WORKING PAPER 2M

MARINE TRAFFIC RISK ASSESSMENT (MTRA) REVIEW REPORT

By

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MARINE TRAFFIC AND NAVIGATIONAL RISK ASSESSMENT ASPECTS FOR WESTPORTS DEVELOPMENT PROPOSED EXPANSION OF CONTAINER TERMINAL CT10 – CT17 AND ITS ASSOCIATED WORKS AT WESTPORTS PULAU INDAH SELANGOR

By

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For

WESTPORTS MALAYSIA SDN.BHD.

FINAL REPORT

April 2020

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1 THE PROJECT

1.1 BACKGROUND TO THE PROJECT

The proposed project is to construct and operate another **8 additional new terminals,** i.e. **CT10 – CT19,** as a continuation from the end of the existing Container Terminal CT9 at Westports, Pulau Indah. With the expansion from the existing 9 container terminals there will be a total of 17 container terminals. This project is very important for Westports Sdn Bhd to increase their current port handling capacity from 15 million TEUs to 27 million TEUs.

This **Marine Traffic Risk Assessment** (MTRA) forms one of the many studies the project is required to undertake for approval of the project. The existing 9 Container Terminals consisting of 18 berths had been operating safely in Pulau Indah for many years. This MTRA study addresses the marine activities within and in the proximity of 5km radius of the proposed Container Terminals site and includes commercial shipping, fishing and recreational activities.

To assess the effect of the proposed expansion works on the shipping and navigation, a Marine Traffic and Navigational Risk Assessment ("MTRA") was carried out in accordance with the recommendations contained in the Formal Safety Assessment by the International Maritime Organisation and with reference to the Notis Perkapalan Malaysia NPM 02/2019.

The MTRA recognises that shipping is subject to a regulatory regime comprising of a number of international conventions. In summary, these conventions address safety of life at sea, the prevention of pollution of the marine environment as well as the standards and training of personnel onboard vessels. In conducting the assessment, compliance with regulatory requirements is presumed. It however recognises that the extent of application of the requirements does vary with a number of factors including the size and type of vessels. The assessment acknowledges that persons on recreational crafts and fishing vessels may not be trained, nor have the level of competence expected of a professional mariner.

The MTRA study was based on the information obtained through:

- a marine traffic survey conducted over a period of time in order to appreciate the existing marine traffic patterns and fishing operations by visiting the site and also observing the traffic pattern through the visual as well as AIS monitoring from the AIS centre. The results of this survey provided a comprehensive list of vessel traffic types, routing information and provided a baseline for future forecasting; and
- stakeholders consultation.

The main considerations for the assessment are:

- during the construction period encompassing the reclamation works and progressing into the construction of the berths and its associated facilities; and
- continuous operation of the Container Terminals upon completion and commissioning.

In conducting the MTRA, a range of vessel types and numbers had been included in the assessment criteria. The assessment acknowledges that the increased number of vessels increases the number of personnel (vessel crew) in the area.

1.2 INTRODUCTION AND BACKGROUND OF WESTPORTS

Westports started out as Kelang Multi Terminal Sdn. Bhd. (KMT) in 1994. It was renamed as Westport Sdn. Bhd. since 1997 and now, the world-renowned port carries the name Westports Malaysia Sdn. Bhd. The seaport terminal has played a leading role in Malaysia's efforts to provide storage, bunkering, cargo/freight handling and other port related facilities which add to Malaysia's importance as a link in the global maritime trade.

In the early 90's, in order to have a major port of call for shipping lines in the port industry with world-class facilities, a large swathe of swampland near a remote fishing village in Pulau Indah, located on the west coast of Selangor was deemed to be the most strategic and sustainable location. Thus, land reclamation exercise was carried out on the identified site and this was followed by the construction of an extensive quay complemented by port facilities that make Westports the nation's largest multi-purpose port.

Initially operating as a conventional terminal, Westports gradually transformed into a mega hub for both local and transhipment containers. Today, Westports serves as the main gateway for container and conventional cargo for central Peninsular Malaysia hinterland, thanks to the strategic location and deep-water berth which allows it to accommodate large vessels.

The location of the proposed project is given in **Figure 1** below, showing the location of Westports and the neighbouring port facilities of Northport, Port Klang Free Zone (PKFZ) and Port Klang Authority (PKA).

With the recent increase in shipping activities at Port Klang, there is a need to expand the port facilities in this region. This chapter of the Marine Traffic and Navigational Risk Assessment (MTRA) report provides some background on the need for the proposed expansion of Westports in line with the nation's growth in maritime trade.

This MTRA report covers the marine risk associated with the construction and operations of the new container terminals referred to as Westports Phase II expansion or "the Project" from hereon, and its associated works for container handling by Westports Sdn. Bhd.

Figure 1 Location of Westports, Port Klang Authority (PKA), Northport & Port Klang Free Zone (PFKZ)

Source: Port Klang Authority Annual Report 2016

1.3 GROWTH AND EXPANSION OF TERMINALS AT PORT KLANG & WESTPORTS

Port Klang, which is recognised as Malaysia’s principal gateway and busiest port, is strategically located on the west coast of Peninsular Malaysia at the northern end of the Straits of Malacca, about 50km west of the nation’s capital Kuala Lumpur. Port Klang is generally made up of three ports, i.e. the **Northport, Southport** (Southpoint) and **Westports**.

In the year 2000, Northport and Southport merged into one entity, currently known as Northport (M) Bhd. Since then, Westports has been further developed because the other port terminal operators were facing a shortage of space for terminal expansion.

Westports is targeted to be the main port terminal operator due to the higher capacity to cater for very large volumes of cargo throughput. Over the years, Westports has been expanding its container terminals to cater for the increase in shipping activities i.e. import, export and transhipment.

In 2018, container throughput at Westports has improved to 9.5 million TEUs, an improvement from 9.0 million TEUs in the previous year. Its container volume has grown exponentially, making Westports the leading terminal operator in Port Klang controlling 75% of the market share as at year end 2017.

The total cargo throughput at Port Klang has been on a rising trend over the past 13 years, whilst other ports i.e. Port of Penang, Pulau Pinang and Port of Kuching, Sarawak have consistently maintained an average of 15 million metric tonnes.

1.4 AUTHORITY REQUIREMENT AND REFERENCES

The Project falls under two of the prescribed activities listed in the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015, under the First and Second Schedules as shown below. As a prescribed activity, an Environmental Impact Assessment (EIA) study shall be carried out and the EIA report submitted to the Department of Environment (DOE) Malaysia for approval.

- First Schedule of the Order Activity No. 15 Dredging Item 15(a): Capital dredging. Item 15(b): Disposal of waste dredged materials.

- Second Schedule of the Order Activity No. 7 Land Reclamation Item 7(a): Coastal reclamation or land reclamation along riverbanks involving an area of 50 hectares or more.

In response to this requirement, Westports Sdn Bhd (Westports) through SMHB Sdn. Bhd the lead environmental consultant has engaged Aycity Emmar Technologies Sdn. Bhd. to prepare and submit a MTRA as part of the EIA report.

This MTRA has been undertaken in accordance with the methodology of the Formal Safety Assessment ("FSA") as produced by the International Maritime Organisation ("IMO") - MSC/Cir.1023/MEPC/Cir.392 and the Marine Department Malaysia Shipping Notice No. 2/2019.

The following references has been made for compilation of this report:

- Bathymetry Study by EGS (Malaysia) Sdn Bhd
- Hydraulic Study and MetOcean by DHI Water & Environment (M) Sdn Bhd
- Desktop Shiphandling Simulation by BMT
- 3D Full Mission Simulation by KASI (Malaysia) Sdn Bhd
- Marine Traffic Risk Assessment (MTRA) by BMT
- Preliminary Environment & Social Impact Assessment Report by SMHB Sdn Bhd

1.5 AIMS AND OBJECTIVES OF MTRA

The aims and objectives of the MTRA are to:

- identify hazards to navigation and shipping due to the proposed Project arising from the movements and transiting of vessels during the construction and operation of the Project;

- determine the likely effects of these hazards;
- evaluate the impacts of those hazards; and
- recommend mitigation measures where necessary.

1.6 PROJECT TEAM

1.6.1 PROJECT PROPONENT

The Project Proponent is Westports Malaysia Sdn Bhd with contact information as follows:

Westports Malaysia Sdn Bhd

P.O.Box 266, Pulau Indah

42009 Port Kelang

Selangor Darul Ehsan, Malaysia

Contact Person: Mr Ahmad Damanhuri Bin Ibrahim, Head of Civil Engineering (The Projects)

Telephone: (03) 31694000

Facsimile: (03) 31694100

Email: ahmad@westports.com.my

1.6.2 MTRA CONSULTANT

This MTRA is carried out by Aycity Emmar Technologies Sdn Bhd. The address and contact information are as follows:

AYCITY EMMAR TECHNOLOGIES SDN. BHD

2A 1st Floor, Block 2

Worldwide Business Park,

Jalan Tinju 13/50,Section 13,

40675Shah Alam, Selangor Malaysia.

Contact Person: Azimbazri Bin Abdul Shukor:

Email: aycity@gmail.com

Phone: 603 – 55116103

Fax: 603–55117103

The specialists who undertook this MTRA study are listed in Error! Reference source not found., ogether with their roles and qualifications.

Table 1 MTRA Specialists And Their Qualifications

Name	Role	Qualification
Azimbazri Bin Abd Shukor	Aids to Navigation Specialist	Registered and Approved DOE& Marine Department Marine Risk Consultant
Captain Halim Bin Othman	Marine Specialist	B.Sc. Nautical Studies,Indonesia Certificate of Competency Deck Officer Class 1 (Master Mariner) – Indonesia

2 PROJECT DESCRIPTION

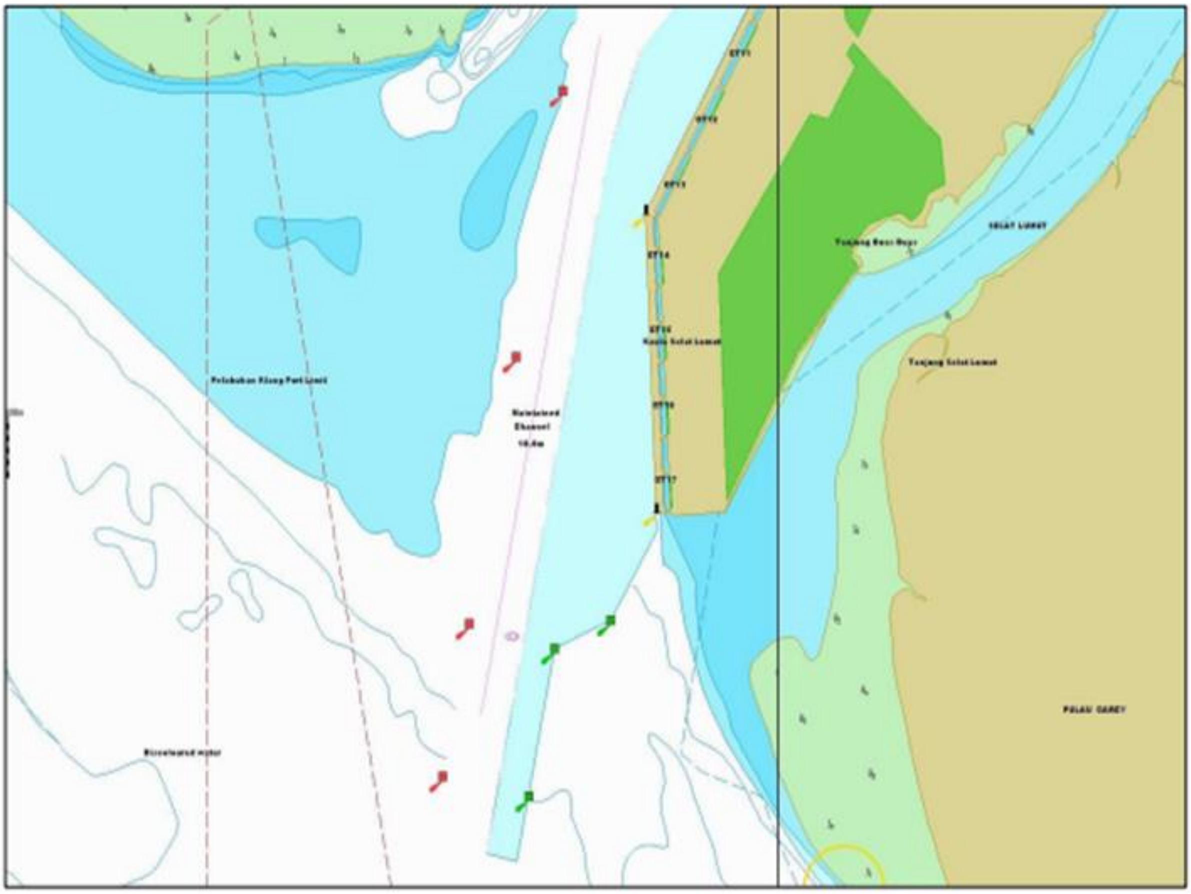
2.1 PROJECT LOCATION

The proposed project location is to the southwest of the existing container terminal CT9 Westports as shown in the **Figure 2** and **Figure 3** below.

Figure 2 Location of the Marine Facilities within Port Kelang Port Limits and the Project

Source: Notice KS/LPK/01/2012 Port Klang Authority (2012)

Figure 3 Proposed Expansion Container Terminals Location on FMSS



Source: KASI (Malaysia) FMSS

2.2 PROJECT COMPONENTS

The proposed Project involves the construction of the port facilities on the approximately 542ha of reclaimed land at the southwestern tip of Pulau Indah. The components of the Project are briefly described below:

- The construction of 8 new terminals with nominal length of 600m each that will be able to accommodate 16 berths on the proposed site location as indicated in the boundary site plan;
- Dredging works for the approach channel and berthing area as indicated in their respective drawings;
- The installation of all fittings to the terminal including containers, cranes, etc; and
- Land filling of the area behind the terminals with dredged material to acceptable ground level.

Figure 4 Proposed Site Location & Layout of Westports Phase II

Source: Google Earth (adapted on 10th July 2019)

2.3 PROPOSED WESTPORTS CONTAINER TERMINALS EXPANSION AND ITS ASSOCIATED WORKS – PHASING AND LAYOUT ARRANGEMENT

Table 2 Existing Port Phasing at CT1-CT9 at Westports

Year	2008	2013	2015	2016	2018	2019
CT Operation	CT1 – CT5	CT6	CT7	CT8	CT9 (P1)	CT9 (P2)
No. of Berths	10	2	2	2	2	2
Total No. of Berths	10	12	14	16	18	20
Total Capacity (mil TEUs)	7.5	10	10	11	14	15

Source: BMT

Table 3 Proposed Phasing of Wesports Phase II Expansion

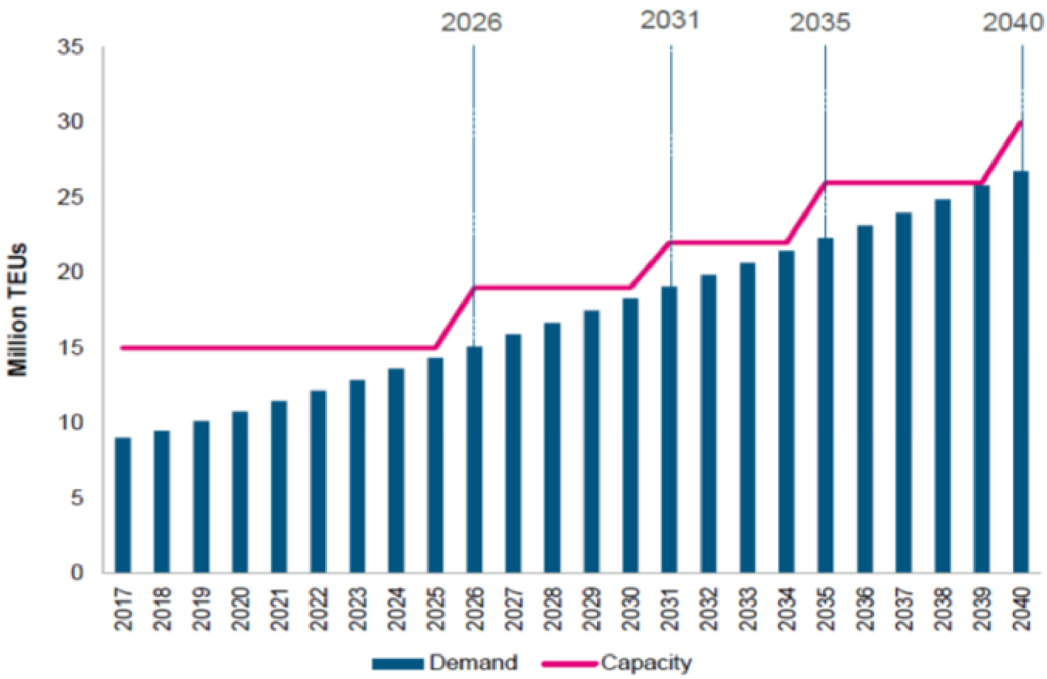
Phasing	Phase 1	Phase 2
Development of Container Terminals	CT10 – CT13	CT14 - CT17
No. Of Berths	4	4
Planned Year of Completion (upon completion of reclamation works)	2025	2032

Figure 5 Proposed Terminals Layout Arrangements

Point	Approximate Coordinates	
	Latitude	Longitude
A	N 2°54'25.04"	E 101°16'43.35"
B	N 2°54'15.84"	E 101°16'59.17"
C	N 2°54'04.81"	E 101°17'05.55"
D	N 2°53'18.74"	E 101°17'06.52"
E	N 2°52'57.15"	E 101°16'52.18"
F	N 2°52'00.82"	E 101°16'29.23"
G	N 2°51'58.76"	E 101°16'05.68"
H	N 2°53'18.18"	E 101°16'03.79"
I	N 2°53'12.74"	E 101°16'25.04"

Source: Google Earth (adapted on 10th July 2019)

Figure 6 Phasing Plan of Westports Phase II Extension



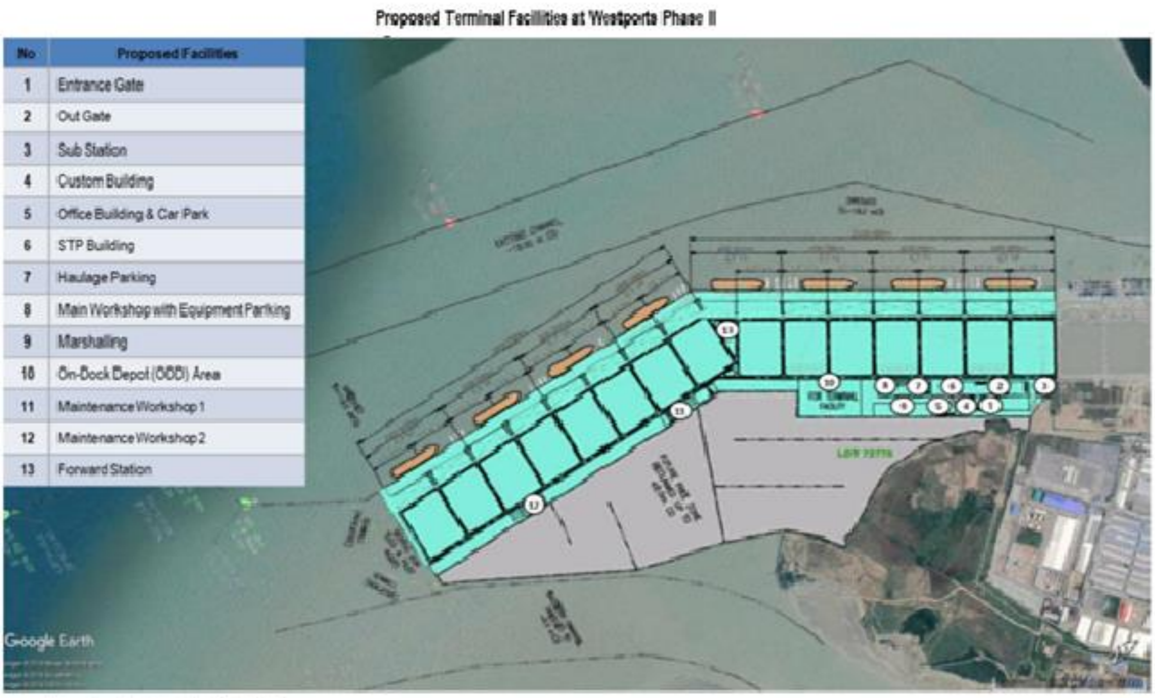
Source: BMT

Figure 7 Proposed Dredging Area, Container Terminals and Containment Area

Source: Google Earth (adapted on 10th July 2019)

2.4 METHOD STATEMENT OF WORKS INCLUDING SCHEDULING

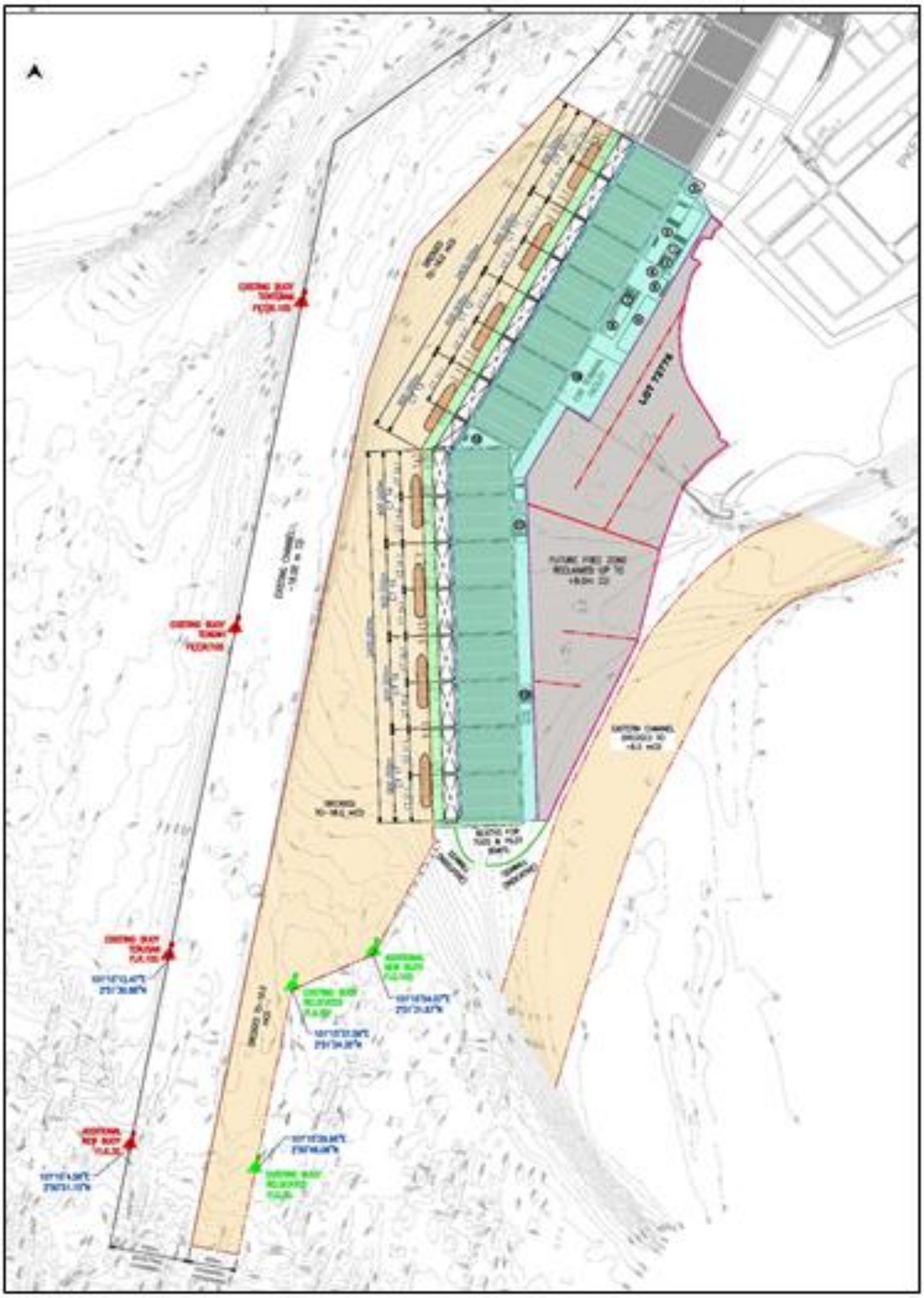
Figure 8 Proposed Terminal Facilities



Source: Google Earth (adapted on 10th July 2019)

2.4.1 DREDGING & RECLAMATION WORKS AND CONSTRUCTION OF CONTAINER WHARF

Figure 9 Final Layout Plan



Source : SMHB

2.4.2 COMMISSIONING/ OPERATIONAL PHASE

Figure 10 Final Layout Plan Phase 1

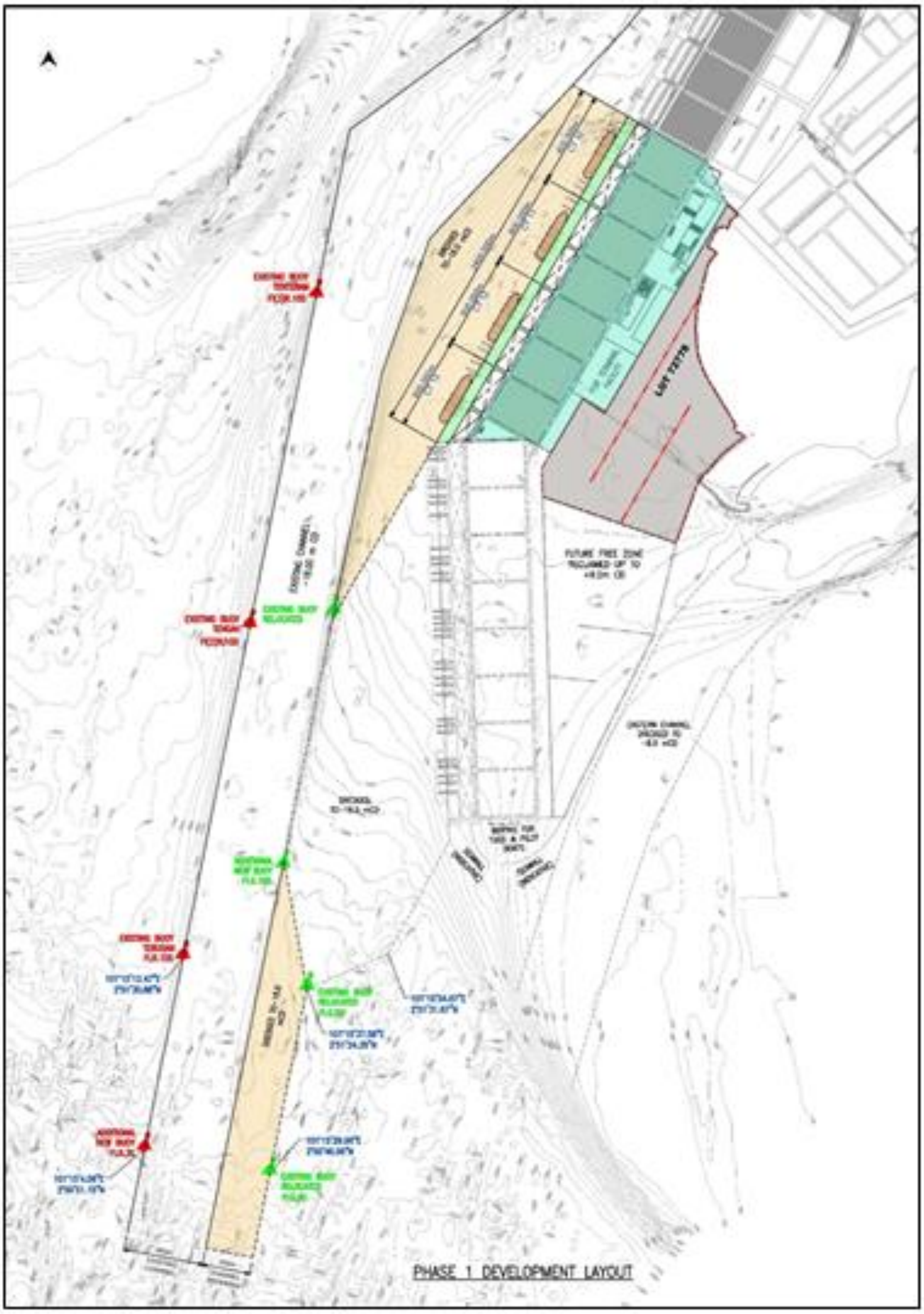
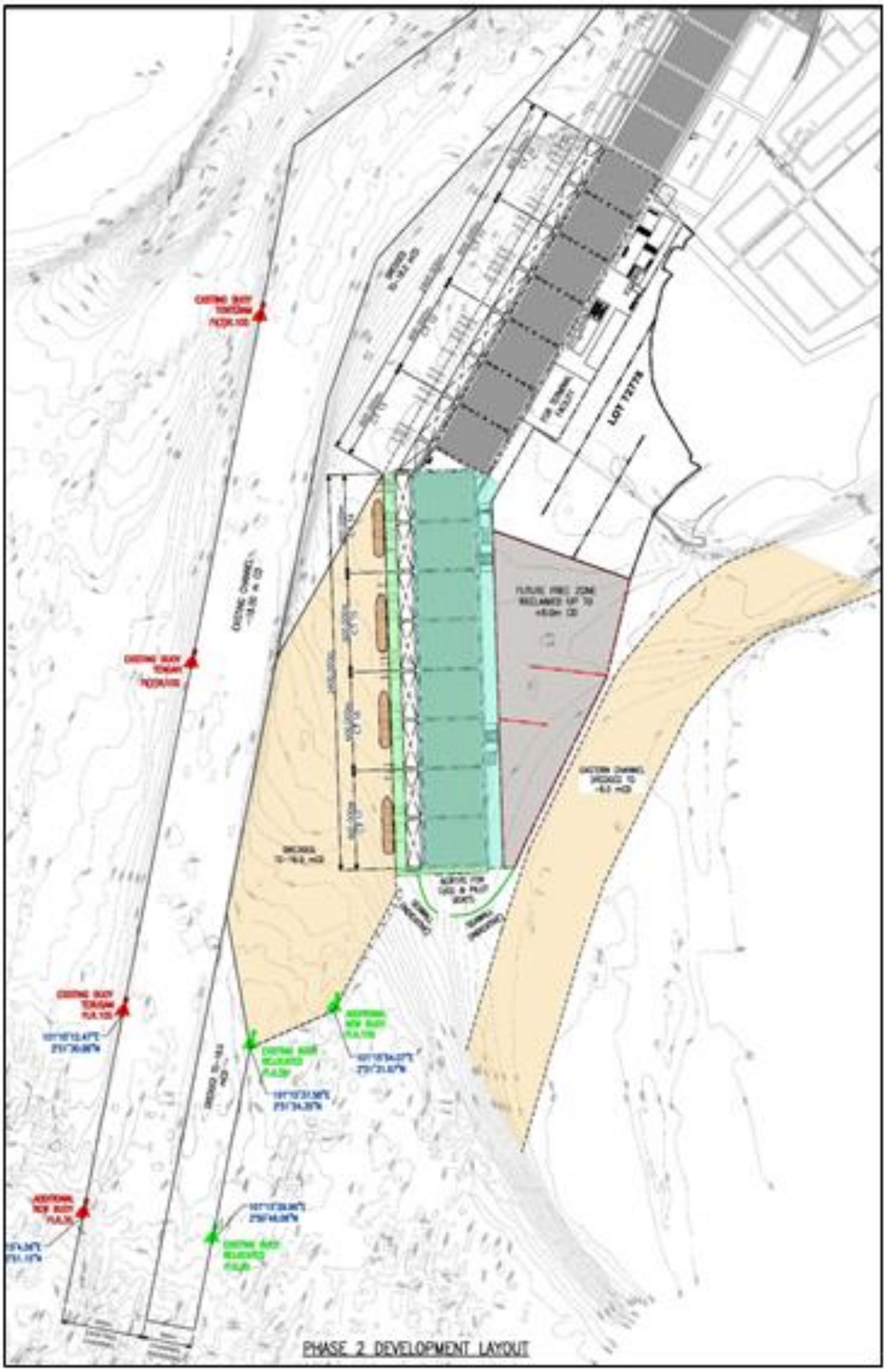


Figure 11 Final Layout Plan Phase 2



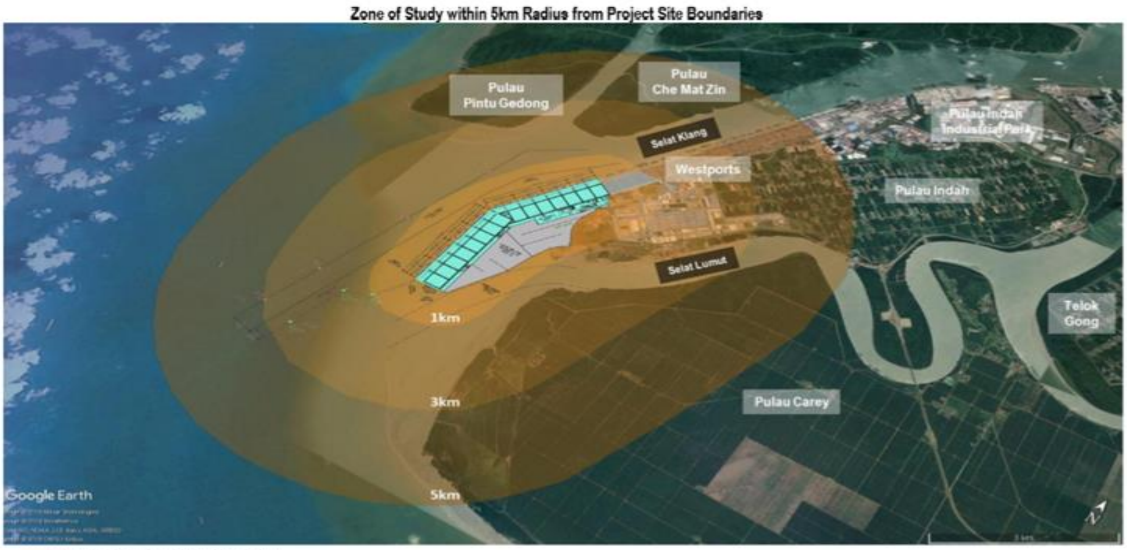
2.4.3 CONSTRUCTION WORKS

The proposed Project is expected to commence in 2021 and the construction period is expected to take 30 years and will be completed in 2050.

2.5 THE LIMITS OF THIS REPORT

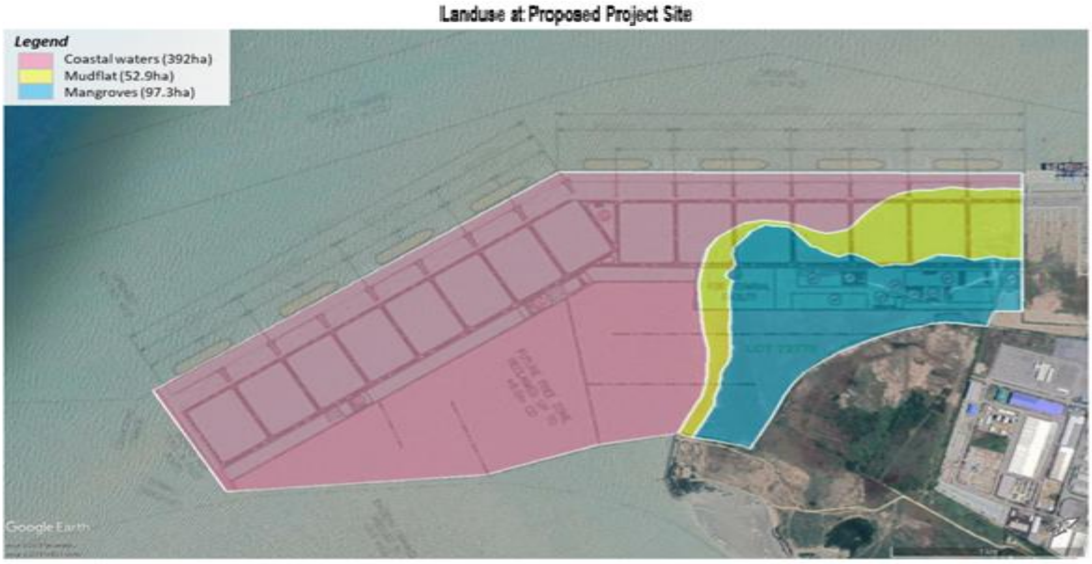
This report does not cover the entire waters within the port limits of Port Klang. The limit of the study area is within a general 5 km radius from the centre of the project site as indicated in the **Figure 12** below.

Figure 12 General Limits of the Study Area covered by this Report



Source: Google Earth (adapted on 10th July 2019)

Figure 13 Landuse at the Project Area

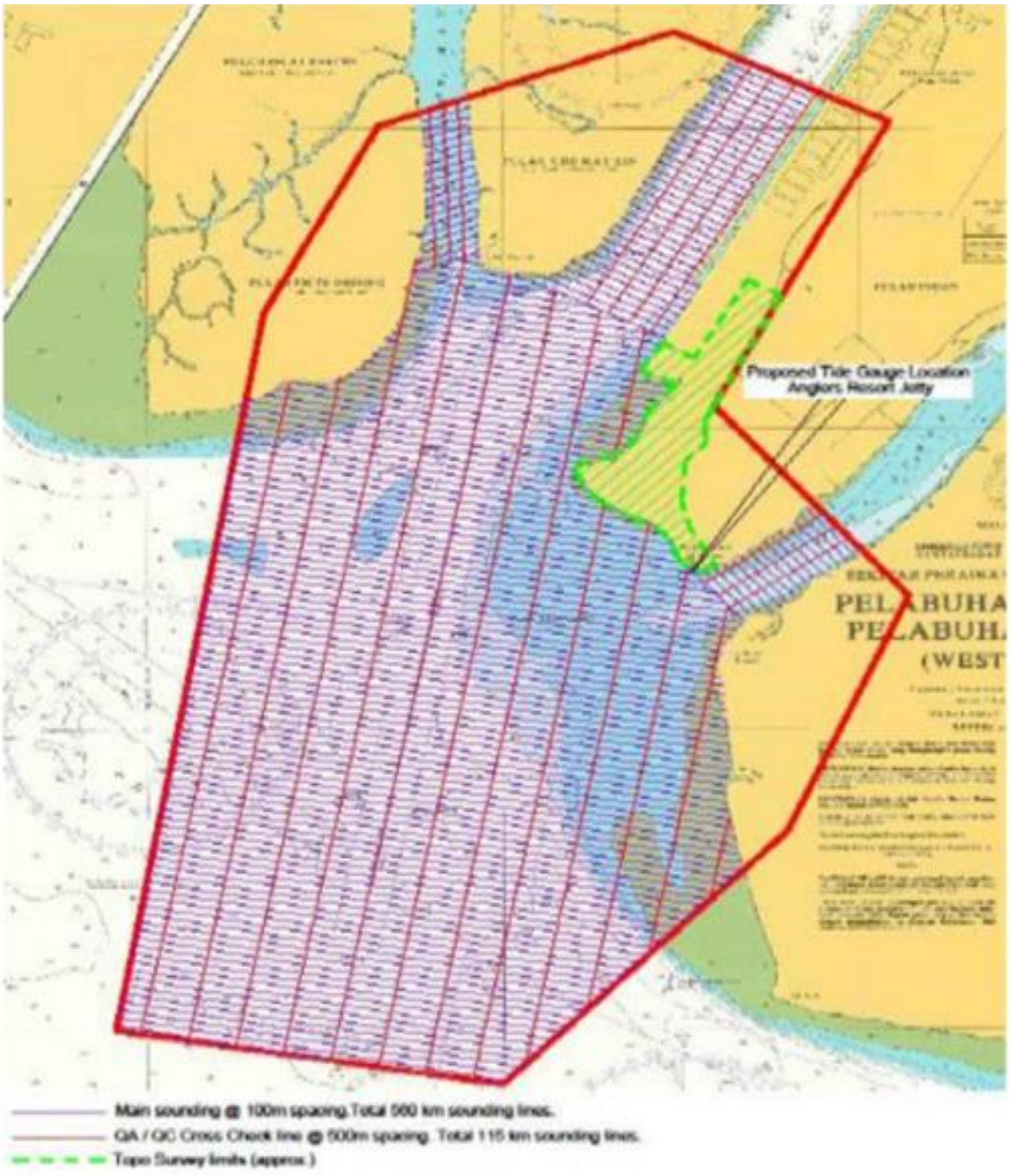


Source: Google Earth (adapted on 10th July 2019)

2.5.1 THE BATHYMETRIC SURVEY OF THE PROPOSED SITE

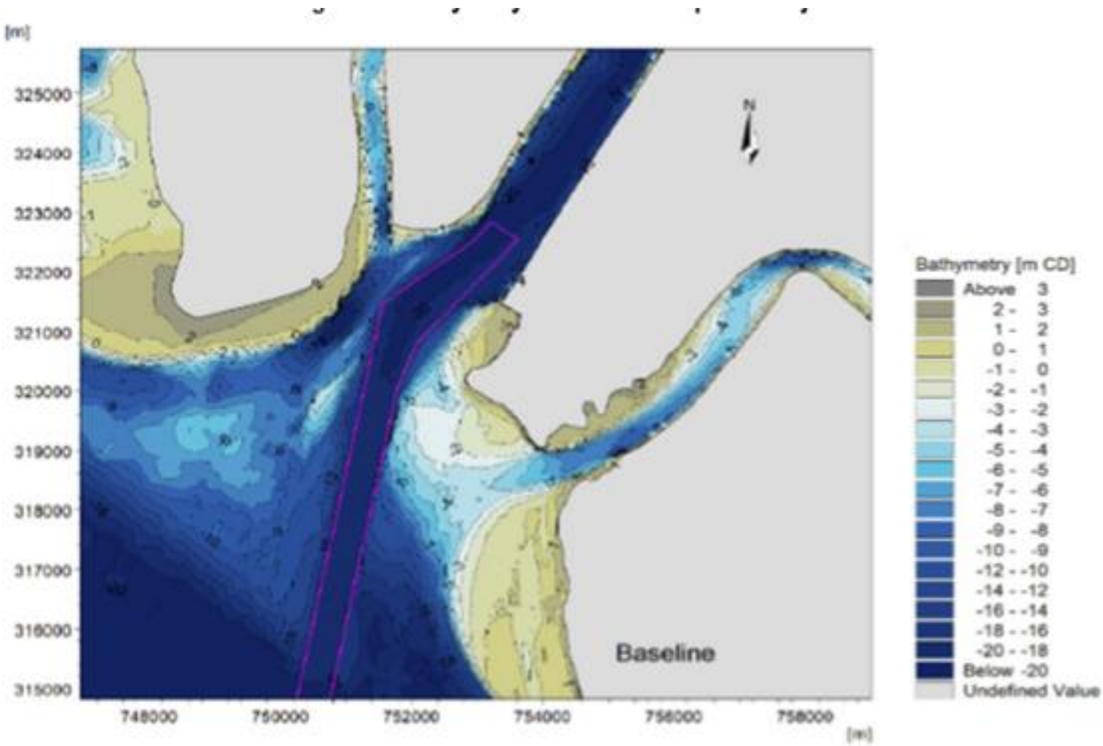
The sea chart for Westports MAL5300 published and prepared by the National Hydrographic Centre of Royal Malaysian Navy and the latest Bathymetry survey by EGS (Malaysia) Sdn. Bhd. were used as references for this MTRA. Bathymetric survey of the proposed project site was also carried out by EGS (Malaysia) Sdn Bhd in July 2018 and a copy of the survey results is given in **Figure 14** below. The proposed project requires dredging works from the existing navigational channel to the wharf frontage to ensure that the channel is sufficiently deep for the intended size of vessels to use the proposed terminals. The sounding figures given below was reduced to mean sea level for the location.

Figure 14 Hydrographic Multibeam Sounding at the Container Terminals Location



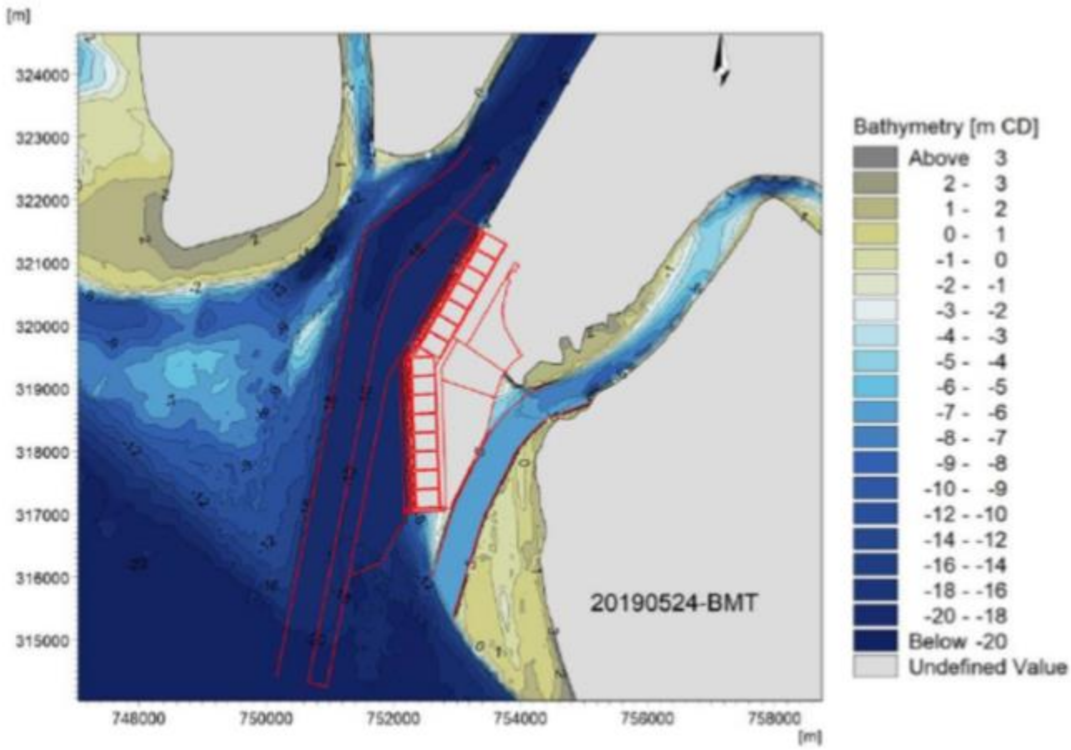
Source: Topographic & Bathymetric Survey Report, EGS (Malaysia) Sdn Bhd (July 2018)

Figure 15 Bathymetry Chart at the Project Site



Source: DHI Malaysia

Figure 16 Bathymetry Chart with Incorporation of Final Port Layout



Source: Hydraulic Study for Westports Expansion by DHI dated 18th June 2019

3 EXISTING SITE CONDITIONS

3.1 INTRODUCTION – THE PORT

Westports is a manmade port from the originally swampy area at Pulau Indah which provided natural sheltered harbour from the waves of the Straits of Malacca. The area falls within the Port Klang port limits declared under the Merchant Shipping Ordinance, 1952 as shown in **Figure 17** below. It is an industrial free trade zone port. The port limit covers the Selat Klang waterway and the navigable rivers within the port area, and extends south of Pulau Carey.

Figure 17 Gazetted Port Limits of Port Klang and 3 Ports Location

3.2 WESTPORTS – BACKGROUND AND FACILITIES

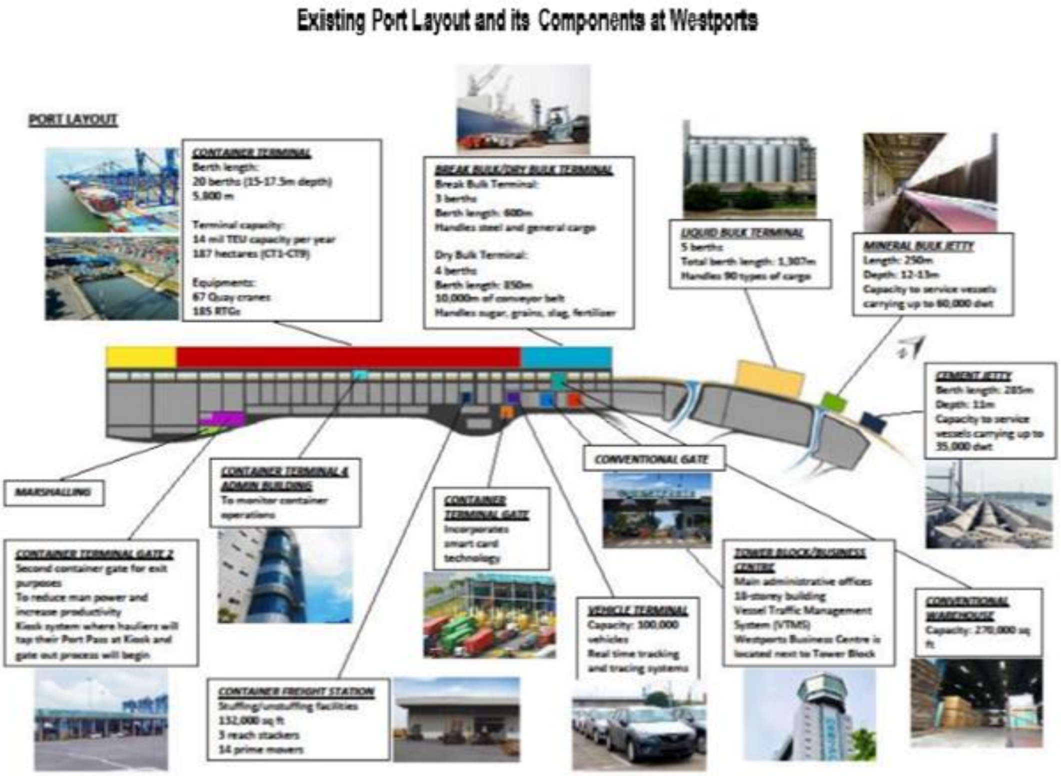
3.2.1 EXISTING PORT COMPONENTS

The existing port components comprise of container terminals, break bulk, dry bulk, liquid bulk terminals, mineral bulk jetties and cement jetties. Other port components include the tower block, business centre, container terminal gate, vehicle terminal, maintenance and repair bays and marshalling centre. **Figure 18** shows the existing port layout and its components at Westports whilst the functions of the components and services are as listed in **Table 4**. The existing port facilities consisting of wharves, yards and buildings at Westports, their uses, year of construction and the build-up area are as summarized in **Table 5**. Meanwhile, **Table 6** shows the type and number of facilities available at Westports, i.e. berths, storage yards and equipment.

3.2.2 PORT FACILITY AND INDUSTRY

Pulau Indah's economic growth to a large extent is based on Westports port facilities and the industrial development that is driven by the port. Westports and the development of Pulau Indah began in 1994 with its master developer, Central Spectrum Sdn Bhd. According to the developer's website, as of 2016, about 500 companies have established operations in the Pulau Indah Industrial Park and the Halal Hub in areas related to manufacturing, chemicals, freight forwarding, materials handling, fabrication, logistics, warehousing, labelling and packaging, food processing and production, etc. This does not include the industrial premises located inside the Port Klang Free Zone and the liquid bulk handling and storage area operated by Westports. By the end of 2019, a new regional distribution and supply chain centre for ASEAN will be set up by IKEA, the Swedish furniture retailer. This is in addition to the Selangor Bio Bay, a biotechnology R&D centre and a mixed-use project currently planned by Central Spectrum Sdn Bhd. With respect to impacts, job creation, employment opportunities, income generation, livelihood improvement, intensification of usage of local ancillary services, and strengthening the value chain in targeted industries, are some of the direct and indirect multiplier effects that are likely to arise from the continued operation and expansion of Westports and the existing, committed, and proposed industries in Pulau Indah.

Figure 18 Existing Marine Facilities at Westports



Source: Westports webpage, http://www.westportsmalaysia.com/Port_Layout-@-Port_Layout.aspx

Table 4 Existing Port Components and Services at Westports

No.	Port Components / Services	Functions
a)	Container Terminals (CT1 – CT9)	Wharf and yard for berthing and storing containers
b)	Dry Bulk Terminal	Handles minerals or grains stored in loose piles which moves without mark or count, e.g. potash, industrial sand, wheat, sugar
c)	Break Bulk Terminal	Manages non-containerised general cargo, e.g. iron, steel, machinery, wood pulp, yachts
d)	Liquid Bulk Terminal	Handles cargo transported and stored in liquid form, e.g. palm oil, diesel oil, petrol
e)	Mineral Bulk Jetty	Manages mineral resources, e.g. iron ores
f)	Cement Jetty	Transports cement using loading/discharging pipes, which connects jetty to consignee facilities
g)	Bulk Storage	Handles steel, timber, agriculture and mineral cargoes
h)	On-Dock Depot (ODD)	Stores empty boxes within terminals
i)	Reefer (Refrigerated Containers)	Handles temperature sensitive cargoes
j)	Bunkering	Supplies fuel for ships docking at terminals
k)	Distripark	Provides storage services and warehousing of cargoes
l)	Container Freight Station (CFS)	Transit point for global cargo distribution
m)	Vehicle Transit Centre (VTC)	Provides services for pre-shipment and pre-delivery inspections and minor repairs

There are 4 types of marine facilities available within the vicinity of Westports comprising container terminals, break bulk terminals, dry bulk terminal, liquid bulk terminals, mineral bulk jetties and cement jetties.

Table 5 Port Facilities and its Current Uses at Westports

Port Facility	Description & Current Use	Year of Construction	Build-Up Area ('000m^2)
CT1			
Wharf and Yard	Wharf and yard for berthing and storing containers	1997	91.2
Buildings	Container gate, Marshalling building, Storage facilities and M&R workshop	1996	6.1
CT2			
Wharf and Yard	Wharf and yard for berthing and storing containers	1997 & 2000	150.0
Buildings	Storage facilities	1999	2.7
CT3			
Wharf and Yard	Wharf and yard for berthing and storing containers	2001	131.4
Buildings	Storage facilities	2003	38.3
CT4			
Wharf and Yard	Wharf and yard for berthing and storing containers	2005	137.6
Buildings	Admin building and M&R workshop	2007	19.2
CT5			
Wharf and Yard	Wharf and yard for berthing and storing containers	2008	137.6
CT6			
Wharf and Yard	Wharf and yard for berthing and storing containers	2011 & 2012	180.3
CT7			
Wharf and Yard	Wharf and yard for berthing and storing containers	2013 & 2014	175.8
Buildings	Container gate, Marshalling Centre, M&R workshop	2016	127.1
CT8			
Wharf and Yard	Wharf and yard for berthing and storing containers	2016	263.1
CT9			
Wharf and Yard	Wharf and yard for berthing and storing containers	2017	100.1

Table 6 Current Facilities at Westports

Components	Container Terminals	Liquid Bulk*	Dry Bulk	Break Bulk*
Berths				
Number of berths	20	5	5	3
Length (metres)	5,800	1,307	1,135	600
Draft (metres)	15.0 – 17.5	9.0 – 16.5	13.5 – 15.0	15.0
Storage				
Annual capacity (mil TEUs)	14			
Reefer points	2,428			
Warehouses (sq. metres)			11,706	6,689
Open yard (sq. metres)			-	68,840
Equipment				
Quay cranes	67			
Rubber-tyred gantry cranes	185			
Straddle carriers/empty stackers	16			
Prime movers	524			
Trailers	466			
Reach stackers	11			

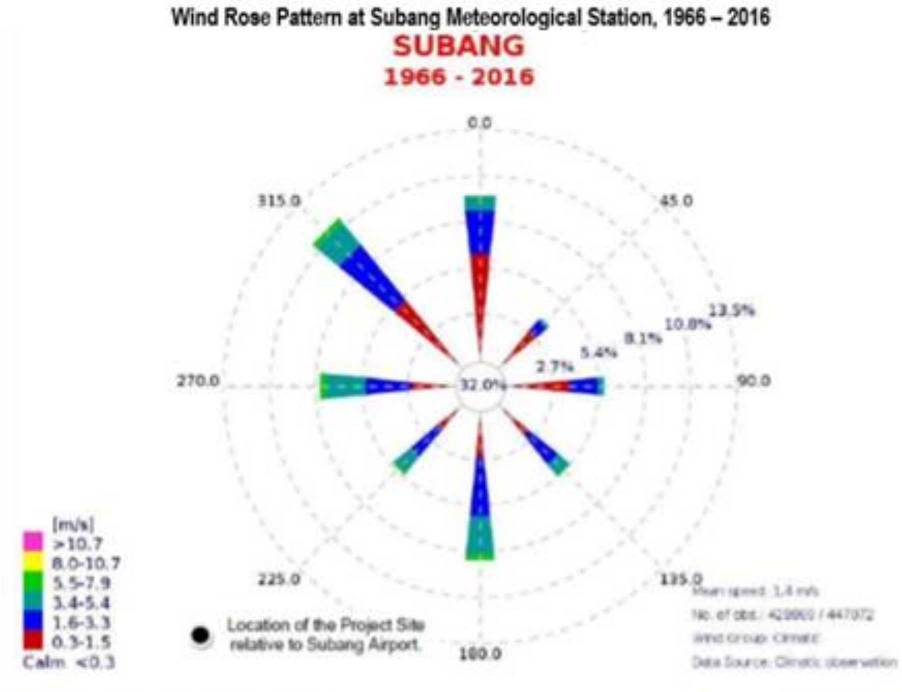
Source: Port Klang Authority's Official Portal (April 2019), http://www.pka.gov.my/index.php/en/facilities-/container-.html
**Data obtained as at June 2018.*

3.3 MET-OCEAN CONDITIONS

3.3.1 WIND

Wind roses showing the prevailing wind speed and wind direction at the project location for the different averaging periods are shown in **Figure 19**, and annual percentage of wind directions and speed recorded at Subang Meteorological Station Subang are shown in the **Table 7** below.

Figure 19 All Year Wind Rose For 50 Years Recorded Showing Wind Speed & Direction



Source: Malaysian Meterological Department (2016)

Generally, the northeast (NE) monsoon is characterised by strong persistent winds of above 8 m/s from the north-easterly sector between December and March. The withdrawal of the NE monsoon occurs between April and May with the formation of largely unsteady wind fields. From June through to September, south-easterly to south-westerly winds are observed during the southwest monsoon (SW). The withdrawal of the SW monsoon is indicated by the wind shifting towards a more northerly direction between October and November.

Table 7 Annual Percentage Frequency of Wind Direction and Speed

Annual Percentage Frequency of Wind Direction and Speed at Subang Meteorological Station

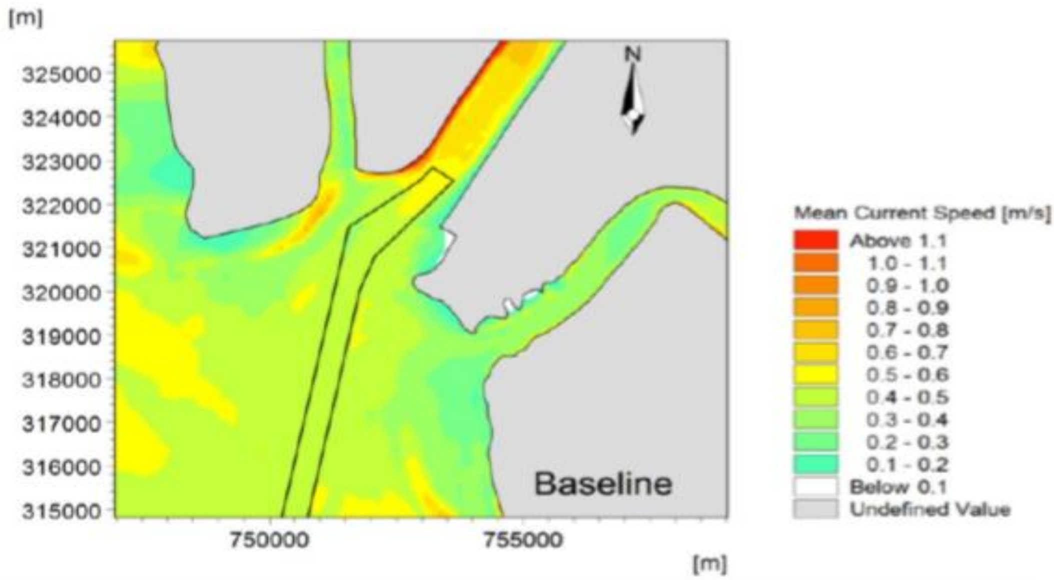
Station: **Subang**
Year: **1966 – 2016**
Period: **All 24 hours**

Speed (m/s)	Annual Frequency									
	N	NE	E	SE	S	SW	W	NW	Calm	Total
< 0.3	-	-	-	-	-	-	-	-	31.7	31.7
0.3 – 1.5	6.9	3.1	4.1	2.5	2.9	2.0	2.8	5.7	-	30.0
1.6 – 3.3	2.8	0.9	1.9	2.5	3.8	2.4	3.0	4.6	-	21.9
3.4 – 5.4	0.9	0.2	0.4	0.9	2.6	1.4	2.7	1.9	-	11.0
5.5 – 7.9	0.1	0.0	0.0	0.1	0.3	0.2	0.4	0.3	-	1.4
8.0 – 10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
> 10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
Total	10.7	4.2	6.4	6.0	9.6	5.9	8.8	12.6	31.7	-
Mean Speed (m/s)	1.5	1.3	1.5	2.1	2.6	2.4	2.7	2.0	-	-

Source: Malaysian Meterological Department (2016)

3.3.2 SURFACE CURRENT

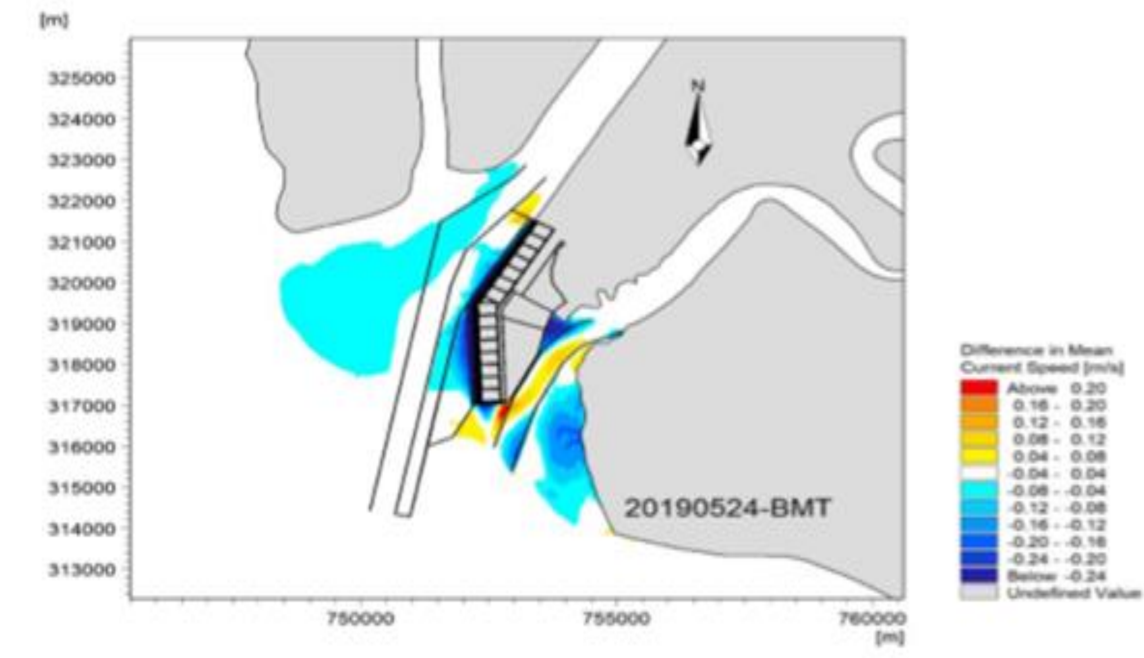
Figure 20 All year surface current at Port Kelang South Channel



Source: Hydraulic Study for Westports Expansion – Input to Environmental Consultant dated 1st March 2019

Source: DHI Water & Environment (M) Sdn Bhd

Figure 21 All Year Surface Current at South Channel



Source: Hydraulic Study for Westports Expansion by DHI dated 18th June 2019

Source: DHI Water & Environment (M) Sdn Bhd

Table 8 Tidal Level at Port Klang

Tidal Levels (referenced to mCD)		Pelabuhan Klang
Highest Astronomical Tide	HAT	5.82
Mean High Water Spring Tides	MHWS	5.09
Mean High Water Neap Tides	MHWN	3.72
Mean Sea Level	MSL	3.03
Mean Low Water Neap Tides	MLWN	2.35
Mean Low Water Spring Tides	MLWS	0.98
Lowest Astronomical Tide	LAT	0.00

Source RMN

4 MARINE TRAFFIC AND OTHER MARINE ACTIVITIES

This section elaborates on the existing marine traffic conditions along the South Channel, which also serves as the main navigation channel of the existing Westports and for the proposed Westports Phase II expansion. Future projection of the marine traffic had also been assessed by taking into account the proposed Westports Phase II expansion.

4.1 STATISTICS OF VESSELS CALLS AT WESTPORTS

4.1.1 WESTPORTS HISTORICAL DATA

From the historical data obtained from Westports Sdn Bhd, vessels with length of overall (LOA) of 150 – 200m and 250 – 300m dominated the number of ship calls at the Westports Container Terminals from April 2018 – March 2019, as shown in **Table 9**. The annual throughput was recorded at a total of 9.8 million TEUs, comprising 7,146 ship calls. The proposed Westports Phase II expansion will have berths of 600m in length, which is the industrial standard for new container terminals. This will allow Westports Phase II to accommodate vessels with longer LOA, while the existing terminals will cater for the smaller vessels.

Table 9 Historical Records of Ship Calls at Westports Container Terminals in April 2018 – March 2019

Length of Overall, LOA (m)	Number of Ship Calls	Throughput (TEUs)
50 – 100	535	112,000
100 – 150	543	309,000
150 – 200	2,345	2,125,000
200 – 250	662	763,000
250 – 300	2,189	3,713,000
300 – 350	501	1,162,000
350 – 400	371	1,638,000
Total	**7,146**	**9,823,000**

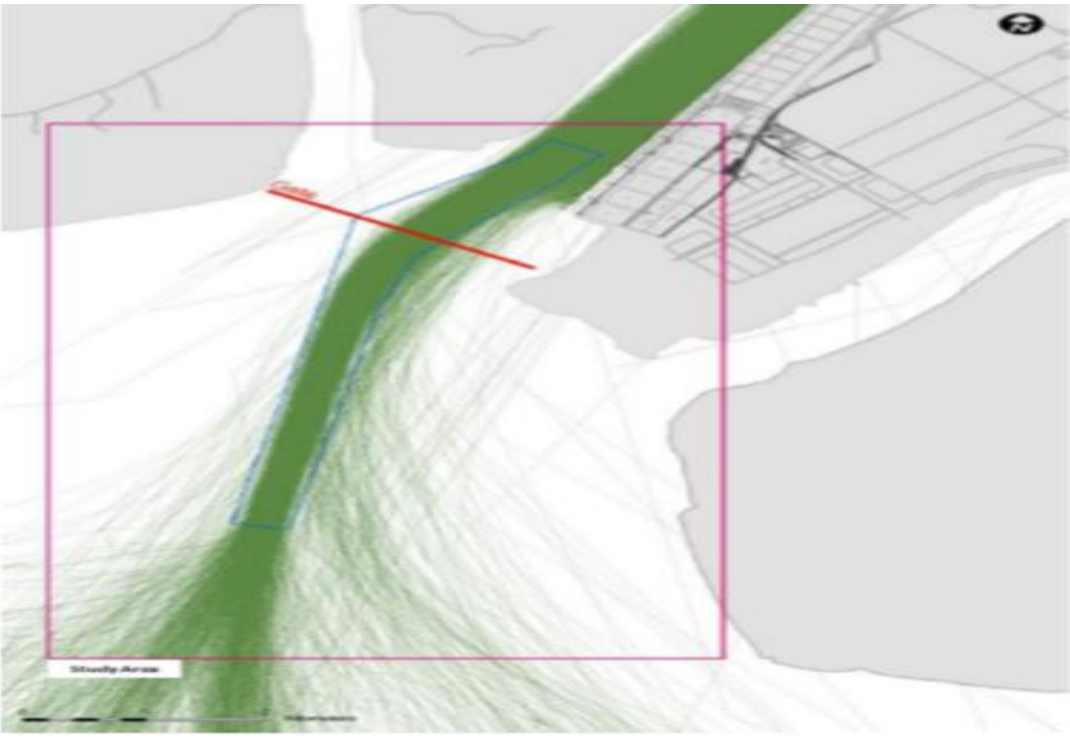
Source: Marine Traffic Risk Assessment (MTRA) by BMT Asia Sdn. Bhd. (9th July 2019)

4.1.2 AUTOMATIC IDENTIFICATION SYSTEM (AIS) DATA

From the distribution of vessel types and cargo size by LOA as shown in **Table 9** above, it can be concluded that approximately 76% of the total traffic are contributed by movements of vessels related to the Container Terminals. In terms of vessel size, over 85% of the container ship movements are between the LOA range of 100 – 300m, while the remaining are container ships contributed by LOA exceeding 300m.

In terms of directionality of vessels, it has been identified from the AIS data analysis that the northbound and southbound tracks were at similar level, with each direction ranging around 22 – 23 ship calls per day. **Figure 22** illustrates the traffic pattern of both the northbound and southbound vessels, with the width of the vessels' passage at approximately 500m.

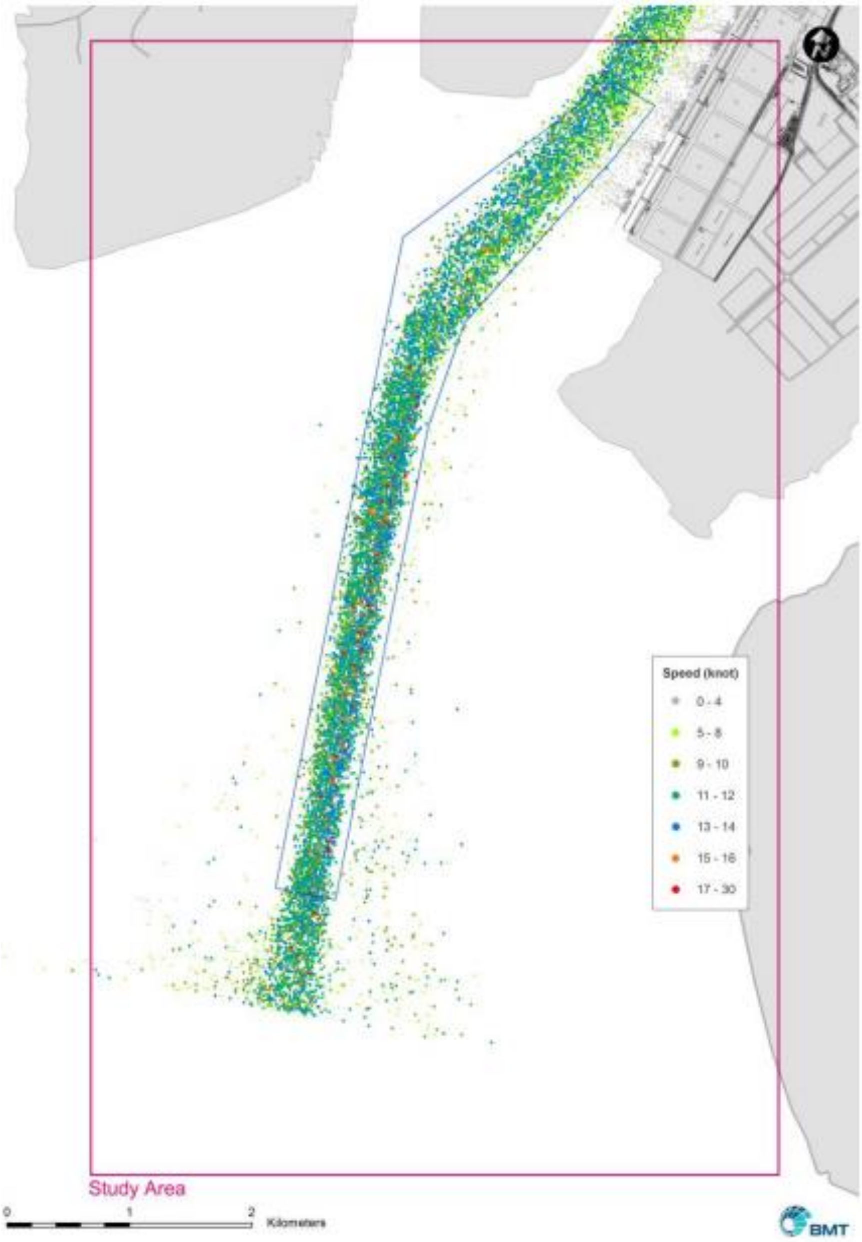
Figure 22 Tracking of Vessels with Automatic Identification System (AIS) in August 2018



Source: Marine Traffic Risk Assessment (MTRA) by BMT Asia Sdn. Bhd. (9th July 2019)

Meanwhile, the average travelling speed of vessels along the South Channel is between 10 – 12 knots. The travelling speed of vessels is an important aspect in understanding the maneouvering behaviour of the vessels. **Figure 23** shows the average travelling speed of vessels along the South Channel.

Figure 23 Speed in South Channel (One Month Ocean Going AIS Data)



The Marine Traffic Risk Assessment conducted by BMT Asia Sdn. Bhd. utilised the Automatic Identification System (AIS) data obtained from MarineTraffic.com throughout the whole month of August 2018. This assessment focused on the traffic pattern along the South Channel, port facilities and vessel size distribution, and navigating speed in the Study area.

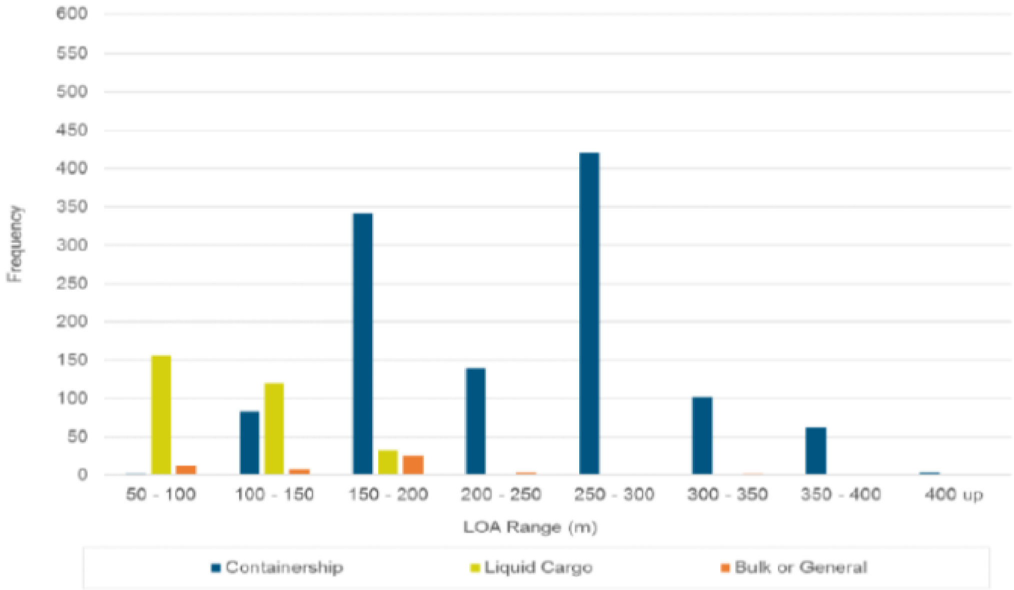
A counting gate was set across the port entrance to Westports and Northport as a reference to form the baseline vessel route structure for the marine traffic analysis; the counting gate location is indicated in **Figure 24** below.

Based on this assessment, each vessel types are grouped based on the facilities as listed below:

- Container Terminals – for container or cargo ships carrying containers, reefers, or containerships;
- Conventional Terminals
- Liquid Cargo – for asphalt/bitumen tankers, chemical tankers, crude oil tankers, LPG tankers, oil products tankers, and oil tankers;
- Dry Bulk, Break Bulk, or General Cargo – includes bulk carriers, cargo, cargo – Hazard A (Major), general cargo, heavy lift vessels, heavy load carriers, and vehicles carriers.

In the assessment of the baseline marine traffic, tugboats and pilot boats were not considered in the traffic data analysis as these were considered ancillary to the main vessels entering and leaving the port. Ferries and recreational vessels were also excluded because of their irregular and fractional transits.

Figure 24 Distribution of Traffic by LOA in August 2018

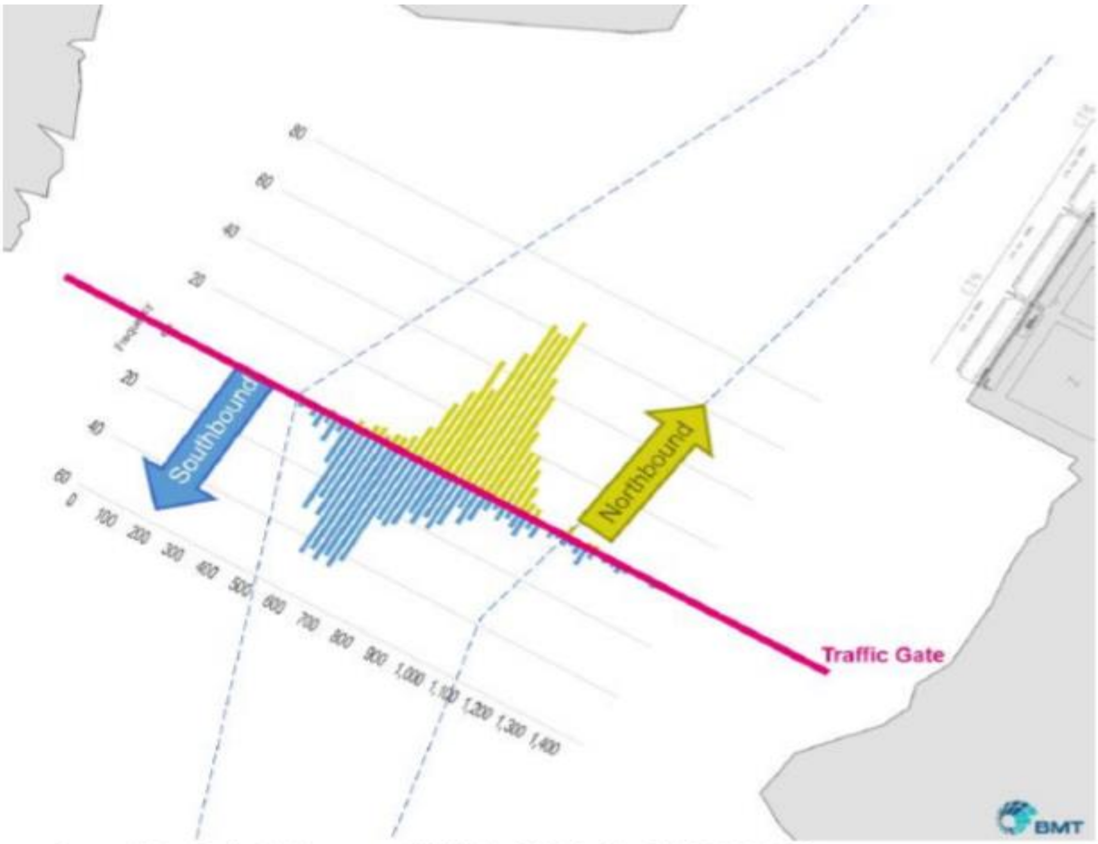


Source: Marine Traffic Risk Assessment (MTRA) by BMT Asia Sdn. Bhd. (9th July 2019)

4.2 MOVEMENT OF SHIPPING VESSELS WITHIN PORT LIMITS

Upon completion of the expansion of Westports Phase II, it is anticipated that more shipping vessels will navigate along the Southern Channel of Selat Klang, and berthing activities at Westports will correspondingly increase in numbers.

Figure 25 Traffic Pattern and Route Width at the Main Navigation Channel



Source: Marine Traffic Risk Assessment (MTRA) by BMT Asia Sdn. Bhd. (9th July 2019)

The potential impacts expected to arise from the increase in movement of shipping vessels within the port limits, and also the increase in berthing activities and other related port operations, are as follows:

- Marine traffic congestion – With the commencement of port operation at Westports Phase II, the sea traffic along the Northern and Southern Channel of Selat Klang is expected to increase.
- It is forecasted that Westports Phase II will accommodate larger containership of LOA more than 200m.
- The rise in the number of shipping vessels navigating especially along the Southern Channel of Selat Klang may cause marine traffic congestion and possible increase in the risk of collision between vessels.
- In the Marine Traffic Risk Assessment (MTRA) led by BMT, four (4) scenarios were simulated as listed below:
- Scenario A – The baseline, representing the existing marine traffic.
- Scenario B – Without the presence of Westports Phase II, but assuming that the traffic will grow to the forecasted level. All the future throughput is expected to use the existing terminal facilities. This Scenario assists in reviewing whether the increased traffic level is driving the risks, although it is already known that the existing port facilities are incapable

of handling the traffic due to insufficient capacity.

- Scenario C – With the presence of Westports Phase II operating under existing traffic level. This Scenario assists in reviewing whether the proposed expansion of Westports Phase II is the driving risks.
- Scenario D – Traffic environment with the presence of Westports Phase II and traffic will grow to the forecasted level.

4.3 FISHING ACTIVITIES

There are about 852 licensed fishing boats operating at all four fishing districts in the vicinity of the proposed project area. The numbers of fishing districts, fishing villages or bases and fishing boats within the study area are shown **Table 10** below.

The traditional fishing grounds for coastal fishermen stretches eight (8) nautical miles from the coastline. However, that area had been reduced significantly when the Port Limits and Pilotage Area of Port Klang was introduced.

The affected boats are mainly sampans made of glass reinforced fibre materials with outboard engines as seen in **Figure 26** below. Based on interviews with local fishermen, it was noticed that their fishing equipment typically uses include drift nets, trolling lines, fish traps and pots.

These small fishing boats do sometimes criss-cross the navigational channels when sailing to and from their respective fishing grounds, but they do not pose any hazard to the navigation of merchant vessels within Port Klang Port Limits.

The fishermen are well aware that they are prohibited from fishing close to the marine facilities, navigational aids and the approach channel of the commercial and marine facilities within the Port Limits. Their drift nets, however sometimes drift close to, or even encroach into the navigational channel to the marine facilities and they will immediately haul back their nets and clear away from the area. They are well aware of the danger being hit by passing ships and know that they are not supposed to impede the passage of the vessel using the approach channel.

Table 10 Fishing Villages in the Klang and Langat Fishing Districts

Fishing District	Fishing Village	No. of Fishermen	No. of Licensed Boats
Pulau Indah	Pengkalan Orang Asli Pengkalan Sg Kembong Pengkalan Sg Pinang Pengkalan Telok Nipah Pengkalan Sg Candung	81	70
Pulau Ketam	Pengkalan Pulau Ketam Pengkalan Sg Lima	1134	607
Pulau Carey	Sg Kurau Sg Judah Kg Melayu	80	60
Sungai Langat	Jeti Simpang Telok Kg Kelanang Kg Permatang Pasir Kg Bandar Kg Sri Tanjung Kg Sepakat	156	115

Source: Selangor State Fisheries Department

The traditional fishermen are dependent on the waters of the Klang Islands for their livelihood. Fisheries catch landings data of the traditional fishermen from the Selangor State Lembaga Kemajuan Ikan Malaysia (LKIM) for a period of 10 years (2007 – 2017) is given in **Table 11**.

Higher fish landings were from the Klang district and this is perhaps due to the larger number of fishermen and number of boats especially at Pulau Ketam. **Table 12** shows the fish landings data by the Selangor State Fisheries Department. The data suggests a decrease in fish catch from 2016 to 2017. Interviews conducted with the local fishermen also indicated that their fish catch had reduced over the years.

To compensate for the loss of traditional fishing grounds, a number of inshore or coastal fishermen are going further out to the nearby islands to fish, for example, to Pulau Ketam and Pulau Tengah. However, their encroachment into other fishing areas, e.g. Pulau Ketam, contravenes the conditions of their fishing licenses. During the stakeholders' discussion with Port Klang Authority (PKA), it was mentioned by PKA that the current Port Limits is not expected to be increased with the expansion of Westports Phase II. Hence, this Project is not expected to further diminish the fishing area.

Figure 26 Fishing Jetty at Pengkalan Sg. Kembong, Pulau Indah

Source: Aycity Emmar

Table 11 Fish Landings and their Values for Artisanal Fishing Activities (Zone A)

Fishing District	Landing Sites	Landings (kg)	Value (RM)
Langat	Sijangkang	152,324	741,602
	Kelanang	287,591	2,835,118
	Tanjung Sepat	1,338,977	6,256,840
Total		**1,778,892**	**9,833,560**
Klang	Pelabuhan Klang	246,459	2,193,801
	Pandamaran	10,265,722	6,912,122
	Sementa	285,106	2,705,567
	Pulau Ketam	13,817,677	9,912,236
Total		**24,614,964**	**21,723,726**

Source: Selangor State Lembaga Kemajuan Ikan Malaysia (LKIM)

Table 12 Fish Landings in Klang and Kuala Langat, 2016 – 2017

Fishing District	Year / Fish Landings (kg)	
	2016 (kg)	2017 (kg)
Klang	27,364.60	24,161.69
Kuala Langat	3,815.44	2,613.98
Total	**31,180.04**	**26,775.67**

Source: Selangor State Fisheries Department

To compensate for the loss of livelihood and income, a number of coastal fishermen have switched to supplying recreational fishing boats, fishing huts, breeding and sale of live baits for recreational fishing as well as taking recreational fishermen out to sea. Although fishing tourism and frequency of recreational fishing trips from each fishing jetty per day/week/month cannot be quantified yet, anecdotal evidence including feedback from an interview with some local fishermen at the Kg Sg Kembong jetty confirmed that recreational fishing and boat hire are popular activities in Pulau Indah.

The main recreational fishing and fishing tourism areas are the coastal areas along Selat Klang, Selat Lumut and as far as Pulau Ketam. This includes the waters in or near the Project site which had been identified by the local fishermen as a popular and frequently used area for recreational fishing. These areas of interest contain extensive mangrove systems and river mouths that are breeding places for mud crabs and prawns. Recreational line fishing is mainly conducted off privately owned boats. Some areas are located outside the Project site, but the recreational fishermen would need to travel through the Project area to reach these destinations.

Besides the fishing activities, there is a thriving fish cottage industry related to the fishing industry that includes the production and packaging of fishballs, dried seafood products i.e. fish, cuttlefish and squid as well as other prawn-based products such as satar, otak-otak and belacan. The local populace will also look for bivalves (lokan – Polymesoda expansa) and edible gastropods (siput sedut – Cerithidea obtusa) during low tide, on the mudflats and mangroves to enhance their diet.

4.4 AQUACULTURE

Aquaculture activity is mainly carried out by cage culture that includes fishes like merah (Lutjanus malabaricus; fry size = 2.5 inches), siakap (Lates calcarifer; fry size = 5 inches), kerapu (Epinephelus sp. – hybrid of giant grouper (E. lanceolatus) and tiger/marble grouper (E. fuscoguttatus); fry size = 3 to 6 inches) (Epinephelus spp.), snapper (Lutjanus johni; fry size = 2 to 2.5 inches) and silver pomfret (Trachinotus blochi – imported from Taiwan; fry size = 2 inches).

Data from the Selangor State Fisheries Department shows that there are 40 licensed cage culture operators. The cage cultures are located in the channels surrounding Pulau Ketam, Pulau Tengah, Pulau Selat Kering, Pulau Che Mat Zin, and Pulau Klang as marked in **Figure 27**.

The total water area of all the cages adds up to 30.17 ha, amounting to 17,668 registered cages. The feed for the caged fishes comprises pellets as well as trash fish. In a recent interview with the aquaculture farm owners, they have indicated that there has been a declining trend in the aquaculture production for the marketable fish size (0.6 – 1 kg) in the last 10 years (2010 – 2018) for the caged culture fishes. Concerns of the aquaculture industry relates to water pollution and sediment, weather, diseases (viruses, bacteria and parasites), and quality of fry.

Figure 27 Location of Cage Culture of Aquaculture Industry in the Klang Islands

Source: Google Earth (adapted on 10th July 2019)

4.5 RISKS TO NAVIGATION DUE TO FISHING ACTIVITIES

Fishing is being done all along the coast in Port Klang to the open sea where ships are anchored or passing by in the Straits of Malacca. Their drift nets, however, may sometimes drift close to, or even encroach into the channel or close to marine facilities. The fishermen will then haul back their nets when are found to have encroached into such areas. Fishing boats do cross the navigational channels when sailing to and from their fishing grounds. The fishermen are aware that they are not supposed to impede the passage of vessels using the approach channels.

4.6 OTHER MARINE FACILITIES

4.6.1 MARINA JABATAN LAUT AND PENINSULAR SAILING CLUB SELANGOR

Besides the above four marine facilities along the Selat Kelang within Westports, there are two more marine facilities on Pulau Indah facing Selat Lumut south of Westports within the range of study area, the Marina and Shipyard.

These marina facilities are located between Jeti Nelayan Sungai Kembong and Inai Kiara Shipyard; the marina serves on average about 40 sailing yachts of various sizes.

Figure 28 Marina Jabatan Laut, Pulau Indah

Source: Aycity Emmar

4.6.2 SELAT MELAKA SHIPBUILDING CORPORATION SDN. BHD. SHIPYARD PULAU INDAH

Inai Kiara Sdn Bhd, Malaysia's largest dredging and reclamation company, owns the third largest Trailing Suction Hopper Dredger (TSHD) in the world, named MV Inai Kenanga and having its shipyard named Selat Melaka Shipbuilding Corporation Sdn. Bhd. located at Pulau Indah facing Selat Lumut near the project site.

The main concern here is the provison of adequate manoeuvring room for the biggest dredger which may using Selat Lumut going to this yard.

The main principle particulars of MV Inai Kenanga is stated below:

Length (OA): 197.9m, Draft (loaded): 12m, Number of engines: 2
Engine specs: MAN - 12V48/60B - Str - 12 cyl - - rpm, Speed (loaded): 18.45 knots
Hopper volume: 34600 m^3
Dredging depth: 45m, Dredging depth (extended): 120m
Suction pipe diameter: 1.2m, Number of dredging pipes: 2

Figure 29 Selat Melaka Shipyard Pulau Indah

Source: Aycity Emmar

Figure 30 Inai Kenanga Dredger

5 PORT AND MARINE SERVICES

5.1 PORT CONTROL CENTRE AND VESSEL TRAFFIC SERVICES

There is a Central Port Control Centre and VTS for Westports and Northport at Port Klang at the moment, managed by Klang Port Authority, but each individual Terminal Operator has their own communication Centre to regulate and control their marine traffic using Very High Frequency (VHF) Radio.

5.2 BERTHING SERVICES

The Port Klang Authority being a regulator for these pilotage district has issued pilotage licence for the Northport and Westports pilots.

There are altogether a latest figure of thirty-six (36) pilots from Northport and forty-five (45) pilots including trainees from Westports. The pilots are holders of Certificate of Competencies under the STCW 1978/95, trained and examined under Port Klang Authority pilotage training scheme and certification. Both ports marine services are headed by their respective Marine Managers as their key personnel.

Table 13 Key Marine Personnel for Westports and Northport

Westports	Designation	Northport	Designation
Capt.Mazhazli Jamaludin	Marine Manager	Capt. Halimi Mohd Nasir	Marine Manager

Source Marine Department Westports and Northport 2020

Table 14 Number of Pilots Employed by Westports Malaysia Sdn Bhd

Class of License	Un-Restricted	Stage 4	Stage 3	Stage 2	Stage 1	Remarks
Number of Pilot	15	9	6	4	5	Trainee pilot: 6
Limitation	Nil	Piloting up to 350m	Piloting up to 260m	Piloting up to 180m	Piloting up to 110m	

Source: Marine Department Westports. 2020

Table 15 Particulars of Westports Pilots & Mooring Boats – 6 units

Name/ Particular	Tuah 1	Tuah 2	Tuah 3	Tuah 7	Tuah 8	Tuah 9
Type of Boat	Pilot	Pilot	Pilot	Pilot	Pilot	Pilot
Year built	2017	2017	2017	2017	2017	2017
Length (m)	14.5m	14.5m	14.5m	14.5m	14.5m	14.5m
Breadth (m)	3.68m	3.68m	3.68m	3.68m	3.68m	3.68m
Draft (m)	0.96m	0.96m	0.96m	0.96m	0.96m	0.96m
Engine Maker	Cummins	Cummins	Cummins	Cummins	Cummins	Cummins
Numberof Engines & HP	2 x 305HP	2 x 305HP	2 x 305HP	2 x 305HP	2 x 305HP	2 x 305HP
Speed	10 kts	10 kts	10 kts	10 kts	10 kts	10 kts

Source: Marine Department Westports. 2019

Table 16 Particulars of Westports Tug Boats – 9 units

Name / Particulars	**Kejora Prosper**	**Kst Zenith**	**Neon**	**Nimble**	**Kantan Johan**	**Kejora Enam**	**Pollux**	**Kantan Nilai**	**Super Tenang**
Type of tug	Pusher	Z-Tech	Pusher ASD	Pusher ASD	Pusher	Tractor	Z-Tech	Pusher	Tractor
Year built	2011	2010	2003	2003	2010	2005	2005	2011	2019
Length (m)	32.0 m	27.40 m	29.95 m	29.95 m	33.8 m	27.8 m	27.4 m	30.98 m	36.65 m
Breadth (m)	11.5 m	11.5 m	9.8 m	9.8 m	9.0 m	9.8 m	11.5 m	9.60 m	13.60 m
Draft (m)	5.5 m	5.2 m	3.5 m	3.5 m	3.0 m	5.35 m	5.2 m	3.0 m	5.3 m
Engine Maker	Niigata	Caterpillars	Niigata	Niigata	Niigata	Niigata	Caterpillars	Niigata	Wartsila
Number of Engines & HP	2 x 2500 hp	2 x 2500 hp	2 x 1884 hp	2 x 1884 hp	2 x 2000hp	2 x 1800 hp	2 x 2500 hp	2 x 1600 hp	2 x 2610 hp
Type of Tug / Propulsion	Fixed pitch propeller	Twin screw fixed pitch	Twin screw fixed pitch	Twin screw fixed pitch	Z Peller	Fixed pitch propeller	Z-Drive Schottel SRP 1215FP	Z Peller	Azimuth Schottel SRP
Bollard Pull	70 tons	65 tons	60 tons	60 tons	52 tons	45 tons	60 tons	48 tons	70 tons
Speed Max	12 knots	12 knots	12 knots	12 Knots	12 knots	12 knots	12 knots	12 knots	10 knots

Source: Marine Department Westports. 2020

5.3 AIDS TO NAVIGATION (AtoN)

The Marine Department has the responsibility for the provision and maintenance of aids to navigation within Malaysian territorial waters. The light dues collected from ships that call at Malaysian ports are managed by the Light Dues Board of Peninsular Malaysia. The funding is channelled to the Marine Department for the provision and maintenance of the aids to navigation.

The aids to navigation in Port Kelang is the responsibility of the Marine Department. The setting up of new aids to navigation would be planned by the Safety of Navigation Division of the Marine Department and the laying of buoys or the construction of beacons would be handled by the vessels under Light Dues. To date the aids to navigation in Port Klang have been adequate and functioning.

5.3.1 BUOYS

This responsibility includes the setting up of buoys and there are existing 7 buoys in the navigational channel to, and within, the approach to the Westports. It is recommended to install two additional marker buoys to indicate the extension or widened entrance of the channel and to reposition the Selat Buoy further south on completion of the dredging works in the proposed project site.

Table 17 Buoys along the navigation channel

No.	Name	Latitude	Longitude
1	South Fairway	2º50.35' N	101º 15.05' E
2	Terusan	2º 51.49' N	101º 15.38' E
3	Pintu Gedong	2º 51.46' N	101º 15.59' E
4	Tengah	2º 52.66' N	101º 15.60' E
5	Selat	2º 52.01' N	101º 15.72' E
6	Tenteram	2º 53.83' N	101º 15.82' E
7	Buas Buas	2º 53.79' N	101º 16.03' E

5.3.2 BEACONS

Beacons in the vicinity of the Project area are administered by the Malaysian Marine Department and located at the following locations:

Table 18 Beacons along the navigation channel

No.	Name	Latitude	Longitude
1	Tg Sarang Lang	3º 00.20' N	101º 20.30' E
2	National Hydrographic Center Jetty N End	2º 59.68' N	101º 20.71' E
3	National Hydrographic Center Jetty S End	2º 59.64' N	101º 20.68' E
4	No. 25	2º 58.52' N	101º 18.48' E
5	Pulau Indah Star Cruise Terminal	2º 59.22' N	101º 20.17' E
6	Tg Mahang Leading Lights Front	2º 54.91' N	101º 16.02' E
7	Tg Mahang Leading Lights Rear	2º 55.02' N	101º 16.04' E

5.4 ACCIDENT STATISTICS

According to the Port Klang Authority office, there have been cases of accidents or incidents reported for the past 17 years at Westports, as per the table below. From these statistics, it shows that the port is considered to be a safe port. With the implementation of mitigation measures and acquired experiences on how to bring down the occurrence of accidents, it can be seen that for the last 4 years, there has been a tremendous reduction in the number of accidents compared to the previous years.

None of these cases were reported to have involvement of personnel injury, fire or pollution due to oil spill. All the accidents are attributable to operational faults and not to faults in facilities design.

Table 19 Number of Accidents at Westports

Year	Contact	Collision	Grounding	Sinking	Fire	Pollution	Total
2003	1	1	NIL	NIL	NIL	NIL	**2**
2004	NIL	NIL	NIL	NIL	NIL	NIL	NIL
2005	2	1	2	NIL	NIL	NIL	**5**
2006	1	2	2	NIL	NIL	NIL	**5**
2007	NIL	NIL	1	NIL	NIL	NIL	**1**
2008	1	NIL	NIL	NIL	NIL	NIL	1
2009	2	1	1	NIL	NIL	NIL	**4**
2010	1	2	2	NIL	NIL	NIL	**5**
2011	1	5	NIL	NIL	NIL	NIL	**6**
2012	1	NIL	1	NIL	NIL	NIL	**2**
2013	1	1	NIL	NIL	NIL	NIL	**2**
2014	1	1	NIL	NIL	NIL	NIL	**2**
2015	2	1	NIL	NIL	NIL	NIL	**3**
2016	NIL	NIL	NIL	NIL	NIL	NIL	NIL
2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL
2018	1	NIL	NIL	NIL	NIL	NIL	**1**
2019	1	1	NIL	NIL	NIL	NIL	**2**
							41

6 RISK ASSESSMENT METHODOLOGY

This chapter describes the basis of the methodology used in conducting the MTRA and explains the assessment process followed. The assumptions made during the assessment are set out in this chapter.

6.1 FORMAL SAFETY ASSESSMENT

6.1.1 OVERVIEW

The Formal Safety Assessment (FSA) methodology is based on the FSA recommended by the International Maritime Organisation or IMO. The FSA process is contained in the IMO publication "Formal Safety Assessment, Consolidated text of the Guidelines for Formal Safety Assessment for use in the rule-making process (MSC/Circ.1023- MEPC/Circ.392), 2007".

The guidelines for the FSA process was prepared to assist relevant organisations in evaluating new regulations for maritime safety and protection of the marine environment. The Marine Department Malaysia preferred the FSA methodology to be applied for MTRA. In determining a level of risk, this methodology combines the frequency and severity of a hazardous event. This is in line with the classic approach in risk assessment.

Based on the FSA methodology, each identified combination of hazardous events and hazards is first listed in a hazard log. Each combination is then assessed based on the frequency and severity of the potential consequences associated with each hazardous event/hazard. The level of risk associated with each combination is assessed based on a criticality matrix and a tolerable matrix. The latter determines whether each risk level is broadly acceptable, tolerable or unacceptable.

When determining the levels of consequence and frequency, all the factors that could influence, or likely to influence the outcome of that specific situation need to be considered. The frequency and severity of consequence are based on all factors that include the following:

- routes of vessels in the area;
- realistic worst-case weather conditions;
- use and application of other navigational aids that might reasonably be available;
- aids to navigation in the vicinity; and
- level of training and knowledge of the person-in-charge of the vessel's navigation.

In other words, each individual hazard in each combination of hazards and hazardous events is deemed as the primary cause of the event with other influencing factors considered in the assessment. Adoption of this holistic view is considered synonymous with the approach that would, in a real-life situation, be considered by the person-in-charge of a vessel. This therefore represents a meaningful and robust assessment.

In line with IMO guidelines, the frequency and consequence bands are defined based on a logarithmic scale. This is to ensure that the resulting criticality matrix could be established by adding the frequency and consequence indices. The advantage of this approach is that the resulting risks, when expressed in terms of the number of casualties per hazardous event and the annual frequency of occurrence, can be used to produce a FN curve. 'N' relates to the number of fatalities per hazardous event and 'F' is the potential frequency per year of these occurring.

The change in risk to people, due to the intended Project, has been assessed and mapped to produce FN curves. FN curves provide a useful means of illustrating how the risk to people has changed.

6.1.2 FREQUENCY BANDS

The frequency bands in this assessment, as shown in **Table 20**, are based on the bands of annual frequency contained in the IMO Guidelines. The banding includes an expression in terms of frequency of occurrence per year for the purposes of creating annualised criticality matrix to enable production of an FN curve.

In this method, the term frequency means the number of times per year that a hazardous event occurs as a result of a particular hazard.

Table 20 Frequency Bands and Definitions

	Band	Definition	F per Year
Frequencies	1. Virtually never	Likely to occur once in one hundred thousand years (1/2,000 chance of occurring in 50 years)	10^{-5}
	2. Extremely infrequent	Likely to occur once in ten thousand years (1/200 chance of occurring in 50 years)	10^{-4}
	3. Very infrequent	Likely to occur once in a thousand years (1/20 chance of occurring in 50 years)	10^{-3}
	4. Infrequent	Likely to occur once in one hundred years (50% chance of occurring in 50 years)	10^{-2}
	5. Frequent	Likely to occur once in ten years	10^{-1}
	6. Very frequent	Likely to occur once or more a year	1

Source: IMO (2007)

6.1.3 CONSEQUENCE BANDS

The consequences of each combination are assessed with respect to elements that include people, the environment, property and the business of the developer. The consequence bands are taken from the IMO Guidelines with respect to consequences to people, and include an expression of equivalent fatalities for each band for the purposes of creating an annualised Criticality Matrix (see **Table 21**). For the other three elements, consequences of comparable tolerability are added.

Table 21 Consequence Bands and Definitions

	Band	People	Environment	Property	Port Developer/ Operator	Equivalent Fatalities
Consequence	1. Insignificant	Single or minor injuries	No pollution released into the sea	Minimal damage. Little or no cost	Little or no financial loss	10^{-2}
	2. Minor	Multiple or severe injuries	Tier 1 spill	Damage costing up to RM1 Million	Losses of up to RM1 Million	10^{-1}
	3. Major	Single fatality or multiple severe injuries	Tier 2 spill	Major damage costing up to RM10 Million	Major losses of up to RM10 Million	1
	4. Severe	Multiple fatalities	Tier 3 spill	Severe damage costing over RM10 Million	Severe losses over RM10 Million	10

Source: IMO (2007)

6.1.4 CONFIDENCE AND UNCERTAINTY

Some degree of uncertainty is inevitable in the process of assessing future risks. The uncertainty is due to factors such as the sparseness of statistical information on accidents and relates to both the frequency and consequences of hazardous events. This methodology addresses both elements in the following manner.

Where the consequences of an event are uncertain, a worst-case scenario is assumed and described as such in the hazard log. For example, when considering the consequence to the environment of a collision between vessels, it is assumed that large tankers were involved; whereas in the case of consequences to people, it is assumed that the casualties were aboard passenger ships. In this way, the uncertainty of consequences is dealt with according to the precautionary principle.

In terms of frequency, uncertainty has been addressed by referencing to the level of confidence in the information and factors considered when making the assessment.

The level of confidence is indicated in the hazard log, on the basis given in **Table 22**. Where there is low confidence, the assessed level of frequency has been increased as a precaution by one frequency band (i.e. by a factor of ten).

Table 22 Basis of Confidence Level

Confidence Level	Basis of Estimation
High	Estimation made on the basis of the known current situation, real-world trials, validated simulations, computer modelling or quantitative calculations
Low	Estimation made on the basis of expert opinion or qualitative analysis

Source: IMO (2007)

6.1.5 CRITICALITY MATRIX

The risk of each combination is assessed by summing the frequency and consequence indices. As the frequency and consequence bands are in logarithmic scale, the risk is effectively calculated based on a multiplication of the frequency and consequence of the hazardous event:

a) Risk = Frequency x Consequence; and

b) Log (Risk) = Log (Frequency) + Log (Consequence).

The risk value can be calculated or looked up from the Criticality Matrix shown in **Table 23**.

Table 23 Criticality Index

Frequency		Consequence: 1 Insignificant	2 Minor	3 Major	4 Severe
Frequency	6 Very frequent	7	8	9	10
	5 Frequent	6	7	8	9
	4 Infrequent	5	6	7	8
	3 Very infrequent	4	5	6	7
	2 Extremely infrequent	3	4	5	6
	1 Virtually never	2	3	4	5

Source: IMO (2007)

6.1.6 TOLERABILITY MATRIX

The risks assessed are divided into three bands of tolerability, namely: unacceptable, tolerable and broadly acceptable in the Tolerability Matrix (see **Table 24**), based on the Criticality Index described in **Table 23**.

Although the Malaysian Government does not specify the explicit levels of acceptable or unacceptable risk, these are effectively established by case law. The criticality scores, which are used to inform the tolerability bands used in this risk assessment methodology, are intended to be interpreted with common sense, rather than rigidly complied with in all circumstances.

Risks with an annual fatality rate of one in one hundred (10^{-2}) or greater are deemed unacceptable; whereas risks with an annual fatality rate of one in a million (10^{-6}) or less are considered broadly acceptable. In other words, where there is one death occurring in less than 100 years, it is considered unacceptable; whereas where there is one death occurring in more than one million years, it is considered broadly acceptable. Risks falling between these two bands are deemed tolerable, subject to the requirements described in the Tolerability Matrix in **Table 24**.

Table 24 Tolerability Matrix

Criticality Index	Tolerability	Description
7 to 10	Unacceptable	Further control measures are necessary in order to reduce the level of risk unless the "with Project" risks are no greater than the "without Project" risk; in which case the risk will be treated as tolerable.
4 to 6	Tolerable	The risk is tolerable, provided that: ▪ The level of risk has been properly assessed based on the best available evidence or advice. ▪ The results of the risk assessment have been used to determine control measures. ▪ The residual risks are kept as low as reasonably practicable ("ALARP"), i.e. the cost of further control measures would be grossly disproportionate to the risk reduction achieved. ▪ The risks are periodically reviewed to ensure that they still meet the ALARP criteria. For example, by ascertaining whether new controls need to be introduced where new knowledge or techniques have become available.
2 to 3	Broadly acceptable	The level of risk is regarded as insignificant and adequately controlled. No further action is required to reduce the risk.

Source: IMO (2007)

It is noted that the methodology may assess certain "without Project" risks, i.e. the existing risks, to be unacceptable; in which case the corresponding "with Project" risk will be treated as tolerable, provided that there is no incremental risk associated with the Project.

6.2 MTRA ASSUMPTIONS

This MTRA considered the requirements of the applicable legislation and regulations that have, over many years, been developed and are intended to further protect the safety of life at sea and protection of the marine environment. These include the following international conventions:

- Safety of Life at Sea ("SOLAS") which include a provision for the ISPS Code;
- The Prevention of Pollution from Ships 1973 ("MARPOL"), as modified;
- Standards on Training, Certification and Watchkeeping for Seafarers 1978, as amended ("STCW"); and
- The International Regulations for Preventing Collisions at Sea 1972 ("COLREGS"), as amended.

The International Ship and Port Facility Security (ISPS) Code is an amendment to the Safety of Life at Sea (SOLAS) Convention (1974/1988) on minimum security arrangements for ships, ports and government agencies. Having come into force in 2004, it prescribes responsibilities to governments, shipping companies, shipboard personnel, and port/facility personnel to "detect security threats and take preventative measures against security incidents affecting ships or port facilities used in international trade". As a new port facility is going to be extended thence an amendment or addition to the existing port security manual has to be included. The best way to get it approved and included into the Westports Port Security Manual would be to hire an ISPS registered surveyor to conduct a new port security audit and write a new chapter for this new security facility and its security arrangement.

The Marine Department Malaysia recognises that, due to their sizes and types, it may not be appropriate for certain vessels to comply fully with the requirements of the conventions listed. Such vessels may instead comply with an applicable licensing requirements or standards adopted by the Marine Department Malaysia.

Almost all commercial vessels are designed, constructed and maintained in accordance with the rules of a ship classification society that is a member of the International Association of Classification Societies ("IACS").

In conducting the MTNRA, it was assumed that all commercial ships that would call at Port Klang are built and operated in accordance with the rules of a classification society that is a member of IACS and the applicable requirements of the aforementioned international conventions.

6.2.1 RISK ASSESSMENT PROCESS

The risk assessment process begins with identification of hazards and hazardous events. The combinations of hazards and hazardous events will then be populated in a hazard log before transferring to a master MTRA table.

In the master MTRA table, each combination of hazards and hazardous events in the hazard log is examined and assessed for its risk level, under the following scenarios:

- Scenario 1 - present day scenario without the Projects;
- Scenario 2 - the scenario whilst construction of the projects is in progress; and
- Scenario 3 - future scenario following the completion of the Projects and the full operation of the CT10 – CT19, i.e. the operation phase.

A Frequency Band will be determined for each combination of hazards and hazardous events, in accordance with **Table 20** for each scenario. The Confidence Level of the allocated frequency is recorded in accordance with **Table 22**. If the Confidence Level is deemed to be low then the frequency band is increased by one level.

Once the final frequency band is determined, the consequence of the hazardous event, due to a particular hazard, is assessed. The levels of consequence are assessed in accordance with **Table 21**, for the following elements:

- people;
- the environment;
- property; and
- the developer/operator.

Following the determination of a level of frequency and consequence for each scenario, the risk level is obtained by looking up the criticality index (see **Table 23**). The frequency, consequence and risk level are populated into the master MRA table. The table is graded by colour that indicates unacceptable risks in orange/red, tolerable risks in yellow and broadly acceptable risks in green.

After all combinations of hazards and hazardous events are examined and assessed, the combinations that have higher unmitigated risk levels in the future scenario as compared to the baseline present day scenario can be identified easily. For these combinations, one or more control measures will be proposed to bring the risk levels down to a tolerable level.

Once the risk levels for these combinations are brought down to a tolerable level with the proposed control measure(s), all events in the hazard log will be re-assessed, considering all proposed control measures are in place. This re-assessment will show that some events would benefit from a control measure that is targeted at another event, termed as a beneficial control.

For some combinations of hazards and hazardous events, the risk levels that are initially assessed to be tolerable can be further reduced when control measure(s) is assumed to be in place.

6.2.2 ESTIMATED NUMBER OF HAZARDS AND BAND MATRICES

Table 25 Estimated number of hazards identified for the next 15 years which is based on the accidents reported in the last 15 years

Hazard Category	Number of Identified Hazards in 15 years				Frequency Band	Consequence Band
	Scenario 1	**Scenario 2**	**Scenario 3**	**Total**		
Collision	16	3	3	**22**	**5**	**2**
Contact	16	5	8	**29**	**6**	**1**
Grounding	9	3	1	**13**	**3**	**1**
Personal injury	-	-	-	**-**		
Person lost at sea	-	-	-	**-**		
Security	-	-	-	**-**		
Sinking	-	-	-	**-**		
Fire & Explosion	-	-	-	**-**		
Pollution	**-**	**-**	-	**-**		
Total	**41**	**11**	**12**	**64**		

7 STAKEHOLDERS ENGAGEMENT

The stakeholders for the proposed Project include government agencies, statutory bodies, port operators, facilities owners and other interested parties. The local knowledge and professional experience of the stakeholders have been used to verify the evidence presented for assessment as well as to review and confirm the findings of and conclusions reached for this MTRA.

7.1 CONSULTATION

The following stakeholders have been consulted:

- Marine Department Malaysia, Central Region;
- Klang Port Authority;
- North Port Berhad;
- Persatuan Nelayan Kawasan Port Klang; and
- BMT Malaysia Sdn Bhd.

7.2 RESOLUTION PROCESS

In the pre-assessment stage, stakeholders were consulted for their views and concerns on the proposed Project. It was found that their views and concerns fell into two distinct categories:

- safety of vessels transiting the navigational channel; and
- operation & engineering practices and suggestions for inclusion in the MTRA.

Details of these viewpoints and concerns were recorded and used to form the basis of agreement and resolution.

The stakeholders were consulted to share their views on the potential risk assessment which would be considered in the risk assessment.

7.3 SUMMARY OF STAKEHOLDERS' VIEWS/CONCERNS AND RESOLUTIONS

All the stakeholder's views or concerns have been addressed and have been included in the following chapters.

8 HAZARD IDENTIFICATION (HAZID) PROCESS

This chapter describes the hazard identification process undertaken as part of the MTRA. Although a HAZID workshop was not conducted separately, a conceptual Master Plan workshop which was held at BMT's office in Kuala Lumpur from 20 – 21 June 2019 had included hazard identification in the discussions. This Master Plan workshop was conducted after a Desktop Simulation exercise involving 7 pilots from Westports together with the Consultant Engineers and a Competent Senior Pilot. The reports from the workshops are attached as **Appendix 2E**.

8.1 RISK ASSESSMENT AREA

This MTRA covers the Port Klang South Channel towards Pintu Gedong within Port Klang limits. It is considered that the works under the proposed Project does not affect the risk levels outside this area.

8.2 IDENTIFICATION OF HAZARDS AND HAZARDOUS EVENTS

It is recognised in the risk assessment that a wide engagement of different disciplines and communities of interest is necessary in the characterisation of issues in risk assessment, and that there is openness to the greatest degree possible so that thinking can be exposed to alternative views. To this end, the identification of hazards was undertaken in tandem with a wide stakeholder consultation exercise involving a range of shipping, port, fishing, development and government interests.

The dialogue with stakeholders and incorporation of consultees' feedback into the process provided greater confidence in the inputs and results of the risk assessment. Other inputs used to assist in the identification of hazards are listed below:

- Marine traffic analysis has been used to determine the numbers and types of vessels typically using the area so that the hazards relating to traffic density and particular types of vessel operations could be determined.
- Data concerning accidents and incidents including information obtained from the Marine Department Malaysia Central Region was used to assist in determining the types of hazards and hazardous events that have historically occurred in the area.
- Weather data was used to determine any specific types of hazard that might exist due to environmental conditions, such as periods of restricted visibility or high wind and waves.

The hazards which have been identified and the resulting potential hazardous events are typically reported in the form of a Hazard Log.

One master mariner conducted a detailed review of the inputs to develop a list of hazards that could cause or contribute to one or more hazardous events. Once the hazards had been identified, each hazard was in turn examined to determine the hazardous events that it might cause or contribute to.

8.3 HAZARD CATEGORIES

In order to facilitate the risk assessments, the following hazard categories are used:

- contact – anchored ships and anchor marker buoys;
- collision;
- grounding;
- fire and explosion;
- person lost at sea;
- personal injury;
- equipment failure;
- sinking; and
- falling object.

In the risk assessment, pollution is considered a secondary accident category as it is only likely to occur as a result of one of the above accident categories. Due to their design, large container ships, tankers and specialized ships do not pose a significant pollution risk except for their bunker tanks. These bunker tanks are however normally well protected by the double hull construction. This consideration is further supported by the absence of pollution incidents in the past involving large container ships, new tankers and specialized ships such as dredgers.

8.4 INCIDENTS

When establishing the frequency of an unwanted event occurring, it is important to take into consideration the historical record of incidents in the area.

The small number of recorded incidents, albeit being a positive sign in terms of safety, may not sufficiently provide meaningful statistics. It is noted that the incident records have apparently not been maintained consistently, nor have near-misses been included. Specific records for the Port Klang areas or the Port Klang port limits are not available for assessment. This lack of proper formalised reporting and recording may have contributed to the low rate of known incidents.

8.5 RISK IN NAVIGATION AND MITIGATING MEASURES

The key risks to navigation for vessels using the Port Klang South Channel waters are: collision, contact and grounding. These risks apply both during the construction period and after the container terminal is operational.

The mitigating measures that would need to be taken are:

a) The tugs and barges that will be used for construction may encounter other vessels entering, transiting or departing from Port Klang or the local fishermen who may originate from any of the landing places along the coast and many other jetties along the area. This can lead to a crossing situation that may affect the project vessels safe movements to the project site. Ensuring continuous keeping of a good lookout and monitoring all vessels approaching can mitigate collision and ensure risk of collision is avoided.

b) The mitigating measures will rely on the control centre for the control of movements of the installation vessels from the shore depot that will direct the contractor's vessels and inform them of approaching through vessels. The control centre will help in communication and co-ordination with other vessels and resolve any situation that may affect the approach of the project craft. Tugs assisting the project vessels will also be able to help in making safe transit through the project area.

c) The risk of contact is possible with vessels at anchorage and fixed installation such as anchor marker buoys. Contact with anchor marker buoys can be avoided with the usage of fluorescent painting on marker buoys and lightings at night. Contact with vessels at anchor can be avoided by keeping a wide berth when approaching them and avoid close quarter situation when navigating to and from the project site.

d) Grounding can be mitigated by having the operational area fully surveyed, mark the area with grounding risk including navigational aids. The use of local pilot as guides would enhance the safety of navigation to the ship's bridge team while on the construction site, giving it smooth communication and avoiding shallow patches while moving towards the appropriate berth with full confidence.

9 FULL MISSION SHIPHANDLING SIMULATION (FMSS) STUDY

As part of the masterplan study for the proposed expansion of their container terminals, KASI (Malaysia) Sdn Bhd (hereinafter referred to as "KASI") was appointed by Westports to conduct a Full Mission Shiphandling Simulation (FMSS) study for the Westports Phase II Expansion.

9.1 STUDY OBJECTIVES

The objectives of the FMSS are as follows:

- Assess the suitability of the dredged channel for use by the design vessels;
- Assess the suitability of the manoeuvring areas (ie. turning circles) for use by the design vessels;
- Assess towage requirements;
- Assess requirements for safety enhancement measures such as the placement of aids to navigation;
- Assess extent of time spent / level of encroachment within the existing navigation channel during berthing / unberthing operations (especially while turning);
- Identify potential navigational concerns during approach, berthing, unberthing, and departure operations at the proposed new berths.

9.2 FMSS COMMITTEE

The FMSS Committee, chaired by Captain Mazhazli Jamaludin of Westports Malaysia Sdn Bhd, consisted of members from Lembaga Pelabuhan Klang, local pilots and KASI. A full list of the members is attached as **Appendix 2H**.

9.3 NAVIGATION SIMULATION RUNS ON APPROACH, BERTHING, UNBERTHING AND DEPARTURE

After the area model was set up, a series of real-time ship handling simulation runs were carried out using model ships. Run designs were based on agreed scenarios best suited to give the desired result stated in the scope of work. KASI's in-house NTPRO 5.40 full mission shiphandling simulators was used for the simulation study.

Shiphandling simulation runs were conducted under accurate and realistic environments to model the behaviour of design ships under baseline and given met-ocean conditions. The runs covered the following:

- Approach Runs
- Berthing Runs
- Unberthing Runs
- Night Operations
- Emergency Runs

A number of simulation runs of various scenarios were carried out in the program and a run "matrix" was produced. The runs started either from the pilot boarding station or at a point closer to the berth (for arrival runs) or from a berth of the jetty (for departure runs). Passing traffic, adverse weather and visibility restrictions were also incorporated into some of the runs to simulate realistic conditions at Westports.

The numbers, sequence and scenarios for each of the simulation runs were jointly decided by Westports project team and KASI. Some of the runs ended when the vessel was tied safely to the berth. Other simulation runs ended when the ship was positioned parallel to the berth, within 50 meters from the berths, under the tugs control.

The simulation program included scenarios when a distressed vessel is under emergency situation, including vessel engine or tug failures.

9.4 ASSESSMENT OF SIMULATION OUTCOMES

The simulation runs were reviewed by a panel comprising of ship handling and navigation experts from KASI, Westports and Lembaga Pelabuhan Klang based on the level of piloting difficulty and ship controllability. Ship controllability was assessed based on the evenness of ship tracks, as shown in the run plots, extent of main engine orders, tug capacities and the pilot's assessment of the level of control of the ship experienced during the runs.

- Post-run evaluation and overall debriefing was conducted after each run;
- A number of post-run reviews were conducted using the simulator's replay facility;
- Written records of the post-run outcomes, evaluations and reviews, and recommended potential changes to the port / jetty layout / infrastructure were prepared and incorporated in the report.

9.5 SIMULATION AREA MODEL DATABASE OF WESTPORTS PHASE II EXPANSION

The 3D simulation exercise area model for the Westports Phase II Expansion includes the proposed new berths (CT10 to CT17), new dredged approach channel / basin as well as the existing Westports berths (CT1 to CT9). A screenshot of the area model and graphic view is shown in **Figure 31** and **Figure 32** below.

Figure 31 Screenshot of 2D Simulation Exercise Area Model of Westports Phase II Expansion

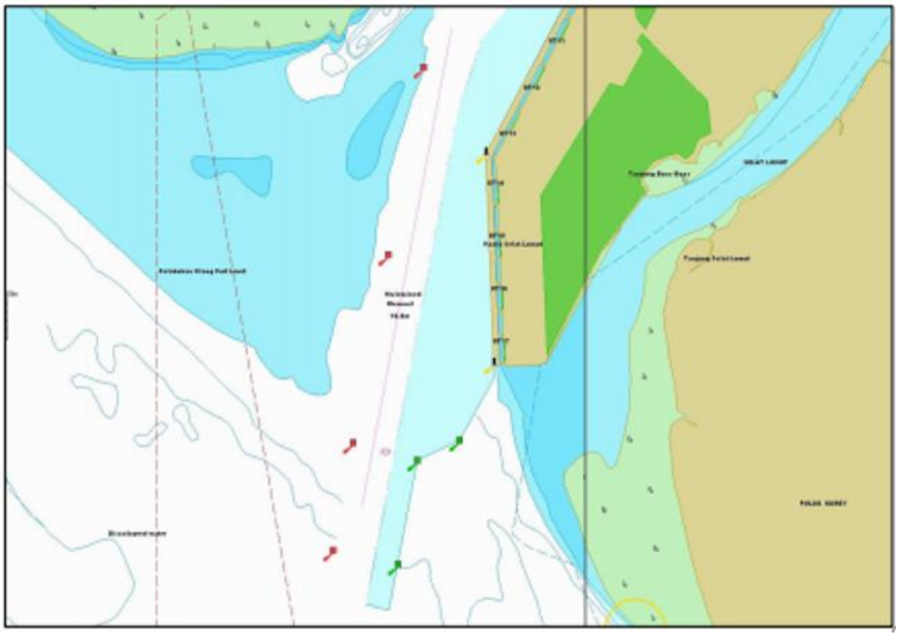
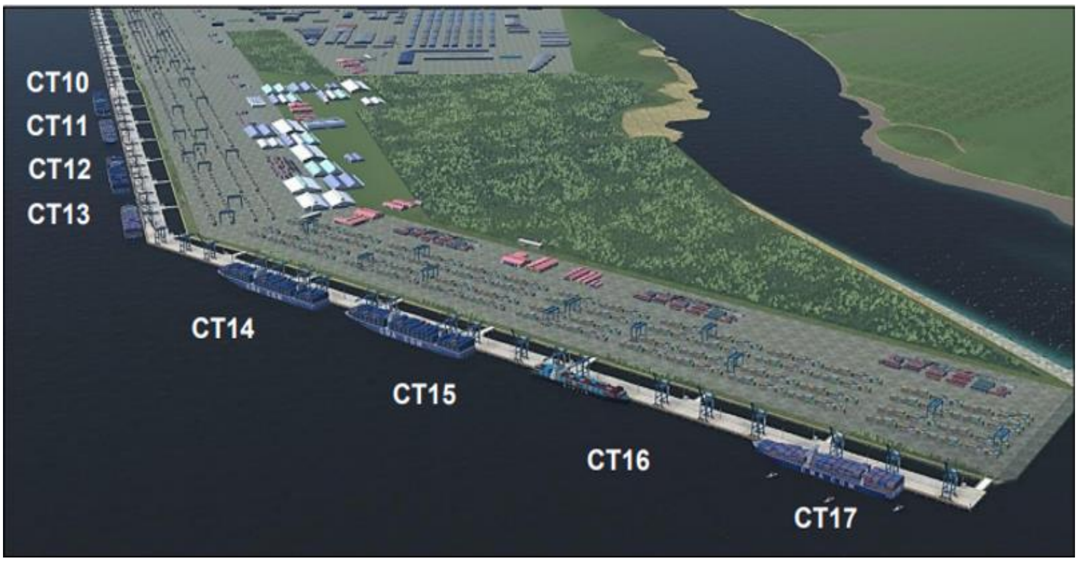


Figure 32 Screenshot of 2D Simulation Exercise Area Model of Westports Phase II Expansion

9.6 WESTPORTS PHASE II EXPANSION CONFIGURATION

Figure 33 3D Simulation Model of the Proposed Expansion



9.7 DESIGN VESSELS AND TUGS

KASI selected ship models for the FMSS that closely approximate the design vessels having sizes close to the design limit for each berth, and therefore represent the worst-case scenario in respect of navigation.

The design vessel for each of the assessed berths are shown in **Table 26** below:

Table 26 Design Vessels

Berth Number	Design Vessel	Tugboat Sizes
CT10	Up to 400m LOA container ships	70T BP ASD Tugs
CT13	260m and 300m LOA container ships	Mixture of 50 and 60T BP ASD Tugs
CT14	260m and 300m LOA container ships	Mixture of 50 and 60T BP ASD Tugs
CT17	Up to 400m LOA container ships	70T BP ASD Tugs

Based on the design vessel specifications provided by Westports (shown in **Table 26**), the following ship models were selected from KASI's ship model library for use in the simulation. The details of the ship models selected for the FMSS are detailed in **Figure 34**. The tugboat models selected are as detailed in **Figure 35**.

Figure 34 Ship Models Used For Simulation Runs

Container Ship 24

Container Ship 29

Container Ship 14

Model	Container Ship 24	Container Ship 29	Container Ship 14
Conditions	Loaded	Loaded	Loaded
LOA (m)	396	300	261.4
Beam (m)	53.6	48.2	32.25
Draft (m)	16	10.9	12.6
Propulsion	FPP	FPP	FPP
Berth No.	CT10, CT17	CT13, CT14	CT13, CT14

Figure 35 Tug Models Used For Simulation Runs

50T BP ASD Tugboat

60T BP ASD Tugboat

70T BP ASD Tugboat

Model	50T BP ASD Tugboat	60T BP ASD Tugboat	70T BP ASD Tugboat
Bollard Pull	50	60	70
LOA (m)	26.1	25.3	33.1
Beam (m)	8.9	10.4	12.0
Draft (m)	3.89	4.0	4.9
Propulsion	Z-Drive	Z-Drive	Z-Drive
No. of Thruster	None	None	None

9.8 RUN ASSESSMENT CRITERIA

The assessment of the simulation outcomes were discussed in line with the FMSS objectives and the FMSS findings are categorised into the following sections:

- Dredged Channel (Approach Channel)
- Suitability of Manoeuvring Areas
- Towage Requirements
- Aids to Navigation (AtoNs)
- Potential Navigational Concerns - a run is awarded one of three classifications: Pass,

Marginal or Fail.

Table 27 below lists the criteria for the classifications.

Table 27 Run Assessment Criteria

PASS	• The ship remains under full control at all times • The ship stays within the dredged basin with acceptable clearances or closest point of approach (CPA) from other objects, facilities or obstacles. • For berthing manoeuvres, the ship ends the run alongside, or in such a position that lines would be ashore without appreciable difficulty, at acceptable speed, with an acceptable sway velocity (less than 0.4 knots / 0.2 ms^{-1}) and no appreciable yaw rate. • For departure manoeuvres, the ship exits smoothly, without risk of drifting onto the jetty or other ships or grounding.
MARGINAL	• The master considers the ship is at the limit of control. • The ship stays within the navigable part of the dredged basin and swing area, but with unacceptable clearances from other objects, facilities or obstacles. • For approach manoeuvres, the ship ends up alongside, but may have an unacceptably high approach velocity (greater than 0.4 knots / 0.2 ms^{-1}). The manoeuvres can be concluded, but minor damage or grounding may occur. • For departure manoeuvres, the ship experiences some difficulty while coming off the berth. The manoeuvre is completed with potential for minor damage only.
FAIL	• The master loses control of the ship. • The ship strays outside the navigable part of the dredged basin and / or grounds. • For approach manoeuvres, the ship cannot get alongside at all, or it has struck the berth or another ship with sufficient force that severe damage may have occurred, or has grounded. • For departure manoeuvres, the ship either cannot come off the berth or encounters significant difficulty in manoeuvring, such that severe damage may have occurred, or the ship grounds.

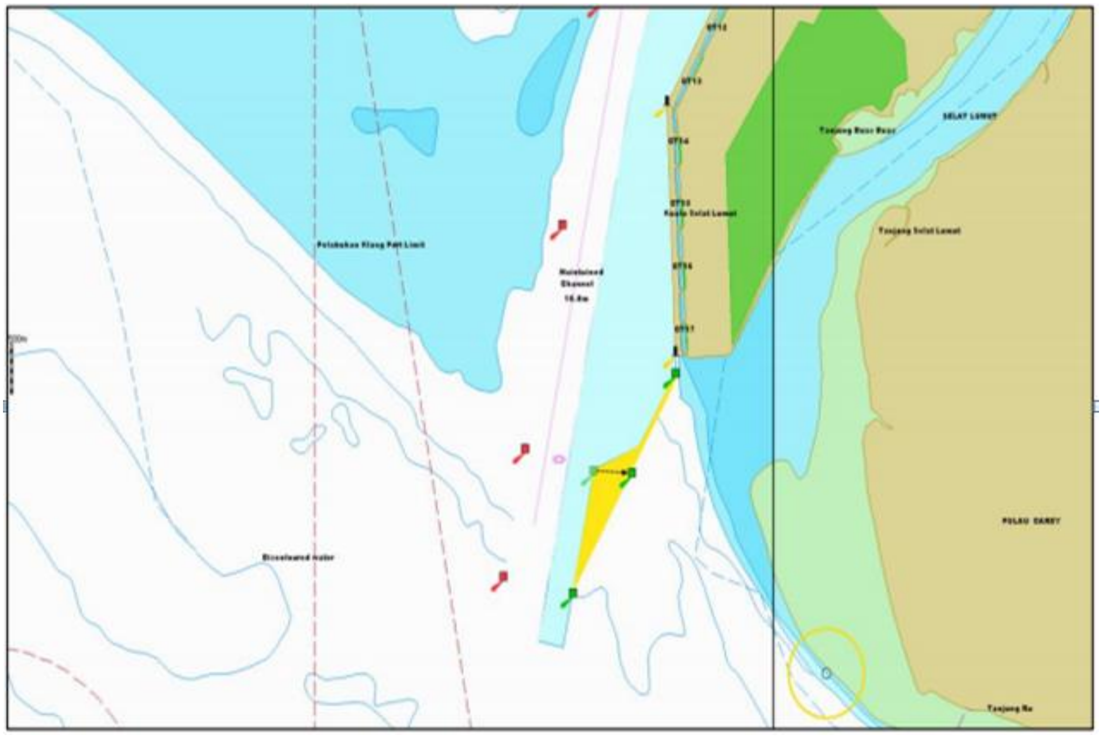
9.9 FINDINGS AND RECOMMENDATIONS

The FMSS findings and recommendations are provided in the following sections according to the categories listed above.

9.9.1 DREDGED CHANNEL (APPROACH CHANNEL)

It is recommended that the 2nd green buoy at the approach channel entrance be repositioned to create more sea room to allow for a more gradual angle of approach (arriving vessels) and more room for vessels to pick up speed from the final berth, CT17 (departing vessels) – as shown in yellow in **Figure 36** below:

Figure 36 Shifting 2nd Green Buoy at Approach Channel Entrance (additional sea room for manoeuvring created is highlighted in yellow)



9.9.2 TOWAGE REQUIREMENTS

The following Tugboat configuration in **Table 28** were found to be sufficient.

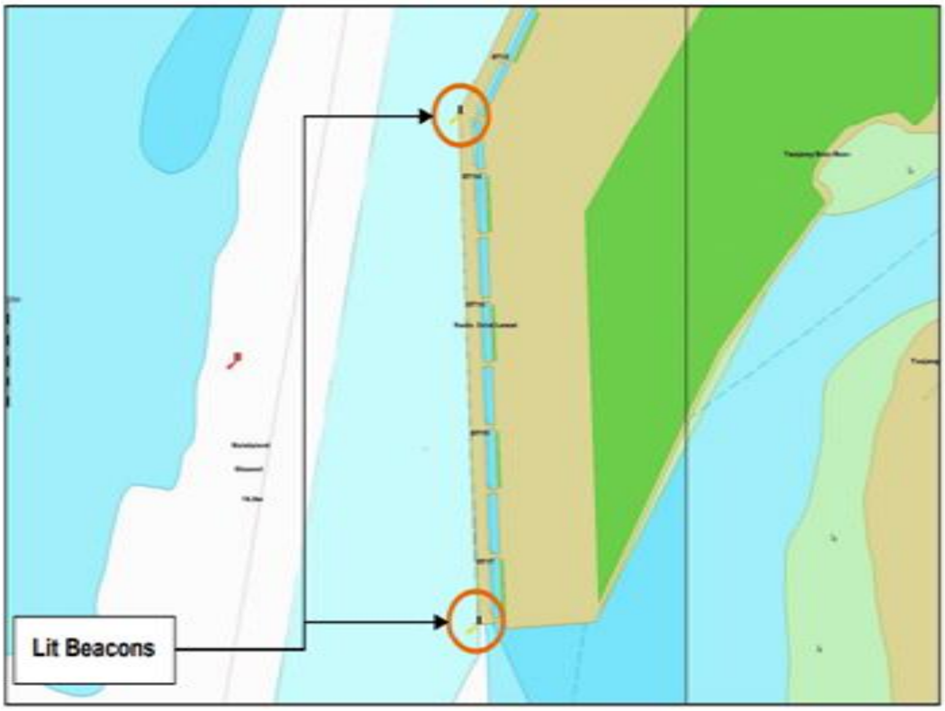
Table 28 Tugboat Configuration

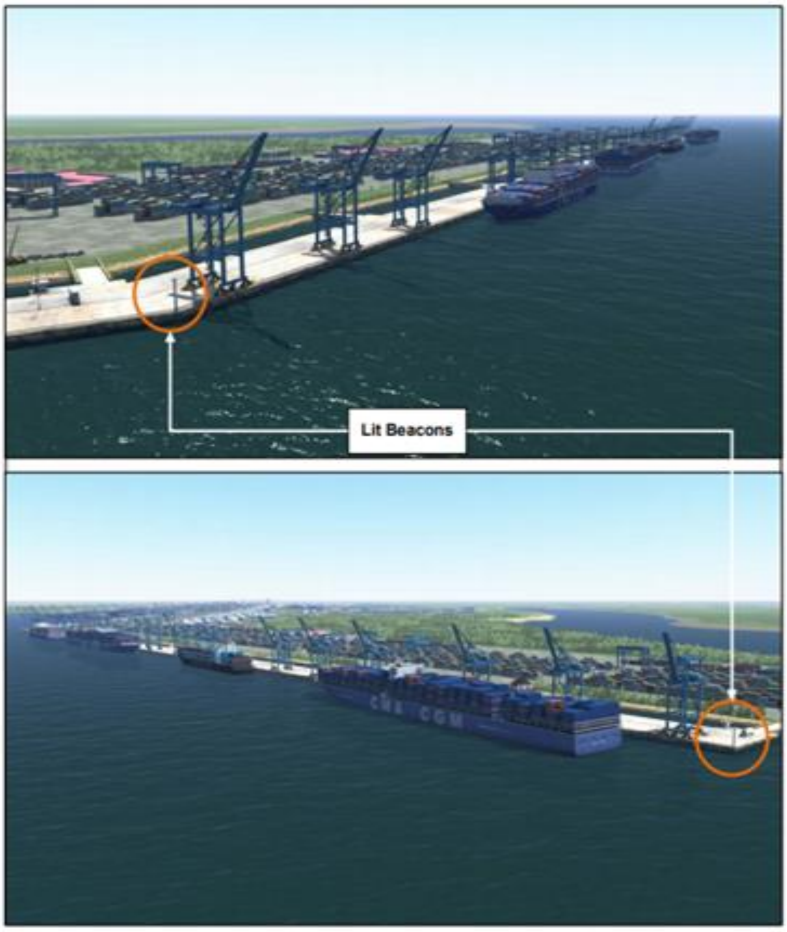
Vessel Size	Tugboat Configuration
400m LOA	4 x 70T BP ASD Tugboats (All Berths)
300m LOA	3 x 60T BP ASD Tugboats (All Berths)
260m LOA	3 x 50T BP ASD Tugboats (CT13 and CT14) 2 x 50T BP ASD Tugboats (Other Berths)

9.9.3 AIDS TO NAVIGATION

It is recommended to install 2 new light beacons at the kink (knuckle) and wharf end (CT17) as shown in **Figure 37**.

Figure 37 Proposed Light Beacons





Source : KASI FMSS

9.9.4 POTENTIAL NAVIGATIONAL CONCERNS

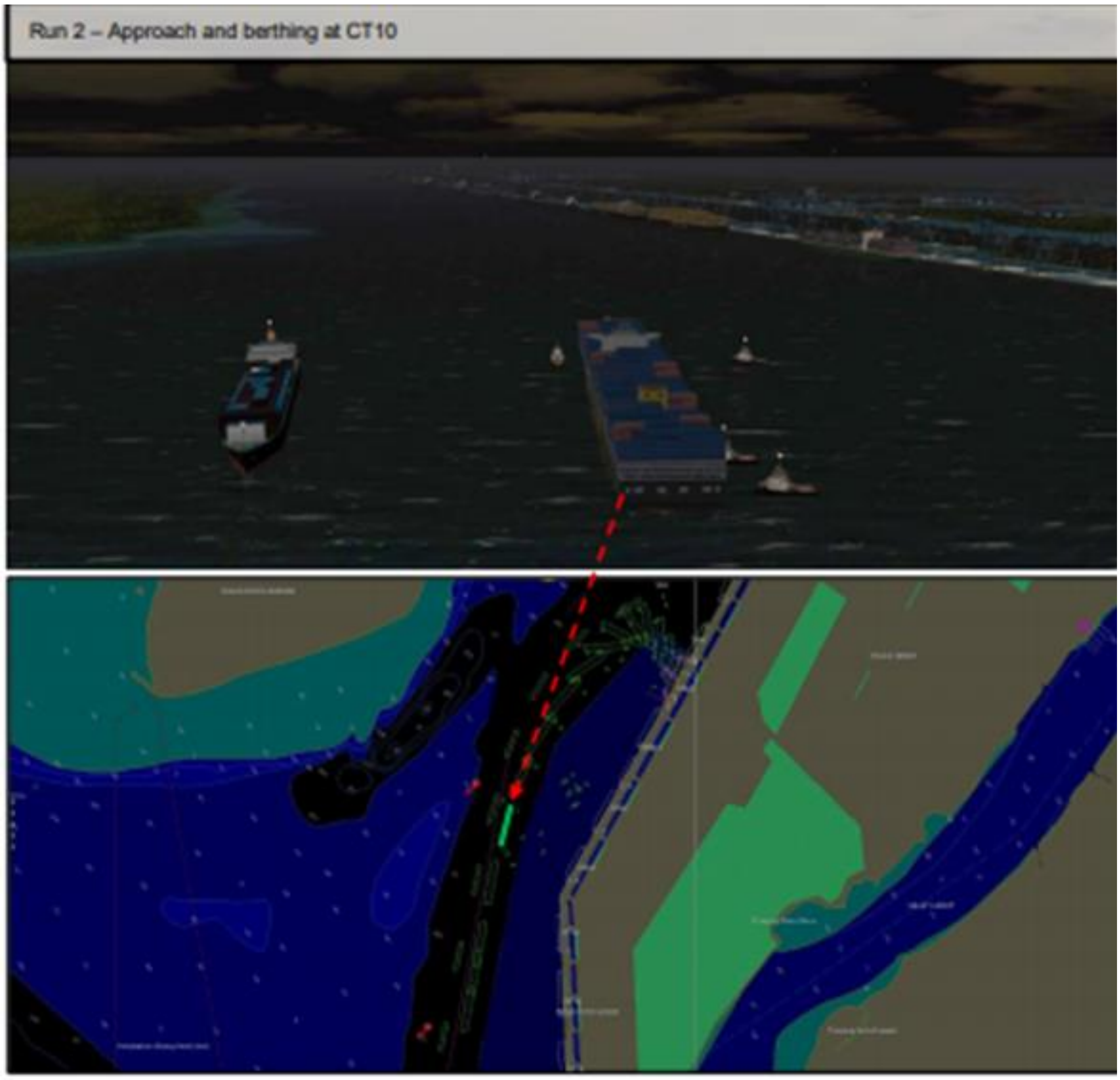
The following potential navigational concerns were identified:

- Extra caution must be exercised when manoeuvring close to the kink (knuckle) due to the shift in current direction (see Run 2 **Table 29** below). It is recommended that pilotage simulation familiarisation training be carried out for the new berths;
- It is critical to maintain good communication with port control, especially on the movements (inbound / outbound) of other vessels;
- For departure operations from CT17, recommend tugboats to escort the vessel until it clears the channel due to strong cross currents within the channel, in case of an emergency situation such as a vessel engine failure or tugboat failure.

Table 29 Approaching, Berthing And Encounter Outbound Vessel

Run No.: 2	Approaching and berthing at CT10 simultaneously with an outbound vessel
Ship Model	Container Ship • LOA : 396m • Beam : 53.6m • Draft : 16m
Environmental Condition	Wind: 20 - 25 knots / SW, Current: Ebb
Run Outcome	Vessel successfully approached and turned toward berth CT10 whilst maintaining sufficient clearances from the outbound vessel. However, berthing speed exceeded 1 knot due to strong current. Run rated Marginal
Recommendation	Pilotage simulation familiarisation training should be conducted to familiarise pilots with the manoeuvres to the new berths and the new current profiles.

Figure 38 Critical Area at Bend/Knuckle due to Change Current Direction



Source: KASI FMSS

9.9.5 SUITABILITY OF MANOEUVRING AREAS

The new dredged basin is considered sufficient for berthing / unberthing operations of the design vessels. The simulation runs indicated that the approach, berthing, unberthing and departure operations of the design vessels to the new berths (CT10 – CT17) will not encroach into the existing navigation channel.

9.9.6 CONCLUSION OF THE FMSS

The findings and conclusions from the FMSS Study validates the layout of the Westports Phase II Expansion with regards to safe ship transit, approach, manoeuvring, berthing, unberthing and departure operations for the design vessels. Additionally, the marine operations to the berths will not have significant navigational impact on the existing navigation channel, subject to compliance with the recommendations listed in this study.

10 RISK ASSESSMENT FINDINGS

This chapter provides a summary of the findings of the risk assessment conducted with regard to the proposed construction of additional container terminals at Westports and the operational activities associated with the Project, in particular the risks to navigation arising from additional marine traffic anticipated following the port expansion.

10.1 FINDINGS

A combination of hazards and hazardous events were assessed for the three scenarios. Each assessment examined for determination of the level of risk to elements such as the people, the environment, property and the developer.

The assessment identified that there are some combinations of hazards that have a risk factor of seven or above, to one or more than one of the elements assessed. These combinations of hazards are deemed to have an unacceptable level of risk and therefore require mitigation measures as described below.

10.2 RISK CONTROL MEASURES

This section describes the control measures that have been proposed to mitigate the risks associated with the proposed container terminal construction, channel deepening and widening works on shipping and navigation. In addition to the control measures for the proposed dredging works, this chapter also includes control measures for navigation out of the port limits to and from the offshore disposal ground.

The proposed control measures, their purposes and effects are given in this section. The primary purpose of a majority of the control measures proposed was to ensure that the port operates safely with due consideration of the need to keep the navigation channel open in whatever circumstances.

In applying the risk assessment methodology, there were nine combinations of hazard and hazardous events that were assessed as having an unacceptable level of risk as listed in **Table 30** below. The assessment showed that with the implementation of the proposed control measures, the residual risk in nine of these cases was reduced to a tolerable level.

Table 30 Proposed Control Measures

Ref	Control Measure	Purpose	Effect
A	**Small boats:**		
	Small boats should give way to big ships as they are more manoeuvreable and can go into shallow areas. Small boat and launches not to cross the bow of big ships.	To ensure that big ships are not impeded when manoeuvring within the port. To give way to big ships when in collision course. To avoid using the deep channel when shallow water could be used.	Reduce collision and impeding big ship navigation; Ensure safety of boat passengers.
B	**Keep alert during passing or overtaking:**		
	All masters, officers and crew of vessels overtaking and being overtaken and vessels passing one another to be alert of the possibility of course deviation due to interaction and to take remedial action quickly.	To prevent situations where collision or grounding taking place when being overtaken or passing another vessel. To ensure sufficient time is available for corrective action to be taken.	No collision; No grounding; No blocking of the channel
C	**Slow vessels:**		
	Slow vessels to keep to the shallow area of the approach channel where possible and not to block the faster ship from overtaking safely.	To allow the overtaking vessels room to overtake the slower vessels.	Maintaining safe navigation in channel; No interaction forces causing uncontrollable situation; No blocking of channel by slow boat.
D	**Avoiding short cut route:**		
	Small ships & fishing vessels to avoid taking short cut routes between construction vessels and landing places; By-laws should be introduced to curb these practices and to penalize them.	To avoid these vessels from running aground at shallow patches which will cause time lost; To assist in refloating them; Prevent pollution if hull is breached and bad publicity to project; Avoid higher casualty statistic.	No grounding in port
E	**Engine and machinery failures:**		
	Port state control inspection should be intensified to reduce poor quality ships from using the port.	Port State Control inspections will show to the ship masters and engineers that the authorities view machineries failures seriously; To ensure high quality of companies and people working for them and the importance in the philosophy of proper maintenance of vessels.	Not to have machinery failures when in port; No grounding or loss of control of ships

Ref	Control Measure	Purpose	Effect
F	**Fire:**		
	Fire prevention plays a greater part in controlling ship fires. Personnel on ships should be fully trained in fire prevention as well as firefighting to prevent fire and to control it if it happens.	To prevent ship fire from occurring; To fight ship fire quickly	No risky situations which may cause fire; No flammable condition to be tolerated on board; Small fire to be extinguished quickly before becoming uncontrollable.
G	**Sinking:**		
	Must ensure no debris floating or submerged in the waters of the port area. Old boats and ships should not be allowed to use port waters.	To prevent floating debris or submerged objects which can be the cause of sinking of boats; To ensure boats serving the port are seaworthy and not a rotten hull type.	Preventing collision with debris and submerged objects resulting in sinking
H	**Manning Standards:**		
	Manning standards of vessels not covered by the STCW should be subject to charterer's terms and with agreed standard. Provide training on use of equipment and techniques specific to a vessel (e.g. AIS and ECDIS).	Smaller vessels are not required to have crew certified by the STCW but are covered under the licensing or small ship requirements	Reduce the risk of navigational error by improving the competency of person-in-charge of vessels at any time (not just the master)
I	**Charts:**		
	Provide cautionary note on the chart during construction phase.	Navigational charts commonly have amendments made to them to indicate areas where works are in progress and may additionally have a note of further explanation. Advise mariners of the presence of an area under construction.	Assist in reducing encounters between construction vessels with port traffic; Reduce navigational errors as vessels will pre-plan any change in their intended route rather than at the time of transiting the area.
J	**Charts:**		
	Publish new edition of sea chart for this area when construction and dredging works is completed, given that new development and facilities that have been built and are in operation.	To give ship masters and other mariners the latest information on the additional new facilities and infrastructure at Port Klang; To avoid the authorities from being sued for not having latest information in cases of litigations	Safety of navigation in the area; Provide up-to-date information to ship masters of existing facilities and information of the nautical nature

Ref	Control Measure	Purpose	Effect
K	**Notices to Mariners (NTM)**		
	Requesting non-containers terminal construction and dredging vessels to remain outside the project area and give vessels involved in the project a wide berth.	NTM are regularly promulgated by various means to give early warning to mariners of any notable events. This NTM is aimed at all non-terminal construction and dredger vessels as their level of interest in the operation may hamper the safety of construction operations.	Reduce the number of recreational craft and fishing vessels hampering operations. Maximise sea room available for construction vessels. Navigational errors or mistakes made by recreational craft will not affect the safety of operations as they will be far enough away.
L	**Notices to Mariners (NTM) :**		
	During the operational phase, a NTM and or similar arrangement used to promulgate information to all mariners including Fishermen's Organisation concerning ongoing activities in the project area.	To keep all mariners operating locally advised of any operational or maintenance activities, specifically aimed at fishermen through Persatuan Nelayan as it is likely they will continue to fish within the Port Klang area.	Limit the activities of fishermen and other mariners to the designated navigational channel; Maximise sea room available for construction and dredging vessels; Reduce encounters between vessels.
M	**Notices to Mariners (NTM) :**		
	During the construction phase, NTM to be issued to advise all mariners including Persatuan Nelayan, the construction activities and operations and in particular the position of this terminal.	Necessary to promulgate position of working area of the project to avoid it being fouled.	Reduce risk of fishing vessel's and smaller craft from encroaching the project area; Reduce risk of fishing vessel claiming not knowing the position of the additional terminals.
N	**Aids to navigation:**		
	Ensure aids to navigation such as navigational buoys, beacons and platform lights and beacons are on triple redundancy for bulbs and power. Service and maintain aids to navigation at regular intervals by relevant parties	To meet IALA reliability in aids to navigation of at least 98% for buoys, 99% for beacons and 99.99% for lighthouses	Prevent smaller vessels especially fishing boats (sampan) from hitting the buoys and cause damage as well as potential loss of life; Ensure aids to navigation in the Westports area are

Ref	Control Measure	Purpose	Effect
	and maintain records of the servicing and maintenance works.		always functional and effective.
O	**Project site planning:**		
	Project management must plan to maintain clear passages, fairways and anchorage areas for construction vessels movements and anchoring, as well as tying up.	To provide all ship masters and vessels operators the project site plan and the importance to adhere to the planning and compliance requirements. Failure may result in having to implement deterrent measures.	To ensure availability of passageways at project site and also ensure vessels anchor in designated places; Will ensure a safer work site.
P	**Construction Site safety & PPE:**		
	All workers to be given safety training for working afloat; PPE to be worn at all times including lifejackets or personal floatation devices.	To ensure workers safety and reduce casualties at work site.	No stoppages due to lost man hours due to accidents.

11 IMPLICATIONS TO STAKEHOLDERS

The likely implications of the proposed Project to each category of stakeholders are presented in **Table 31.** The table also includes a brief summary of how the identified adverse risks could be mitigated.

Table 31 Equity of Risk to Stakeholders

Stakeholder Category	Stakeholder Types	Comments	Mitigation of Adverse Risks
Risk Imposer	The developer and/or owner of the Project (Westports Malaysia)	They are likely to be the main beneficiary of the Project	The developer and/or operator of the Project have obligations to implement the control measures
Risk Taker	South Channel waters users (general public)	Users are subject to risk of ships contacting and colliding when using the waterways within the container terminal during construction and also when the new terminal is in operation.	Proper markings and lighting to ensure safe transit of ships near the new terminal.

Stakeholder Category	Stakeholder Types	Comments	Mitigation of Adverse Risks
	Navigation stakeholders	The navigation stakeholders are commercial shipping industry, fishermen and the terminal owner	The new berths to be charted with markings and lightings to assist/control ship navigation through the South Channel waters.
	Insurers	The risk would cascade to the marine insurance industry and the developer's insurer	The location of the Project, its design and safe distance were designed to minimise the impact on safety of navigation
Risk Beneficiary	**The owner of the Project**	**The owner would expect to achieve a financial reward**	**The contractors and the project proponent will be required to comply with detailed procedures concerning the safety of navigation in the port limits particularly in the transit, passing and overtaking situations, to ensure general public safety.**
	General public	The general public would be able to get more goods and much faster with a boost to the country's economy	
	The Government	The project would assist the Government in achieving its stated objectives in terms of economic growth and balance of payment	
	Owners and operators of companies employed in the construction, operation and maintenance of the Project	Other beneficiaries include those involved in the construction and operation of the Project	
Risk Payer	The owner of the Project	The major costs of managing the risk would rest with the owner of the Project	The costs include that of developing and implementing the mitigation controls set out in this MRA
	Navigation aids authority, the Marine Department of Malaysia	Some costs would be incurred by the Navigation aids authority and the Marine Department	
Risk Sufferer	General public, seafarers, fishermen, operators of the terminals	The possibility of a violation, mistake, lapse or slip whilst carrying out their navigation duties may lead, or contribute to a disastrous event ~~where the Westports might be closed~~	The port operation will be required to comply with detailed procedures concerning their transit and navigation arrangements for the navigation safety, VTS advice and other support activities
	Owner and users of Westports and users of the South Channel		
Risk Observer	Port and marine authorities	Awareness of the project, may also be	

Stakeholder Category	Stakeholder Types	Comments	Mitigation of Adverse Risks
		beneficial in terms of indirect exposure to their potential investors, and may also suffer consequences, e.g. if ships are involved in accidents within the port limits	

12 CONCLUDING STATEMENT AND RISK CLAIM

A Marine Traffic Risk Assessment ("MTRA") of the proposed Westports Expansion and its associated works and subsequent operation had been conducted. This chapter summarises the assessment process together with the main findings of the assessment and culminates in a risk claim.

12.1 COLLECTION OF EVIDENCE

In order to present a reasoned argument to support the risk claim, a clear and concise evidence is required to establish hazard levels and the types of marine operations currently practised within the proposed project site and subsequent operation.

Evidence was also obtained from historical data, such as accident and incident statistics and reports, in order to establish the trends and frequency of events which were considered in this MTRA.

12.2 CONSULTATION

Views and opinions of stakeholders on the proposed project and its subsequent operation were sought. The consultation was undertaken with a wide range of stakeholders. At the pre-assessment stage, their views were sought to identify their concerns which were subsequently considered in the MTRA when identifying potential hazardous events and their causes or contributory factors (hazards).

Many of the stakeholders consulted are users of the area, such as facilities operators, pilots, shipyard and marina operator in the vicinity. Their local knowledge and professional experience of the stakeholders consulted were used to verify the evidence presented for assessment, to review and confirm the findings and conclusions.

12.3 THE MTRA

Mitigation measures to minimize the impacts relating to increased ship movement and port operations are discussed below. In order to minimize the risks relating to marine traffic congestion, a few recommendations are listed below:

- Firstly, the navigation channel along Selat Klang should be widened for a clear traffic separation for both northbound and southbound vessel movements. The findings from the marine traffic risk assessment model have shown that the predicted risk level can be reduced by the implementation of traffic separation scheme of inbound and outbound traffic along Selat Klang.

- Another way to mitigate the risks is the implementation of the Passage Plan Approval System (PPAS) which permits real-time forecasting of marine traffic movements based on the updates of the Vessel Traffic Management System (VTMS).
- The aims of PPAS are (i) to predict traffic utilization within fairways, (ii) to review and approve passage plans, and (iii) to provide advice to vessel masters and pilots of potential conflicts between vessels.
- Efficient port management can reduce collision risk potential between vessels. The implementation of a centralized port management system will assist in increasing the port efficiency, with the cooperation and support by Vessel Traffic Centre (VTC), pilots, and port operators.
- A centralized port management system will assist port users and the traffic control unit to acquire up-to-date ship tracking information and to allow efficient scheduling. Several existing technological facilities which controls the port efficiency include Vessel Traffic Management System (VTMS), Port Klang Net (PKNet), and DagangNet.
- To minimise the risk of marine traffic accidents, PKA operates the Vessel Traffic Management System (VTMS) which is a monitoring and surveillance system that monitors marine traffic and ship movements within the pilotage districts of Northern and Southern Channel.
- Identification and tracking of vessels by their “call signs” is conducted for the scheduling of arrival and departure of shipping vessels. In the event of a possible ship collision, an early warning will be relayed so that the vessels can take appropriate action to avoid any collision from occurring.
- Port Klang Net (PKNet) is another system where information on container movements in and out of the terminals are updated to the system for tracking purposes. Westports, on the other hand is connected to DagangNet that enables the exchange of information between shipping lines, customs, and other related maritime agencies.
- Optimisation of port activities and resources can result in an efficient management of the port. VTMS control can be improved and enhanced by proper scheduling and management of vessels that would ensure no vessels, through their entire transit of the waterway, would be placed in a position where an active encounter may be created, which would subsequently reduce the potential of collision risks.

Mitigation measures (controls) have been proposed to address the combinations assessed as having an unacceptable level of risk. A re-assessment of all the combinations identified within the MTRA was undertaken to establish the residual risk with the controls in place. The re-assessment showed that, with all controls in place, all identified combinations of hazard and hazardous events have a level of risk that is considered to be tolerable or broadly acceptable.

12.4 RISK CLAIM

A detailed MTRA was conducted to identify and assess the risks to navigation that may arise due to the proposed project during construction and its subsequent operation. The MTRA considered the proposed container expansion project with respect to the operation of this marine facility, existing vessels traffic levels and those that might reasonably be expected in future.

The MTRA identified a number of situations that increases the risks to navigation arising from the construction works and the operation of the facility. Those risks were carefully assessed. It is considered that with the mitigation controls proposed, when implemented, the risk to navigation would controlled to acceptable levels.

12.5 CONCLUSION

The MTRA identified a number of situations that increase the risks to shipping and navigation arising from the proposed expansion of container terminals at Westports. Those risks were carefully assessed, and controls proposed such that, when implemented, the risk to shipping and navigation would not be increased beyond the level that presently exists.

- The MTRA determined that the proposed project **do not present any hazard that would be detrimental and unacceptable** to the safe navigation of vessels in the South Channel of Port Klang port limits and the surrounding waters. However, the dredging contractor and construction company will be required to submit a separate Marine Risk Assessment prior to commencement of the works.
- The findings and conclusions from the FMSS Study validates the layout of the Westports Expansion with regards to safe ship transit, approach, manoeuvring, berthing, unberthing and departure operations for the design vessels. Additionally, the marine operations to the berths will not have significant navigational impact on the existing navigation channel, subject to compliance with the recommendations listed in this study.
- The proposed project Westports Phase II will accommodate larger vessels (LOA >200m) and the forecasted marine traffic using the Southern Channel upon the full completion of the port expansion would increase by two times (2X) as compared to the existing marine traffic volume.
- The increase in traffic volume may cause marine traffic congestion and also increase the risk of ship collisions and safety hazards towards fishing boats. With a proper marine traffic management plan and port traffic control, these risks can be minimized significantly.
- The Port Klang Authority utilizes a Vessel Traffic Management System (VTMS) to monitor marine traffic and ship movements within the pilotage districts. Furthermore, Malaysia has adopted the **Convention on the International Regulations for**

Preventing Collisions at Sea 1972 since 1980 which provides the navigation rules to prevent collisions between vessels, including large ships and smaller fishing vessels.

- In the Marine Traffic Risk Assessment (MTRA) conducted by BMT and reviewed by Aycity Emmar Technologies Sdn. Bhd., several mitigation measures are recommended as outlined below:

  (1) the navigation channel along south Selat Klang should be widened for a 2-way operation which will significantly reduce the forecasted risk level;

  (2) the development of the Automated Passage Plan System which functions to optimize the arrival activities of vessels will subsequently improve safety by 50%;

  (3) to introduce a traffic separation scheme which will reduce the chances of irregular crossings and proximity of head-on between vessels thus will effectively control the potential increase in risk in the long run; and

  (4) the number of pilots, tugs and pilot boats need to be increased accordingly to cope with marine traffic workload demands when all the terminals are operational.