with the forecast traffic are assessed in the following section.

4 Marine Traffic Risk Assessment

4.1 Introduction

The previous section has developed the existing and future traffic regimes suitable to assess the risk level associated with the proposed Westport Phase 2 expansion within a marine traffic risk model.

This section presents the methodology and results of the marine traffic risk model and assesses the potential risk impacts due to the Final Layout Plan over the future marine environment within the Study Area.

4.2 Assessment Approach

Simulation Model

BMT's Dynamic Marine Traffic Model (DYMITRI) has been adopted to model the marine traffic environment and predict risk levels across the Study Area. The DYMITRI traffic model has been used as a principal tool for the identification of marine risk for critical infrastructure projects and specifically developed to realistically examine the competition for waterspace within crowded waterways.

DYMITRI works in a time-stepping mode with events driven by the circumstances at any time in the play area. Traffic is randomly generated and caused to run along a number of routes, the routes being defined by the route structure. Route numbers, structure and boundaries are determined by AIS Data.

Routes, or sections of routes, that are defined as exclusive allow only one ship to pass at any time. Properties are imposed on each vessel as it moves through the study area and these determine its status at any time. The simulation causes ships to move along each route at a speed defined at each gate, however the vessel may have to slow to avoid a conflict situation or speed up again to reach the target speed, once the situation is over.

Conflicts are dealt with by avoidance manoeuvres in which groups of vessels take avoiding action by slowing and/or steering out of danger. Each vessel travelling within the model has an autonomous pilot acting according to the Collision Regulations or local priorities. Traffic "bunching" and "knock-on" effects are accurately modelled as vessels move within fairways. The frequency of "active encounter" collision avoidance manoeuvres can be identified, and collision risk directly developed.

Risk Level Quantifier

Active Encounter information (e.g. coordinates, encountering vessel types, speed, headings, etc.) is logged and following it is processed by data models to illustrate the risk distribution and changes of magnitude on increasing/decreasing number of encounters within the Study Area.

The risk level is expressed by the annual active encounters (as "AEs" below), which indicate the frequency of two vessels' domain overlapping, and the requirement for an avoidance manoeuvre to be made.

4.3 Modelling Scenarios

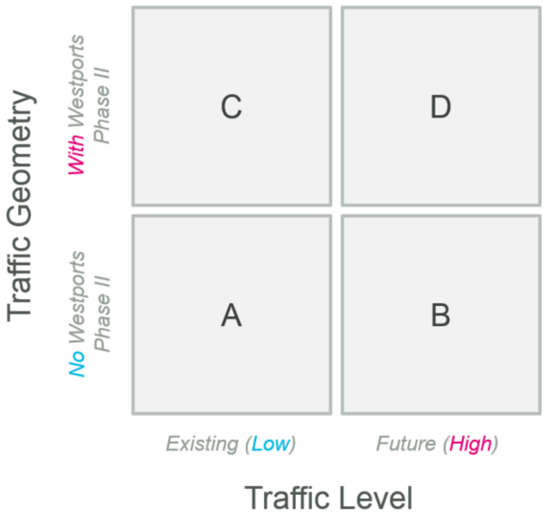
A matrix considering the two major factors leading to potential marine traffic risk generated due to the Westport Phase 2 expansion is established and illustrated in Figure 4-1 and the factors consider:

(i) vertical axis: Change of Geometry due to introduction of new development

(ii) horizontal axis: Change of Traffic due to traffic growth on existing activities

By comparing any two of these grids in the matrix, conclusion can be made on whether the waterway geometry or the traffic volume is the dominant factor augmenting the risk.

Figure 4-1 Risk Evaluation Matrix



In this MTRA, following four scenarios were conducted.

Scenario	Description
A	The baseline, representing the existing traffic
B	Without presence of the Westports Phase II, but assuming the traffic will grow to the forecasted level at Phase 1 and all the future throughput using the existing facility – this is in fact an artificial case assists in reviewing whether increased background traffic levels is driving risk.
C	With presence of the Westports Phase II, under existing traffic level, assuming all vessels running at Baseline level. This is also an artificial situation assists in reviewing whether expansion at Phase 2 is driving risk.
D	The traffic environment with presence of the Westports Phase II land formation and traffic will grow to the forecasted level

A summary of modelled traffic input is included in Appendix A.

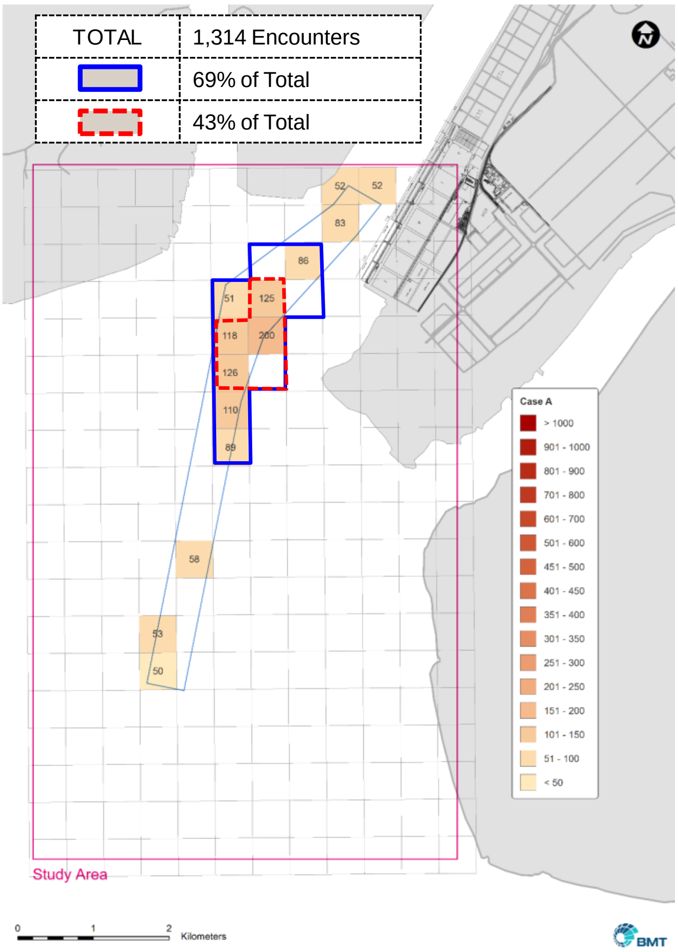
4.4 Baseline Risk Model

4.4.1 Baseline Present Traffic Model

Scenario A

The annual risk profile of Baseline model has been identified and illustrated in Figure 4-2.

Figure 4-2 Encounter Profile of Baseline Model



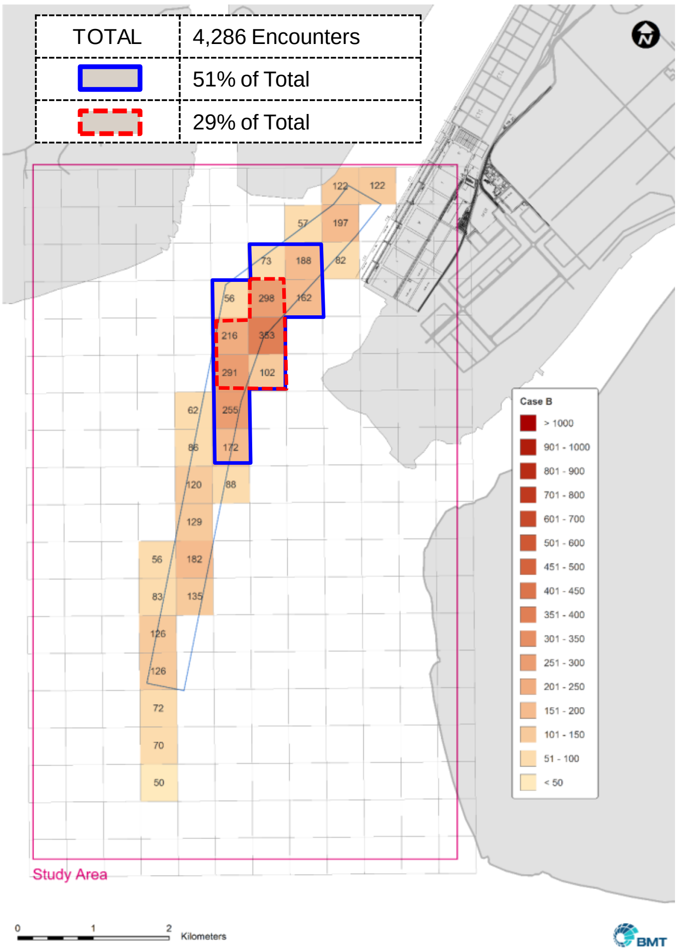
An initial review of marine traffic model is conducted and 1,314 AEs per annum is identified. In terms of distribution of AEs, the model has identified that 69% of encounters take place at waterspace at the north end of the South Channel and entrance of South Klang Strait (indicated in the Blue square) and 43% of encounters are found focus at turn along the South Channel (indicated in the Red square).

4.4.2 Baseline Future Traffic Model

<u>Scenario B</u>

Prior to examining the impact of the Westport expansion, it is necessary to develop the future traffic model without the development geometry. Future traffic growth (Table 3-11 refers) on existing route patterns has been adopted and model output has been identified and presented in Figure 4-3.

Figure 4-3 Encounter Profile of Baseline Future Model



In view of future traffic increases; model output from Scenario B predicts a total of 4,286 encounters per year.

Considering future traffic growth and with significant container vessels traffic along the South Channel a key result is that the 60% increase in total vessel traffic from 2018 to 2040 has led to 3.3 times (330%) increase in encounters. This result highlights the sensitivity of the Study Area to additional increases in marine traffic volumes and the significance of this parameter in reviewing the impact due to the Westport expansion development in the future year.

A comparable outcome with Scenario A has been identified for spatial distribution of risk, the model has identified that 51% of encounters take place at waterspace at the north end of the South Channel (indicated in the Blue square) and 29% of encounters are found at waters near the turn (indicated in the Red square).

4.5 Future Risk Model

4.5.1 Baseline Traffic Model with Westport Expansion

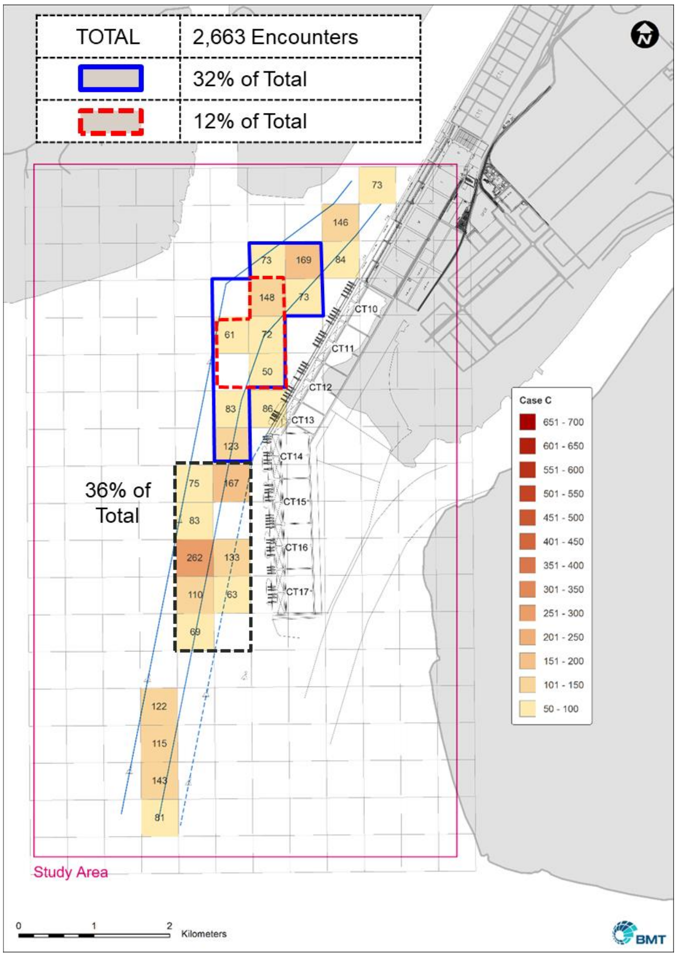
<u>Scenario C</u>

The preliminary assessment of impact has been conducted on the basis of no increase in future traffic and a review solely on the basis of Westport expansion footprint and the generated traffic pattern.

In response, the presence of Westport reclamation modification onto the existing traffic pattern has been adopted for modelling. Traffic separation for movements to existing Westport and Northport is applied and vessel arriving at Westport Phase 2 will navigate along the new channel.

Within the Study Area the model predicts an annual 2,663 of encounters. The model results for Baseline Present Scenario C is shown in Figure 4-4.

Figure 4-4 Encounter Profile of Baseline Model with Westport Expansion



It can be reviewed from the analysis that the Westport Phase 2 layout and generated traffic impose constraints on the existing traffic environment, where total encounters has increased by 100% from the Baseline Model and encounters are found predominately:

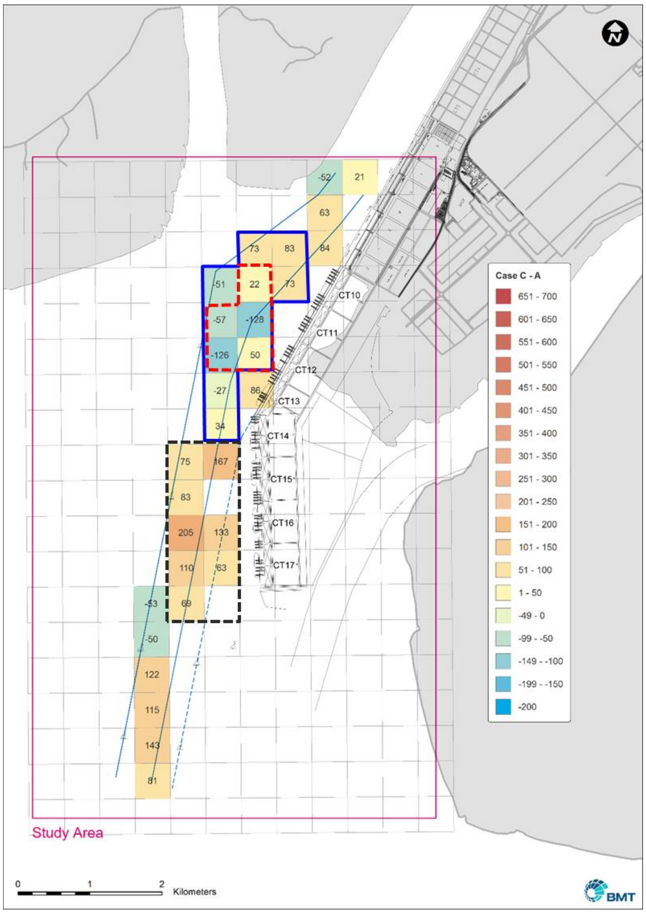
- in waterspace near CT14 to CT17 (indicated in the Black square – 36% of total encounters) where Westport Phase 2 vessel's departure routes (southbound) generate crossing traffic movements with existing traffic along the South Channel.
- in waterspace near CT10 & CT11 (indicated in the Red square – 12% of total encounters) at the turn of the South Channel.

Additional marine activities generated solely at the Westport Phase 2 accounts for 49% of the traffic increase from the Baseline Model.

A clear traffic separation is being modelled for existing vessel traffic movements and the model predicts that the number of encounters has decreased from the Baseline Model.

The projected changes in risk level from the Baseline Model for the updated port layout is illustrated in Figure 4-5.

Figure 4-5 Baseline Model - Changes in Encounters with Westport Phase 2



<u>Compound effects of Contributing Factors</u>

Results of Scenario C identifies the compound effects due to:

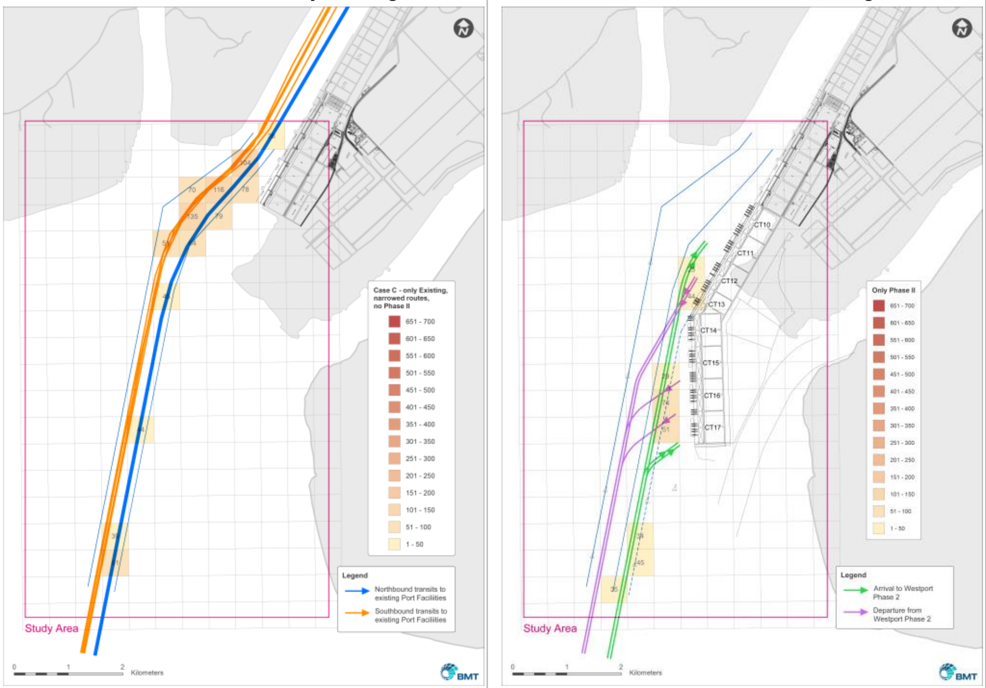
(i) Geometry Change due to implementation of Westport Phase 2 and re-arrangement of existing traffic (traffic separation along South Channel); and

(ii) Traffic Increased at Westport Phase 2.

Additional model runs are conducted to assess the impact due to the each of the individual factors and findings are illustrated in Figure 4-6

Figure 4-6 Encounter Profile of Baseline Model (Geometry/Traffic)

Scenario C1 - Geometry Change	Scenario C2 -Traffic Change



Total Encounters = 922	Total Encounters = 337

In comparing results to the Baseline Risk level, it can be summarised from the analysis that:

- Changes in geometry only (rearranging existing traffic along the South Channel, without Westport Phase 2 traffic) will bring upon a reduced degree of risk at 2010 traffic level at 30% decrease against the Baseline Model (Scenario A); and
- Changes in Traffic along the new Channel (adopted only traffic generated at Westport Phase 2) will bring upon a risk level representing a 26% (337/1,314) of Baseline Model (Scenario A).

It can be reviewed that by either modification of existing traffic or introducing additional traffic generated at Westport Phase 2, the model predicts an encounter profile less than the Baseline levels. However, the compound effects of these factors, predominately due to crossing traffic along the South Channel, have led to an increase of 100% in encounter risk level against the Baseline Model.

4.5.2 Future Traffic Model with Westports Expansion

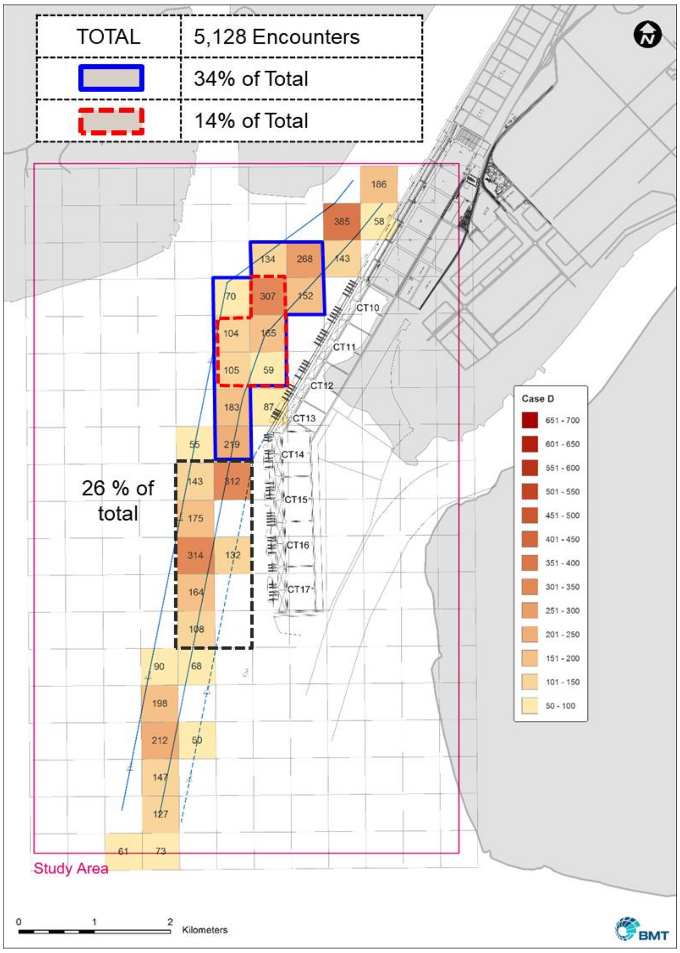
Scenario D

Scenario D has been developed to assess the impacts of the Westport Phase 2 considering future traffic growth. Encounter risk prediction considering the updated port layout is adopted onto future traffic condition including the generated traffic at the Westport Phase 2.

Additional marine activities generated at the Westport Phase 2 accounts for 44% of the overall traffic increase from the Baseline to Future Traffic Model.

Within the Study Area the model predicts an annual 5,128 of encounters. The encounter results for Scenario D is shown in Figure 4-7. Total encounters have increased by 20% from the Future Model (Scenario B).

Figure 4-7 Encounter Profile of Future Model with Westport Expansion

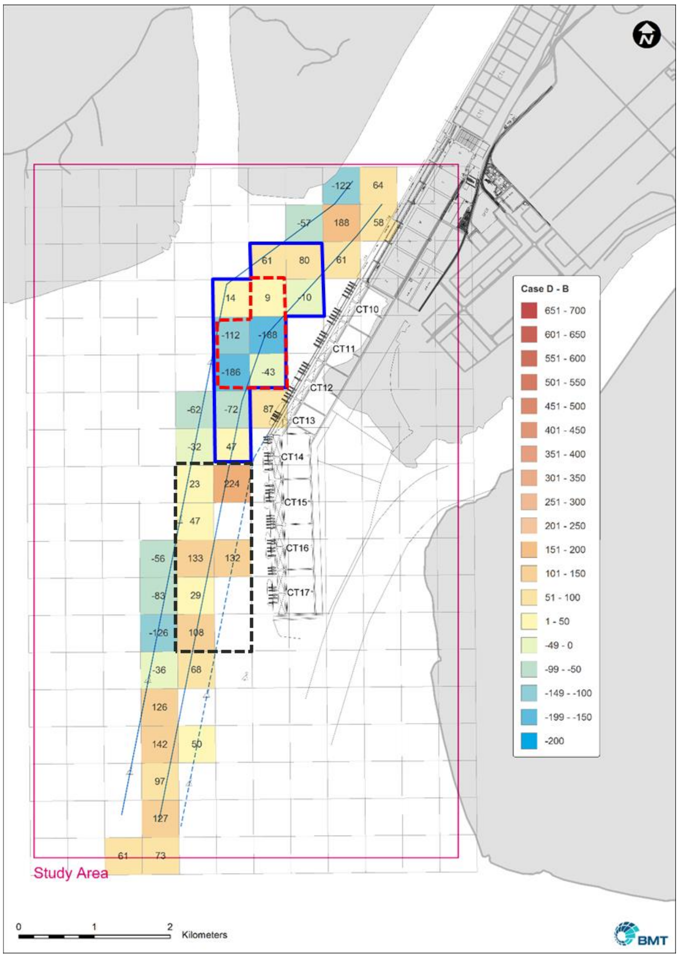


In view of spatial distribution of encounters, it is observed that in general most encounters take place at waterspace at:

- the turning section of South Channel (indicated in the Blue square 34% of total encounters), due to the traffic growth at existing Westport and other port facilities; and
- waters west of CT16 to CT17, (indicated in the Black square 26% of total encounters), where Westport Phase 2 vessel's departure routes (southbound) generate crossing traffic movements with existing traffic along the South Channel)

In view of the risk impact from the combined consequence of geometry change and increased traffic volume, the projected changes in risk level from the Future Model is illustrated in Figure 4-8.

Figure 4-8 Future Model - Changes in Encounters with Westport Phase 2

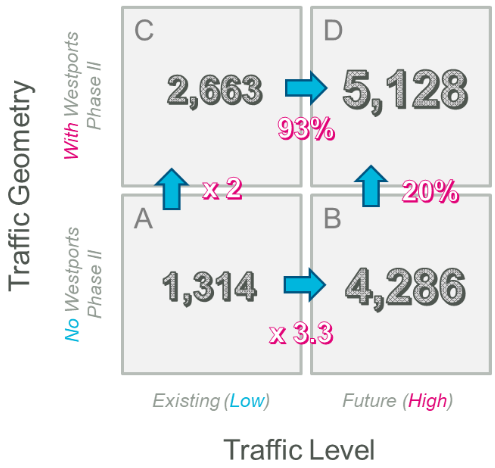


It is observed that the changes in encounters under the Future traffic model are focused (as compared to the Baseline Future traffic model – Scenario B) at waterspace comprising crossing traffic at near CT14 to CT17 along the South Channel.

4.6 Risk Assessment

The encounter numbers in each scenario and increment level are presented as:

Figure 4-9 Encounter Numbers Summary



The following key points are summarised from the marine traffic risk model:

- *Scenario A and Scenarios B*: Considering future traffic growth and with significant container vessels traffic along the South Channel a key result is that the 60% increase in total vessel traffic from 2018 to 2040 has led to 3.3 times (330%) increase in encounters.
- *Scenario A and Scenarios C*: from the analysis that the Westport Phase 2 layout impose constraints on the current vessels' navigation routes, total encounters has increased by 100% from the Baseline Model and increased numbers
- It can be concluded that the risk brought by the Westport Phase 2 is less than the risk due to traffic growth in future years.
- *Compound effect of Scenarios C*: in comparing results to the Baseline Risk level, it can be summarised from the analysis that:
  - Changes in geometry only will bring upon a reduced degree of risk at 2010 traffic level at 30% decrease against the Baseline Model; and
  - Changes in Traffic along the new Channel will bring upon a risk level representing only 26% of Baseline Model.
- Separate runs (C1 & C2) under Scenario C have been conducted to assess risk solely due to the traffic along the existing channel and risk due to traffic along Phase 2. The results have shown that the numbers of encounters have significantly reduced. Therefore findings from the model have predicted that

risk level can be managed by separation of traffic, i.e. traffic management, where C1 & C2 present as extreme cases.

- *Scenario B and D*: For assessing impact brought upon by the Westport Phase 2 geometry at future traffic conditions; by comparing Scenario B and D at future traffic level, the assessment identified a 20% increase in number of encounters due to 34% increase in total traffic.
- In view of spatial distribution of encounters, it is observed that in general most encounters take place at waterspace at the north end of the South Channel with a focus at the turn and at waterspace comprising crossing traffic at near CT14 to CT17 along the South Channel.

4.7 Summary

The marine risk from navigation within the Study Area has been developed following the analysis within the DYMITRI model. A risk assessment of encounters has been conducted for scenarios considering the existing and future traffic levels with and without the Westport Phase 2 development.

The port facility layout plan as developed in Section 2 have been assessed. The model identifies that the introduction of the Westport Phase 2 development along the South Channel has led to an increase of risk level due traffic growth in general and re-arrangement of traffic movements along the South Channel.

It needs to be recognized that increases in potential encounters risk level is unavoidable due to increased traffic volume. Addressing the safety concerns over the marine activities along the South Channel, risk control measures are reviewed and presented in the following sections.

5 Recommendations

5.1 Introduction

The previous section has reviewed and identified the change of traffic pattern, potential conflicts and risk level brought by the proposed implementation of the Westport Phase 2 development considering future traffic growth and possible impact on its adjacent waterspace.

On the basis of findings above, this section reviews the operational issues of the port facilities and recommends mitigation measures for the safe and efficient operation of future marine activities in the local waters.

5.2 Port Efficiency Measures

5.2.1 Operations

Existing Technology considers:

- VTMS - vessel traffic management system under the supervision of the PKA and this system provides information on vessels transiting the harbour such as cargo onboard, last and next port of call and the vessel's particulars
- Port Klang Net (PKNet) - system where information on container movement in and out of the terminals are updated to the system for tracking purposes.
- DagangNet - Westports is connected electronically to DagangNet that enables the exchange of information between shipping lines, customs and other maritime agencies.

Efficient port management involves optimising port activities and resources. Existing Vessel Traffic Management System control (http://www.pka.gov.my/index.php/en/facilities/vtms) may be enhanced by vessel scheduling and management that would seek to ensure no vessels, through their entire transit of the waterway, would be put in the position where an Active Encounter was created, and/or vessels moved quickly through the access/departure “pipeline” – all of which would reduce collision risk potential.

Increased efficiency could be achieved through the implementation of a centralised port management system and can only be achieved through full cooperation between VTC, port operators and pilots. A centralised management system can assist port users and traffic control unit to acquire up-to-date ship tracking information and allow efficient scheduling, in particular for departure movements, for better port operation planning and enhanced berth utilisation.

This would provide accurate information exchange between VTMS, ship and terminal operators, pilots, tugs, agents and customs, as it critical that the information/process is monitored, updated and communicated to all parties for time planning purposes.

Existing examples of this technology and applications are at present deployed in ports across the world; two examples include:

- Singapore Port's "PORTNET" system - a system designed to connect the shipping lines, hauliers, freight forwarders and government into a port community for integrated vessel management. A key indication on improved port efficiency have shown that, "PSA handle a 25% increase in container volume on a year-on-year basis"
- Additionally, the Port of Rotterdam has announced in 2012 its intent to adopt the Harbourmaster Management Information System (HaMIS) that aims to "enhance the efficiency of the nautical process to optimize port accessibility" to handle the forecast 40% increase in vessel movement in the next 20 years.

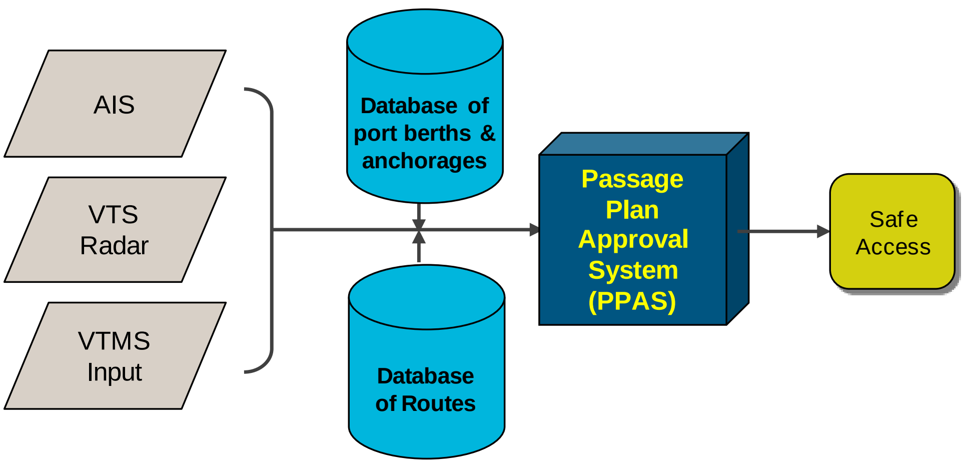
5.2.2 Ocean-going Vessel Passage Plan Approval System

An essential subset of port efficiency will be a "Passage Plan Approval System" (PPAS) which would permit real time forecasting of marine traffic movements based on the current VTS situation updating the initial Vessel Traffic Management System (VTMS) information. Specifically, the system would aim at:

- Predict traffic utilisation within fairways;
- Receipt and approval of passage plans, and
- Provide advice to vessel masters and pilots of potential vessel conflicts.

The architecture of the inputs to system may be illustrated as below:

Figure 5-1 PPAS System Data Architecture



All these elements of the system presently exist, and as vessel volumes along the access channels increase, and vessel size increases the flexibility of the system decreases: it is apparent that the system will become more constrained at peak periods during normal operations.

It is anticipated that the ships' passage plans will be received by VTMS personnel and the initial information entered into the VTMS, as at present. The position of all VTS participating vessels underway would be represented (with data from AIS), and as new vessels were introduced into the traffic system the computer would automatically evaluate the proposed passage plan and translate it into a ship definition and route which will be fed into PPAS to check for any conflicts during passage to the anchorage, berth, fairway or open sea.

Practical port management measures which embed the functionality of the PPAS are being implemented in workable platforms internationally for safer and more efficient navigation and berthing; such as the "PORTNET" system adopted in Singapore Port. It could be envisaged that port safety and efficiency in Port Klang could be managed through technology advancement and further development of a centralized vessel management system in a phased manner over the coming years.

It is in a early stage of the project to quantitively estimate the value of such a system, but if it had the potential of reducing the Active Encounters created; by scheduling of arrival and departure movements at Westport Phase 2 berths and therefore minimise the interaction involving a vessel crosses the fairway in front of another vessel in-transit.

6 Summary

BMT has conducted a preliminary analysis to identify and evaluate any traffic constraints and risk that potentially brought by the presence of Westports Expansion under the final layout plan.

Marine traffic activity has been reviewed, and developed from a series of sources, including historical port records and one month's position data of vessels, sampled for August 2018. Vessel type, size, position and speed have been evaluated.

Projection of vessel activities at Westport for the future case has been established based on a capacity reaching 15M TEUs and 12M TEUs at CT1 to 9 and Westport Phase 2 respectively.

A baseline marine traffic model has been established based on vessel tracks as identified from AIS data and has adopted the traffic volume in 2018/19 and in forecast year of Westport Phase 2 (2040) as baseline and future case respectively.

The risks associated with this traffic increase have been examined by simulation within BMT's Dynamic Marine Traffic Simulator. It was identified that:

- It can be concluded that the risk brought by the Westport Phase 2 is less than the risk due to traffic growth in future years
- In view of spatial distribution of encounters, it is observed that in general most encounters take place at waterspace at the north end of the South Channel with a focus at the turn and at waterspace comprising crossing traffic at near CT14 to CT17 along the South Channel. .

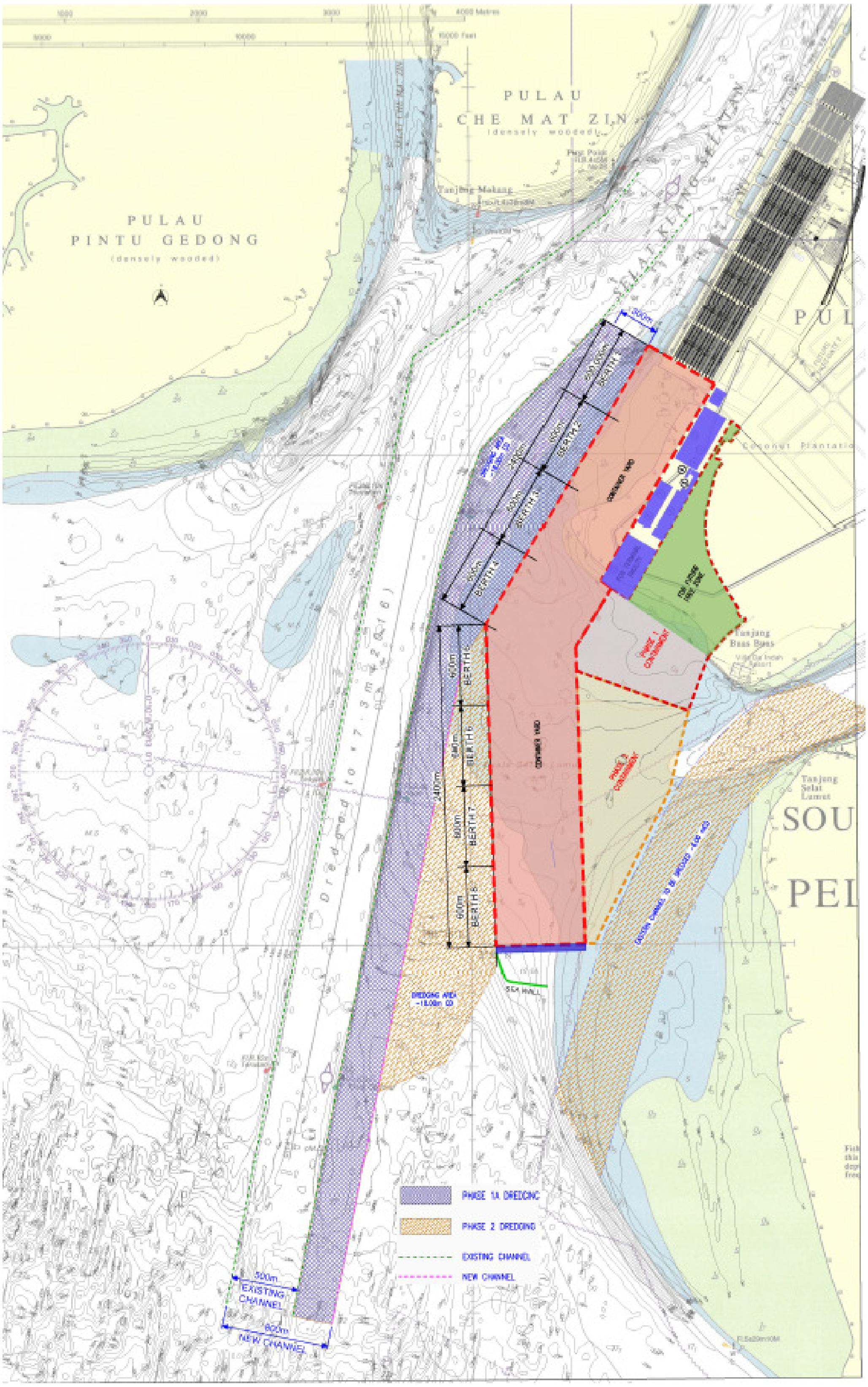
Recognizing the particular concerns over the marine activities along the South Channel and waters adjacent to the berths of Westport Phase 2, risk control measures are reviewed. Recommendations of mitigation measures to address the impacts have been made in relation to traffic management for the approach and departure activities at the Westport Terminals and development of an Automated Passage Plan System as a holistic approach to manage all vessels movements along the South Channel.

Appendix A

Modelled Traffic Input

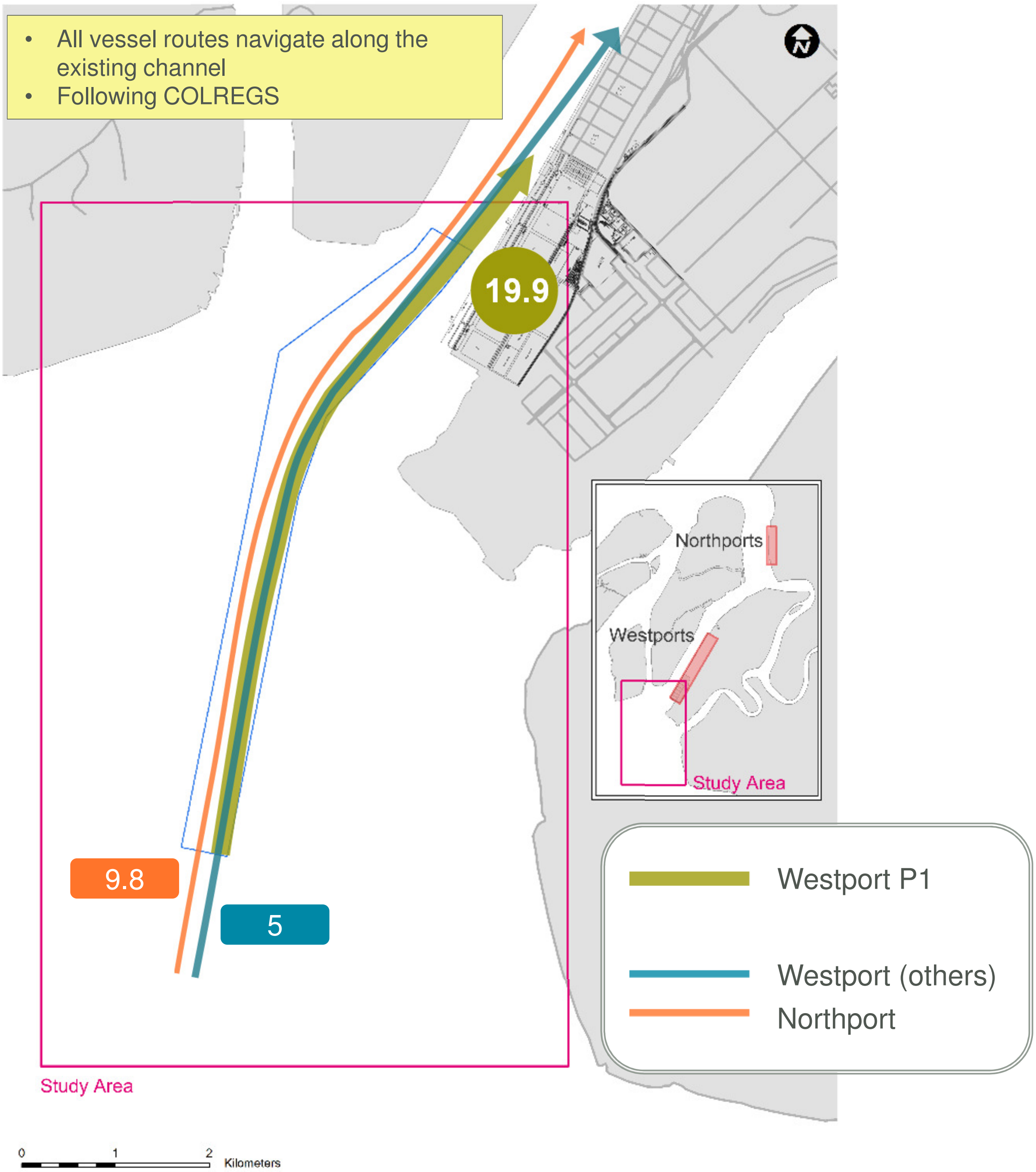
Model Scenario	**A**	**B**	**C**	**D**
Total Daily Arrival	**31.5**	**50.2**	**48.5**	**68.7**
Description	Baseline	Future Baseline	Baseline + Phase 2	Future
Traffic Activities	2018 level	2040 level	2018 level	2040 level
Westport Phase 1	✓10M TEUs	✓15M TEUs	✓10M TEUs	✓15M TEUs
Westport Phase 2			✓12M TEUs	✓12M TEUs
Conventional Terminal	✓	✓	✓	✓
LBT 5				✓
Cruise Terminal	✓	✓	✓	✓
NorthPort	✓	✓	✓	✓

Modelled Port Layout



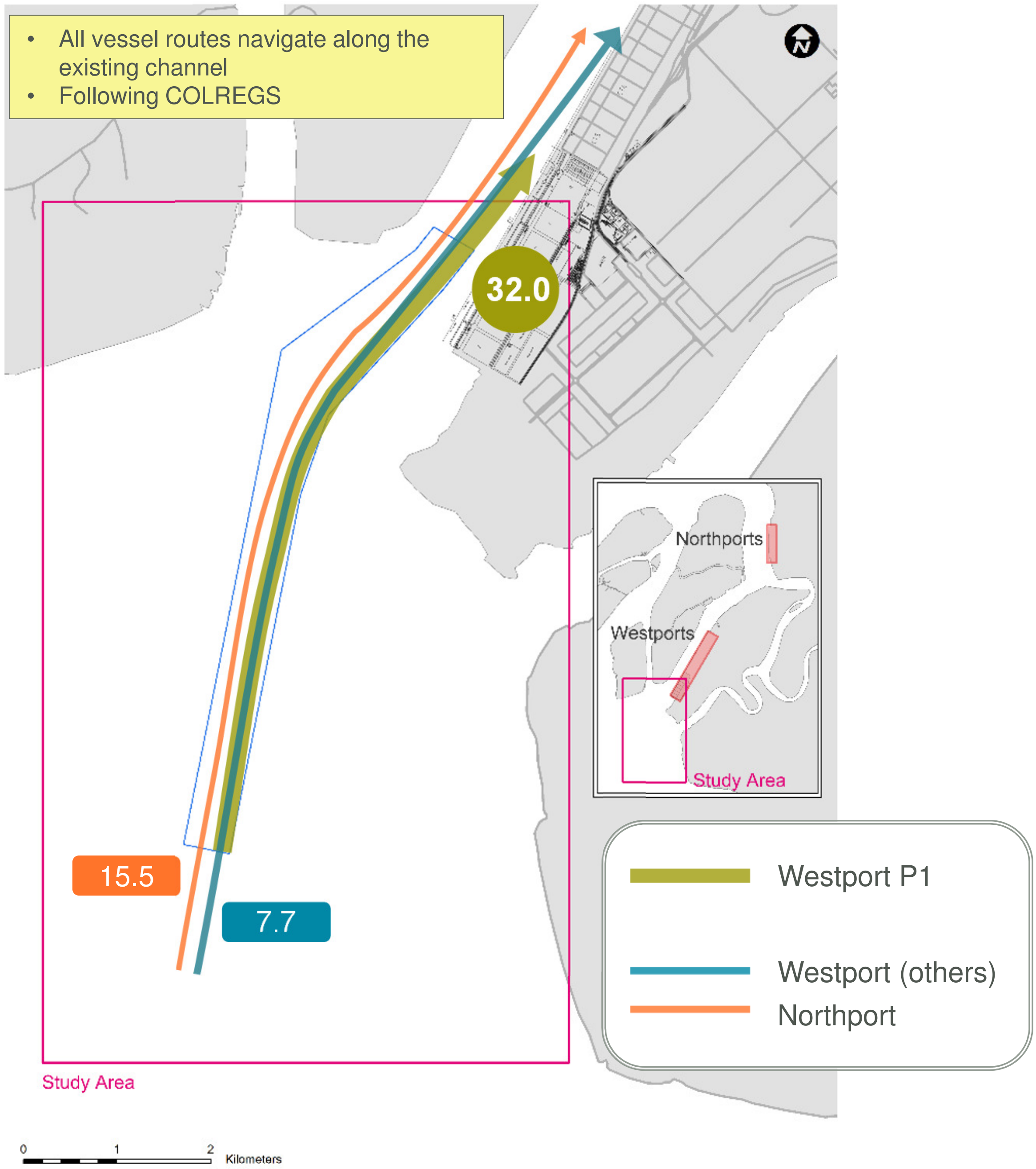
Scenario A – Baseline (all traffic along existing channel)

Traffic Activities	2018 level	
Westport Phase 1	✓10M TEUs	19.9
Westport Phase 2	*not included*	/
Conventional Terminal	✓	4.5
LBT 5	*not included*	/
Cruise Terminal	✓	0.5
Northport	✓	9.8
	Total Daily Arrival	**34.7**



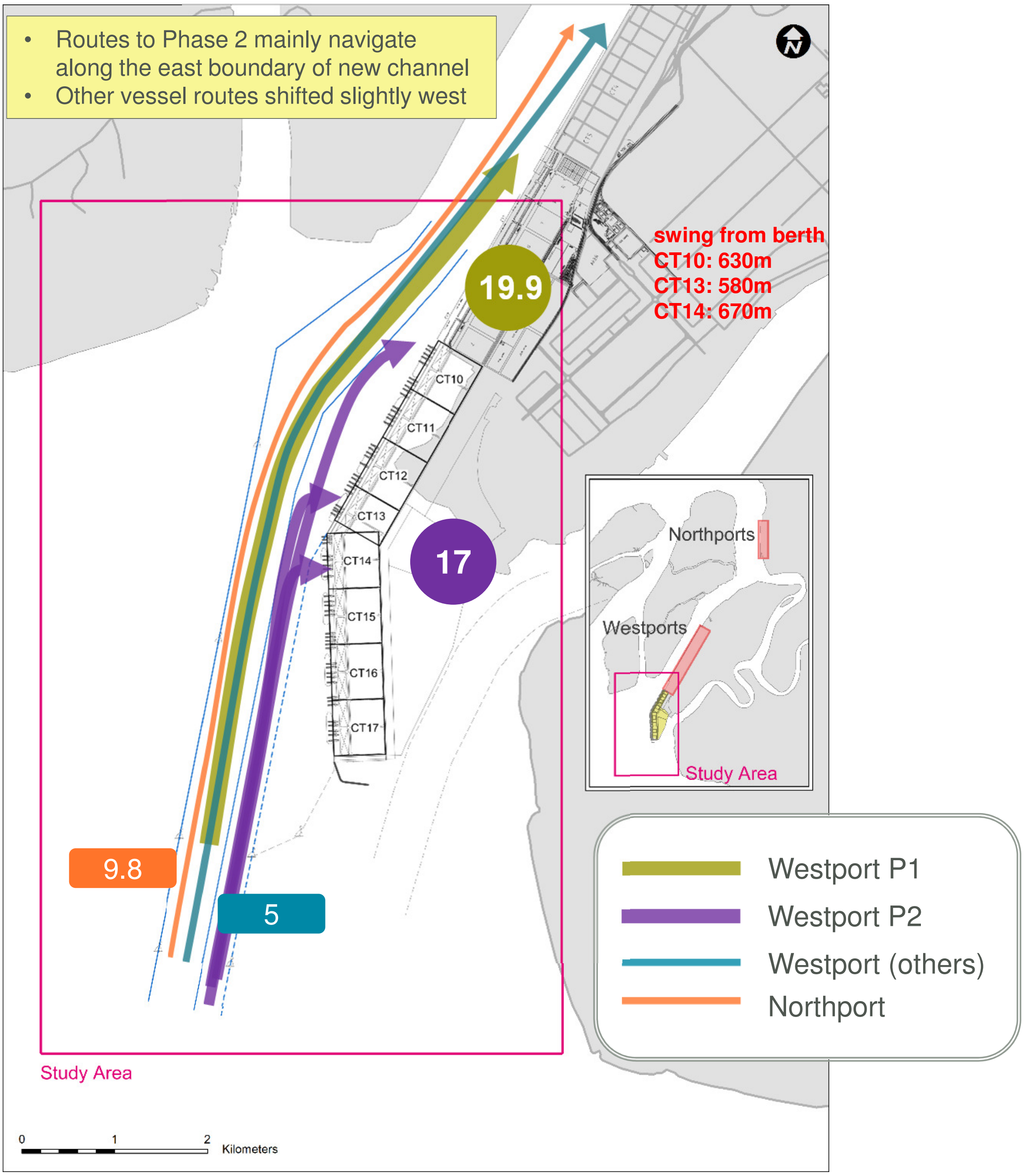
Scenario B – Future Baseline (all traffic along existing channel)

Traffic Activities	2040 level	
Westport Phase 1	✓15M TEUs	32.0
Westport Phase 2	*not included*	/
Conventional Terminal	✓	6.8
LBT 5	*not included*	/
Cruise Terminal	✓	0.9
Northport	✓	15.5
	Total Daily Arrival	**55.2**



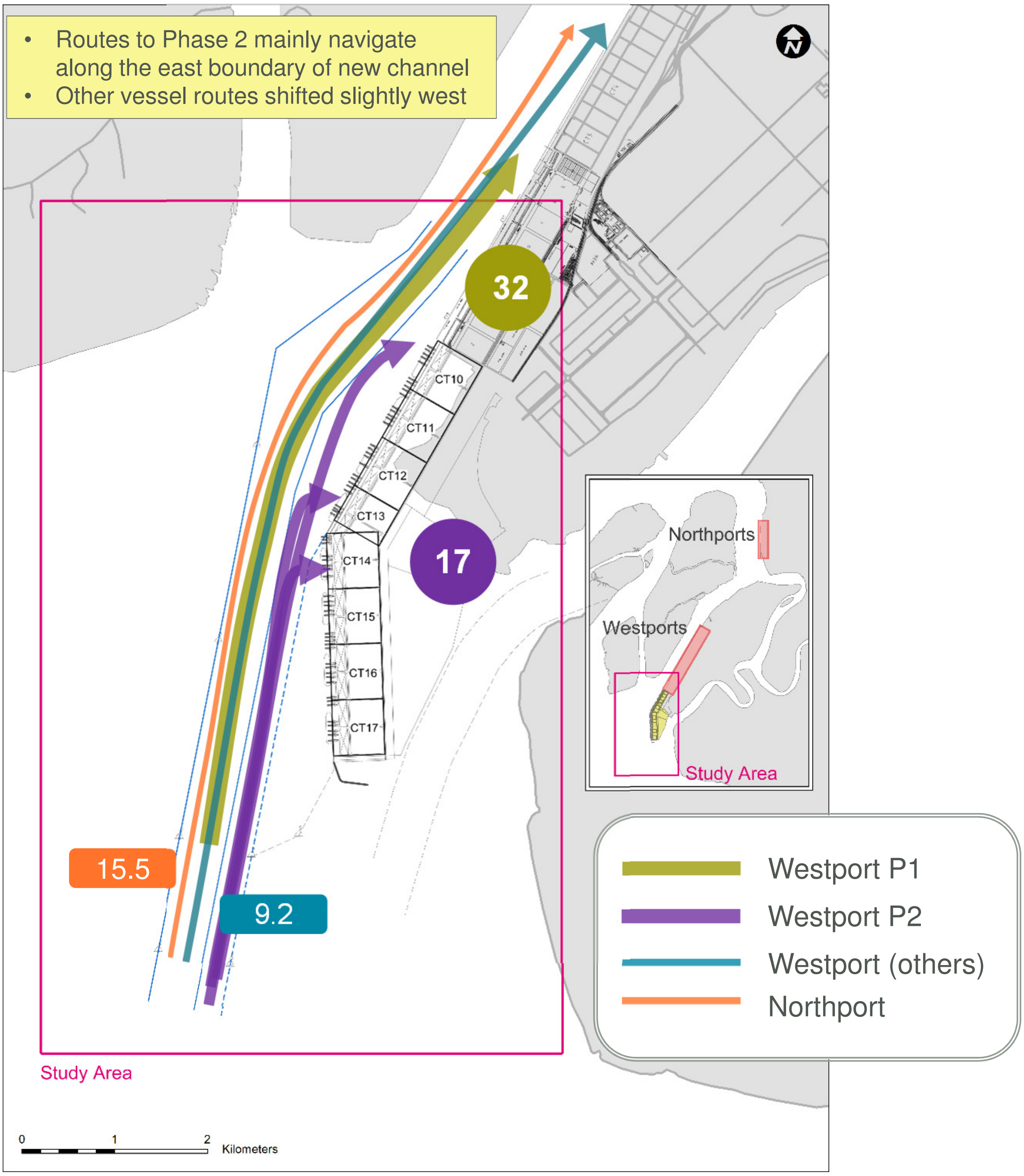
Scenario C – Baseline & Phase 2

Traffic Activities	2018 / 2040 level	
Westport Phase 1	✓10M TEUs	19.9
Westport Phase 2	✓12M TEUs	17
Conventional Terminal	✓	4.5
LBT 5	*not included*	/
Cruise Terminal	✓	0.5
Northport	✓	9.8
	Total Daily Arrival	**51.7**



Scenario D – Future (CT10 to CT17) Phase 2A & 2B

Traffic Activities	2040 level	
Westport Phase 1	✓15M TEUs	32
Westport Phase 2	✓12M TEUs	17
Conventional Terminal	✓	6.8
LBT 5	✓	1.5
Cruise Terminal	✓	0.9
Northport	✓	15.5
	Total Daily Arrival	**73.7**



	Scenario A		Scenario B		Scenario C				Scenario D	
	Baseline		Future Baseline		Baseline & Phase 2				Future	

Container Vessels

Vessel Calls by LOA in Westports, April 2018 - March 2018

Vessel LOA	Annual Arrival	TEU per exchange	Scenario A: Vessel Arrival CT 1 - 9 (Baseline) — Daily — Forecast at 10M TEU at Phase 1	Scenario A: Annual TEU ('000) for Baseline	Scenario B: Vessel Arrival CT 1 - 9 (Phase 1) — Daily — Forecast at 15M TEU	Scenario B: Annual TEU ('000) for Baseline (Forecast at 15M TEU)	Scenario C: Vessel Arrival CT 1 - 9 (Baseline) — Daily — Forecast at 10M TEU at Phase 1	Scenario C: Vessel Arrival CT 10 - 17 (Phase 2) — Daily — Forecast at 12M TEU at Phase 2	Scenario C: Annual TEU ('000) at Phase 2	Scenario C: Vessel Arrival Baseline + CT10 - 17 — Daily	Scenario D: Vessel Arrival (Phase 1 + Phase 2) — Daily — Forecast at 15M TEU at Phase 1; Forecast at 12M TEU at Phase 2	Scenario D: Annual TEU ('000) at Phase 1 and 2
50 - 100	535	209	1.5	115	2	153	1.5	0	0	1.5	2	153
100 - 150	543	569	1.5	311	2	415	1.5	0	0	1.5	2	415
150 - 200	2345	906	6.5	2150	8	2646	6.5	0	0	6.5	8	2646
200 - 250	662	1,153	1.9	799	8	3366	1.9	7	2946	8.9	15	6312
250 - 300	2189	1,696	6	3715	9	5572	6	5	3096	11	14	8668
300 - 350	501	2,319	1.4	1185	2	1693	1.4	3	2540	4.4	5	4233
350 - 400	371	4,416	1.1	1773	1	1612	1.1	1	1612	2.1	2	3224
>400	0	5,500	0	0	0	0	0	1	2008	1	1	2008
WestPort	**7146**	**9,823**	**19.9**	10,049	**32**	15,458		**17**	12,200	**36.9**	**49**	27,658

Daily Arrival

Forecast at WestPort is established based on:

* Ship Arrival Records from April 2018 to March 2019
* TEU exchange is established based on TEU by Vessel LOA Records from April 2018 to March 2019

Assumption
Phase 1: Full Capacity is 15M TEUs
Phase 2: Full Capacity is 12M TEUs

Conventional Termainl

Vessel Calls by LOA in Westports, April 2Arrival (Apr 2018 - March 2019)

Vessel LOA	Annual Arrival	Scenario A: Vessel Arrival Conventional Terminal — Daily	Scenario B: Vessel Arrival Conventional Terminal — Daily — Rate of change from 2018 to 2 50%	Scenario C: Vessel Arrival Conventional Terminal — Baseline Traffic	Scenario D: Vessel Arrival Conventional Terminal — Daily — Rate of change from 2018 to 2040 50%
<=100	182	0.5	0.8	0.5	0.8
100 – 150	600	1.7	2.6	1.7	2.6
151 – 200	679	1.9	2.9	1.9	2.9
201 – 250	69	0.2	0.3	0.2	0.3
251 – 300	1	0.1	0.2	0.1	0.2
301 – 350	6	0.1	0.2	0.1	0.2
351 – 400	0	0	0.0	0.0	0.0
>=401	0	0	0.0	0.0	0.0
Conventional Terminal	**1537**	**4.5**	**6.8**	**4.5**	**6.8**

Forecast at Conventional Terminal is established based on:

* Ship Arrival Records from April 2018 to March 2019

Assumption
Assuming no expansion on existing facility, a growth rate of 50% from 2018 to 2040 at existing capacity is adopted

Cruise Terminal

Cruise Liner Arrival in 2019

		Annual	Scenario A: Vessel Arrival Cruise Terminal — Daily	Scenario B: Vessel Arrival Cruise Terminal — Daily — Rate of change from 2018 to 2 100%	Scenario C: Vessel Arrival Cruise Terminal — Baseline Traffic	Scenario D: Vessel Arrival Cruise Terminal — Daily — Rate of change from 2018 to 2040 100%
January	31					
February	31					
March	34					
April	19					
May	7					
June	4					
July	0					
August	0					
September	0					
October	2					
November	10					
December	24					
Annual	162		0.4	0.9	0.4	0.9
Naval Ship Arrival in 2018	10		0.0	0.1	0.0	0.1
Cruise Terminal	**172**	**172**	**0.5**	**0.9**	**0.5**	**0.9**

Forecast at Cruise Terminal is established based on:
* Cruise Liner arrival schedule in 2019
(http://crew-center.com/klang-malaysia-cruise-ship-schedule-2019)

* Naval Ship records identifies 10 arrivals in 2018 (provided by Westport)

Assumption
The current usage at the cruise liner berth ranges from 0 - 31 monthly arrival and possible growth may be expected.

Assuming no expansion on existing facility, a growth rate of 100% from 2018 to 2040 at existing capacity is adopted

LBT5

Estimated Monthly Future Traffic by Westport

		Scenario D: Vessel Arrival LBT5 — Daily
LNG Vessel – Import (Qmax)	2	
LNG Vessel - Export	7	
LPG Vessel – Import (VLGC)	2	
LPG Vessel - Export	30	
Annual	492	1.5
LBT5		**1.5**

Forecast at LBT5 established based on:

* Expected Monthly Arrival for:
LNG Vessel – Import (Qmax)
LNG Vessel - Export
LPG Vessel – Import (VLGC)
PG Vessel - Export

* Total Monthly Arrival = 41

NorthPort

		Scenario A: Vessel Arrival NorthPort — Daily — Pecentage of Traffic along South Channel 74%	Scenario B: Vessel Arrival NorthPort — Daily — Rate of change from 2018 to 2 58%	Scenario C: Vessel Arrival NorthPort — Baseline Traffic	Scenario D: Vessel Arrival NorthPort — Daily — Rate of change from 2018 to 2040 58%
Port Klang Authority Annual Arrival	4843	9.8	15.5	9.8	15.5
NorthPort		**9.8**	**15.5**	**9.8**	**15.5**

Forecast at NorthPort established based on:

* Statistics by Port Klang Authority identifies;
Total Arrival at Port Klang (2018) = 14,547
Total Annual Arrival Record (2018) at Port Klang for Container + Conventional = 13,518
Total Annual Arrival Record (2018) at Westport for Container + Conventional = 8,675
Therefore Total Annual Arrival Record (2018) at Notthport Container + Conventional = 4,843
(or Daily Arrivals = 4,843 / 365 = 13 at Northport)

Based on AIS Data, it is identifed that out of the total traffic to Northport, 26% transits via the north entrance and 74% transits via the South Channel.

Therefore 74% of total arrival at Northport will transits via the South Channel and include in the traffic Model.

Adopting a cargo growth rate based on Westport (Phase 1) from 9.6TEUs in 2018 to 15M TEUs in 2040, a CAGR of 2.1% is calculated and equals a rate of change of 58% from 2018 to 2040.

For a conservative approach, assuming a similar growth rate at Westport is applied in Northport and taken in consideration of no significant expansion, a growth rate from Baseline to Future of 58% on traffic at Northport is adopted

	Scneario A	Scneario B	Scneario C	Scneario D
Marine Traffic Model Input	**34.7**	**55.2**	**51.7**	**73.7**