Republic of the Union of Myanmar
Myanma Port Authority

THE PREPARATORY SURVEY FOR THE PROJECT FOR EXPANSION OF YANGON PORT IN THILAWA AREA

FINAL REPORT 1

June 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

The Overseas Coastal Area Development Institute of Japan
NIPPON KOEI CO., LTD

ABBREVIATION

A	ADB	Asian Development Bank
	AFTA	ASEAN Free Trade Area
	AIS	Automatic Identification System
	APEC	Asia-Pacific Economic Cooperation
	ASEAN	Association of Southeast Asian Nations
	AWPM	Asia World Port Management Co., Ltd
	AWPT	Asia World Port Terminal
B	BA	British Admiralty
	BOD	Biochemical Oxygen Demand
	BOT	Build Operate Transfer
	BS	British Standard
C	CBD	Central Business District
	CCTV	Closed Circuit Television
	CD	Chart Datum
	CDL	Chart Datum Level
	CFS	Container Freight Station
	CPI	Consumer Price Index
	CSI	Container Security Initiative
	CY	Container Yard
D	DA	Designated Authority
	DD	Detailed Design
	DDT	Dichloro-diphenyl-trichloroethane
	DFR	Draft Final Report
	DL	Datum Level
	DMA	Department of Marine Administration
	DMH	Department of Meteorology and Hydrology
	DO	Dissolved Oxygen
	DWT	Dead Weight Ton
E	EIA	Environmental Impact Assessment
	EIRR	Economic Internal Rate of Return
	ENC	Electronic Navigational Chart
	ETA	Estimated Time of Arrival
	ETD	Estimated Time of Departure
	EU	European Union
F	FC	Foreign Cost
	FCL	Full Container Load
	FDI	Foreign Direct Investment
	FIRR	Financial Internal Rate of Return

	FR	Final Report
	F/S	Feasibility Study
	FT	Freight Ton
	FZ	Free Zone
G	G8	Group of Eight
	GC	Gantry Crane
	GDP	Gross Domestic Product
	GIS	Geographic Information System
	GMS	Greater Mekong Subregiomal
	GRT	Gross Registered Tonnage
	GT	Gross Tonnage
	GTAP	Global Trade Analysis Project
H	HP	Horse Power
	HSHD	Department of Human Settlement and Housing Development, MOC
	HHWL	Highest High Water Level
	HWL	Hight Water Level
I	IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
	IAPH	International Association of Ports and Harbors
	ICR	Inception Report
	IMO	International Maritime Organization
	ISPS	International Ship and Port Facility Security Code
	ITR	Interim Report
	IWD	Inland Waterway Department
	IWT	Inland Water Transport
J	JETRO	Japan External Trade Organization
	JICA	Japan International Cooperation Agency
	JPY	Japanese Yen
L	LC	Local Cost
	LCL	Less than Container Load
	LED	Light Emitting Diode
	LOA	Length Overall
	LWL	Low Water Level
M	METI	Ministry of Economy, Trade and Industry (Japan)
	M&E	Mechanical and Electrical
	MIPL	Myanmar Integrated Port Ltd.
	MIP	Myanmar Industrial Port
	MITT	Myanmar International Terminal Thilawa
	MLIT	Ministry of Land, Infrastructure, Transport and Tourism
	MNPED	Ministry of National Planning and Economic Development
	MOC	Ministry of Construction

	MOECF	Ministry of Environmental Conservation and Forestry
	MOT	Ministry of Transport
	M/P	Master Plan
	MPA	Myanma Port Authority
	MSL	Mean Sea Level
	MWL	Mean Water Level
N	NCEA	National Cmmission of Environmental Affairs
	NK	Nippon Koei Co., Ltd.
	NM	Nautical Mile
	NSDS	National Sustainable Development Strategy
O	OCDI	Overseas Coastal Area Development Institute of Japan
	ODA	Official Development Assistance
P	PAPRD	Project Appraisal and Progress Reporting
	PCB	Polychlorinated biphenyl
	PCCD	Pollution Control and Cleansing Department
	PFSA	Port Facility Security Assessment
	PFSP	Port Facilities Security Plan
	PFSO	Port Facility Security Officer
	PHAJ	The Ports and Harbors Association of Japan
	PHC	Prestressed High-strength Concrete
	PIANC	World Association for Waterborne Transport Infrastructure
	PVD	Prefabricated Vertical Drain
	PZ	Promotion Zone
R	RC	Reinforced Concrete
	ReCCAP	Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia
	RSO	Recognized Security Organization
	RTG	Rubber Tired Gantry Crane
S	SAFE	Security and Facilitation in a Global Environment
	SEZ	Special Economic Zone
	SFA	State Fund Account
	SOLAS	Safety of Life at Sea
	SS	Suspended Solids
	STS	Ship-to-Shore
T	TBT	Tributyltin
	TEU	Twenty-feet Equivalent Unit
	T-N	Total Nitrogen
	T-P	Total Phosphorus

	TSHD	Trailing Suction Hopper Dredger
U	US	United States
	USA	United States of America
	USCG	United States Coast Guard
V	VAT	Value Added Tax
	VHF	Very High Frequency
	VTMS	Vessel Traffic Management System
	VTS	Vessel Traffic Service
W	WCO	World Customs Organization
Y	YCDC	Yangon City Development Committee

Exchange Rate

January, 2013

	USA (US$)	Japan (JPY)	Myanmar (Kyat)
US$	1.00	83.64	858
JPY	0.0120	1.00	0.00117

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1. Outline of the Study

Myanmar has a population of about 60 million and spreads across an area of 680,000 km2, making it one of the relatively larger countries in ASEAN, however, its economic development has been delayed due to economic sanctions imposed by foreign countries. Myanmar offers cheaper labor costs than surrounding countries, and also, is geographically located next to India, the People's Republic of China and ASEAN countries which have large industrial power and strong consumption demand, which gives Myanmar great development potential. Therefore, the recent lifting of sanctions is most likely to trigger a rapid economic development in Myanmar.

Moreover, there is a general election planned in 2015 which many believe will bring more democracy to Myanmar, and also planned in 2015 is the reduction and abolition of custom tax within the ASEAN region, hence it is envisaged that Myanmar with such a high potential would attract significant foreign investment and thus there needs to be speedy infrastructure development in order to prepare a good environment for such investment.

1.1. Background of the Study

To support the future economic development of Myanmar, key roles will be played byYangon Port in Yangon City (Yangon Main Port) and Yangon Port in Thilawa Area (Thilawa Area Port) which have Yangon, the largest city in Myanmar, as the hinterland. The two ports have limitations in channel depth, however, considering the proximity to the largest city as well as the development of SEZ (Special Economic Zone) in the hinterland, they are expected for the time being to function as the gateway ports supporting the economic development of Myanmar, coping with the rapid increase of cargo handling volume.

1.2. Objectives of the Study

In this context, the project for expansion of Yangon port in Thilawa area (The Project) is to clarify the division of roles between Yangon Main Port and Thilawa Area Port, and develop and expand the port in order to satisfy the cargo demand of the hinterland SEZ as well as the whole of Myanmar, for the economic development of Myanmar. In this study, the cost, implementation arrangement, operation and maintenance scheme, socio-environment consideration of the Project and also the applicability of PPP scheme are studied. The objective of this study is to formulate the '**Yangon Port Basic Development Policy**' which will clarify and define the role of Yangon Main port and Thilawa Area Port, and based on this Basic Development Policy, to formulate the '**Thilawa Area Port Urgent Development Plan**', which includes the urgent works as the first phase implementation package, followed by '**Thilawa Area Port Development Plan**' covering all the projects targeting year 2025, and finally, '**Yangon Port Master Plan**' which will also include the future plan of Yangon Main Port and Thilawa Area Port. In this interim report, '**Thilawa Area Port Urgent Development Plan**' is included. Other deliverables will be included in the final report.

1.3. Study Area

The study area is mainly Yangon Port in Thilawa Area. In addition, as it is essential to analyze the role sharing with Yangon Main Port and nationwide industrial development trend in order to elaborate the strategies relevant to Yangon Port in Thilawa Area, the study area entails the whole of Myanmar. The location of the study area is show in below.

Prepared by the Study Team

Figure 1.3-1 Yangon Port Limit and Location of Yangon Main Port and Thilawa Area Port

Figure 1.3-2 Location of the Study Area

1.4. Framework of the Study

1.4.1. Counterparts/Steering Committee

The Counterpart of the study team is Myanma Port Authority (MPA). MPA has the land rights of the Study Area in Thilawa area and is in the position to delegate or contract out the operation of the port container terminal. Also they are in charge of the dredging and management of the channel from the river mouth to Yangon main port, together with the safety of navigation in that channel. Regarding the inclusion of Ministry of Transport (MoT) which is the governing ministry for MPA, the Study Team has been proposing that MPA set up and hold a Steering Committee including MoT, however, MPA has been reluctant to do so and thus no Steering Committee has been held. One reason might be the geographical distance between Yangon where MPA sits and Nay Pi Taw where MoT is located.

1.4.2. Stakeholders

Regarding the resettlement of the residents within the Study Area, the Study Team has been in close communication with the Thilawa Special Economic Zone (SEZ) Development Study Team, and discussed with MPA the prospects of holding a Stakeholders meeting with those residents, together with the related government organizations such as the Department of Human Settlement and Housing

Development, Ministry of Construction, and the Yangon Regional Government. MPA was in effect a Stakeholders meeting independently in February 2013.

1.4.3. Study Team

The Study Team is comprised of the experts listed in Table 1.4-1;

Table 1.4-1 The member list of the Study Team

Dr. Tadahiko YAGYU	Team Leader / Port Planning	OCDI
Mr. Satoshi SASAKURA	Environmental Conditions Survey 1	OCDI
Mr. Takemasa SOMA	Environmental Conditions Survey 2	OCDI
Mr. Kazuyuki YAMAGUCHI	Demand Forecast	OCDI
Mr. Yoshihisa TATENO	International Shipping	OCDI
Mr. Kuniomi HIRANO	Hinterland Development Planning	NK
Mr. Takeshi SUZUKI	Economic and Financial Analysis	OCDI
Mr. Mitsuhiko OKADA	Port Management and Operation Systems 1 (including Public Private Partnership)	OCDI
Mr. Yushi ANDO	Port Facility Design	NK
Mr. Toshihiro KATO	Cost Estimation and Construction Planning (Civil Works)	NK
Mr. Shojiro KOGA	Cost Estimation and Construction Planning (Machinery)	NK
Mr. Tamotsu TAMURA	Channel Dredging and River Erosion	NK
Mr. Kazuhisa IWAMI	Channel Planning	NK
Mr. Yusei SAKAE	Navigation Safety Planning	NK
Mr. Seiichi TAKINO	Work Vessel Planning	NK
Mr. Toshiya AKASAKI	Natural Condition Survey (Geological)	NK
Mr. Kentaro KIMURA	Natural Condition Survey (Bathymetric)	NK
Mr. Toshiyuki HIROE	Port Management and Operation Systems 2	OCDI
Mr. Akihito HIURA	Port Planning 2	OCDI
Mr. Naoyuki SHIRAYAMA	Coordinator / Assistant of Port Planning	OCDI

1.4.4. Study Schedule

The work schedule is as shown below;

Table 1.4-2 Work Schedule of the Study

【THE PREPARATORY SURVEY ON THE PROJECT FOR EXPANSION OF YANGON PORT IN THILAWA AREA】
Work Schedule

Calendar Month	2012						2013					
	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.
Study Month	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Information Collection and Analysis												
Survey												
Report	▲ ICR				▲ ITR				▲ DFR		▲ FR	

ICR : Inception Report, ITR : Interim Report, DFR : Draft Final Report, FR : Final Report

1.5. Outline of Relevant Studies

As for the existing reports, the study team has collected and reviewed those related to national development strategy. Also, the team has collected and analyzed reports related to the transport sector and Yangon Port from Ministry of Transport (MOT) and MPA. Important points which require extra attention are as follows.

1.5.1. REVIEW ON YANGON PORT

Regarding the current situation on Yangon Port, related laws and regulations on ports of Myanmar, and related master plans on port development of Yangon are presented in Chapter 2.2, 2.3 and 3 of this report.

1.5.2. REVIEW ON PORT MANAGEMENT

Regarding the port management in Yangon, details are presented in Chapter 2.5 of this report.

1.5.3. REVIEW ON SEZ

Amongst the Special Economic Zone (SEZ) plans in Myanmar, that of Thilawa Area is very important, especially when conducting the demand forecast of Thilawa Area Port. The detailed analysis is presented in Chapter 2.4 of this report.

2. Present Situation Relevant to Ports in Myanmar

2.1. Socio-economic Trends

2.1.1. Economic Trends

There are some notable high growth industries which are fuelling Myanmar's economy. It is expected that those industries become the engine for Myanmar's economy.

(1) Natural Resource Development

Natural Gas, Power Generation, Mining

Natural gas is transported to Thailand through Pipeline from off-shore gas field Yatagan and Yadana directly. Transport of natural gas from Rakhing state off-shore gas field to China is expected to start soon.

(2) Labor intensive Industries

Garments, Shoemaking

As wages in Myanmar are lower than surrounding countries, these types of industries are expected to attract foreign investment.

(3) Construction and Real Estate

Public Investment, States Property Disposal.

(4) Consumer products and Endurance consumer products (Cars, Home electrical products etc.)

As economic sanctions by US and EU countries are removed, foreign investment is expected to increase.

2.1.2. Gross Domestic Products (GDP)

Myanmar's economy has been growing steadily, recording annual growth of 5.1% and 5.3% in each year of 2009 and 2010 respectively. Driving force industry fields are hydraulic power generation, development of capital Nay Pyi Taw, highway construction and development of natural gas. According to an ADB forecast, economic growth rate after 2011 is also expected to achieve more than 5.5 %. IMF's GDP per capita forecast for the year 2010 is US$ 702. As long-standing economic sanctions by US and EU countries are removed, foreign investment is expected to increase. President U Thein Sein has targeted economic growth of 7.7 % until the year 2015. Table 2.1-1 shows the GDP growth rate from 2007 to 2010 and projection by ADB from 2001 and 2013.

Table 2.1-1 GDP Growth Rate of Past Record and Projection in Myanmar

	2007	2008	2009	2010	2011	2012	2013
GDP Growth Rate (%)	5.5	3.6	5.1	5.3	5.5	6.0	6.3

Source：ADB

2.1.3. Population

Last population census was conducted in 1983 and next census is planning for 2014. Therefore, estimated population data has been used. Estimated population published by Central Statistics Organization in 2009 is 50,931,000. High population density regions are Mandalay division, Ayeyarwady division, Yangon division and Rakhine state, with each region accounting for 14%, 13.5%, 11.7% and 11% of total population respectively. Central Statistics Organization estimates annual population growth rate has been 1.29%. Table 2.1-2shows estimated Myanmar population by region.

Table 2.1-2 Estimated Myanmar Population by Region

unit : thousand

	2003	2004	2005	2006	2007	2008	2009
Kachin State	1,393	1,423	1,453	1,484	1,511	1,539	1,560
Kayah State	301	310	319	328	336	344	351
Kayin State	1,607	1,641	1,674	1,709	1,740	1,771	1,794
Chin State	502	510	518	526	533	541	545
Sagaing Division	5,777	5,901	6,028	6,159	6,274	6,392	6,480
Tanintthary Division	1,490	1,525	1,562	1,599	1,632	1,665	1,691
Bago Division	5,420	5,514	5,609	5,707	5,793	5,879	5,944
Magway Division	4,976	5,080	5,187	5,296	5,392	5,491	5,564
Mandalay Division	7,407	7,571	7,739	7,910	8,062	8,216	8,333
Mon State	2,735	2,801	2,868	2,936	2,997	3,060	3,106
Rakhine State	2,968	3,023	3,078	3,134	3,183	3,233	3,271
Yangon Division	6,188	6,322	6,460	6,600	6,724	6,849	6,944
Shan State	5,142	5,223	5,306	5,390	5,464	5,539	5,595
Ayeyarwady State	7,318	7,455	7,595	7,737	7,863	7,858	7,952
Total	53,224	54,299	55,396	56,515	57,504	58,377	59,130

Source：Statistical Yearbook 2010

2.2. Port and Relevant Transport Sectors

2.2.1. Ports

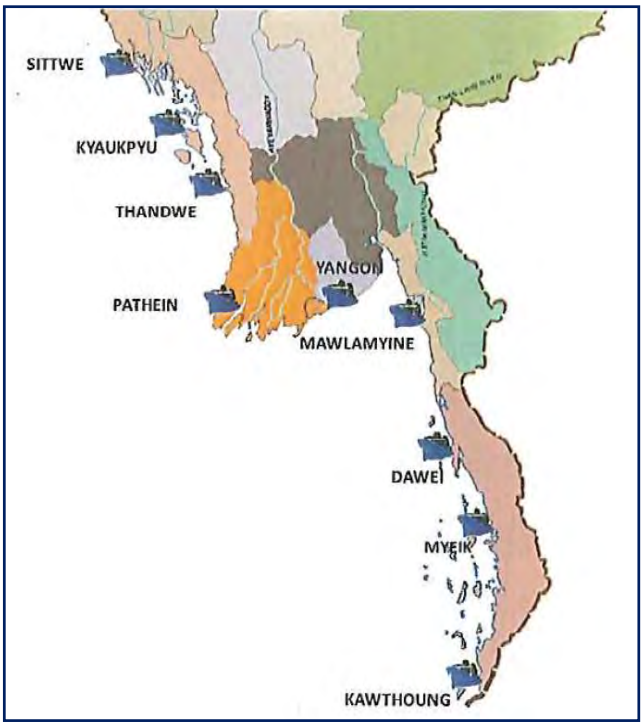
Yangon port was established in Myanmar in 1756. In 1972, the Board of Management for the Port of Yangon was redefined as the Burma Ports Corporation. It became the Myanmar Port Authority (MPA) in 1989.

MPA manages ports in Myanmar as a public corporation under the jurisdiction of the Ministry of Transport. The capital investment plan of MPA must be authorized by the government. On the other

hand, the use of private capital such as B.O.T (Build-Operate-Transfer) is becoming more common.

There are nine main ports in Myanmar. Yangon port is a river port, located upstream about 32km from the mouth of the Yangon-river. The maximum ship sized which can currently call the port has a draft of 9m and a length of 167m. Navigation during ebb tide is difficult due to the shallowness of about 6 m at the estuary of Yangon River. It is necessary to wait about six hours until high tide.

Deep Seaport is necessary to accommodate large ships which are expected in line with the forecasted cargo growth in the future. Deep Seaport is currently planned at Kyaukpyu, Kalegauk, Dawei, and Bykpyin.



Source: MPA

Figure 2.2-1 Ports in Myanmar

2.2.2. Shipping (Container Ship)

(1) World Trend on Container Ship Size Increase

According to Drewry Publishing, about 17% of cargo in tonnage basis and about 80% in monetary basis of international cargo transport are containerized. And container cargo volume in the Asian region is expected to increase at a rate of 6-8 % per annum.

About 82 % existing container ships are smaller than 5,000 TEUs size and the average size of newly built container ships is about 4,000 TEUs. The size of container ships in operation by shipping routes is as below;

- Europe-Asia Route: about 89 % of all are larger than 5,000 TEUs
- North America-Asia Route: about 91 % of all are larger than 3,000 TEUs
- Intra-Asia: about 98 % of all are smaller than 3,000 TEUs.

In addition to the above, the recent tendency of deploying ULCS (Ultra Large Container Ships: over 10,000 TEU and larger) has accelerated the shipping lines' action to rearrange the fleet structure by imputing larger type container ships into the regional service route such as intra-Asian service replacing the current smaller type vessels. This effect is called "Cascade Effect".

(2) Container Terminals in Asian Countries

Middle class ports in the Asian region are listed in the Table 2.2-1, and 2.2-2.
The port of Laem Chabang ranks first among the ports. The port of Yangong of Myanmar is not listed in the table because it has no official relations with The Containerization International Magazine, the compiler of the world container throughput for many years.

Unofficially, the number of containers numbers handled at the port of Yangon is said to be about 450,000 boxes, and because almost all containers handled at the port are 20 foot containers, it is safe to say that the 450,000 boxes is equivalent to 450,000 TEU.

Accordingly, Yangon Port is ranked around 11th among the Asian middle sized ports in 2013. The Port will be ranked within the group of Top 10 ports in the quite near future as the country's big population exceeds 60 million.

While Asian Ports continue to develop, some are facing challenges which are listed on the Table 2.2-3.

Table 2.2-1 Asian Middle Class Ports (1st-13th)

	Port	Country	2010 TEU (World Rank)		2009 TEU
1	Laem Chabang	Thailand	5,068,076	21	4,537,833
2	Tanjubg Priok	Indonesia	4,714,857	24	3,804,805
3	Colombo	Sri Lanka	4,000,000	28	3,464,297
4	HCMC	Vietnam	3,856,000	30	3,563,246
5	Tnajung Perak	Indonesia	3,030,000	37	2,270,000
6	Bangkok	Thailand	1,452,829	76	1,222,048
7	Karachi	Pakistan	1,370,000	78	1,307,000
8	Haiphong	Vietnam	953,646	101	815,831
9	Pasir Gudang	Malaysia	826,268	108	844,855
10	Davao	Philippines	524,496	152	336,647
11	Cebu	Philippines	492,776	157	487,721
12	Semarang	Indonesia	384,522	186	356,461
13	Vung Tau	Vietnam	293,912	211	96,000

Source : Containerization International Year Book 2012

Table 2.2-2 Asian Middle Class Ports （14th-26th）

	Port	Country	2010 TEU (world rank)		2009 TEU
14	Binturu	Malaysia	251,296	227	248,390
15	Sihanoukville	Cambodia	224,206	238	207,577
16	Cai Lan	Vietnam	204,129	252	185,235
17	Kuantan	Malaysia	142,080	284	132,252
18	General Santos	Philippines	140,023	286	130,805
19	Songkhla	Thailand	127,627	291	138,054
20	Visakhapatham	India	126,482	294	95,161
21	Manila	Philippines	125,042	295	176,241
22	Pulupandan	Philippines	92,689	314	89,762
23	Danang	Vietnam	89,199	319	69,720
24	Sibu	Malaysia	80,333	326	66,210
25	Qui Nhon	Vietnam	72,224	331	54,649
26	Zaboanga	Philippines	67,251	336	63,079

Source : **Challenges being felt at Some Middle Class Asian Ports**

Table 2.2-3 Estimated Myanmar Population by Region

Country	Ports	Challenges
Vietnam	Cai Mep	Feeder service between HCMC and Cai Mep faces difficulties because of high transfer cost by trucks or barges. （Truckage is said to be around US$100/20’）because by the high drayage. Container throughput is far under the forecasting amount.
Indonesia	Tanjung Priok （Jakarta）	Rough handling of cargo often results damage. Pilferage is not rare. The port has a Bad reputation among shipping lines and shippers。
Canbodia	Shihanoukville	Because of its midway-position between Laem Chabang and Cai Mep, the port is often skipped.
Philippines	Manila	Port congestion is almost permanent. On top of this, cargo is handled in a rough measure and security is poor. There is usually a long line of trucks waiting at the gate wate.
Myanmar	Yangon	Container ships exceeding 1,000 TEU have difficulties entering/leaving the Port. Yangon is the problem port in the region.
Thai	Laem Chaban	It was feared that the port would lose its status as an Asian hub port due to the development of Cai Mep port. However, because the number of containers handled at Cai Mep has been smaller than expected, the situation at Laem Chabang is stable for the time being.

Source :JICA Study Team

Majority of container ships sailing in the Asian region is about 3,000 TEUs (40,000 DWT with a draft of 12m). Aiming at receiving this size of ships, container terminals with the depth of 14 m are developed at Cai-Mep Thi-Vai in Vietnam while a depth of 16 m is available at Laem Chabang in Thailand and a container terminal with the depth of 14 m is planned at Sihanoukville Port in Cambodia.

Port of Yangon has a vast surrounding area. The number of ports which have directly connected with the port of Yangon through many service routes is numerous. In addition to the above mentioned ports, some important ports have to be added. Those ports are;

Bay of Bengal Ports------Some ports of Bangladesh, East Coast of India

Sri Lankan Port----------Colombo

Indonesia Ports----------Tanjung Priok

In out-looking the future of the containerization of Myanmar, the biggest element that may affect the containerization development is the speed and quality of containerization in the countries facing the Bay of Bengal.

The East-West Container Trunk Line network has nearly completed in 20th Century. On the other hand, North-South Trunk Line network is on the half way. The cross-way port connecting East-West Line and North-South Line is getting more and more important. Typical cross-way port is Colombo.

The port of Colombo was once one of the major transshipment ports next to Singapore. However, Colombo slipped down a minor local port because of losing many customer shipping lines during the civil war days. The throughput was far below 1.5 million TEUs in those days. Fortunately for Colombo, the civil war ended and the numbers of calling ships are gradually increasing recently.

The basic concept of the container transportation system is to maintain the horizontal connecting line between two points (A and B). Thus, the participating shipping lines can't enjoy the maximum profit if either point (A or B) is less developed in containerization. In this sense, Colombo is a desirable partner port to Yangon. It is Yangon Port that should try hard to develop the container system in the region so that Colombo and Yangon be on the same level of terminal operation and other infrastructure. Port of Colombo is an advanced container terminal port and ships from Yangon can enjoy the complete terminal service in Colombo.

On the other hand, ports facing Bay of Bengal such as Chittagong is not the case. In the port, containerization development level is not satisfactory. For example, the shortage of container berths and shallow drought at berths. The same-level containerization in Bay of Bengal ports will become an important condition for the development of those countries. The same remarks can be applicable to the ports on East Indian Coast. In those regions, the container terminal development is delayed compared to that on West coast ports such as JHNP.

In India, the shipping business as well as water-front business was the responsibility of British people for a long time. Indian rail service was major role for domestic transportation and carried out by Indians. Therefore, containerization is still at the cradle days even today. It is hoped that the economical interface of Myanmar with East India will mutually beneficial, and the containerization development in both countries is desired.

The **Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation** (**BIMSTEC**) is an international organisation involving a group of countries in South Asia and South East Asia. These are: Bangladesh, India, Myanmar, Sri Lanka, Thailand, Bhutan and Nepal.

On 6 June 1997, a new sub-regional grouping was formed in Bangkok and given the name BIST-EC (Bangladesh, India, Sri Lanka, and Thailand Economic Cooperation). Myanmar attended the inaugural June Meeting as an observer and joined the organization as a full member at a Special Ministerial Meeting held in Bangkok on 22 December 1998, upon which the name of the grouping was changed to BIMST-EC. Nepal was granted observer status by the second Ministerial Meeting in Dhaka in December 1998. Subsequently, full membership has been granted to Nepal and Bhutan in 2004. Myanmar acted as a chairman for the period of 2009-2013.

In the first Summit on 31 July 2004, leaders of the group agreed that the name of the grouping should be known as BIMSTEC or the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation.

BIMSTEC has Fourteen priority sectors which cover all areas of cooperation. Six priority sectors of cooperation were identified at the 2nd Ministerial Meeting in Dhaka on 19 November 1998. They include the followings:

- Trade and Investment, led by Bangladesh
- **Transport and Communication, led by India**
- Energy, led by Myanmar
- Tourism, led by India
- Technology, led by Sri Lanka

India is serving as chairman of the Transportation and Communication group. The aim is to promote the well balanced development of the waterfront facilities in the region.

Bay of Bengal Initiative for
Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)

Map of South and Southeast Asia indicating BIMSTEC members.

Establishment **June 6, 1997**

Source: BIMSTEC HP

Figure 2.2-2 BIMSTEC area

(3) Deep Sea Port Development in Myanmar

The water depth at the Myanmar coastal area is generally shallow. Thus there are very few suitable locations for deep sea port development. Kyaukpyu Port located on the north part of the east coast is being constructed by China as a deep sea liquid bulk handling port and Dawei Port to the south of the country is being developed by Thailand and as a deep sea general cargo/container port.

However the development of Dawei Port is being suspended due to the shortage of investment funds of a Thai developer (Italian-thai) and Myanmar government is proposing to Japanese government to support the project implementation. In addition, those ports are located about 400 to 500 km from the Yangon area. Although such deep sea ports which are able to accommodate large general cargo/container ships are developed in Myanmar, secondary waterborne transport is needed due to insufficient development of inland transport means and the long distance haul of cargoes to the big market of Yangon from possible new deep sea ports. Economic benefit of the development of deep sea ports located at a great distance from Yangon area is very small.

2.2.3. Inland Water Transport

Ayeyarwaddy and Chindwin are the main rivers that can be used in all seasons; they cater to both national and regional transport. There are 218 inland waterways ports. Maximum drafts are about 4.5ft to 5.5ft. No terminals are capable of handling containers for intermodal transportation at the inland waterways. On the Ayeyarwady and the Lower Chindwin, there are some 400 river stations in addition to 16 important general cargo ports.

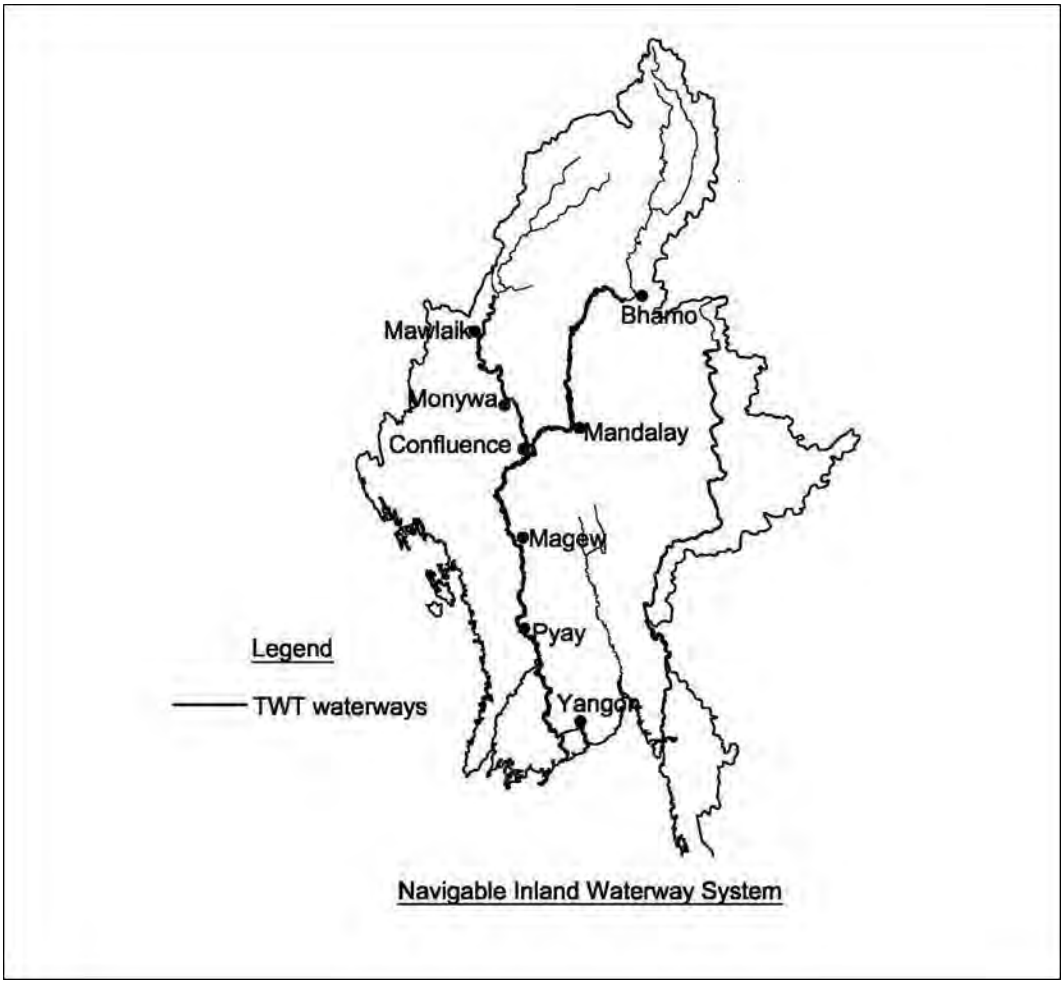
Source:「Inland Water Transport」 Ministry of Transport

Figure 2.2-3 Inland Water Ports

The most distinctive weather of inland waterways is the remarkable difference of the depth of water between the rainy dry seasons. The water depth is greatest from July through August, reaching about 8 to 13 meters. Problems that constrain river navigation are insufficient depth, the narrow channel and sharpness of bends in the low water season, and high velocities of the current in the high water season. But the major constraint is the insufficient depth in the low water season. In general, the period from the middle of November to the middle of May the following year is the low water season.

"Inland Water Transportation" (IWT) was established to bear the inland water transportation of Myanmar. IWT was nationalized in 1948. The main function of IWT is as follows.

- To carry out the transportation of passengers and Cargo along the navigable waterways of Ayeyarwady, Chindwin and also in the Dala areas, Rakhine, Mon and Kayin States.
- To operate ferry services for the convenience of passengers and vehicles.



Source:「Inland Water Transport」 Ministry of Transport

Figure 2.2-4 Inland Water Network

Table 2.2-4 Inland Water Route and Service

The Long Distance Route

No.	Route	Ports of calls	Frequency	Distance (miles)
1	Yangon-Phyarpon (Day)	Yangon - Kyelkhtaw - Kyeikat - Phyarpon	3 trips/week	64
2	Yangon-Phyarpon (Night)	Yangon - Kyelkhtaw - Kyeikat - Phyarpon	Daily	64
3	Yangon-Bogalay	Yangon - Kyelkhtaw - Kyeikat - Mawkhhyun - Bogalay	2 trips/day	87
4	Yangon – Bogalay (Special)	Yangon - Bogalay	2 trips/ week	87
5	Yangon – Mawkhyun	Yangon - Kyekat - Kyeiktaw - Mawkhyun	Daily	100
6	Yangon – Laputta (I.R)	Yangon - Maubin - Kanbet - Labutta	3 trips/week	168
7	Yangon – Laputta (O.R)	Yangon – Maubin - Wakaema - Miyaungmy - Kyarkan - Labutta	2 trips/ week	171
8	Yangon – Laputta (Special)	Yangon - Labutta	2 trips/ week	171
9	Yangon- Myaungmya	Yangon - Maubin - Wakeame - Miyaungmya	Daily	135
10	Yangon – Pathine (night)	Yangon – Maubin - Wakaema - Miyaungmy - Pathine	Daily	172
11	Yangon - Khyungon	Yangon - Khyungon	4 trips/week	110
12	Yangon - Eainme	Yangon - Eainme	2 trips/week	105
13	Yangon - Khoanmanga	Yangon - Khoanmanga	4 trips/week	105
14	Pathine- Ngathainegyaung	Pathine - Ngathaingyaung	2 trips/week	77
15	Hinthata - Phyarpon	Hinthata - Pyarpon	2 trips/week	152
16	Yangon – Pyay	Yangon - Pyay	2 trips/week	263

The Opposite Bank Route

No.	Route	Ports of calls	Frequency	Distance (miles)
17	Yangon - Kanaungto	Yangon - Kanaungto	10 trips/day	5
18	Yangon - Dalla	Yangon - Dalla	46 trips/day	3
19	Wardan – Dalla (RoRo)	Warden - Dalla	7 trips/day	3
20	Sint O Tan - Shaparchaung	Sint O Tan - Shaparchaung	12 trips/day	3
21	Wardan - Seikgyi	Wardan - Seikgyi	2 trips/day	3

Source:「Inland Water Transport」 Ministry of Transport

As shown in Figure 2.2-3, inland water transport has developed in the Delta Division west from Yangon city. Persons and goods are transported at sixteen ports. Inland water transport is extending to Mandalay and the northern area. Inland water transportation service is the transport of person and goods by ferry. Barges are also used to transport goods, but the majority is carried by ferry. The daily number of passengers using the ferry between Yangon-Dala exceeds 35,000 on average. IWT conducts management, operation and maintenance, and construction. More than half the ships are 40 years of age or older. The issues related to inland water transportation are the need to increase transport capacity, and to acquire new and bigger ships.

Source : Inland Waterway Transport, Ministry of Transport

Figure 2.2-5 Examples of Inland Water Transport

2.2.4. Roads

Myanmar has a road network of about 148,689km. The various categories of road are as follows.

Table 2.2-5 Categories and Length of Road

Categories	Road Length
Union Highways	19,503km
Township network road	19,579km
Major city road and other roads	27,507km
Village and boundary area roads	82,100km
Total	148,689km

Source: Ministry of Construction

The pavement rate to all road length is about 21.16%. (with 1.83% categorized as concrete pavement, and 19.33% as asphalt pavement)

The B.O.T (Build-Operate-Transfer) system has been introduced for road and bridge construction. The B.O.T contract term is 40 years. It can do the extension of five years three times. There are B.O.T roads run by 29 local companies. B.O.T roads length is 5,896km (3,663miles). The number of registered vehicles is 2,331,663 in 2011.

National policy of the infrastructure development program is as follows.

- Development of transport linkages and economic corridors between the neighboring countries.
- Development of roads and bridges standard along the linkages of Regions and States, and the Union Highways.

The serial plan is as follows.

- All the ASEAN/ASIAN Highways
- Current Union Highways upgrading
- Current other highways upgrading and new projects

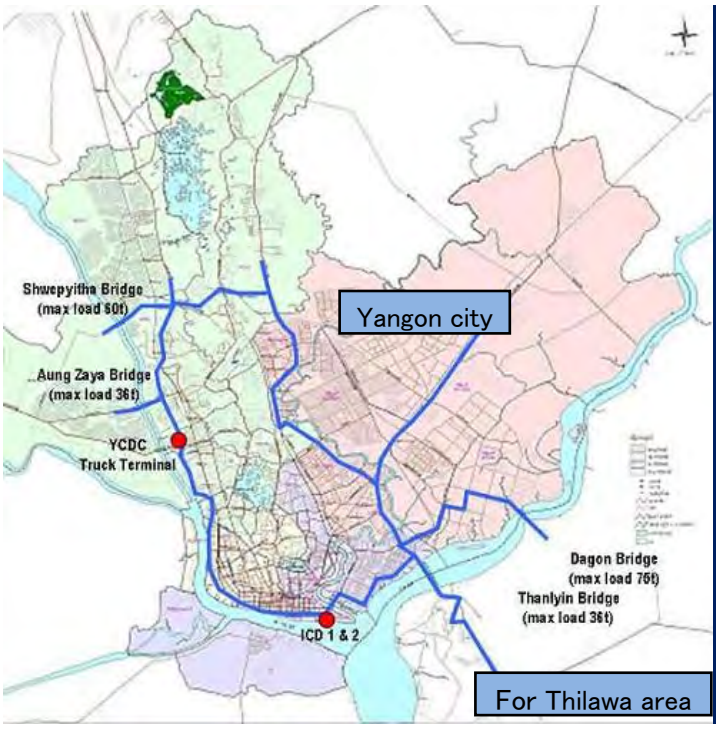
The Ministry of Construction public-works bureau is responsible for the construction and maintenance of roads in Myanmar. Ministry of Construction drafts 5-year maintenance plans for roads and bridges. The third plan (2011-2016) is currently being carried out.

Road network of Yangon city region is shown in Figure 3.7-7.Tthere are five roads running in the north direction but only one road extending to the south.

Bago river runs between Yangon city and the Thilawa area. Yangon-Thanlyin Bridge and Dagon Bridge are the main routes. Yangon-Thanlyin Bridge is a combined bridge with railway. The load limit is 36t. Dagon Bridge opened in October, 2007. It has a load limit of 75t and six round trip lanes.

The Yangon-Thanlyin Bridge conveniently connects both districts. But the load limitation and insufficient number of lanes make it impractical. It is necessary to use Dagon Bridge to transport containers etc. There is a residential area between the Thilawa area and Yangon-Thanlyin Bridge. There is a concern that residents could be affected by the increase in traffic expected in the future.

Traffic congestion is due to trailer trucks carrying logs and containers occurs in Yangon city. Yangon city has a regulation of traffic that truck can pass the roads. In the future the road will be improved between Yangon city and Thilawa area, which should ease traffic congestion. (See figure 3.7-2)



Source : The Project for the Strategic Urban Development Plan of the Greater Yangon

Figure 2.2-6 Designated Container Truck Routes

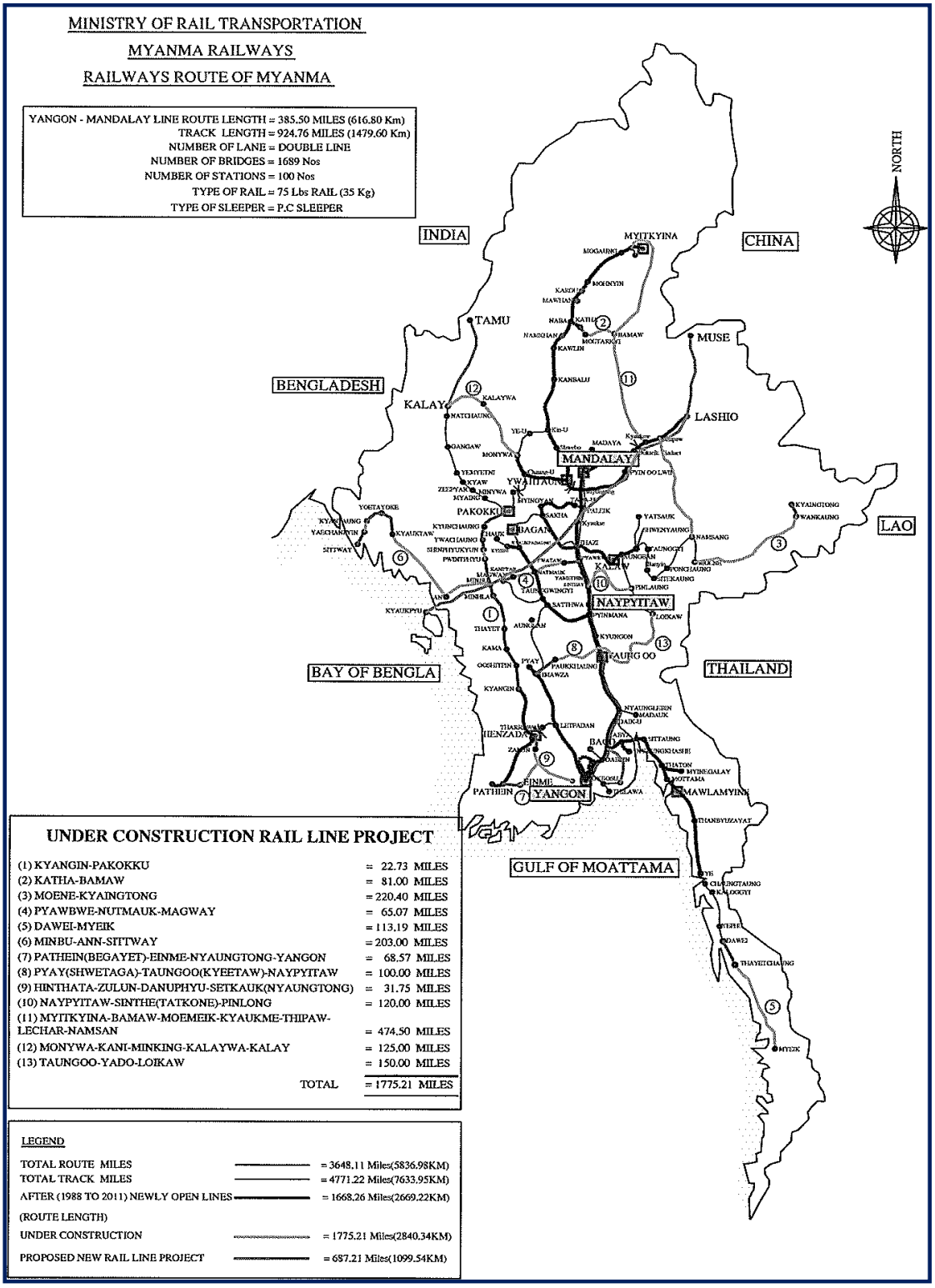
There is an existing road behind Yangon Port in Thilawa Area. The road has two lanes used by freight vehicles but is in poor condition. A concrete pavement road with two lanes has recently been constructed.

(Prepared by the Study Team)

Figure 2.2-7 Concrete Pavement Road behind Thilawa Area Port

2.2.5. Railways

Railway routes in Myanmar extend 5,831km while total track length is 7,633km. Thirteen new routes with a total length of 3,608km will be added as part of an expansion plan. Approximately 700km has already been completed while the rest is under construction. Moreover, there are 37 steam locomotives, 260 diesel-electric locomotives and 137 diesel oil pressure locomotives. Some 184 of 397 diesel locomotive cars are over 30 years of age. In addition, there are 189 rail buses, 1,261 passenger coaches, and 3,188 freight wagons.



Source: Ministry of Rail Transportation

Figure 2.2-8 Railway Route of Myanmar

From 2010 - 2011, expenses (66,382.9 6million kyats) exceeded revenues (33,164.62 million kyats) by almost double. Therefore, the ministry of rail transportation has drafted an improvement plan which focuses on the following key issues:

- Upgrading of the Railway Network
- Standardization of rolling stocks
- Need to install modernized level crossing gates
- Isolation on circular line and trunk line(Yangon-Mandalay, Yangon-Pyay)
- Modernization of Yangon station
- Fencing around the circular rail line
- Electrification of rail system

Myanma Railways, as a state-owned organization, has been contributing to the development of the country. Myanma Railways is expecting more participation from private partners enhance its quality of services and Myanmar's economy.

The rail network of the whole of Myanmar is shown in Figure 2.2-8. A single track railway is laid between Rangoon city and the Thilawa area. The end of the line is in the vicinity of MITT in Thilawa area. Commuter and work rolling stock sometimes uses the railway track only.

Freight bogies use the railroad truck of Yangon Port but container cars do not. In future, if container cars are to use the truck, a huge handling yard and railway trucks for exclusive container use will be needed.

Source : The Project for the Strategic Urban Development Plan of the Greater Yangon

Figure 2.2-9 Railway Cargo Line and Cargo Stations in Yangon

Source : Google, Study Team

Figure 2.2-10 Rail Track Alignment in Thilawa Area

2.3. Flow of Port Related Cargo

2.3.1. External Trade Trend of Myanmar

Table 2.3-1 shows historical trend of commodity wise trade value of Myanmar. Trade value of Export and import has increased from 2005 to 2010.

Table 2.3-1 Trade Value by Commodities Throughput in Myanmar

unit : million Kyat

	2005	2006	2007	2008	2009	2010	2011
Export							
Total Amount	20,647	30,026	35,297	37,028	41,289	49,107	49,288
Natural Gas	6,235	11,676	13,938	12,996	15,854	13,947	18,860
Pulse	1,876	3,498	3,463	4,069	5,063	4,450	5,312
Garment	1,586	1,602	1,555	1,594	1,544	2,100	2,685
Teak	1,723	1,750	1,540	1,146	1,172	1,709	1,901
Hardwood	1,027	1,189	1,424	1,066	1,519	1,596	1,674
Fish	544	725	1,059	972	1,053	1,168	1,593
Rice and rice products		18	553	1,112	1,391	1,092	1,439
Raw Rubber				122	406	849	707
Prawn	576	608	556	472	346	367	444
Sesame	106	171	209	173	184	251	313
Others	6,973	8,789	11,000	13,306	12,758	21,578	14,360
Import							
Total Amount	11,514	16,835	18,419	24,874	22,837	35,509	48,764
Refined mineral oil	1,561	3,967	2,034	3,192	3,674	7,711	10,404
Machinery non-electric and transport equipment	1,786	2,718	4,162	7,240	4,908	6,661	9,846
Base metal and manufactures	1,164	1,184	1,206	1,818	1,993	3,066	5,112
Electrical machinery and apparatus	646	708	861	949	977	1,928	2,515
Plastic	574	720	857	909	859	1,372	1,684
Fabrics of artificial and synthetic fabrics	917	1,060	1,169	817	780	1,151	1,371
Edible vegetable oils and other hydrogenerated oils	571	478	1,058	1,610	976	1,122	2,131
Pharmatiutical products	362	555	636	679	798	1,003	1,177
Cement	53	116	153	147	313	775	811
Paper, paperboard and manufacture	296	303	292	392	318	390	531
Rubber Manufactures	140	211	287	258	351	338	426
Others	3,443	4,817	5,705	6,863	6,890	9,992	12,757

Source : JETRO

Among export commodities, natural gas ranks first with 30% of total export value followed by beans, garments and teak.

Among import commodities, refined mineral oil ranks first followed by non-electric machinery and transport equipment and base metal and manufactures.

Among main export partner countries, Thailand ranks first followed by Hong Kong, China, India and Singapore. Main export commodity from Myanmar to Thailand is natural gas while precious stones is the main commodity exported to Hong Kong; precious stones, rubber products, fishery products and agricultural products are the main products for China and pulse, teak and hardwood are the main commodities bound for India.

Among main import partner countries, China ranks first followed by Singapore, Thailand, Korea and Indonesia. Main import commodities to Myanmar from China are non-electric machinery and transport equipment, electrical machinery and apparatus, spare parts and garment material. From Singapore main import commodities are refined mineral oil and machinery. From Thailand are gas oil drilling machine and construction materials.

Japan is the main market for the garment industry of Myanmar. In 2009 and 2010, almost 40% of garment products were exported to Japan.

Table 2-3-2 shows historical trend of Myanmar trade value with partner countries

Table 2.3-2 Myanmar Trade Value with Partner Countries

unit : million Kyat

	2005	2006	2007	2008	2009	2010	2011
Export							
Total Amount	20,647	30,026	35,297	37,028	41,289	49,107	49,288
Thai	7,869	13,534	15,530	14,341	17,431	16,065	20,599
Hong Kong	1,488	2,317	3,573	3,611	5,163	10,531	224
China	2,125	3,530	3,833	3,352	3,359	6,663	11,984
India	2,842	4,217	4,007	4,388	5,513	4,858	5,639
Singapore	1,533	1,048	2,210	4,638	3,691	2,500	2,917
Malaysia	540	508	653	1,716	832	2,446	823
Japan	790	952	1,021	1,006	966	1,314	1,730
Korea	224	354	406	347	411	821	1,160
Indonesia	381	506	477	155	205	228	221
Germany	364	430	366	294	223	213	229
Others	2,491	2,630	3,222	3,180	3,495	3,468	3,762
Import							
Total Amount	11,514	16,835	18,419	24,874	22,837	35,509	48,764
China	2,716	4,186	5,473	6,578	6,855	12,005	15,038
Singapore	3,240	5,928	4,490	5,713	6,593	9,117	13,557
Thai	1,376	1,749	2,111	2,151	2,070	3938.6	3,734
Korea	499	487	591	1,027	1,221	1683.4	2,434
Indonesia	336	540	1,140	1,140	760	1526.1	2,342
Japan	611	896	1,335	908	1,412	1417.1	2,724
India	465	917	955	797	1,059	1079.9	1,762
Malaysia	811	635	636	1,972	871	805	1,636
USA	478	248	122	-	101	327.5	1,426
Germany	123	175	166	261	183	287.2	511
France	-	-	-	115	196	223.1	353
Others	859	1,075	1,402	4,213	1,517	3,099	3,247

Source : JETRO

2.3.2. Cargo Handling Volume in Myanmar Ports

Myanmar port cargo handling volume throughput is shown in Table 2.3-3. Cargo handling volume doubled from 12,370,000 tons in 2006 to 25,700,000 tons in 2011. Cargo handling volume of foreign trade and coastal trade in year 2011 are 23,300,000 tons and 2,410,000 tons respectively. Share of coastal trade cargo volume is only 10% of total cargo volume. Foreign trade cargo volume has doubled during the last five years, however, coastal trade cargo volume has not significantly changed, staying at around 2,000,000 tons.

Table 2.3-3 Cargo Handling Volume throughput in Myanmar Ports

unit:ton

		2006	2007	2008	2009	2010	2011
International	Import	5,168,750	5,812,793	5,735,245	9,172,538	11,908,660	14,225,240
	Export	5,146,594	5,541,104	8,122,714	11,146,486	7,146,366	9,059,520
	total	10,315,344	11,353,897	13,857,959	20,319,024	19,055,026	23,284,760
Coastal	Unload	937,622	929,259	814,511	760,640	1,027,881	1,101,651
	Load	1,115,308	1,134,394	1,114,189	1,140,100	1,372,667	1,309,746
	Total	2,052,930	2,063,653	1,928,700	1,900,740	2,400,548	2,411,397
Total		12,368,274	13,417,550	15,786,659	22,219,764	21,455,574	25,696,157

Source：MPA

2.3.3. Cargo Handling Volume of Regional Main Ports in Myanmar

There are regional main ports, Sittwe port, Kyaykpyu port, Thandwe port, Pathein port Mawlamyine port, Dawei port, Myeik port and Kawthaung port. Table 2-3-4 shows cargo handling volume of each port. Coastal trade cargo volume is much higher than foreign trade cargo volume at almost of all ports.

Sittwe port handled 181,000 tons of cargo in 2011 of which 73% of the total or 133,000 tons was coastal unloaded cargo.

Kyaukpyu port handled 294,000 tons cargo in year 2011. Average cargo handling volume between 2006 and 2009 was only 20,000 tons, however, from year 2010 the cargo volume started to suddenly increase. The reason for the increase is assumed to be the development of the Energy facility in Kyaukpyu port.

Thandwe port handled 33,000 tons cargo in year 2011. Coastal loaded cargo volume accounts for about 60% of total cargo volume every year.

Pathein port handled 48,000 tons of cargo in year 2011. Ratio of export cargo volume and coastal unloaded cargo volume are relatively big.

Almost the entire cargo handling volume at Mawlamyine port is for coastal trade. In 2011, coastal loaded cargo volume increased to 120,000 tons from 40,000 tons the previous year.

Dawei port handled 532,000 tons of cargo in year 2011. Coastal loaded cargo volume occupies about 88 % of total cargo volume.

The export cargo handling volume at Myeik port increased to 810,000 tons suddenly from 110,000 tons of previous year. That volume had further increased to 2,200,000 tons in next year. It is said that these large volume of export commodity is sea sand to neighboring countries.

Table 2.3-4 Cargo Handling Volume of Regional Main Ports in Myanmar

unit: ton

			2006	2007	2008	2009	2010	2011
Sittwe	International	Import	3,803	2,147	2,130	1,591	9,523	6,270
		Export	26,471	30,849	28,997	26,657	16,840	17,295
		total	30,274	32,996	31,127	28,248	26,363	23,565
	Coastal	Unload	63,659	75,696	92,714	110,789	138,012	133,304
		Load	14,009	18,339	35,709	53,708	52,835	24,394
		total	77,668	94,035	128,423	164,497	190,847	157,698
	Total		107,942	127,031	159,550	192,745	217,210	181,263
Kyaukpyu	International	Import				3,332	167	163,643
		Export						514
		total	0	0	0	3,332	167	164,157
	Coastal	Unload	9,705	326	5,194	7,024	54,255	110,036
		Load	2,369	17,836	16,433	22,676	24,767	19,901
		total	12,074	18,162	21,627	29,700	79,022	129,937
	Total		12,074	18,162	21,627	33,032	79,189	294,094
Thandwe	International	Import						
		Export	5,958	6,126	8,539	9,633	11,402	6,185
		total	5,958	6,126	8,539	9,633	11,402	6,185
	Coastal	Unload	10,795	9,563	11,423	9,054	10,552	7,241
		Load	12,569	30,030	35,013	40,395	36,939	19,865
		total	23,364	39,593	46,436	49,449	47,491	27,106
	Total		29,322	45,719	54,975	59,082	58,893	33,291
Pathein	International	Import				2,296	14,612	19,874
		Export	16,767	20,560	36,122	14,840	11,049	15,496
		total	16,767	20,560	36,122	17,136	25,661	35,370
	Coastal	Unload	33,870	41,880	30,563	29,735	30,555	10,610
		Load	7,465	8,140	6,106	2,800	4,620	1,970
		total	41,335	50,020	36,669	32,535	35,175	12,580
	Total		58,102	70,580	72,791	49,671	60,836	47,950
Mawlamyine	International	Import						2,643
		Export		23,079				
		total	0	23,079	0	0	0	2,643
	Coastal	Unload	32,124	27,462	21,162	19,922	34,847	25,480
		Load	29,900	24,142	20,768	8,653	40,827	120,460
		total	62,024	51,604	41,930	28,575	75,674	145,940
	Total		62,024	74,683	41,930	28,575	75,674	148,583
Dawei	International	Import	10,201	9,099	5,319	4,637	4,245	35,201
		Export	96,266	121,859	39,215	80,673	1	
		total	106,467	130,958	44,534	85,310	4,246	35,201
	Coastal	Unload	37,835	34,576	27,553	27,098	34,804	61,663
		Load	401,774	389,189	399,174	352,651	479,370	435,022
		total	439,609	423,765	426,727	379,749	514,174	496,685
	Total		546,076	554,723	471,261	465,059	518,420	531,886
Myeik	International	Import	964	18,777	1,214	30,093	35,380	43,340
		Export	64,985	110,549	806,570	2,172,433	160,876	937,328
		total	65,949	129,326	807,784	2,202,526	196,256	980,668
	Coastal	Unload	93,246	89,073	62,625	48,403	80,626	67,837
		Load	71,638	68,058	60,024	43,954	80,303	91,575
		total	164,884	157,131	122,649	92,357	160,929	159,412
	Total		230,833	286,457	930,433	2,294,883	357,185	1,140,080
Kawthaung	International	Import	144,194	157,235	99,818	97,184	137,049	142,353
		Export	6,126	2,151	1,426,758	2,636,570	1,281,913	1,220,728
		total	150,320	159,386	1,526,576	2,733,754	1,418,962	1,363,081
	Coastal	Unload	43,283	36,094	39,566	49,941	44,518	36,063
		Load	173,266	185,229	152,002	165,573	186,046	197,523
		total	216,549	221,323	191,568	215,514	230,564	233,586
	Total		366,869	380,709	1,718,144	2,949,268	1,649,526	1,596,667

Source : MPA

Export of sea sand from Kawthaung port also increased from 2008 the same as Myeik port. Total cargo handling volume in year 2011 was 1,600,000 tons. Foreign trade cargo volume was

1,360,000 tons.

In general, from Yangon port, consumer products, petrol oil and lubricants and construction material are transported to local ports and farmer products, raw rubber and marine products are transported to Yangon.

Coastal trade volume of each port shows that the remote ports such as Sittwe, Myeik and Kawthaung handles more cargo than ports closer to Yangon. Due to the insufficient land transport network, the role of marine transportation is quite important for sustaining the lives of rural residents.

2.3.4. Border Trade

Myanmar is bordered by China, Thailand, India, Bangladesh and Laos. To reduce the negative impact of economic sanctions by US and EU countries, Myanmar strengthened its trade network through border trade with neighboring countries.

Main border trade partners area China and Thailand. Border length between Myanmar and China is about 2,200 km. Border trade with China is the main artery for the Myanmar economy and Myanmar has become the largest trade partner for Yunnan Province of China. Main gate with China border trade is Muse.

Border trade value with Thailand accounts for almost 90% of total trade value. Main border trade gate with Thailand is Myawadhi.

Table 2.3-5 shows border trade cargo volume from ASEAN Japan Transport Partnership Information Center. Except for year 2009, annual average cargo volume is about 400,000 tons.

Table 2.3-5 Import Cargo Volume through Border Trade

unit: ton

	2008	2009	2010	2011
Total Import Cargo by Road	457,000	119,000	356,000	360,000

Source: ASEAN Japan Tranport Partnership Information Center

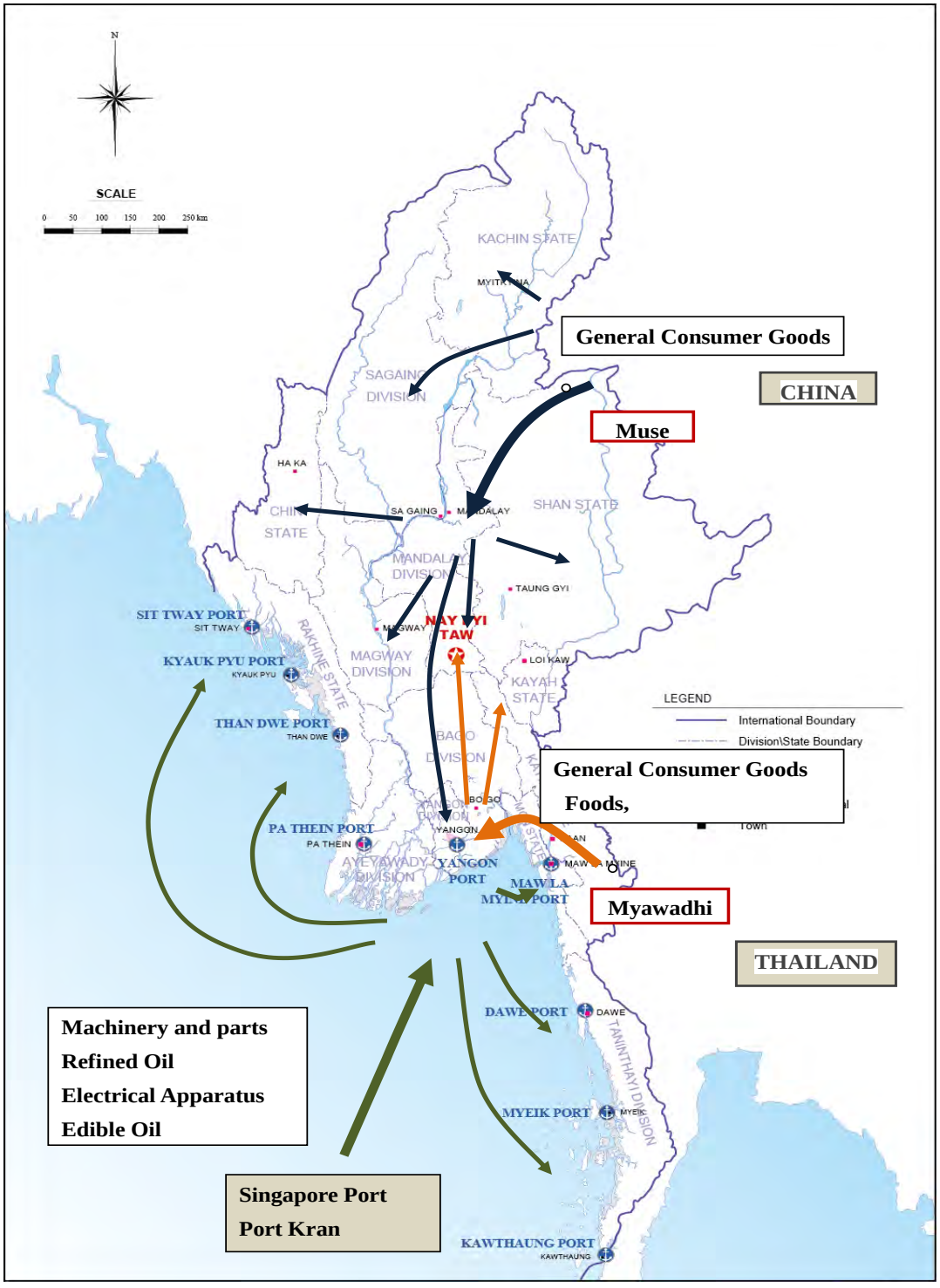
Main border trade commodity from China is general consumer products. They are piled up in Mandalay once then delivered to each region by land transportation. On the other hand, main commodity through Myawadhi from Thailand is food and general consumer goods.

Natural gas is transported to Thailand through Pipeline from off-shore gas field Yatagan and Yadana directly.

2.3.5. Image of Cargo Flow in Myanmar

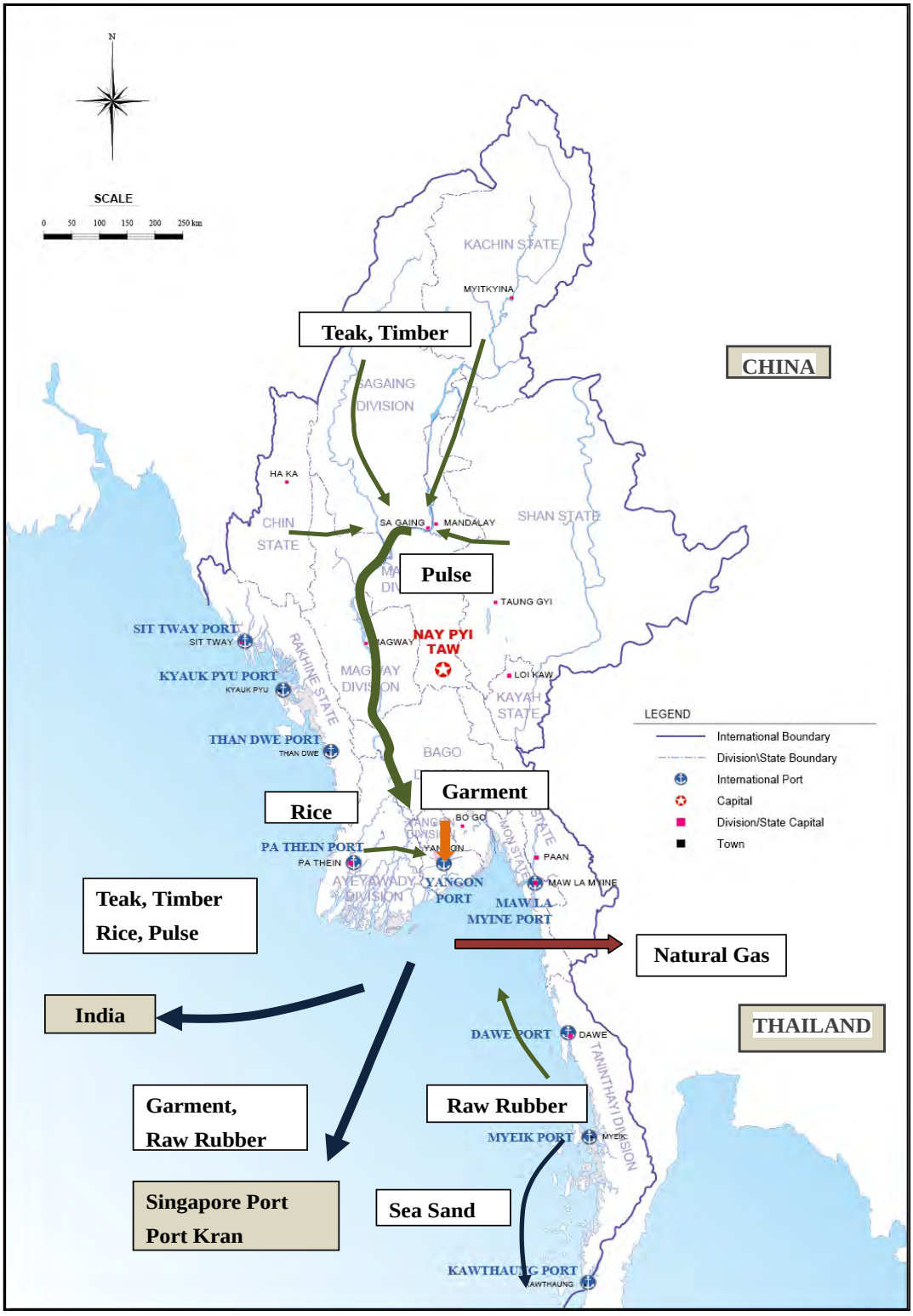
Kachin state and Sagaing division are production center for teak and timers which are main export commodities. They are transported on the barge through Ayeyarwady River. Delta region is the production center for rice. Rice is piled up at Pyay and transported to Yangon through Ayeyarwady River. The southern region is the main production center of raw rubber which is transported to Yangon by coastal shipping.

Figure2.3-1 and 2.3-2 show the flow of main commodities of international trade in Myanmar country.



Source：Study team

Figure 2.3-1　Image of Main Import Commodity Flow in Myanmar



Source：Study team

Figure 2.3-2　Image of Main Export Commodity Flow in Myanmar

2.3.6. Revitalization of Economy through Development of Economic Corridor and AFTA

Mekong regional countries, Cambodia, Laos, Myanmar, Thailand, and Vietnam had Free Trade Area (FTA) agreement to remove tariff wall with China accordingly trade barrier on border becomes lower. Cambodia, Laos, Myanmar and Vietnam which were some of the last countries to join ASEAN made an agreement to remove tariff wall by 2015 though some exceptions will remain. They have already started reducing the rate of taxation. Liberalization of trade in Mekong region is expected to progress rapidly. Along with development of the economic corridor and prompt border passage with custom clearance, Myanmar will create a smooth distribution network with ASEAN countries to increase competitiveness of export commodities thoroughly high efficient transport and lower tax rates.

(Prepared by the Study Team)

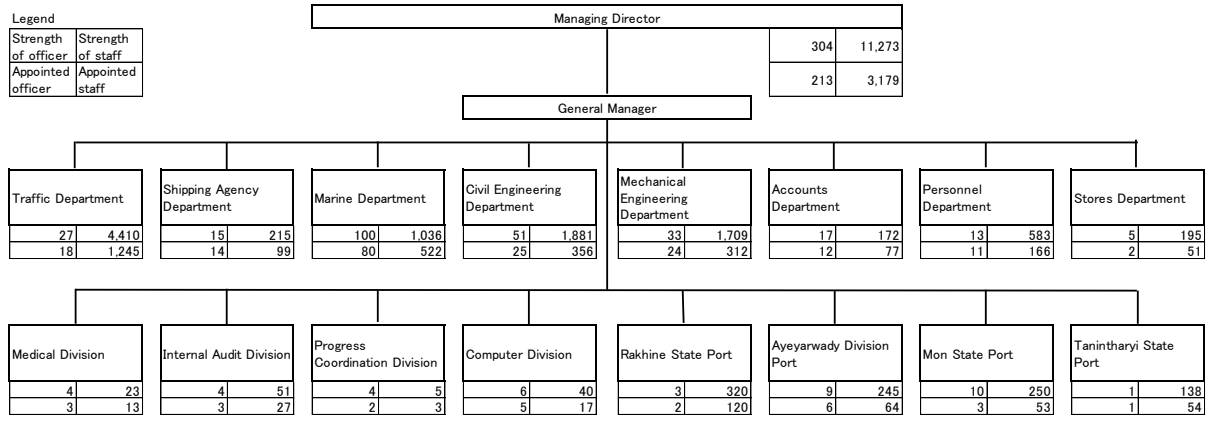
Figure 2.3-3 Economic Corridor

2.4. Port Management System

2.4.1. Organization of Myanma Port Authority

Myanma Port Authority (MPA) is a public entity under the Ministry of Transport (MOT) and responsible for the administration of all coastal ports in Myanmar. Its mission is to provide wide-range port-related services including stevedoring services (loading, discharging, and storage of cargoes) and marine services (pilotage, navigation lights and light houses, communications, mooring for vessels, tug service, water supply, fuel bunkering). MPA is also responsible for civil engineering works (planning, construction, maintenance and repair of port infrastructure, dredging and survey works in channels and basins) and mechanical and electrical engineering works, (building, maintenance and repair of service vessels and other floating crafts, buoys and electrical installations). MPA establishes a tariff table which is applied in both public and private terminals.

MPA's tasks are stipulated in the Yangon Port Act enforced in 1905 and the Notification of Designating the Duties and Rights for Port Corporation issued by the Ministry of Transport and Communications on August 4, 1976. Burma Ports Corporation was later reorganized into MPA in 1986. The Yangon Port Act revised in 1958, 1959 and 1962 comprises the following chapters: Preliminary, Constitution of the board, Conduct of business by the board, officers and servants, Property of the board, Borrowing powers, Disposal of funds, Annual estimates and accounts, Control of president of the union, General powers of the board, Penalties, and Miscellaneous. The Notification of Designating the Duties and Rights for Port Corporation stipulates the duties and rights of MPA. Its rights include the following: ownership of movable and immovable assets, the right to sue, and establishment of a fund financed by the port income. On the other hand, management of state properties, provision of services specified by the Ministry, and report of the financial statements to the Ministry are among its responsibilities.



Source: MPA

Figure 2.4-1 Myanma Port Authority Organization Chart (as of July 31, 2012)

MPA also practices The Ports Act (1908) stipulating the rules for the safety of shipping and the conservation of ports as well as port dues, The Outports Act (1914) stipulating dues applicable in eight outports (Sittwe, Kyauk Phyu, Thandwe, Pathein, Mawlamyine, Myeik, Dawae, Kawthong), and The Light House Act (1937) stipulating lighthouse dues. There is a plan to combine three port-related laws, The Yangon Port Act, The Ports Act, and The Outports Act.

MPA is composed of eight departments, four divisions and four out-port offices (Figure 2.5-1). The total number of employees is 3,392, approximately 30 % of the authorized strength (11,557). The number of employees decreased roughly 1,000, or 24 %, from February, 2009. Half of the decrease was due to the privatization of the Bo Aung Gyaw Terminal in Yangon Port.

2.4.2. Financial Conditions of MPA

From 1989-1990, State Economic Enterprises are required to deposit their receipts to the State Fund Account (SFA) and their expenditures are borne by the SFA. MPA has been in the red since 2006-2007 (Table 2.5-1). State Economic Enterprises in the Transport Sector are incurring a loss in 2009-2010 (Table 2.5-2).

Table 2.4-1 Current cash budget of MPA

(Million kyats)

Year	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Receipts	1,761.0	2,074.0	2,595.2	2,958.3	3,516.1
Expenditure	1,715.0	3,911.8	4,329.5	5,369.4	5,396.8
Surplus+/Deficit-	＋46.0	-1,837.8	-1,734.3	-2,411.1	-1,880.7

Source: Statistical Yearbook 2010, Ministry of National Planning and Economic Development

Table 2.4-2 Current cash budget of State Economic Enterprises in the transport sector

(Million kyats)

Enterprises	Receipts	Expenditure	Surplus+/Deficit-
Myanma Five Star Line	5,880.7	5,887.1	-6.4
Inland Water Transport	6,474.2	11,435.0	-4960.8
Myanma Port Authority (MPA)	3,516.1	5396.8	-1,880.7
Myanma Shipyards	2,764.2	3,255.1	-490.9
Myanma Airways	10,406.1	11,309.3	-903.2

Source: Statistical Yearbook 2010, Ministry of National Planning and Economic Development

2.4.3. Privatization of the Port Sector

MPA started to transfer the construction and operation of terminals to the private sector in late '90s in line with the government policy aimed to promote privatization of state enterprises. In Myanmar, privatization of public services is approved by the Privatization Commission established in 1995 on a project basis. Privatization effort has been targeted to the enterprises suffering from underutilization, lack of technological modernization, uneconomical use of inputs, or small size.[1] In Myanmar, there is no law specifically established to regulate PPP.

Several companies are currently developing and operating port terminals along the Yangon River. Port privatization scheme differs depending on the terminal as described below. MPA intends to continue the development of the port area through BOT. In August 2012, MPA had a tender briefing meeting for several projects including urban development of Botahtaung Jetty and upgrading of Sule Pagoda Terminal No. 1, 2, 3, 4. For the latter project, MPA envisages JV composed of MPA and private companies.

(1) BOT scheme of the Asia World Port Terminal (AWPT)

Asia World Port Management Co., Ltd (AWPM), a subsidiary of Asia World Co., Ltd, developed No. 1, 2, 3, and 4 wharves with the permission from the Myanmar Investment Commission in accordance with the Myanmar Citizens Investment Law, 1994. These wharves were developed based on separate BOT contracts. At that time, no other party showed interest in port operation and thus AWPM secured the contracts without competition.

AWPM signed a 25-year BOT contract for No. 2 wharf with MPA on April 24, 1996 and started its operation in December 1997. This wharf was the first private port in Myanmar. In line with a 30-year BOT contract, AWPM started to construct No. 1 wharf in November 1998 as the second phase and made it operational as a conventional berth in March 2000 and then as a container berth in March 2001. As for No. 3 wharf, AWPM stared its construction in August 2002 based on a 35-year BOT contract and made it operational in November 2005. Due to the economic downturn in 2009, AWPM suspended the development of No. 4 wharf which was started as the 4th phase based on a 30-year BOT contract.

AWPM applied the tariff table of MPA. All ship-related charges are collected by MPA and then paid to AWPM by banks responding to invoices from AWPM. AWPM employs 800+ workers in addition to 500+ strong cargo handling labor force.

[1] Experiences of Myanmar Privatization Programme, U Thein Tun, Ministry of National Planning and Economic Development, Myanmar

(2) BOT scheme of the Hteedan Port Terminal

The construction of Hteedan Port Terminal started in October 2010 based on a 30-year BOT contract and the terminal became operational in June 2012. This terminal was developed by Shwe Nar Wah Co., Ltd, a subsidiary of Asia World Co., Ltd. Shwe Nar Wah Co., Ltd entrusted the operation of the terminal to AWPM. Asia World Co., Ltd took this complex arrangement because AWPM was not allowed to operate two terminals.

(3) BOT scheme of the Myanmar Industrial Port (MIP)

In 2002, Myanmar Industrial Port signed a 60-year BOT contract with MPA and started the operation of the Terminal 1 in January 2003. Terminal 1 (310 m in length) is made up of two wharves and currently handles 400-500boxes/day. Until then, this terminal had been operated by a JV composed of the government and private sector. MAS requested the government to convert the operation scheme to BOT so that it could make quick business decisions. MIP hopes it can extend the BOT term by another 15 years. This terminal boasts stronger quay structures and more sophisticated X-ray equipment compared with adjacent terminals and thus it is attracting US cargos.

MIP started to construct the Terminal 2 (450 m in length) in November 2011. MIP plans to start the operation of 150 m in November 2012. MIP has inland container depots (ICD) and is developing another one. Terminal 1 and 2 are prioritized to container operation though they handle heavy cargos. The tariff table of MPA is applied in MIP.

(4) BOT scheme of the Myanmar International Terminals, Thilawa (MITT)

In 1996, Myanmar International Terminals, Thilawa (MITT), a member of the Hutchison Port Holdings, started to develop a 1000-m terminal in Thilawa based on a 40-year BOT contract and started the operation in 1998. This contract stipulates that additional container berths in Thilawa region will be developed when the per gantry crane throughput of MITT exceeds a certain volume. MITT currently owns only two gantries due to the low use of container vessels resulting from the competition with container terminals in Yangon main port. It is likely to add gantries when container cargo increases responding to the start of the SEZ operation. The concession contract for a new container terminal development in Thilawa will need to be in consistent with the existing contract of MITT.

(5) Operation scheme of the Bo Aung Gyaw Terminal

In July 2010, Lann Pyi Marine Co., Ltd, a subsidiary of Union of Myanmar Economic Holding Ltd, permanently acquired the ownership (land and infrastructure) of the terminal and its operation rights from MPA. 470 MPA employees were transferred to Lann Pyi Marine Co., Ltd as well. Lann Pyi Marine Co., Ltd claims that the shorter navigation time to the terminal is the comparative advantage over its competition.

(6) Operation scheme of Sule Pagoda Terminal No. 1, 2, 3, 4

For this terminal renovation project, seven companies submit a tender responding to the tender invitation meeting held in August 2012. The tender process is still going on as of February 2013. Sule Pagoda Terminal No. 1, 2, 3, 4, built in 1930s and 1940s, is a general cargo terminal, 548 m in length and 9 m in depth. Since the terminal is equipped with sheds behind the quay, its apron is narrow, only 12.2 m in width. Thorough the renovation, sheds will be removed and the terminal will be converted into a multi-purpose terminal (container and general cargo).

According to the tender instructions, a JV composed of MPA and a private company will operate the new terminal with MPA holding the majority of the equity. The private company is expected to carry out construction works including jetty and foundation and to procure and install cargo handling equipment such as quay crane, RTG, and reach stacker. The private company is required to pay a land lease fee and the current income from the existing Sule Pagoda Terminal, five million dollars a year, to MPA throughout the duration of the JV.

Table 2.4-3 Terminals in the ports of Yangon and Thilawa

Terminal	Wharf	Length (m)	Cargo	Operator	Duration of BOT contract (year)	Start of operation
Sule Pagoda	No. 1, 2, 3	411	GC	MPA	NA	1941
	No. 4	137	GC			1932
	No. 5, 6, 7	478.5	GC			1962
Bo Aung Gyaw Terminal	No. 1, 2	274	GC, CC	Lann Pyi Marine Co., Ltd	NA	1941
	No. 3	183	CC			1998
Asia World Port Terminal (AWPT)	Ahlone No. 1	198		Asia World Port Management Co., Ltd (AWPM)	25	2000
	Ahlone No. 2	156			30	1997
	Ahlone No. 3	260			35	2005
	Ahlone No. 4	238			30	uncompleted
Hteedan Port Terminal	Container wharf	630	CC	AWPM (entrusted by Shwe Nar Wah Co., Ltd)	30	2012
	Oil jetty	120	Oil			
Myanmar Industrial Port (MIP)	Terminal 1	310	CC, GC	Myanmar Industrial Port	60	2003
	Terminal 2 (under construction)	450				2012
	Terminal 3 (planned)	1,800			60	2015 (planned)
Myanmar International Terminals Thilawa (MITT)	Present phase	1,000	CC, GC, Ro/Ro, PCC	Myanmar International Terminals, Thilawa Ltd	40	1998

Source: JICA Study Team based on interviews with terminal operators

2.4.4. Tariff and dues

MPA established the standardized tariff and dues, applicable for all ports of Myanmar, on March 1, 1998. Charges are classified into four categories: charges on vessels, charges on cargoes, miscellaneous charges, and container charges. Major charges applicable in ordinary conditions are summarized below. Charges in specific conditions need to be referred to the tariff table. US$ based tariff and Kyat based tariff are respectively applicable for foreign shipping line vessels and Myanmar shipping line vessels (Five Star Lines). MPA plans to revise the currency conversion rate in this table because this rate is based on the former official rate which had been valid until April 2012.

(1) Charges on vessels

Table 2.4-4 Outline of the charges on vessels

Charges	Classification	Unit	Kyats	US$
Port dues	Sea-going vessels	Per 100 GRT per 30 days	150	25
	Inland vessels	Per ton capacity payable half yearly	2	-
Light dues		Per GRT per 30 days	1	0.2
Pilotage charges (Yangon port)	Pilotage according to GRT	Per 500 GRT	95	15
	Pilotage according to draft	For 5.8 m	825	140
		For 7.6 m	1,500	255
		For 9.2 m	2,700	460
	Movements within harbor limits	Per movements		
	Fixed mooring below Hastings		810	140
	Fixed mooring above Hastings		600	100
	A wharf or jetty above Hastings		405	70
	Pilot's attendance	Per occasion		
	Above Hastings		150	25
	Below Hastings		255	45
	Pilot's detention	Per 4 hours		
	Above Hastings		150	25
	Below Hastings		255	45
Berthing charges for	At berths	Per 24 hours		
	Over 3,000 GRT up to		1,458	250

sea-going vessels	6,000 GRT			
	Over 6,000 GRT up to 8,000 GRT		1,701	290
	Over 8,000 GRT up to 10,000 GRT		1,944	330
	Over 10,000 GRT up to 12,500 GRT		2,187	370
	Over 12,500 GRT up to 15,000 GRT		2,430	410
	Over 15,000 GRT		2,673	455
Berthing charges for inland vessels	Self-propelled vessels	Per 4 hours		
	Up to 15 m		25	-
	Over 15 m up to 30 m		75	-
	Over 30 m up to 60 m		125	-
	Over 60 m up to 90 m		175	-

Source: summarized from the MPA tariff table

(2) Charges on cargoes

Table 2.4-5 Outline of the charges on cargoes

Charges	Classification	Unit	Kyats	US$
Conservancy charges	All cargo except coal, salt, and mineral oil product	Per ton	25	-
	Coal, salt, and mineral oil product	Per ton	5	-
Stevedoring charges	General cargo	Per ton	50	2.5
	Rice, rice products, pulses, grain, beans, oil cakes	Per ton	35	2
	Timber	Per ton	100	5
Wharfage charges	At wharf	Per ton	20	
Demurrage charges	All cargo for any period exceeding the free time allowed (normally 72 hours)	Per ton per day for the first 30 days Per ton per day after 30 days	3 6	- -
	All types of motor vehicles cargo for any period exceeding the free time allowed (normally 72 hours)	Per ton per day for the first 30 days Per ton per day after 30 days	30 100	- -
Delivery labour charges	All cargo	Per ton	35	-
Dirty cargo allowance	Handling of explosives, dangerous or dirty cargo, cargo of obnoxious nature, cargo injurious to health	Per gang per shift		
	Stevedoring labour		88	15
	Delivery labour		60	-

Source: summarized from the MPA tariff table

(3) Miscellaneous charges

Table 2.4-6 Outline of the miscellaneous charges

Charges	Classification	Unit	Kyats	US$
Vessel hire and salvage charges	Hire of major vessels	Per day (idling time less		
	Buoy vessel	than 12 hours)	400,000	6,420
	Sea-going tug		250,000	4,070
	Pilot vessel		500,000	8,410
	Hire of harbor craft	Per 6 hour		
	Harbour tug		26,000	470
Charges for the services of mooring gang	Ship mooring gang	Per gang	650	110
	Shore mooring gang	Per gang	410	70
Equipment hire charges	Mobile cranes with lifting capacity	Per hour		
	Up to 10 ton		900	40
	Over 10 ton		1,200	50
	Wharf cranes with lifting capacity	Per hour		
	Up to 3 ton		160	30
	Over 3 to up to 6 ton		400	70
	Over 6 ton		500	85
Land rent and godown hire charges (Yangon Port)	Land rent for other than residential purposes	Per 10 m2 per month		
	Except for Dawbon and right bank of the river		62	168
	Dawbon and right bank of the river		31	138

Source: summarized from the MPA tariff table

(4) Container charges

Table 2.4-7 Outline of the container charges

Charges	Container	Unit	Kyats	US$
Handling charges for import containers	LCL	Per TEU with ship's derrick	2,100	175
	FCL		1,200	150
	FCL for direct delivery		800	130
	Empty		1,000	135
	Empty for direct delivery		700	115
	LCL	Per TEU with MPA's crane	2,280	190
	FCL		1,320	165
	FCL for direct delivery		890	145
	Empty		1,100	150
	Empty for direct delivery		790	130
Handling charges for export containers	LCL	Per TEU with ship's derrick	2,100	175
	FCL		1,200	150
	FCL for direct delivery		765	130
	Empty		975	135
	Empty for direct delivery		695	115
	LCL	Per TEU with MPA's crane	2,280	190
	FCL		1,320	165
	FCL for direct delivery		890	145
	Empty		1,100	150
	Empty for direct delivery		790	130
Handling charges for transshipment/ reshipment containers	Loaded	Per TEU with ship's derrick	1,500	155
	Empty		1,200	135
	Loaded	Per TEU with MPA's crane	1,650	170
	Empty		1,350	150
Container shifting charges	Loaded	Per TEU	1,100	25
	Empty		950	15
Container storage charges	Loaded	Per TEU per day	300	2
	Empty		300	2

Source: summarized from the MPA tariff table

2.4.5. Maritime Safety

Myanmar Port Authority (MPA) is a governmental agency in charge of operating ports of the country. Their main tasks involve with the safety of navigation by supervising ships calling at the port and their navigation in the channels. Generally, port authorities in the world are engaged in the following services.

- To create safety policies on the marine traffic
- To create plans on development of ports and navigation channels
- To establish port regulations
- To construct, maintain and manage port facilities and equipments
- To administrate ports and navigation channels
- To conduct maritime education and training

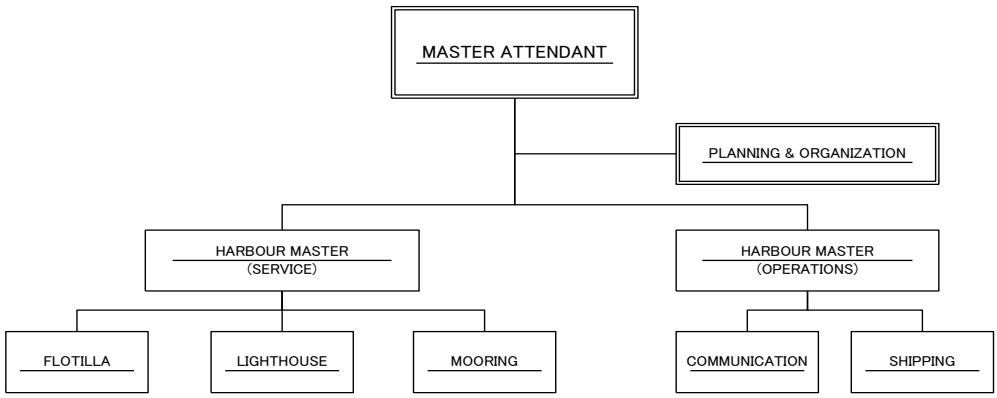
(1) Role of Department of Marine Administration (DMA)

DMA manages vessel inspection, navigation safety, and protection of the marine environment following domestic laws and regulations. The main duties of DMA are as follows.

- Registration and inspection of ships
- Examination of Navigational Officer and Issuance of the Certificates
- Marine accident investigation
- Prevention of marine pollution, management
- Sea search and rescue
- Statistics of Marine Accidents
- Education and training for seafarers
- Advice to the government on maritime technology

(2) Organization Chart of Marine Department

Marine Department is engaged in marine traffic safety operation, such as navigation channel buoy, lighthouse management, pilot service and tugboat service in the territories of MPA.



Source:MPA

Figure 2.4-2 Organization Chart of Marine Department

(3) Services of Marine Department

- To construct, maintain and manage port facilities (e.g. piers, jetties, buoys) and equipments (e.g. container crane, fork lift, reach stacker, trailer, pilot boat, tug boat)
- To construct, maintain and supervise navigation channel and berthing area
- To provide pilot service and tugboat service

2.5. Natural disasters in Myanmar

Myanmar has a very long north-south distance (2051 kilometers), compared to its east-west distance (936 kilometers), geographically rich in diversity, but has been hit by various natural disasters. The southwest coastline is particularly vulnerable to cyclones. There are big rivers flowing north to south, and floods occur frequently. Moreover, the crustal structure is complex and large earthquakes over M6 have often occurred.

2.5.1. Natural disaster situation

The followings are the status of recent major disasters in Myanmar

Table 2.5-1 Status of Recent Major Disasters in Myanmar

Date	Type of Disaster	Summary
Aug. 2012	Flood	Flood occurred in many places for few weeks and several thousand people in Karen State have lost their dwellings.
20 Oct. 2011	Flood	Flood occurred in Magwe District by heavy rain, 59 people died and 27people were missing, and also damaged livestock, crops and buildings.
7 Aug. 2011	Flood	There were heavy rains in various locations over two days, the flood occurred in various districts and states.
24 Mar 2011	Earthquake	M6.8 earthquake occurred near the border of northern Thailand
22 Oct 2010	Cyclone	Cyclone Giri landed. At least 27 people were killed and 15 people were missing.
16 June 2010	Flood	Flood and landslide occurred by heavy rain, bridge was swept

		away, roads were blocked and at least 25 people were killed.
4 July 2009	Flood	More than 1,000 people were sustained damage from landslide by heavy rain in northern Myanmar.
2 May 2008	Cyclone	84,537 people were killed, 53,836 people were missing and 2.4 million people were injured by "Nargis."
6 May 2007	Flood	At least 5 people were killed with the most intense heavy rain among 40 years somewhere in the commercial city.
11 Oct 2006	Flood	13 people were killed in several days by the flood caused by the largest monsoon in the past few years through Myanmar to Thailand.
4 May 2006	Tropical typhoon	Tropical typhoon "Mala" hit the central part, flash floods occurred and more than 18 people were killed.
14 Sept 2005	Landslide	Elementary school was involved in a landslide in the southeast part and more than 30 people including children were killed.
26 Dec. 2004	Tsunami	At least 90 people were killed by the tsunami generated by the earthquake off the coast of Sumatra.
2004/5/28	Cyclone	Cyclone that occurred on the Bengal Bay has passed through the southwest coast area. Storm of wind speed 160km/h caused storm surge and flood killed at least 140 people and 18,000 people lost their houses.

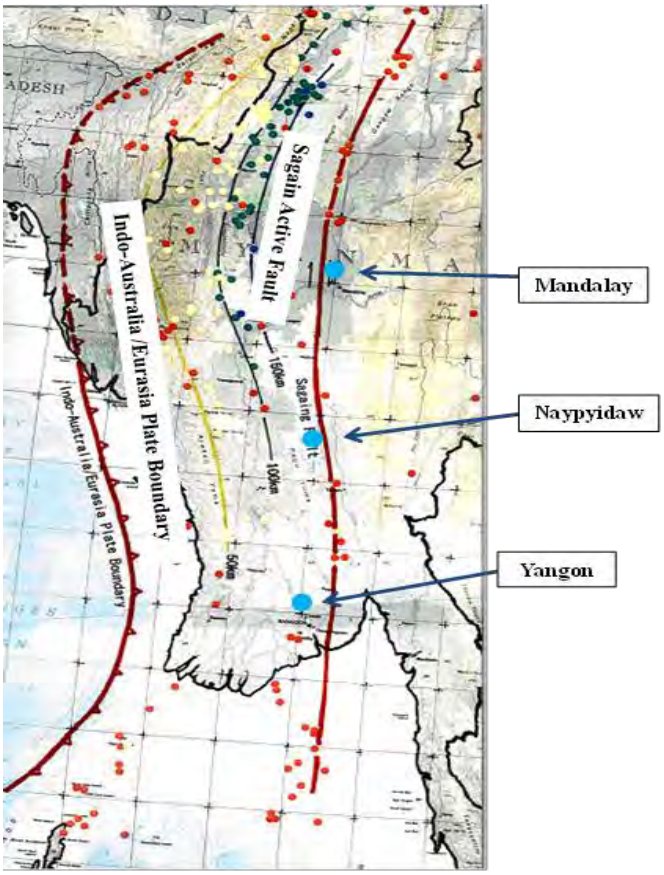
Source: Asian Disaster Reduction Center

2.5.2. Flooding

In Myanmar, the cyclone months range from mid-May to mid-October and are frequently flooded. Rain falls are particularly heavy in western and southern coastal areas, where annual rainfall reaches 4,000mm to 5,600mm. There have been 21 major flooding incidents during the 11 year period from 1997 to 2007, implying that the country has been flooded almost twice every year. Flood damage is widely spread, including human lives, houses, crops, and landslides blocking traffic.

2.5.3. Earthquakes

Myanmar's geological structure is complex, and there is an active fault, which is a border of India-Australian plate and Eurasian-plate, along the western border of Myanmar as shown in Figure 2.6-1. In addition, the Sagain Fault runs 1,200Km in the central part of Myanmar. There have been many strong earthquakes, which seem to be associated with the Sagaing Fault. This active fault extends from the Bago Province at the east of Yangon—through to the country's capital city Naypyidaw and the country's second largest city Mandalay, and to the Kachin State bordered by China. An earthquake associated with the Sagain Fault could result in serious damages to the economy, society and politics.



Source: http://www.gupi.jp/letter/letter012/letter-012.htm

Figure 2.5-1 The Main Active Faults in Myanmar

The major earthquakes occurred in Myanmar in the last 100 years are shown below.

Table 2.5-2 The Major Earthquake Occurred in the Last 100 Years

Date	Location	Magnitude	Description
17 Dec. 1927	Yangon	M7	unknown
8 Aug. 1929	Near Taungoo	unknown	Bent railroad tracks, bridges and culverts collapsed
5 May 1930	Near Khayan	M7.3	500 persons in Bago, about 50 persons in Yangon were killed
3 Dec. 1930	Nyaunglebin	M7.3	Railroad tracks twisted and about 30 persons were killed
27 Jan. 1931	East of INdawgyi	M7.6	Numerous fissures and cracks
12 Sept. 1946	Tagaung	M7.5	unknown
16 July 1956	Sagaing	M7.0	Several pagodas were severely damaged and 40 to 50 persons were killed
8 July 1976	Bagan	M6.8	Several pagodas were severely damaged and 1 person was killed.
22 Sept. 2003	Taungdwingyi	M6.8	Rural houses and religious buildings were severely damaged and 7 persons were killed.
24 March 2011	Shan State	M6.9	More than 270 people were dead or missing.

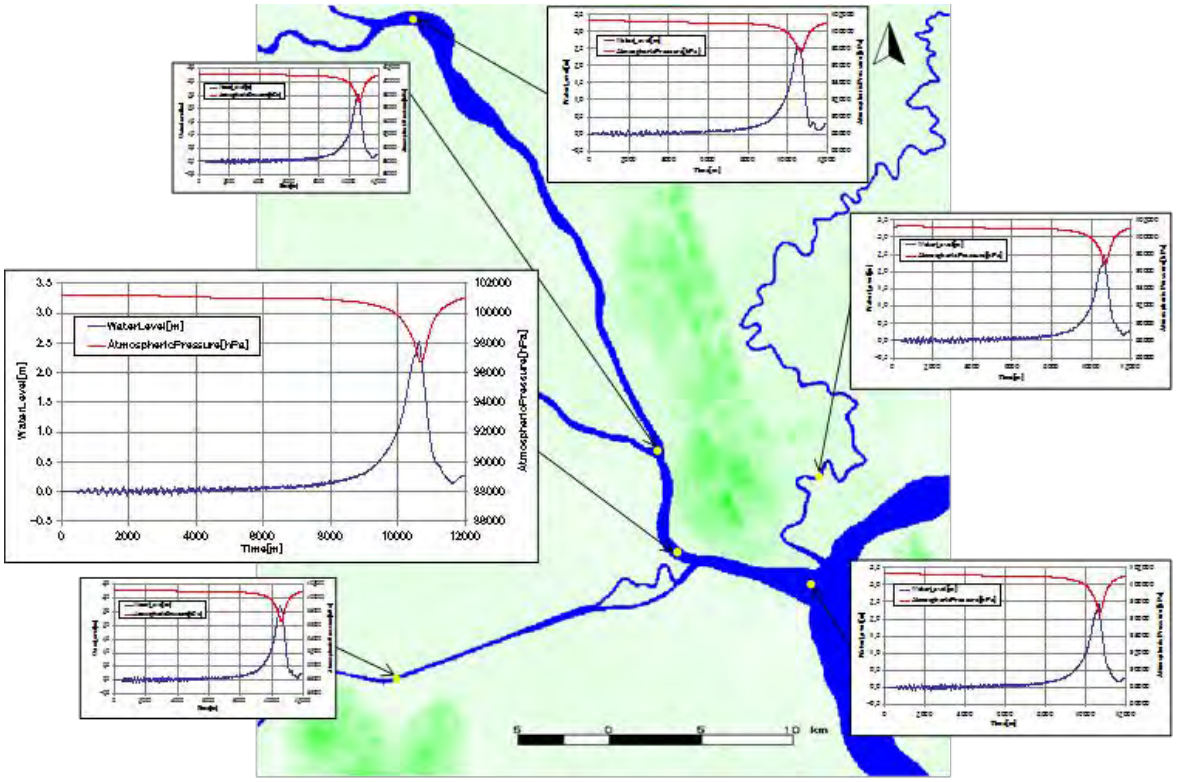
Source: Hazard Profile of Myanmar July 2009, and others

2.5.4. Cyclones

Cyclone is a tropical storm developed in the Indian Ocean, similar to a typhoon in nature. The energy source is the heat of evaporation of sea water whereby the sea surface temperature is more than 26 degrees Centigrade. Over the 119 years from 1887 to 2005, 1,248 cyclones (10.5 per year on average) developed in the Bengal Bay, of which 80 (6.4%, and 0.67 per year) directly hit Myanmar.

Cyclone "Nargis," which caused an enormous damage to Myanmar, occurred in central Bengal Bay on 27 April, 2008. Nargis landed on Myanmar at its peak strength, directly hitting Yangon; severe damages were caused due to high waves, storm surge, and strong wind, after which it ran through to the border of Thailand. The lowland area was attacked by the winds with estimated maximum wind velocity of 51m/s to 61m/s and waves 3.6m high. The height of the storm surge at Yangon Port reached more than 2.5m as shown in Figure 2.6-2. As a result, 84,537 people were killed, 53,836 people were missing, 2.4 million people were affected and the total amount of damage is expected to reach 4 billion US dollars.

It has been pointed out that damages by Nargis have been compounded due to deficiencies of disaster prevention plan, shelter and forecast and warning system and the lack of knowledge of disaster prevention.



Source: The Urgent Project for Rehabilitation of Yangon Port and Main Inland Water Transport in the Union of Myanmar

Figure 2.5-2 Increase of Water Level by Nargis

2.5.5. Storm surge

Cyclone Nargis, occurred in May 2008, and caused major damages due to storm surges in Myanmar's delta region. Storm surges are generated by wind set-up effect and inverse barometer

effect. A wind set-up effect is that strong onshore wind over sea surface raises the water level above the ordinary sea level. The pressure effect of a tropical cyclone causes water level in the open ocean to rise in regions with low atmospheric pressure and fall in regions of high atmospheric pressure. The rising water level counteracts the low atmospheric pressure such that the total pressure at some plane beneath the water surface remains constant. The effect is estimated at a 10mm increase in sea level for every 1hPa in atmospheric pressure.

2At the Yangon Port, 28 out of 37 mooring pontoons were damaged by Nargis' storm surge; many connecting bridges fell down and many ships were sunken or launched on land.

[2] The Port and Airport Research Institute　Urgent field survey report of storm surge disaster in Yangon Port (preliminary report)　10 June 2008

3. Present Situation of Yangon Port

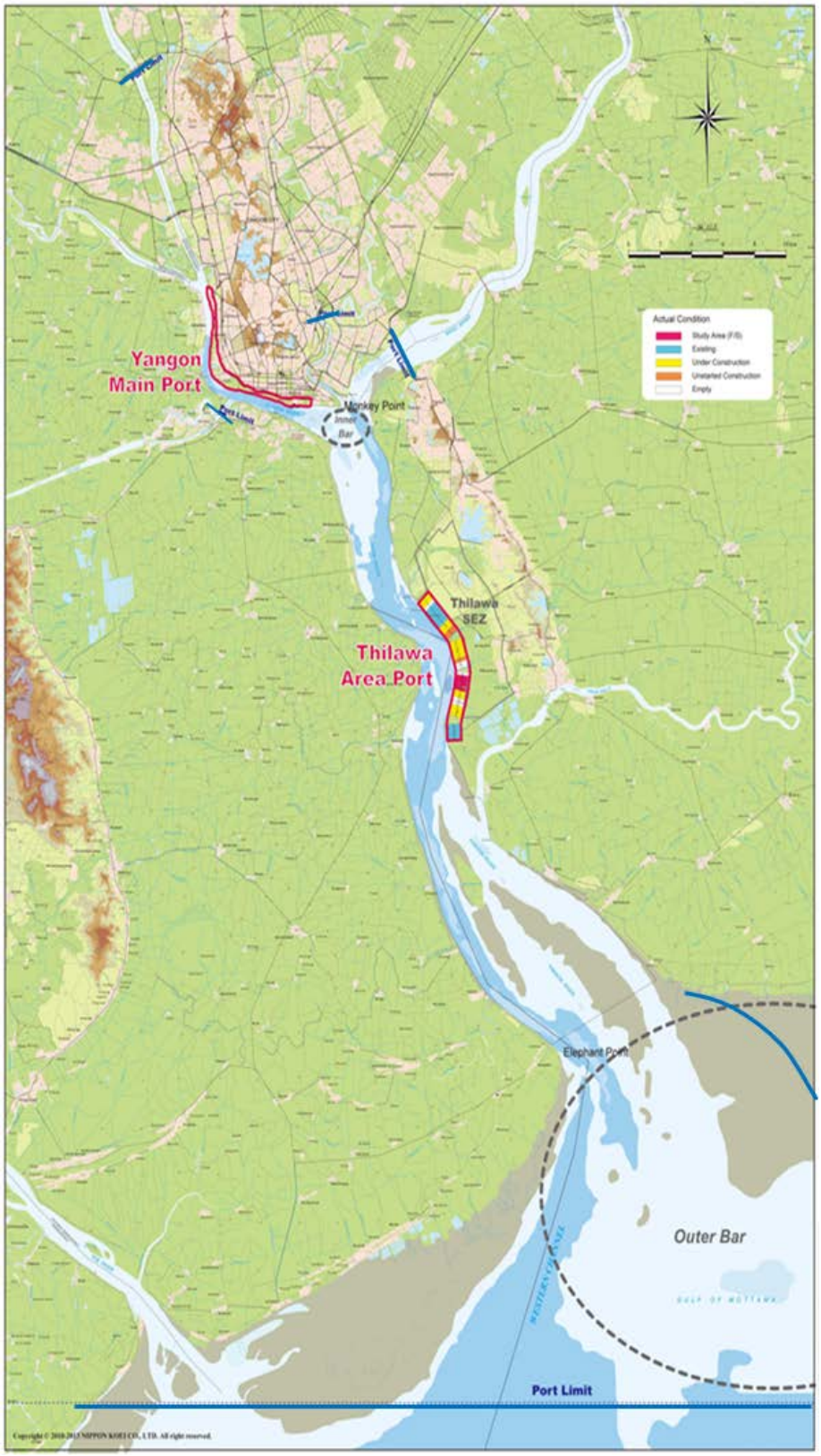
3.1. Overall Port Layout

The major port facilities of Yangon Port are separately located in Yangon Main Port and Thilawa Area Port. Yangon Main Port is located about 32 km from the mouth of the Yangon River and extends about 9 km on the left bank of the river. Thilawa Area Port is located about 16 km downstream and extends on the left bank of Yangon River. Yangon port limit is about 40 km upper side from Yangon River mouth indicated with blue line in Figure 3.1-1.

Major cargo of Yangon Port is handled at container terminals, the general cargo terminal and coastal/inland waterway transport jetties. Myanmar International Terminal Thilawa (MITT) which handles containers, timber and used cars etc. and some other port facilities are currently operating at Thilawa Area Port.

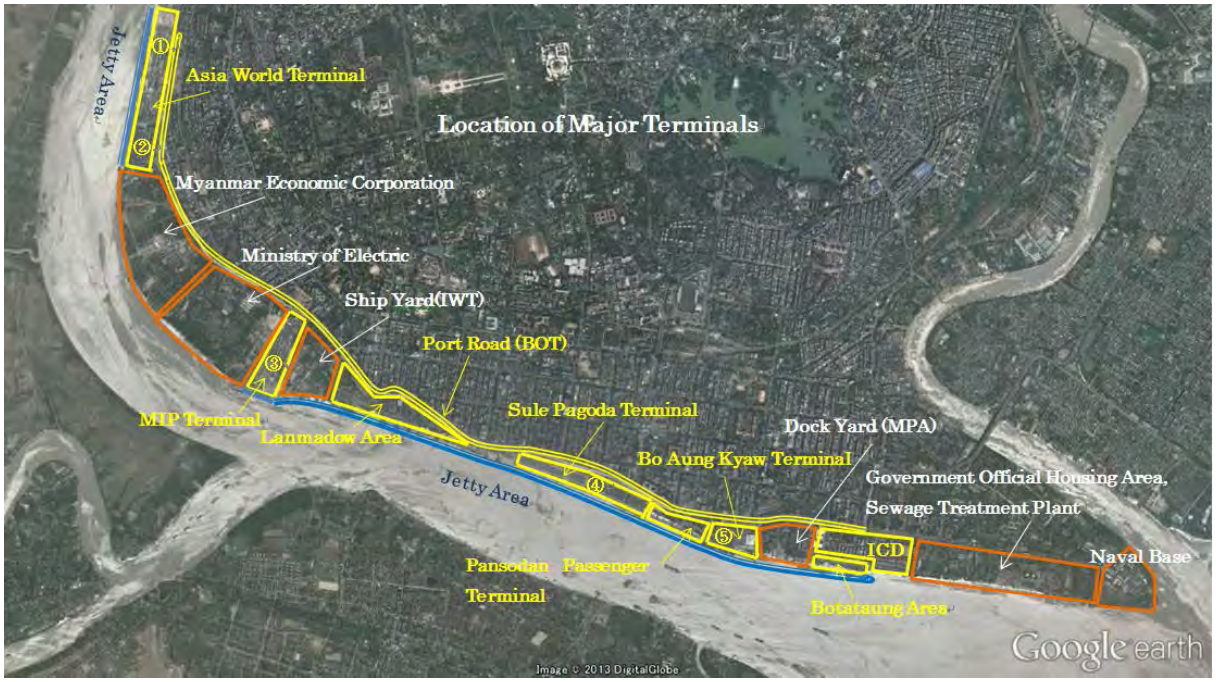
There are jetties and pontoons used for domestic/inland waterway transport and wharves owned by MPA and private companies for handling general cargoes and containers. Locations of the facilities are shown in Figure 3.1-2.

Land Utilization of Yangon main port water front area is shown in Figure 3.1-4 and 3.1-5.



Prepared by the Study Team

Figure 3.1-1 Yangon Port Limit and Location of Yangon Main Port and Thilawa Area Port



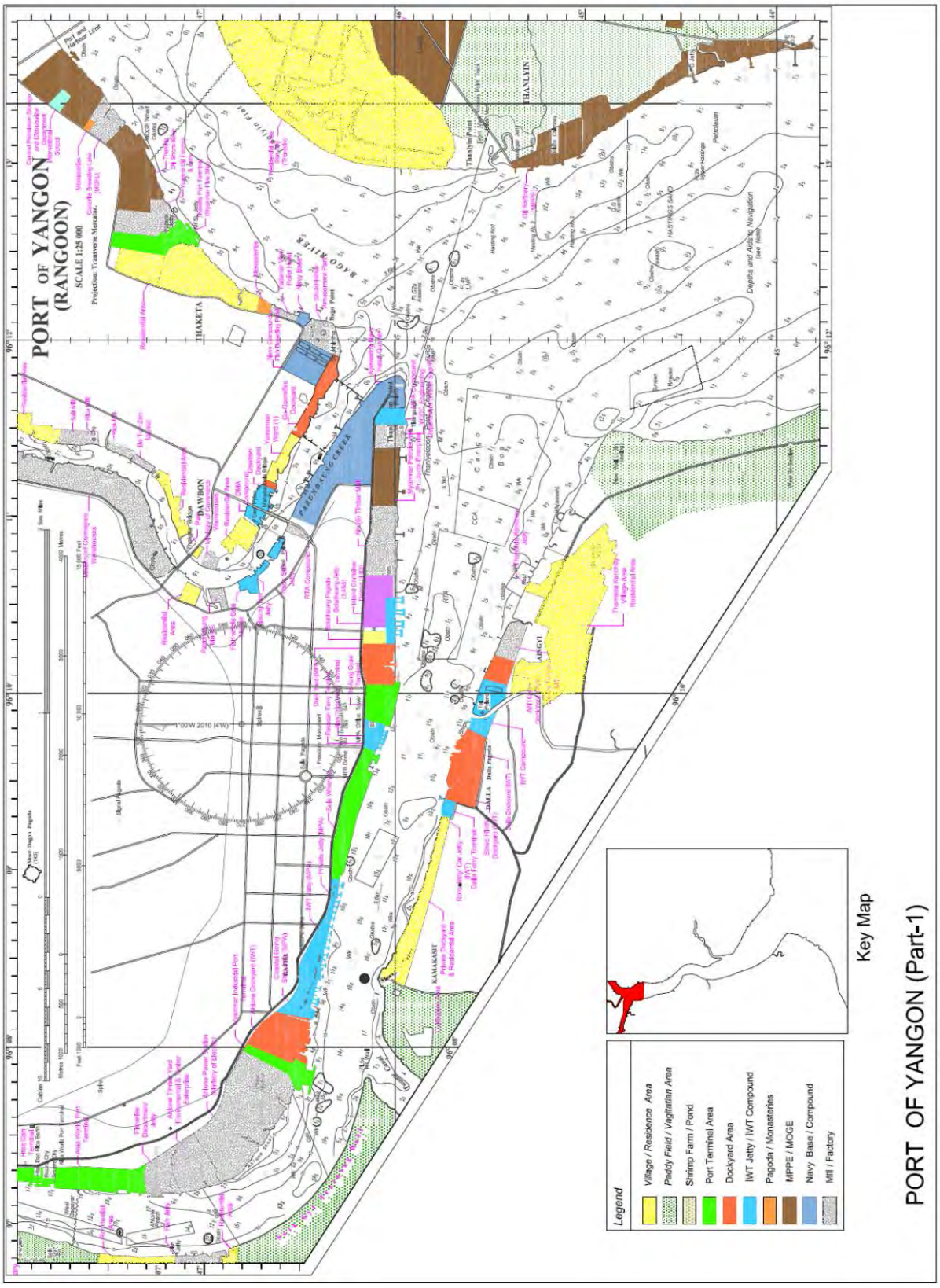
Prepared by the Study Team

Figure 3.1-2 Location map of the main port facilities in Yangon Main Port

Location map of MITT is given in Figure 3.1-3.

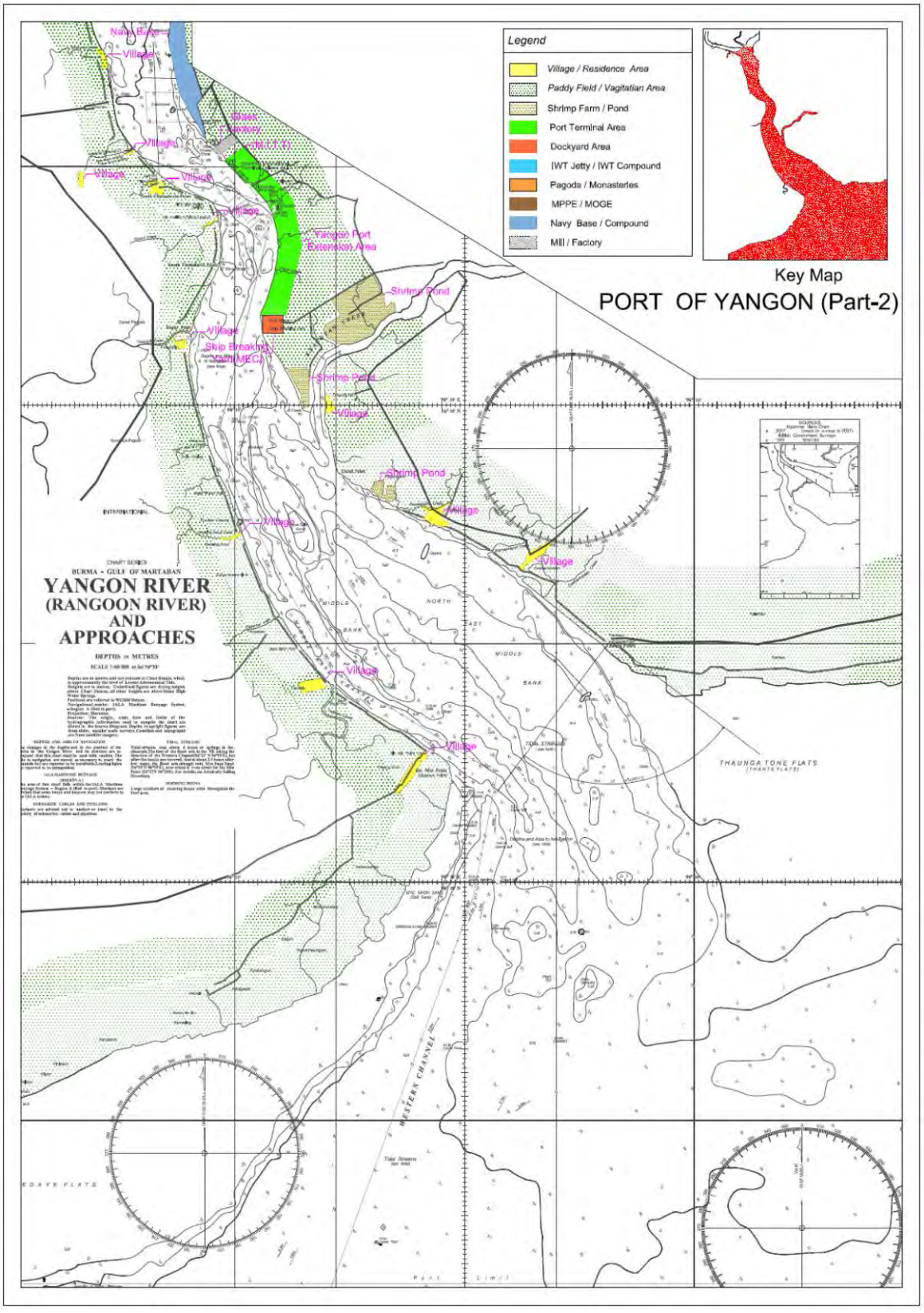
Prepared by the Study Team

Figure 3.1-3 Location map of Thilawa Area Port Facilities



Prepared by the Study Team

Figure 3.1-4 Land Utilization of Yangon Main Port Water Front Area （1/2）

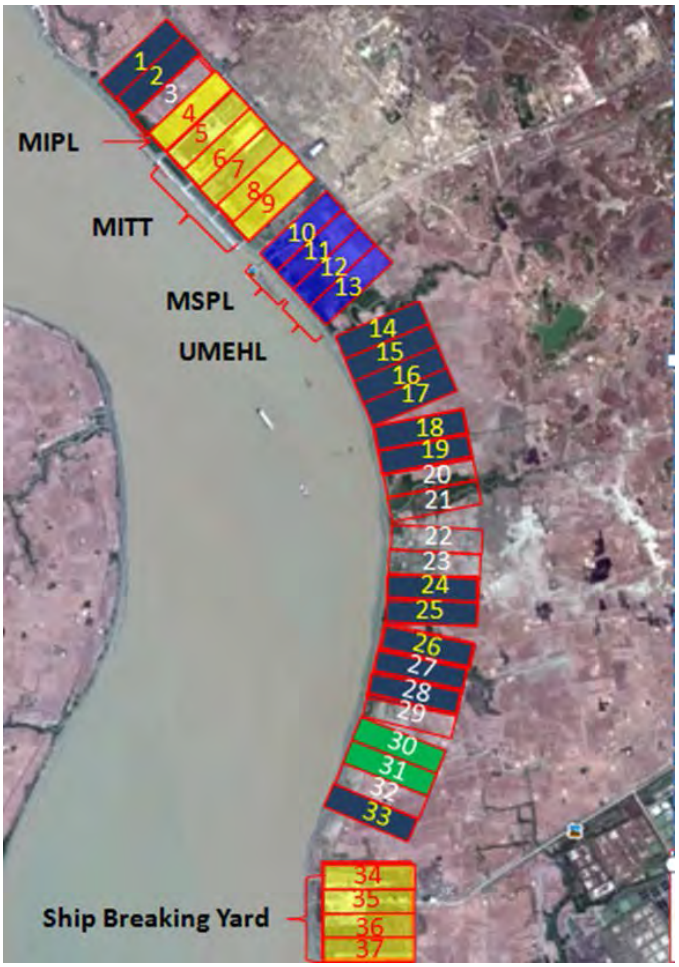


Prepared by the Study Team

Figure 3.1-5 Land Utilization of Yangon Main Port Water Front Area (2/2)

3.2. Port Facilities

The port land area is very narrow at Yangon Main Port because the city area is close to the port area as shown in Figure 3.1-2. Road traffic generated from three container terminals and inland container depots which are spread over the narrow port area results in heavy congestion. In order to alleviate the congestion, the national government instructed MPA to construct a 9 km long road which connects Asia World Terminal in the north and ICDs near Botathaung in the south along the boundary of the port area and the city area. In response, Asia World Company Limited recently completed construction of a 20 m wide port road by BOT scheme. It is a toll road. As of February 2013, this road is operational. Not only container trucks which are design objectives but also some general vehicles are using it. Container traffic effectiveness seems to be improved, however, traffic congestion on roads behind the port does not seem to be alleviated.



Source：MPA

Figure 3.2-1 Plots in Thilawa Area Port

Table 3.2-1 Present Situation of Thilawa Port Terminals

Current Situation of Thilawa Area Port

2013.8

Plot No.	Owner's Name	Situation	Main Cargo
1	Myat Myatta Mon Company Limited { PLOT 1, 2 (A) } Apex Gas & Oil Public Co., Ltd. { PLOT 1,2 (B) } Shwe Taung Company Ltd. { PLOT 1,2 (C) }	Under Construction	Fuel
2			
3	PUMA Energy Group Pte., Ltd	Document Processing	Bitumen and Petrolem Product
4	MYANMAR INTEGERATED PORT LIMITED (MIPL)	Operation	General Cargo
5	MYANMAR INTERNATIONAL TERMINALS THILAWA LIMITED (MITT)	Operation	Container/General Cargo
6			
7			
8			
9			
10	MPA-SMD PORT LIMITED (MSPL)	Pending of Construction	General Cargo
11			
12	Union of Myanmar Economic Holding Limited (UMEHL){PLOT 14}	Construction hasn't started	General Cargo
13			
14		Under Construction	Fuel
15	Elite Petrochemical Co., { PLOT 15,16 (A/B) } Max Myanmar Co., Ltd { PLOT 15,16 C }	Under Construction	Fuel
16			
17	Green Asia Co., Ltd { PLOT 17,18 (A) } Denko Petrochemical Co., Ltd { PLOT 17,18 (B) } Thuriya Energy Depot Management Co., Ltd { PLOT 17,18 (C) }	Under Construction	Fuel
18			
19	Union Solidarity and Development Association (USDA)	Construction hasn't started	Fuel
20	Wilmar International Ltd. {PLOT 20/21}	Feasibility Study	Agricultural Products
21			
22	MPA (ODA Loan) (5 PLOT) {PLOT 22/23/24/25/26}	Under Preparation	Container/General Cargo
23			
24			
25			
26			
27	MPA (PLOT 27}	Remaining	
28	Myanmar Agribusiness Public Corporation Ltd.	Document Processing	Grain Terminal
29	Myanma Agricultural & General Development Public Co., Ltd. {PLOT29}	Document Processing	Grain Terminal
30	Diamond Star Co., Ltd. {PLOT 30}	Document Processing	Grain Terminal
31	MPA Plot ⅔ { PLOT 31 }	Remaining	
31	IGE Service Co., Ltd. { PLOT 31/32 (B)} Kaung Myanmar Aung Shipping Co., Ltd.{Plot 31/32 (C)}	Under Construction	Fuel
32			
33	Padauk Shwe Wah Petrochemical Co., Ltd. {PLOT 33}	Under Construction	Fuel
34	Myanma Economic Coporation (MEC)	Operation	Ship Breaking Yard
35			
36			
37			

Source：MPA

3.2.1. International Cargo Terminal

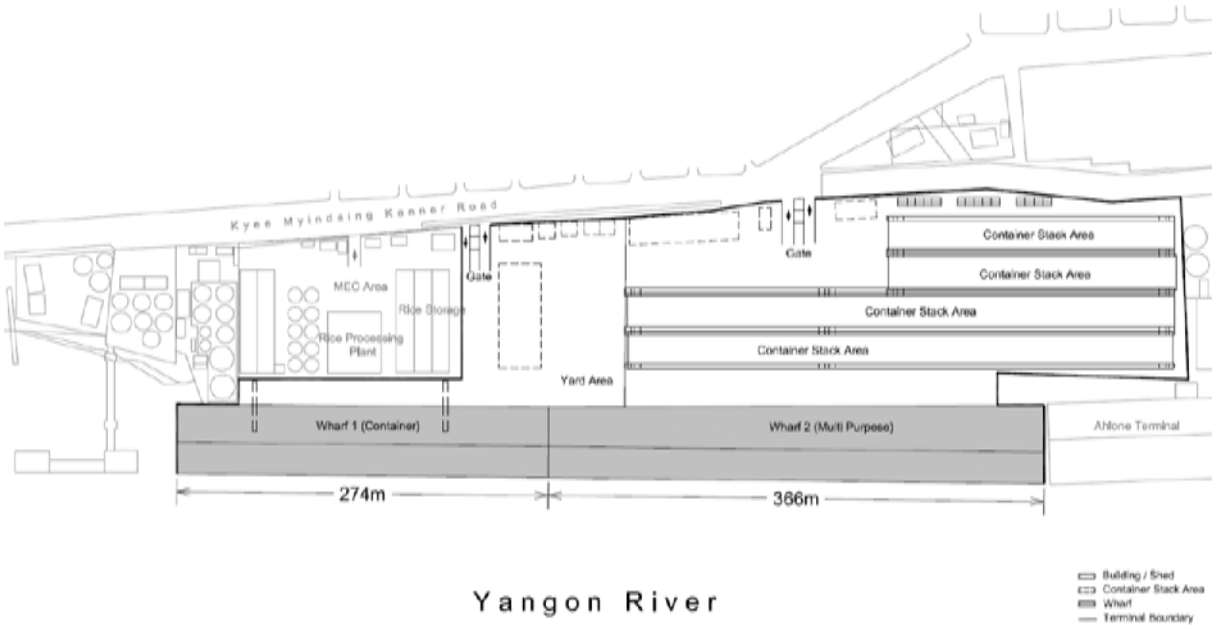
The dimensions of the international cargo terminal in Yangon Port is shown in Table 3.2-2. In the table, Hteedan Port is a part of Asia World Terminal.

Table 3.2-2 Dimensions of International Cargo Terminals in Yangon Port

No.	Yangon Inner Harbor	Cargo Type	Length(m)	Draft(m)	DWT
1	Hteedan Port TML No.2	GC & CTNR	366	9.0	15,000
	Hteedan Port TML No.3	GC & CTNR	274	9.0	15,000
2	Asia World Port TML No,.1	GC & CTNR	198	9.0	15,000
	Asia World Port TML No,.2	GC & CTNR	150	9.0	15,000
	Asia World Port TML No,.3	GC & CTNR	260	9.0	15,000
3	Myanma Industrial Port No.1(MIP)	GC & CTNR	155	9.0	15,000
	Myanma Industrial Port No.2(MIP)	GC & CTNR	155	9.0	15,000
4	Sule No.1	GC	137	9.0	15,000
	Sule No.2	GC	137	9.0	15,000
	Sule No.3	GC	137	9.0	15,000
	Sule No.4	GC	137	9.0	15,000
	Sule No.5	GC	168	9.0	15,000
	Sule No.6	GC	162	9.0	15,000
5	Bo Aung kyaw No.1	GC & CTNR	137	9.0	15,000
	Bo Aung kyaw No.2	GC & CTNR	137	9.0	15,000
	Bo Aung kyaw No.3	CTNR	183	9.0	15,000
	Sub Total 17 Berth				
	Thilawa				
6	Myanmar Integrated Port Ltd(MIPL)	GC & CTNR	200	9.0	20,000
7	MITT	GC & CTNR	200	9.0	20,000
	MITT	GC & CTNR	200	9.0	20,000
	MITT	GC & CTNR	200	9.0	20,000
	MITT	GC & CTNR	200	9.0	20,000
	MITT	GC & CTNR	200	9.0	20,000
	Sub Total 6 Berth				
	Total 23 Berth				

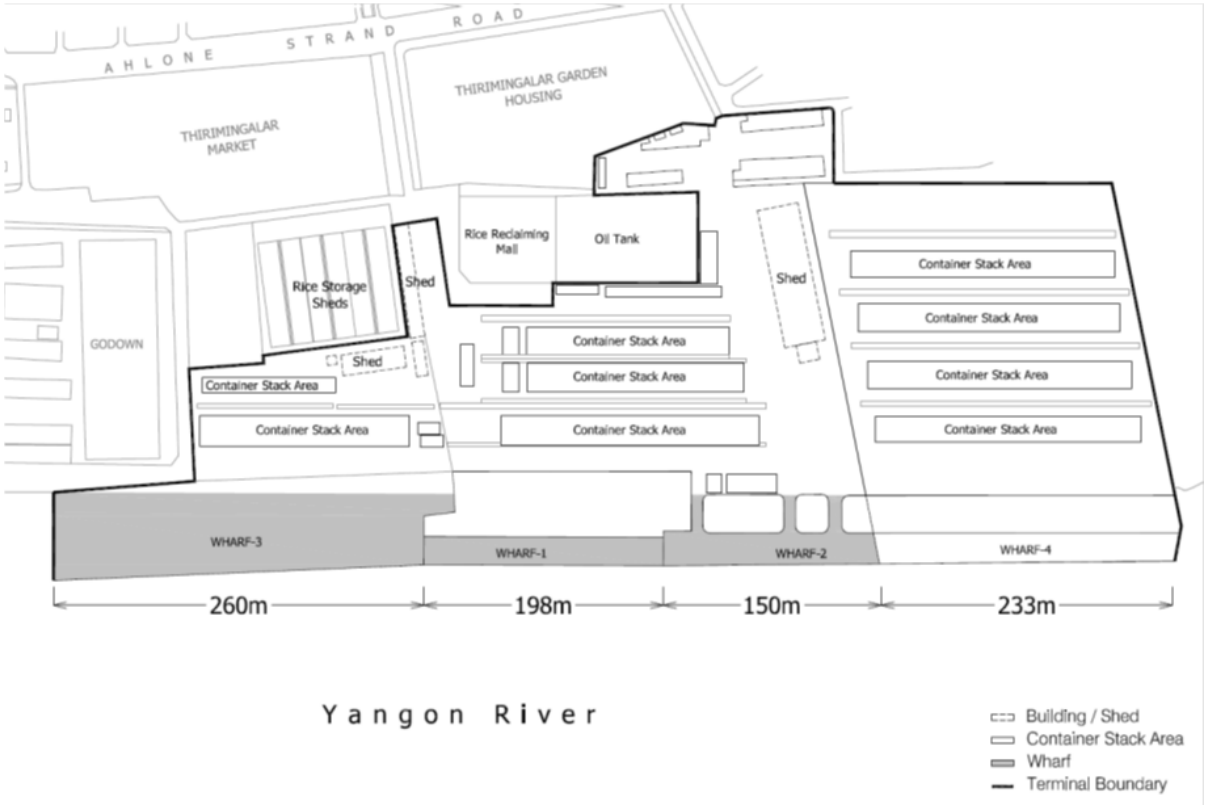
Source:MPA

Outlines of the major terminals are given from Figure 3.2-2 to Figure 3.2-8.



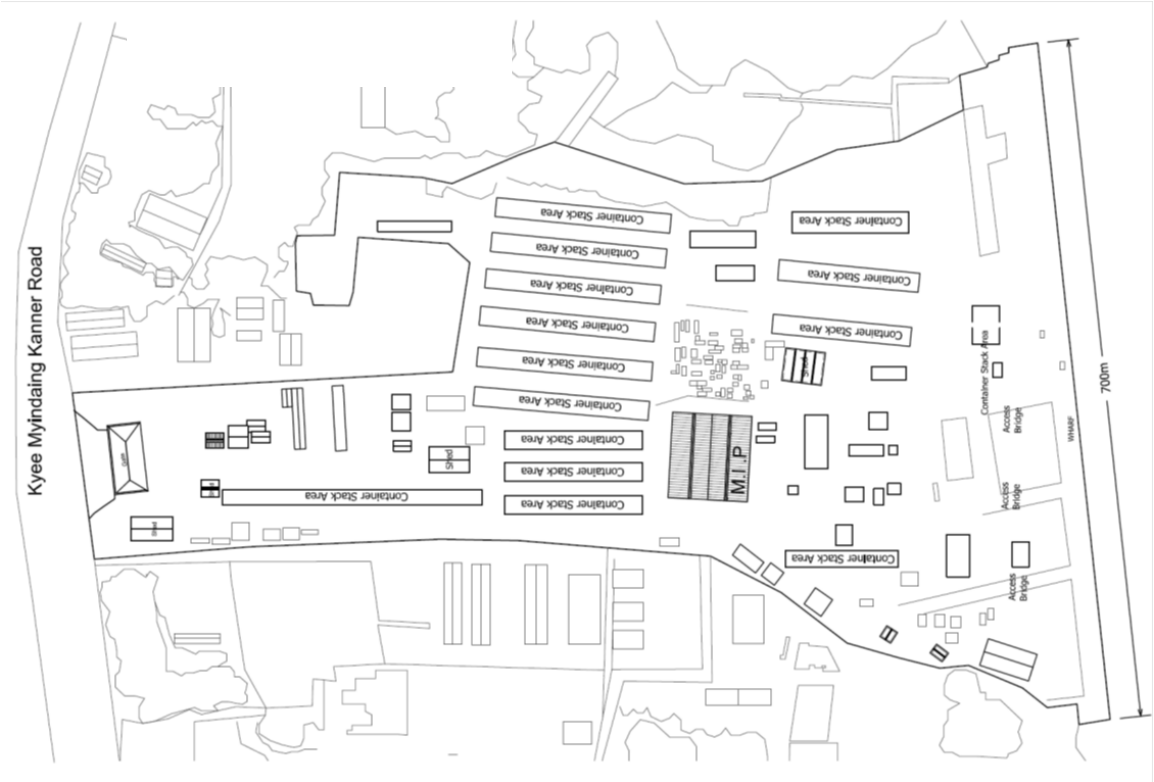
Source : Asia World Terminal (Prepared by the Study Team)

Figure 3.2-2 Layout of Hteedan Terminal



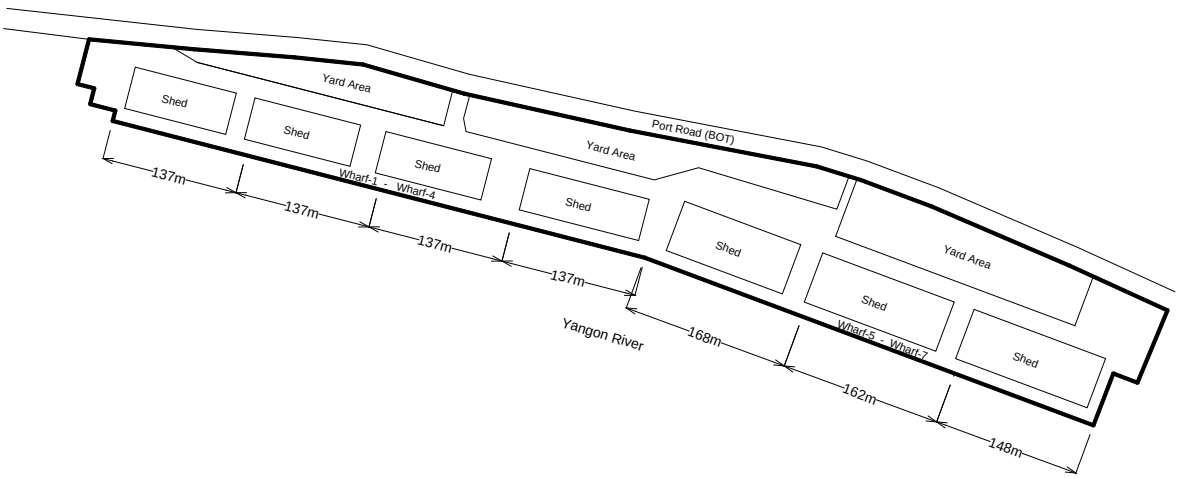
Source : Asia World Terminal (Prepared by the Study Team)

Figure 3.2-3 Layout of Ahlone Terminal



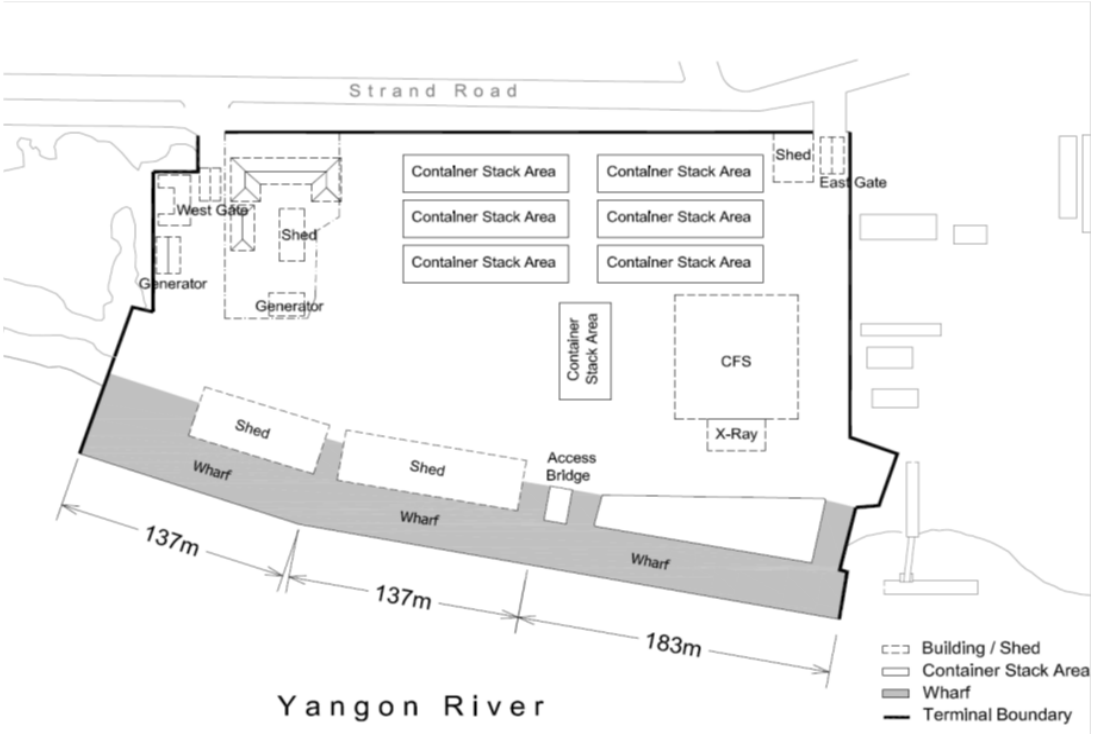
Source：Google Earth (Prepared by the Study Team)

Figure 3.2-4　Layout of MIP Terminal



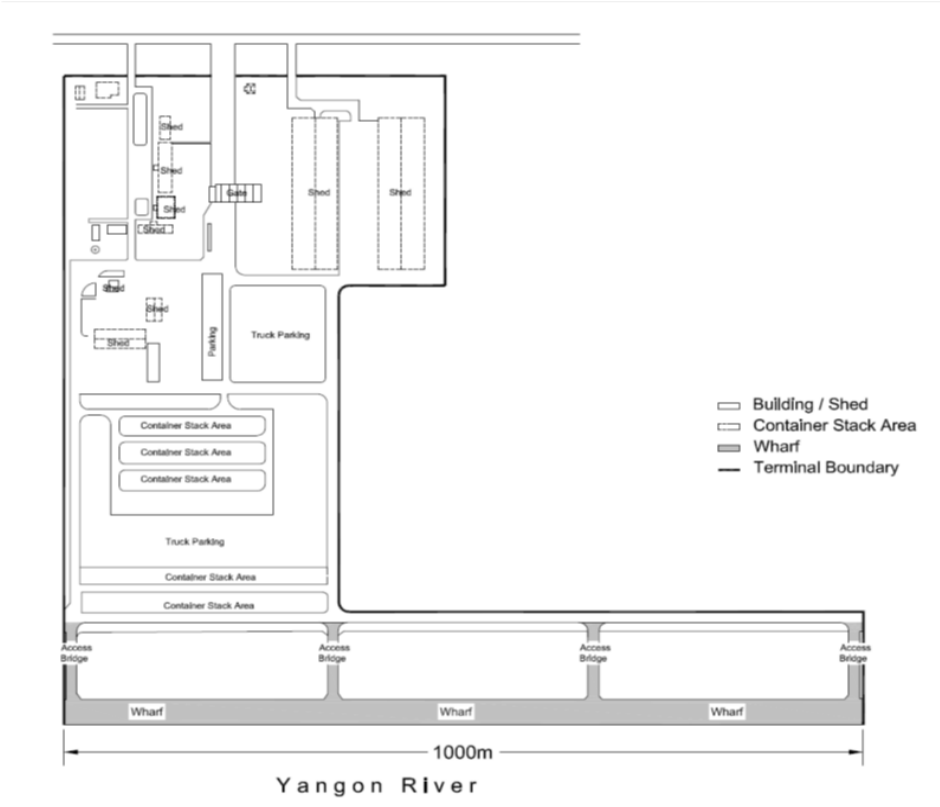
Source：Google Earth（Prepared by the Study Team）

Figure 3.2-5　Layout of Sule Pagoda Terminal



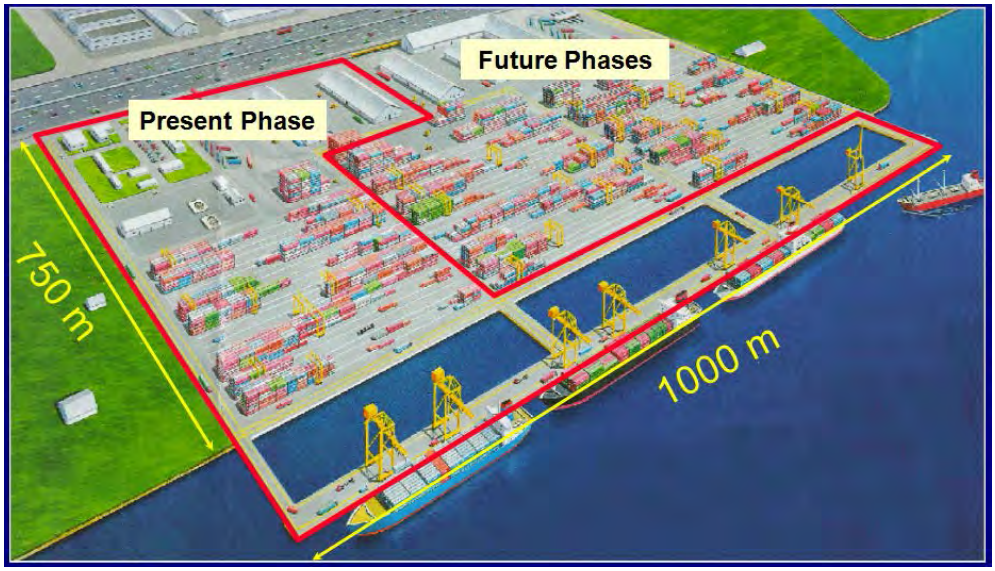
Source: Google Earth (Prepared by the Study Team)

Figure 3.2-6 Layout of Bo Aung Kyaw Terminal



Source: Google Earth (Prepared by the Study Team)

Figure 3.2-7 Layout of MITT Terminal



Source: MITT

Figure 3.2-8 Bird's Eye View of MITT Terminal

As shown in Figure 3.1-2 and Figure 3.2-9, four container terminals are located in Yangon Main Port and one in Thilawa Area Port.

Dimensions of container terminals and particulars of cargo handling equipment are shown in Table 3.2-3.

Table 3.2-3 Dimensions of container terminal and particular of cargo handling equipment in Yangon Port

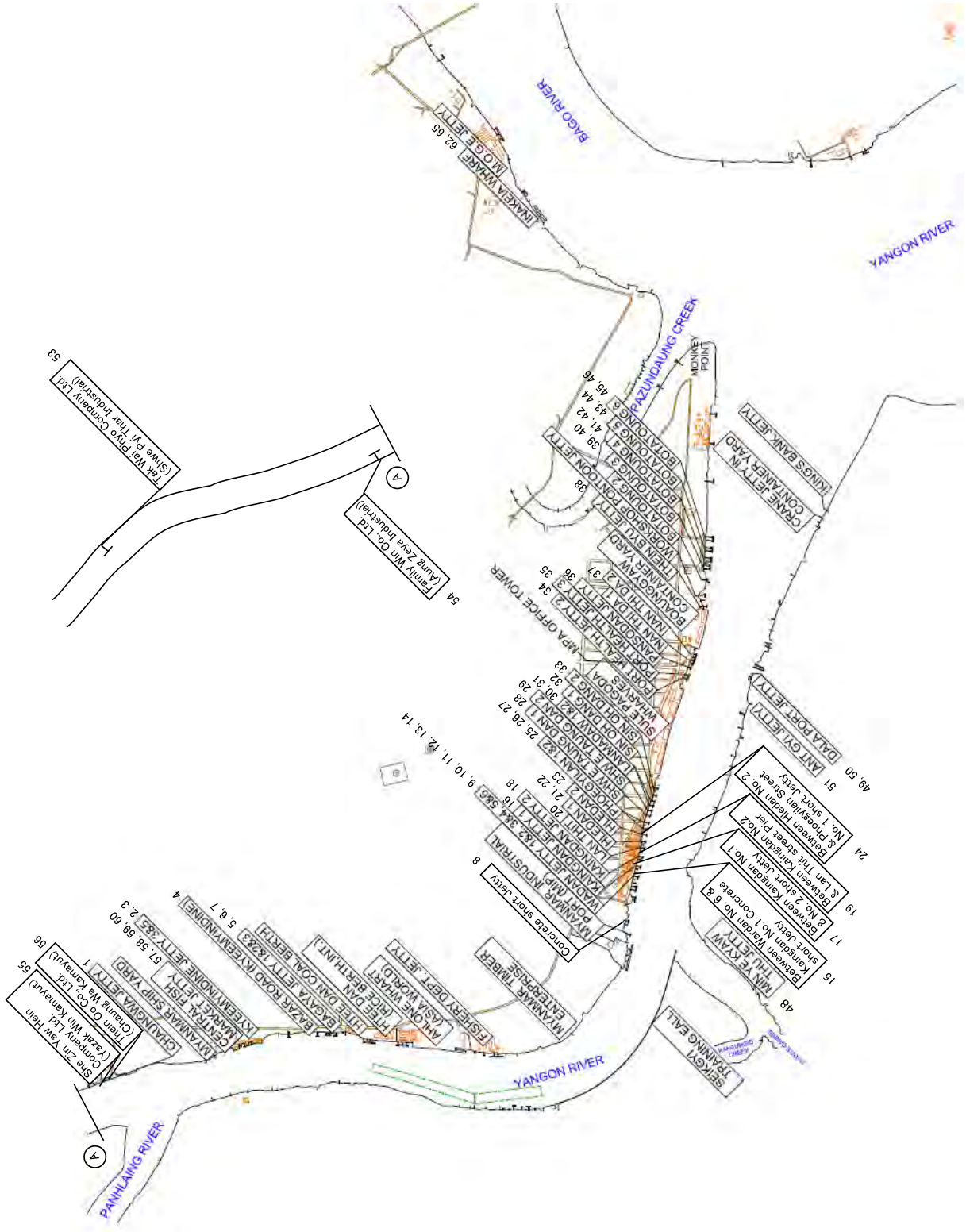
	Asia World Hteedan Terminal		Asia World Ahlone Terminal		Myanmar Industrial Port (MIP) Terminal		Bo Aung Kyaw Terminal		Myanmar International Terminal Thilawa (MITT)	
Berth	No.1 Wharf (Container)	366m, -9m 5.6ha	No. 1 Wharf (Container)	156m, -9.5m	Wharf (155mx2) Container depot	310m, -10m 4,710TEU	No. 1 Wharf	183m, -9m	Wharf (5)	1,000m, -10m
	No.2 Wharf (Bulk, Multi-purpose)	274m, -9m 3.7ha	No.2 Wharf (Container)	198m, -9.5m	Phase 1 Expansion (~2013/3)	450m 2.9ha	No. 2 Wharf	137m, -9m	Yard Capacity	5,000TEUs
			No.3 Wharf (Container)	260m, -9.5m (1~3=6.7ha)			No. 3 Wharf	137m, -9m		
	(Container Strage Capacity, TEUs)	5,342	No.4 Wharf (Under Construction)	238m, -9.5m 4.4ha			Yard (1~3)	2.1ha 2,046TEUs		
Container Handling Equipment	Gantry Crane	2					Gantry Crane	1	Gantry Crane	2
			Mobile Crane	2	Mobile Crane	4	Mobile Crane	2	Mobile Crane	2
	RTG	4			RTG	2	RTG	3	RTG	3
	Reach Stacker	4			Reach Stacker	10	Reach Stacker	19	Reach Stacker	3
	Prime Mover and Trailer	15			Prime Mover and Trailer	40	Prime Mover and Trailer	33	Tractor/Truck	6/65
	Fork Lift	10							Trailer	80

Prepared by the Study Team

3.2.2. Facilities for domestic/inland waterway transport

A total of about 169 thousand tons of cargo is transported by domestic/inland waterways in Myanmar. This cargo is transported by small ships owned by the Inland Waterway Transport (IWT) and private shipping companies mainly through pontoon jetties.

Location map of facilities for the coastal/inland waterway transport is shown in Figure 3.2-9. Name and size and types objective ships are given in Table 3.2-4.



Source: MPA

Figure 3.2-9 Location map of port facilities in Yangon Main Port

Table 3.2-4 Name and Size and Types Objective Ships of Jetties for Coastal/Inland Waterway Transport

No.	Name of Jetty	Size			Remark
		Length (feet)	Width (feet)	Draft (feet)	
1	Chaungwa Jetty	200	40	8.0	Coastal
2	Kyeemyindine No. 3 Jetty	120	20	6.0	Delta
3	Kyeemyindine No. 5 Jetty	80	20	6.0	Delta
4	Kyeemyindine Bazar Jetty	120	20	6.0	Delta
5	Bagaya No. 1 Jetty	120	20	6.0	Coastal
6	Bagaya No. 2 Jetty	120	20	6.0	Coastal
7	Bagaya No.3 Jetty	120	20	6.0	Coastal
8	Concrete short Jetty	177	23	8.0	Public
9	Wardan No. 1 Jetty	120	20	6.0	Delta
10	Wardan No. 2 Jetty	120	20	6.0	Delta
11	Wardan No. 3 Jetty	240	40	8.0	Coastal/Delta
12	Wardan No. 4 Jetty	240	40	8.0	Coastal/Delta
13	Wardan Ro/Ro Jetty	275	18		Public
14	Wardan No. 6 Jetty	120	20	6.0	Coastal
15	Between Wardan No. 6 & Kaingdan No. 1 Concrete short Jetty	105	62	?	Public
16	Kaingdan No. 1 Jetty	120	20	6.0	Coastal
17	Between Kaingdan No. 1 & No. 2 short Jetty	90	11	6.0	Public
18	Kaingdan No. 2 Jetty	120	20	6.0	Delta
19	Between Kaingdan No. 2 & Lan Thit Street Pier	101	11	6.0	Public
20	Lan Thit Street Jetty	120	20	6.0	IWT/Delta
21	Hledan No. 1 Jetty	120	20	6.0	IWT/Delta
22	Between Hledan No. 1 & No. 2 short Jetty	83	12	6.0	Public
23	Hledan No. 2 Jetty	120	20	6.0	Public/Delta
24	Between Hledan No. 2 & Phoegyilan Street No. 1 short Jetty	115	41	6.0	Public
25	Phoegyilan Street No. 1 Jetty	120	20	6.0	Delta
26	Between Phoegyilan Street No. 1 & No. 2 short Jetty	88	31	6.0	Public
27	Phonegyi Street No. 2 Jetty	120	20	6.0	IWT/Delta
28	Shwee Taung Dan No. 1 Jetty	120	20	6.0	IWT/Delta
29	Shwee Taung Dan No. 2Jetty	120	20	6.0	IWT/Delta

30	Lanmadaw No. 1 Jetty	120	20	6.0	Delta
31	Lanmadaw No. 2 Jetty	120	20	6.0	Delta
32	Sin Oh Dan No. 1 Jetty	120	20	6.0	Delta
33	Sin Oh Dan No. 2 Jetty	154	40	8.0	Delta
34	Port Health No. 2 Jetty	294	40	?	Coastal
35	Port Health No. 3Jetty	294	40	?	Coastal
36	Pansodan Jetty	120	20	6.0	IWT/Passenger
37	Nam Thi Da Jetty	480	40	?	MPA/Official
38	Ship yard Jetty	120	20	6.0	MPA
39	Botatoung No. 3 Jetty (upper)	200	40	8.0	MPA/Public
40	Botatoung No. 3 Jetty (lower)	200	40	8.0	MPA/Public
41	Botatoung No. 4 Jetty (upper)	200	40	8.0	IWT/Public
42	Botatoung No. 4 Jetty (lower)	200	40	8.0	IWT/Public
43	Botatoung No. 5 Jetty (upper)	200	40	8.0	IWT/Public
44	Botatoung No. 5 Jetty (lower)	200	40	8.0	IWT/Public
45	Botatoung No. 6 Jetty (upper)	240	40	8.0	IWT/Public
46	Botatoung No. 6 Jetty (lower)	240	40	8.0	IWT/Public
47	Nyaungdan Jetty Bridge	120	20	6.0	
48	Min Ye Kyaw Thu Jetty	120	20	6.0	IWT/Passenger
49	Dalla Ro/Ro Jetty	250	18	?	IWT
50	Dalla Passenger Jetty	120	20	6.0	IWT/Passenger
51	Ant Gyi Jetty	120	20	6.0	Public
52	Thamada Beach Jetty	120	20		Not MPA own
53	Tak Wai Phyo Company Ltd. (Shwe Pyi Thar Industrial)	132	24		Not MPA own
54	Family Win Co. Ltd. (Aung Zeya Industrial)	72	24		Not MPA own
55	Shwe Zin Yaw Hein Company Ltd. (Yazak Win Kamayut)	324	108		Not MPA own
56	Thein Oo Co. Ltd. (Chaung Wa Kamayut)	72	36		Not MPA own
57	Myanmar Millennium Group Co. Ltd. (No. 1 Jetty of Kyeemyindine fish market)	150	160		Not MPA own
58	Myanmar Millennium Group Co. Ltd. (No. 1 Jetty of Kyeemyindine fish market)	88	144		Not MPA own
59	Sanpya Shwe Nga Co. Jetty Bridge (Kyeemyindine fish market)	90	123		Not MPA own
60	Man Myanmar General Trading Jetty (Kyeemyindine fish market)	180	104		Not MPA own
61	Htay Myanmar Trading Co. Jetty Bridge	144	104		Not MPA own

62	Yazana Industrial Fishiyng Products Co,Ltd Jetty (Nyaung Dan)	450	80		Not MPA own
63	Vicking Marine Products Co,Ltd Jetty (Thida port)	264	138		Not MPA own
64	Vicking Marine Products Co,Ltd Jetty (Pyidawthit)	144	48		Not MPA own
65	Yazana Edible Oil Alongside Jetty (Takeda)	254	72		Not MPA own

Source : MPA

There are 65 berths in total including 36 berths for inland waterway transport (IWT, Delta and Public), 10 berths for coastal ships, 3 berths for passenger ships and 14 berths for private use.

Facilities for coastal/inland waterway transport are mainly pontoon type as shown in Figure 3.2-10 which is adaptable to a large tidal change of about 6 m. However, fixed pier type structures as shown in Figure 3.2-11 are also used for coastal ships.

(Prepared by the Study Team)

Figure 3.2-10 Example of Pontoon Type Jetty **Figure 3.2-11 Example of Fixed Pier Jetty**

Pictures of passenger cum cargo ships of IWT called Delta Ship, cargo ship called Market Ship and coastal ships are shown in Figure 3.2-12.

Passenger cum Cargo Ship
（Delta Ship）

Cargo Ship（Market Ship）

Coastal Ship

(Prepared by the Study Team)

Figure 3.2-12 Pictures of Passenger cum Cargo Ship of IWT, Cargo Ship and Coastal Ship

3.3. Cargo Handling Volume

3.3.1. Cargo Handling Volume in Yangon Port

Cargo handling volume of Yangon port has doubled from 10,960,000tons in year 2006 to 21,720,000 tons in year 2011. Cargo volume of foreign trade and coastal trade are 20,670,000 tons and 1,050,000 tons respectively. Until year 2008, foreign trade cargo volume and coastal trade cargo volume had increased gradually every year, however, import cargo volume started to increase rapidly from year 2009.

(1) Cargo Handling Volume in Yangon Main port and Thilawa area

Cargo handling volume of Yangon main port and Thilawa area port are 18,660,000 tons and 3,060,000 tons respectively. Almost of coastal cargoes are handled in Yangon main port.

Table 3.3-1 Cargo Handling Volume in Yangon Main Port and Thilawa Area Port

unit: ton

				2006	2007	2008	2009	2010	2011
Yangon									
	Main	International	Import	3,696,507	4,666,074	5,075,561	8,401,014	10,478,230	11,894,990
			Export	3,616,940	4,032,683	4,555,790	4,741,898	4,408,795	5,714,969
			Total	7,313,447	8,698,757	9,631,351	13,142,912	14,887,025	17,609,959
		Coastal	Unload	613,105	614,589	523,711	458,674	599,712	649,417
			Load	402,318	393,431	388,960	448,163	466,960	399,036
			Total	1,015,423	1,008,020	912,671	906,837	1,066,672	1,048,453
		Total		8,328,870	9,706,777	10,544,022	14,049,749	15,953,697	18,658,412
	Thilawa	International	Import	1,313,081	959,461	551,203	632,391	1,229,454	1,916,926
			Export	1,313,081	1,193,248	1,220,723	1,463,782	1,255,490	1,147,005
			Total	2,626,162	2,152,709	1,771,926	2,096,173	2,484,944	3,063,931
		Coastal	Unload						
			Load				1,527		
			Total	0	0	0	1,527	0	0
		Total		2,626,162	2,152,709	1,771,926	2,097,700	2,484,944	3,063,931
	Total	International	Import	5,009,588	5,625,535	5,626,764	9,033,405	11,707,684	13,811,916
			Export	4,930,021	5,225,931	5,776,513	6,205,680	5,664,285	6,861,974
			Total	9,939,609	10,851,466	11,403,277	15,239,085	17,371,969	20,673,890
		Coastal	Unload	613,105	614,589	523,711	458,674	599,712	649,417
			Load	402,318	393,431	388,960	449,690	466,960	399,036
			Total	1,015,423	1,008,020	912,671	908,364	1,066,672	1,048,453
	Grand total			10,955,032	11,859,486	12,315,948	16,147,449	18,438,641	21,722,343

Source：MPA

(2) Container Cargo Handling Volume in Yangon Port

All container cargo is handled at Yangon port in Myanmar. Table 3.3-2 shows container cargo handling volume in Yangon port. Container cargo handling volume in year 2010 is 335,000 TEU and 4,440,000 tons. Annual increase ratio of container cargo is less than those of total cargo handling volume.

Table 3.3-2 Container Cargo Handling Volume in Myanmar Port

		2004	2005	2006	2007	2008	2009	2010
Export	TEU	77,553	79,330	95,782	109,953	121,348	148,482	167,011
	ton	1,247,984	1,334,620	1,726,990	1,916,037	2,063,443	2,330,219	1,939,262
Import	TEU	80,394	83,030	93,962	113,059	125,364	149,472	168,335
	ton	1,087,986	1,151,965	1,246,601	1,541,239	1,554,282	2,089,863	2,496,199
Total	TEU	157,947	162,360	189,744	223,012	246,712	297,954	335,346
	ton	2,335,970	2,486,585	2,973,591	3,457,276	3,617,725	4,420,082	4,435,461

Source：MPA

(3) Cargo Commodity in Yangon Port

Cargo handling volume by commodity of Yangon port is shown in Table 3.3-3. Main export cargoes by volume are general cargo, timber, rice and rice products. Export volume of timber is about 30% of total export volume and handling volume is ranges from 1,300,000 tons to 1,700,000 tons each year. Export volume of rice increased suddenly from 2008, the handling volume in the year 2009 was 920,000 tons.

On the other hand, main import cargoes by volumes are general cargo of 8,200,000 tons and petrol oil and lubricants of 1,260,000 tons. Average handling volume of petrol oil and lubricants is 1,200,000 tons. However, it is expected that import volume of petrol oil and lubricants will increase in line with economic growth.

Table 3.3-3 Cargo Handling Volume by Commodity in Yangon Port

unit:ton

	2004	2005	2006	2007	2008	2009
Outshipment						
Total	4,773,347	4,724,960	5,332,093	5,619,362	6,165,473	6,655,371
Petrol Oil and Lubricants	66,135	69,491	69,070	61,090	61,730	43,624
Rice and Rice Products	221,943	221,335	38,177	389,678	742,310	920,289
Minerals	53,102	42,426	21,938	29,261	36,049	32,703
Timber	1,599,518	1,730,382	1,776,002	1,693,284	1,301,746	1,514,721
General Cargo	283,649	2,661,326	3,426,906	3,446,049	4,023,638	4,144,034
Inshipment						
Total	5,207,580	5,513,755	5,622,693	6,240,124	6,150,475	9,492,079
Petrol Oil and Lubricants	1,508,994	1,618,868	1,286,630	1,293,394	1,184,468	1,259,189
General Cargo	3,698,586	3,894,887	4,336,063	4,946,730	4,966,007	8,232,890

Source：Statistical Yearbook 2010

(4) Inland Water Tranport Cargo Volume in Yangon Port

Table 3.3-4 shows Inland Water Transport cargo handling volume in Yangon port. Cargo handling volume has been decreasing after the peak volume of 1,480,000tons in year 2003. Handling volume in year 2011 was 570,000 tons. Unloaded cargo volume in Yangon port is more than loaded cargo volume in Yangon port in every year.

Table 3.3-4 Inland Water Transport Cargo Volume in Yangon Port

unit:ton

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Unload	832,530	722,282	613,116	576,657	492,561	453,130	370,890	379,050	403,692
Load	652,055	442,860	443,416	378,135	365,621	178,911	226,905	214,957	171,043
Total	1,484,585	1,165,142	1,056,532	954,792	858,182	632,041	597,795	594,007	574,735

Source：MPA

3.4. Working Vessel

3.4.1. Shipyards under MPA

MPA owns three (3) shipyards, Theinbyu Dockyard, Angyi Dockyard and Setsan Dockyard for repair and maintenance of their facility and equipment. Activity of these shipyards is to repair and maintain dredger, tugboat, pilot boat, grab basket, buoy and other equipment, and to build new tugboat, pilot boat and barges. Factory of Angyi Dockyard has been completely damaged by the Cyclone-Nargis. Setsan Dockyard has problem of sedimentation of silt at the gate of the dock. And Theinbyu Dockyard has recently launched a fire-fighting tugboat. These shipyard facilities are shown in Table 3.4-1 ,3.4-2 and 3.4.-3.

Table 3.4-1 Theinbyu Dockyard

Slipway No.	Slipway Carriage Size (ft.)			Tonnage	Docking Capacity		
					Measurement of Vessel (ft.)		
	Length	Breadth	Draught		Length	Breadth	Draught
1	80.03	19.68	3.94	150.0	120.0	30.0	3.94
2	40.12	9.84	3.28	10.0	50.0	12.0	3.28
3	40.12	9.84	3.28	10.0	50.0	12.0	3.28
4	119.70	26.24	4.92	150.0	180.0	38.0	4.92
5	45.92	12.14	3.28	25.0	50.0	14.0	3.28
6	96.10	26.90	4.92	150.0	90.0	25.0	4.92

Source: MPA

Table 3.4-2 Angyi Dockyard

Slipway No.	Slipway Carriage Size(ft.)			Tonnage	Docking Capacity		
					Measurement of Vessel(ft.)		
	Length	Breadth	Draught		Length	Breadth	Draught
1	55.11	13.12	3.28	30.0	20.0	15.0	3.28
2	55.11	13.12	3.28	30.0	20.0	15.0	3.28
3	100.00	18.04	3.28	100.0	100.0	30.0	3.28
4	100.00	19.68	4.92	150.0	180.0	32.0	4.92

Source: MPA

Table 3.4-3 Setsan Dockyard

Slipway No.	Slipway Carriage Size(ft.)			Tonnage	Docking Capacity		
					Measurement of Vessel(ft.)		
	Length	Breadth	Draught		Length	Breadth	Draught
1	243.0	58.0	16.5	225.0	46.0	13.0	1,400.0

Source: MPA

3.4.2. Tugboat

(1) Current status of Tugboat

1) Owned Tugboat

Calling ship to the Yangon Port in Thilawa Area has to operate in the strong current and shallow depth Yangon River for 32 miles from the entrance of river. Since the navigation channel varies by the influence of mud and sand flow, Pilotage shall be compulsory for calling ship sized more than 200 gross tonnage. Assistance by tugboats is also indispensable for safety navigation in Yangon River. Tugboats owned by MPA are shown in Table 3.4-4.

Table 3.4-4 List of MPA Tugboat

No.	Ship Name	Dimensions			Country of built	Year of built	Main Engine (PS)	Speed (Knot)
		Length (m)	Breadth (m)	Depth (m)				
1	Hai Gyi	20.00	7.00	3.50	JAPAN	1998	1,280	10
2	Nat Thar 1	29.00	8.60	4.30	MYANMAR	-	500x2	9.5
3	Nat Thar 2	25.00	8.00	3.00	MYANMAR	-	750x2	
4	KonBaung1	20.11	5.64	1.98	JAPAN	1964	480	6
5	TayZa	22.83	6.10	1.98	HONGKONG	1956	400	6
6	HayMa	22.83	6.10	1.98	HONGKONG	1956	500	6
7	WaiLa	22.83	6.10	1.98	MYANMAR	1986	480	6
8	Mhan Aung	55.00	13.70	5.30	-		1,500x2	-
9*	（NatMin）	26.00	7.50	3.20	MYANMAR	2012	1,000	12

9*:“MatMin”is under construction as of October 1st, 2012

Source: MPA

Conditions of MPA tugboats are summarized as follows;

- Sharp stem form does not operate stable pushing due to small contact area of fender and causes damage to ship’s shell plate.
- As towing winch is not equipped, changing operation mode of push-pull operation is difficult.
- As towing winch is not equipped, escort operation for course keeping by towline from towing winch is difficult.
- Due to manual lashing of towline to bitt, quick release of towline in emergency situations is difficult.
- Small tugboat is too old for tug operation for large sized ship.

Tugboat owned by MPA is small powered and aging. Modernization of tugboat is necessary to provide the safety and efficient maneuvering assistance to the large calling ship.

2) Assistance for Berthing

As shown in the Figure 3.4-1 below, the ship during berthing operation at Yangon Port keeps distance of approximately 90m from the terminal, drops the starboard anchor, turns hull by anchor and tugboat, and berth at port side of ship during rising tide. In case of falling tide, calling ship drops port anchor and berth at port side.

The maximum draft of calling ship is 8.5m during dry season and 9.0m during rainy season for ship length more than 167m. Ships with draft 7.2m and length over 150m are not allowed for turning operation. Tugboat assistance is not mandatory, and its assistance may depend on the calling ship's condition.

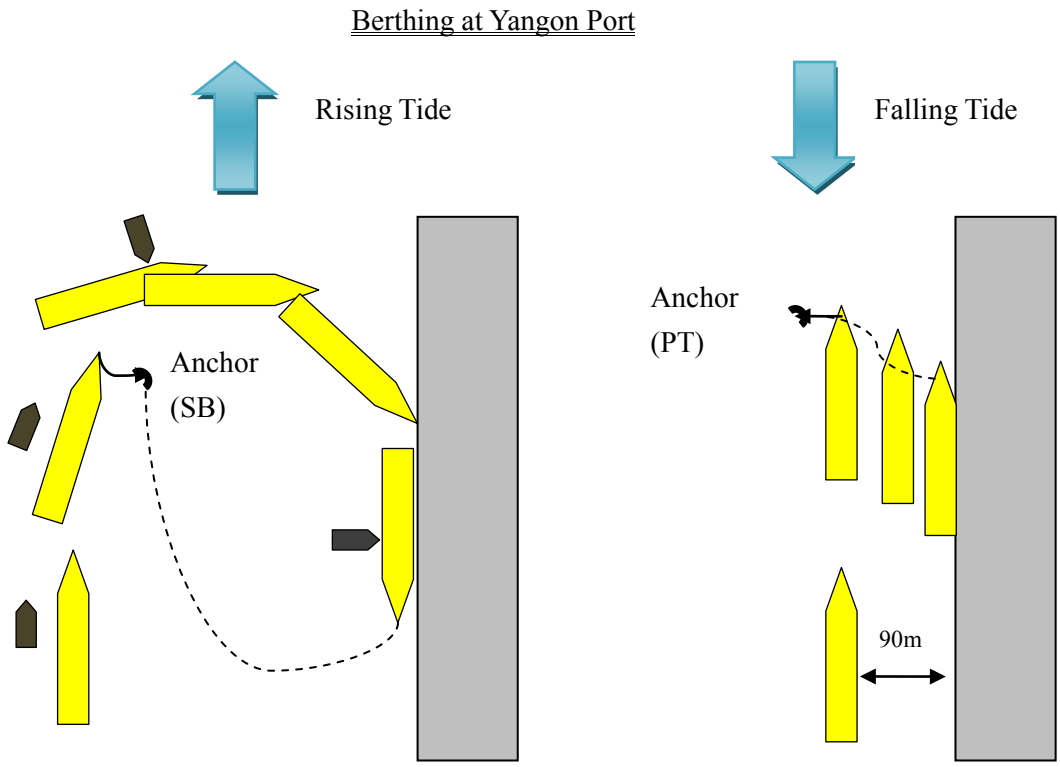


Figure 3.4-1 Berthing Operation at Yangon Port

Currently one (1) tugboat is deployed at Yangon Port in Thilawa Area, and the maneuvering assistance operations of the tugboat is berthing, un-berthing, and towing and pushing when turning the calling ship in the Port.

Large calling ship enter the narrow channel of Yangon River with a pilot from Pilot Station located in outer bar. Escort operation by tugboats has not been done during approaching operation of the calling ship.

3.4.3. Pilot Boat

(1) Current Status of Pilot Boat

Pilotage is compulsory for calling ships over 200 gross tonnages when entering the Yangon Port.

Pilot shall board the calling ship from pilot boat at the meeting point located 1.5 miles away from floating pilot station in the outer bar of the Yangon River. Two (2) large pilot ships are used as a floating pilot station in the outer bar. Large pilot ship "AKARI" stores four (4) pilot boats on board and other pilot ship "MAY KHALAR" stores two (2) pilot boats on board. Each pilot boat sends a pilot to the calling ship at the meeting point.

Figure 3.4-2 Pilot Station and Channel

Figure 3.4-3 Large Pilot Ship "MAY KHALAR"

Pilot boat of 26 feet in length, 8 feet in breadth and 65PS of main engine is too small to operate in the open sea at the rough weather conditions. From the view point of safety operation in the rough sea, large sized pilot boat shall be deployed.

3.4.4. Dredger

(1) Current Status of Dredger

Yangon port is a river port facing the Yangon River. Calling ship to the Yangon Port has to operate upstream in the strong current and shallow depth Yangon River for 32 miles from the entrance of the river. Furthermore, the navigation channel varies by the influence of mud and sand flow. Accordingly, main duty of the dredger is to maintain the constant depth of the channel for calling ship by removing sedimentary soil periodically by dredging.

(2) Location and Frequency of Dredging

Table 3.4-5 Dredging Guideline of MPA

No.	Location	Target Depth (Ft)	Frequency	Dredger Type
1	Monkey Point Channel	13.5	Everyday (Dry Season: Day and Night)	Trailing Suction Hopper Dredger
2	Yangon Port (Foreshore area)	5 – 12	Occasionally	Grab & Hopper Barge
3	Yangon Port in Thilawa Area	>30	Occasionally	Grab & Hopper Barge
4	Middle Bank Channel	Nil	-	-
5	Western Channel (Elephant Point)	Nil	-	-
6	Outer Bar	Nil (>15)	Occasionally (1～2 year interval)	-

Source：MPA

(3) Dredgers Owned by MPA

Table 3.4-6 Trailing Suction Hopper Dredger Owned by MPA

No.	Name	Type	Dimensions			Built Country and Year	Gross Tonnage	Main Engine (PS)	Speed (knots)
			Length (m)	Breadth (m)	Draft (m)				
1	Yadana Theinkha	Dredger	68.33	14.00	4.58	Japan 1998	1,669	3,000	10
2	Thiha-Dipa	Dredger	68.33	14.00	4.58	Japan 1998	1,669	3,000	10
3	Areindamar	Dredger	65.75	14.22	4.58	Germany 1989	1,532	1,475x2	10
4	Ramanya	Dredger	65.32	14.00	4.58	Germany 1989	1,532	1,085x2	10

Source: MPA

Table 3.4-7 Grab Suction Dredger

No.	Name	Dimensions			Country of Built	Main Engine (PS)	Speed (knots)
		Length (m)	Breadth (m)	Draft (m)			
1	Dredger 5	22.7	8.26	0.75	JAPAN	170	-
2	Dredger 8	22.7	8.26	0.75	JAPAN	170	-
3	Dredger 9	22.7	8.26	0.75	JAPAN	170	-
4	Barge 9 *	36.58	7.92	2.44	B&W	150	4.5
5	Barge 13	37.6	7.50	2.00	NORWAY	300	7.0
6	Barge 16	37.6	7.50	2.00	NORWAY	300	7.0
7	Barge 17	37.6	7.50	2.00	NORWAY	300	7.0
8	Barge 18 *	37.6	7.50	2.00	NORWAY	300	7.0
9	Barge 19	37.6	7.50	2.00	NORWAY	300	7.0

Remarks: Barge 9* and Barge 18* were wrecked by Cyclon Nargis

Source: MPA

(4) Dredging at Inner Bar

Dredging navigation channel at Inner Bar by dredger (Trailing Suction Hopper Dredger) is done in accordance with the result of weekly hydrographic survey implemented by MPA. Navigation channel is divided into five (5) lines of depth of 5.6m and with length of 1.6 miles, and the dredging is conducted by each line from the east side to the west side. It takes thirty (30) minutes for dredging one (1) line with 2-3 knots speed; the hopper will be fully loaded with water and mud. After dredging one (1) line, dredger moves to the dumping area with 11-12m water depth, located 1 mile away from the inner bar. As one (1) cycle of dredging and dumping for one (1) line takes approximately one (1) hour, therefore, it takes approximately five (5) hours in total to dredg five (5) lines during low tide condition.

During rainy season from June to December, one (1) unit of dredger is operating for mainly dredging mud. During dry season from January to May, two (2) or three (3) units of dredgers is operating for sand carried by rising current.

Figure 3.4-4 Dredging Area at Monkey Point, Inner Bar

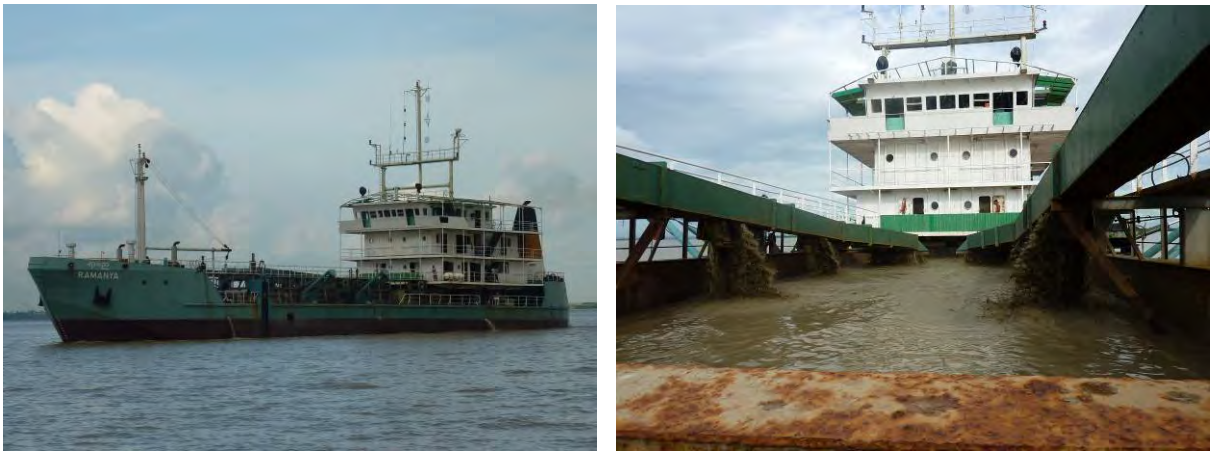


Figure 3.4-5 Dredger"RAMANYA" at Trailing

Figure 3.4-6 Mud in Hopper Bottom After Dumping (Pump RPM 1,250R/M)


Figure 3.4-7 Dredging (Sep.28, 2012) (Pump RPM 1,100R/M)

Dredger suction pump is driven by diesel engine with continuous ratio of 1,500RPM. However, at present suction pump revolution is 1,100RPM which is equivalent to 73% of continuous ratio and only 53% of continuous rated suction discharge pressure.

The result of on board survey of dredging on September 26, 2012 and October 11, 2012 shows that percentage of mud and sand content is approximately 10% at 1,100RPM of suction pump and approximately 30% at 1,250RPM of suction pump respectively. Differences of dredging performance caused by pump RPM is clearly shown in Figure 3.4-8 and Figure 3.4-9. In order to improve dredging efficiency, maintenance of suction pump, driving diesel engine and remote control system for dredging system at wheelhouse shall be necessary. Normally, dredging operation consisting of suction, waiting sedimentation of mud and sand and discharging surface water is repeated until percentage of mud and sand content becomes high to save time to move to dumping area. However, present dredging operation without waiting sedimentation of mud and sand to increase of load factor is suitable for dredging in Monkey Point since the dumping area is close to dredging area.

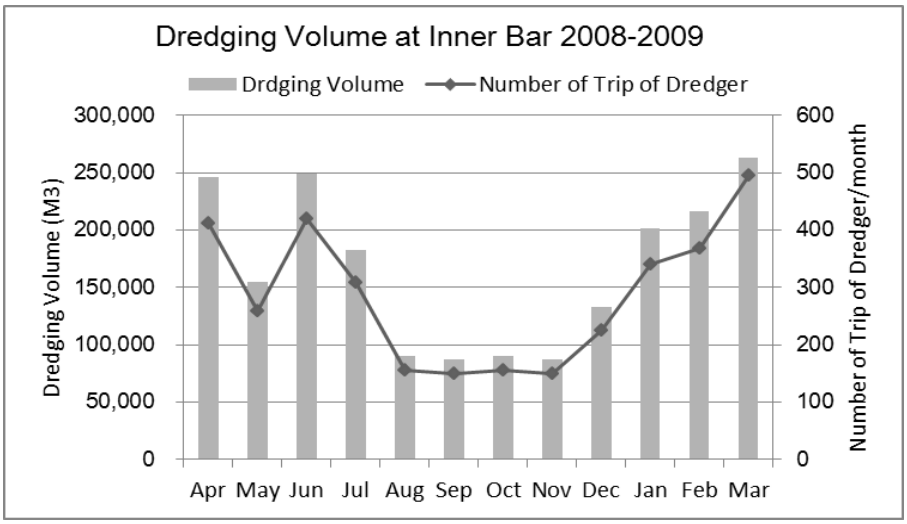
(5) Dredging Volume

Annual maintenance dredging volume of 1-2 million m^3 at Inner Bar and 0.2-0.4 million m^3 at Outer Bar have been currently obtained.

Table 3.4-8 Annual Maintenance Dredging Volume of Navigation Channel

Location	Annual Dredging Volume (Million M^3/Year)
Monkey Point (Inner Bar)	1.0～2.0
Elephant Point (Outer Bar)	0.2~0.4

Source：MPA



Source：MPA

Figure 3.4-8　Monthly Maintenance Dredging Volume

3.5. Navigation Channel

3.5.1. Environment of the water transport　(Navigation Channel in Yangon River)

(1) Environment of the anchorages and Pilot Station (Pilot Vessel) at the Outer Bar

1) Current Environment

All large vessels entering to Yangon port or Thilawa district need to make a pilot on board at the pilot station adjacent to the estuary of Yangon River before entering the river.

34 pilots are registered in MPA as of September 2012. They regularly navigate 5 departing and arriving vessels respectively in a day from the pilot station near the estuary. When the traffic is congested, they navigates 10 departing vessels and 8 to 9 arriving vessels in a day.

There is an anchored pilot vessel as a pilot station. 5 to 6 pilots are always available there and they are alternately on duty. There are two vessels applied for the pilot station. One is larger than the other and applied during the monsoon season. The other is a middle size vessel (Figure 3.5-1) and applied during the other seasons.

2) Problems

Figure 3.5-1 Pilot Vessel

- High age of the Pilot Vessel

  The currently applied pilot vessels as the pilot station are too degraded and aged for the appropriate pilot service. Alternative measures must be considered and executed as soon as possible.

- Pilot Boat

  Can be seen in Figure 3-5-1, the applied pilot boat is small and its LOA is 4m. Even small waves, just 1.5 m high, make them difficult to provide the appropriate pilot service.

- Problems during the monsoon season and rough weather condition

  During the rough weather condition, it is quite difficult to provide the pilot service due to the tough motions of the pilot vessel. As a result, it reduces the efficiency of the port operation. As an alternative of the degraded and aged pilot vessel, it is required to introduce a fixed pilot station so that the pilot service is always available.

- Communication with arriving and departing vessels

  Currently, VHF is the only communication method available for the pilot vessels and the large arriving and departing vessels. It is required to introduce a entire VTMS (Vessel Traffic Management System) that allows the pilot station to communicate with the all vessels in Yangon port, Thilawa district, and Elephant Point.

(2) Anchorage at Outer Bar

1) Current Environment

Can be seen in Figure3-5-2, there are two anchorages for large vessels at the estuary. One is for 7m or less draft vessels and its north end is near Lanthaya Fairway B'y and its south end is 6 miles from there. The other is for 8m or less draft vessels and 6 miles south form the south end of the former, near Dagon Light. Vessels are anchored in the one of the anchorages corresponding to their draft during waiting for berth. There is no anchorage for large vessels over 8m draft. These large vessels are adjusting the arrival time of the Pilot Station at safe deeper water area.

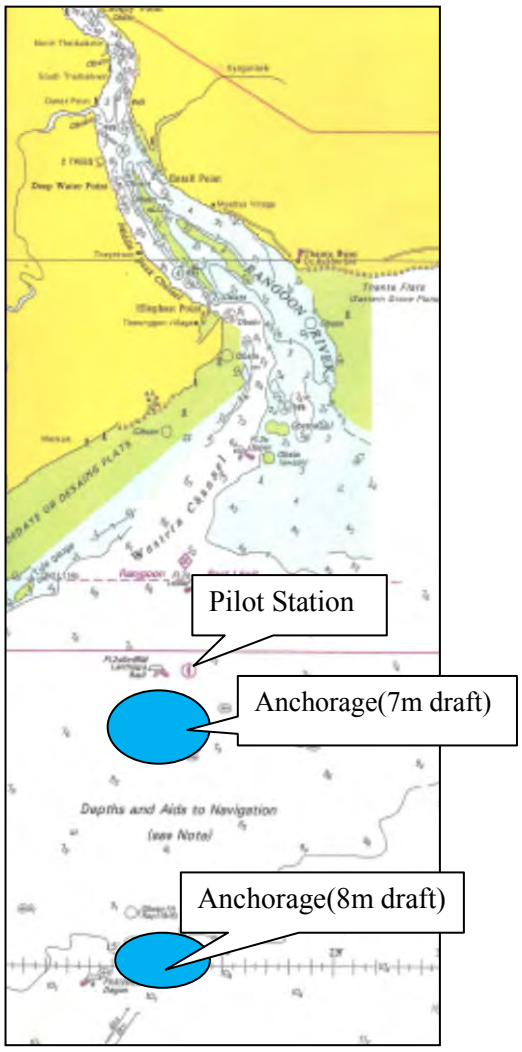


Figure 3.5-2 Anchorage at Outer Bar and Pilot Station

2) Problems

- Environments of the anchoring vessels
- It is incapable for the pilot station to capture the names of the anchored vessels, their locations, and the degree of congestion at Outer Bar without the harbor radar or VTMS. It is expected that the congestion in the anchorages due to the vessels waiting for berth will increase as the cargo volume increases in future. Introducing VTMS should be indispensable as a safety measure.

(3) Water traffic congestion

1) Current Navigation Channel

The distance from the pilot station at Outer Bar to Thilawa district and Yangon port along the passage route of Yangon river is approximately 30miles and 40 miles respectively. There have not

been done any field surveys regarding the congestion of vessels along the passage route. Even VTS has not been introduced yet. As a result, there are no available quantitative data regarding the traffic of vessels in MPA or DMA.

Maximum draft of vessels is restricted to 9m or less due to the shallow water depth of the Yangon port. The shallow depth allows the large vessels to access to the port only during the high tide which is twice a day. As a result, all large vessels congest the passage route during the time. The passage route is restricted to one way at Monkey Point Channel, where the passage route bends sharply and furthermore the width of the passage is minimum and 100m.

Table 3.5-1 Distance & the travel time from Yangon Port to Outer Bar Pilot Station

Point	Distance (N.mile)	Time	@Speed(Knots)
Yangon Port (No.9 Mooring B'y)			
	9.3	1h12m	7.8
Thilawa (LC B'y)			
	30.5	3h10m	9.6
Pilot Station (Outer Bar)			
Total	39.8	4h22m	9.1

Note) Travel Time is based on the On Board Survey 2009 JICA Study team

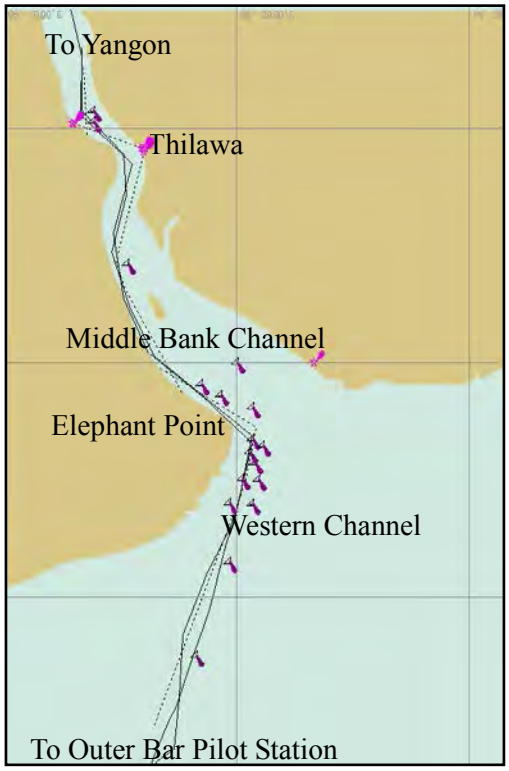


Figure 3.5-3 Current Navigation Channel for large vessels

2) Problems

There are two possible methods to capture the traffic volume and the vessels congestion. Field survey applying a radar to the target area is a typical method. Application of AIS and harbor radar,

which is a part of VTMS functions, for collecting and analyzing data is the other method. In Yangon port and the passage route, neither of the methods has not been done yet. Due to the further developments such as SEZ, it is expected that the traffic volume of vessels will increase drastically. It should be considered to introduce either of a AIS base on land or a VTMS as soon as possible.

(4) Casualty

1) Current Environment

Addition to the strong tidal current and narrow passage width, the lack of aids to navigations and the absence of navigation control system cause the high risk for safety navigation in Yangon port and Yangon river. In spite of the effort paid by the relating authorities such as DMA and MPA, casualties such as vessel collisions and stranding, frequently occur.

As an example of the casualties in the Yangon river passage route, on August 2009, the collision between a Chinese fishing vessel and a Korean merchant vessel resulted in the serious accident in which 14 crews were dead.

Other serious casualties occurring in the last three years, from 2009 to 2011, are listed as follows.

Table 3.5-2 Casualties in the last three years

Date & Year	Time	Incidents	Latitude	Longitude
15th Feb.2009	5:00	MV.Bago and MPA1 Collision	16-35.2'N	96-15.3'E
13th Mar.2009	12:30	MV.Clipper Stamford and Tug Sintha Dastun9 Collision	16-13.127N	96-19.4'E
24th Aug.2009	3:50	MV.Young Brother2 and MV.Iner Prime Collision	16-35.6'N	96-14.9'E
20th May 2011	18:40	MV Intan T2801 Chief Officer Manoverboard	16-14.67'N	96-35.8'E
16th Dec.2011	6:56	MVKota Rukun and RoRo IV Collision	16-45.9'N	96-09.4'E

2) Problems

The causes of the casualties listed above have not been officially disclosed yet, however, it is apparent that the deficiency of the hardware and software for the safety navigation control, such as VTMS and the safety navigation facilities, in the Yangon river passage where navigating vessels is difficult due to the strong tidal current and the narrow passage width is a critical cause of the casualties.

3.5.2. Assisting Facilities and Equipment for the Safety Navigation

(1) Current environment

The following Table 3.5-3, based on the previous survey in 2009, shows the currently available and major aids to navigations and facilities along the area from Yangon port to Outer Bar. Leading Light at Monkey point passage has already been repaired with the assistance of JICA, however, the

other facilities and equipments have not been updated or replaced yet and are still being applied to the service. It is a remaining and potential problem for the navigation safety.

In addition, due to the delay of introducing the Automatic Identify System (AIS) and Global Maritime Distress and Safety System(GMDSS) shore stations, MPA could not manage vessel traffic control properly and rescue the distressed vessels. It is required to construct AIS and GMDSS shore stations and introduce these systems as soon as possible.

(2) Problems

It is expected that the number of the calling vessels will increase as the number of berths for large vessels and cargo vessels increases in Yangon port and Thilawa district, however, it won't be considered as a safe port unless the obsolete facilities and equipments currently applied for the safety navigation assistance are updated or replaced. If they are not, the shipping companies as users might hesitate to send their vessels to the port and district.

For assuring the safety navigation, the facilities and equipments assisting navigation therefore should be prioritized and prepared based on the planed steps. In the interview to MPA, it is found that MPA strongly desires the following three items.

Planning and management of the Communication facilities between vessels and shore is handled by Department of Marine Administration (DMA) of Ministry of Transport and currently project for improvement of these facilities has been in progress as an another project by DMA and JICA.

- First Priority: Constructing a fixed pilot station instead of the pilot vessels

  Reason: Current pilot service is influenced by the tough motion of the pilot vessel resulted from the rough weather condition during the monsoon season.

- Second Priority: Preparing tugboats

  Reason: It requires two or more tugboats with 3000 or more HP to assist the maneuver of vessels calling at Thilawa.

- Third Priority: Preparing facilities assisting in safety navigations such as aids to navigations and VTMS

  Reason: Although MPA is a port control authority, they have not founded the safety navigation control system yet.

Table 3.5-3 Rating list of the navigation assisting facilities and equipments (2009)

No.	Location	Navigation Facilities/Aids/Software	Nos./Name /Data	Rating	Remark
1	Inner Harbour	Jetty for MPA	13 Jetties	3	
2		Jetty for Small Vessels	53 Jetties	2	IWT hires 7Jetties 4 damaged
3		Mooring Buoy for MPA	4 Buoys	3	
4		Mooring Buoy for IWT	7 Buoys	2	IWT needs 10 B'ys
5		Manuevering Area for MPA		3	
6		Manuevering Area for IWT		3	
7		Anchorage		3	
8		RTA Anchorage	1	3	
9		CCA Anchorage	1	3	
10		Dredger	4	3	
11		Tug boat	6	2	200HP-1100HP
12		Pilot boat		2	
13		Communication (VHF) (Port Tower)	1	2	
14		Pilotage Criteria (Cyclone/Emergency	Nil	1	
15		Guidelines for Maneuvering	Nil	1	
16		Pilot Training		2	
17		Tugmaster Training	Nil	1	
18		Shiphandling simulator	Nil	1	
19	Monkey Point Channel	Channel Depth	13.5feet	3	
20		Channel Width	100m	2	
21		Dredging	everyday	3	
22		Signal Station	1	3	
23		Leading Light	4	1	damaged
24		Navigation Buoy	UMP	2	
25			LMP	2	
26	Cross Sands Shoal	Navigation Buoy	Kyartia	2	
27	and Channel		LH	2	
28			ULS	2	
29			LS	2	
30	Chokey Shoal		UC	2	
31			MC	2	
32			LC	2	
33		Leading Light WT Front,Pivot,ST Fron	3	1	damaged
34	D'Silva Shoal	Navigation Buoy	D'Silva	2	
35		Leading Light D'Silva Front/Back	2	1	damaged
36	Hmawun Lumps	Navigation Buoy	Khing Kyaw San	2	
37			Hmawun Lump	2	
38		Leading Light Hmawun Front/Back	2	1	damaged
39	Middle Bank Channel	Navigation Buoy	UMB	2	
40			CMB	2	
41			LMB	2	
42		Leading Post Back South Post	1	1	damaged
43	Westeern Channel	Elephant Point Tower	1	1	damaged
44		Navigation Buoy	UW	2	
45			CW	2	
46			UP	2	
47			LW	2	
48			CS	2	
49			LS	2	
50			ALW	2	
51			Intermediate	2	
52	Outer Bar	Navigation Buoy	Upper Float	2	
53			Lower Float	2	
54		Pilot Vessel	1	2	
55		Dagon Light Ship	1	1	damaged

Source: JICA Study team survey in 2009

3.5.3. Restriction on the Calling Vessels

MPA restricts on the vessels calling at Yangon port and Thilawa district due to the narrow width and the shallow water depth of the Yangon river passage. The length of the vessels calling to Yangon port is restricted to 167m because of the most critical part of the passage "Monkey point", where the passage sharply bends and the width of the passage is only 100m. Furthermore, this critical point restricts the pilot service time to only day time.

The vessels calling at Thilawa district are less restricted than the vessels calling at Yangon port because they don't go through Monkey Point and the only narrow passage they have to navigate is Western Channel.

Table 3.5-4 Restrictions for calling vessels

Item	Season	Yangon	Thilawa
Maximum Ship's Size (DWT)		15,000	20,000
Length over all (LOA)		167m or less	200m or less
Maximum Draft (m)	Rain	9.0	9.0
	Dry	8.5	9.0
Pilot Service Time		Daytime (high tide)	All day (high tide)

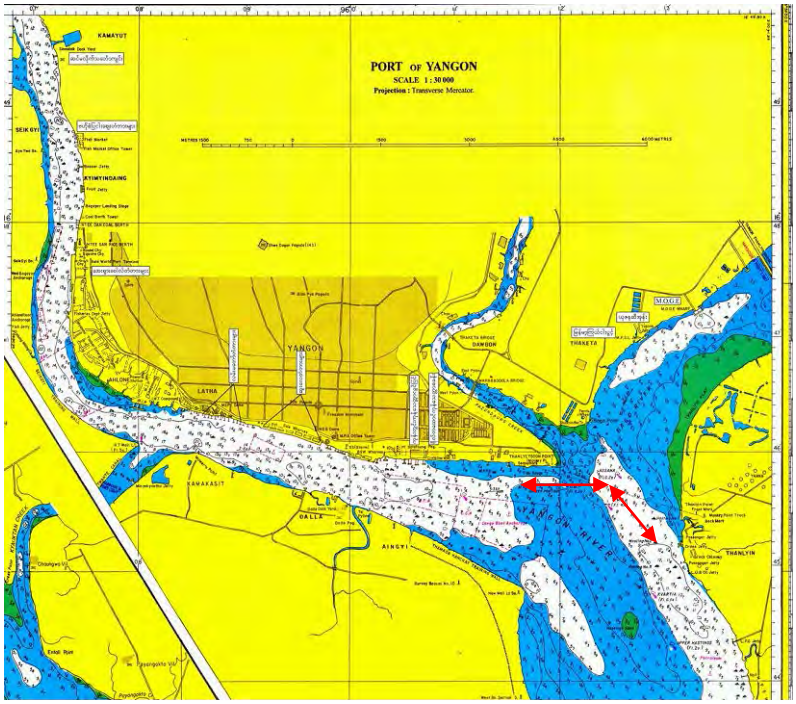


Figure 3.5-4 Monkey Point Channel

3.5.4. Channel Maintenance Present Condition

(1) Current Conditions of Navigation Channel

Yangon Port locates 32km from the mouth of Yangon River. Yangon Port in Thilawa Area

locates 16km from the Yangon river mouth. Figure 3.5-5 shows the location of Yangon Port and its navigational channel. Yangon Port navigational channel maintains the minimum water depth of 6m at low tide by annual maintenance dredging at Monkey Point known as Inner Bar and Elephant Point at the mouth of the Yangon River known as Outer Bar. Channel width of 100m is maintained at the Monkey Point. Channel width of 500m was maintained at the rest of the channel.

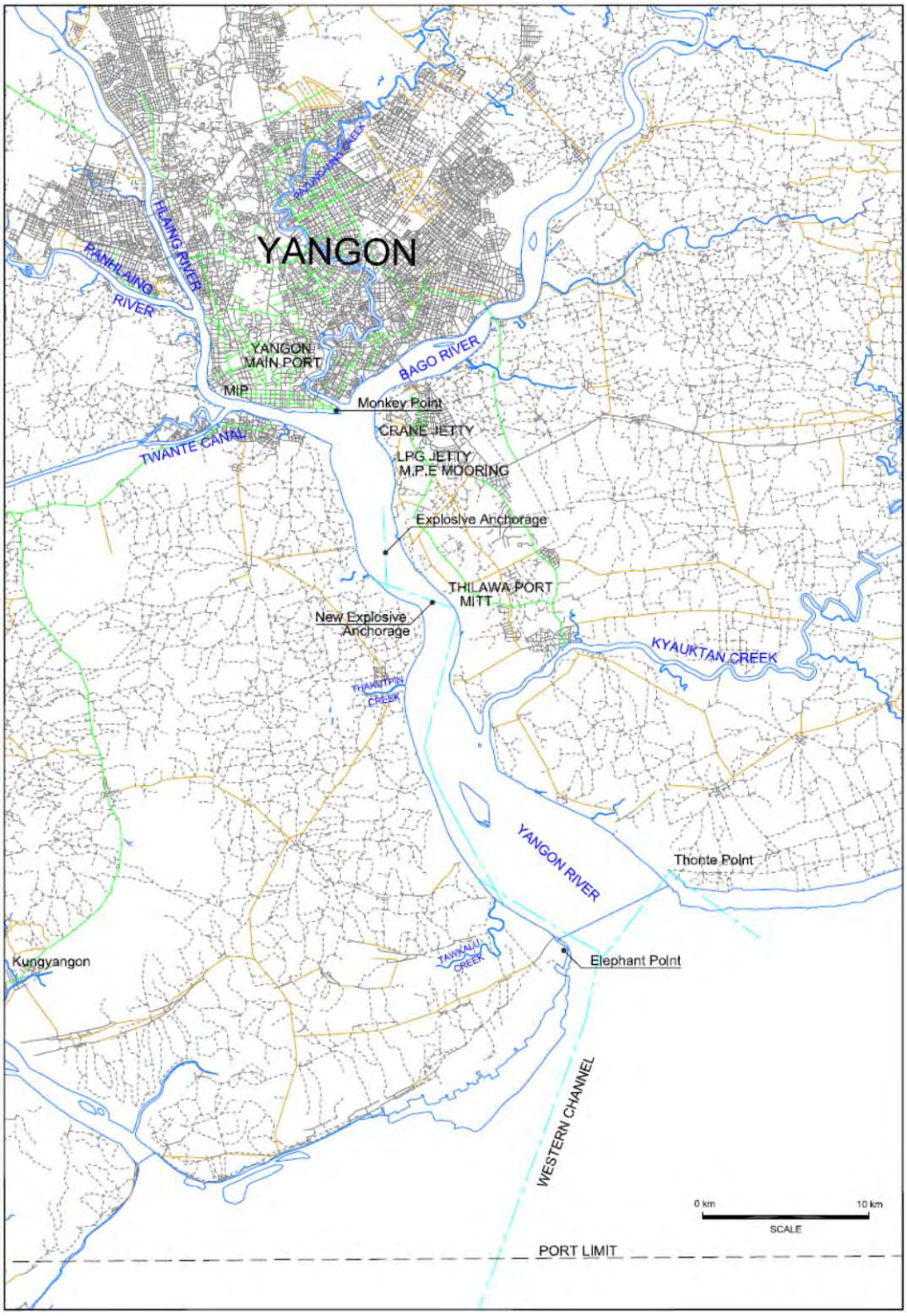


Figure 3.5-5 Yangon Port and Navigation Channel

Because the water depth at the mouth of Yangon River was about -6m, tide channel were used for large ships to enter the Yangon Port. As was shown above, year around maintenance dredging has been done at the Monkey Point and Elephant Point in order to maintain the water depth of -6m at the low tide and channel width of 100m. Due to this reason, it takes 2 high conditions, in other words 24 hours, for large ships to enter Yangon Port and 1 high tide condition for large ships to enter Yangon Port in Thilawa Area.

According to the future plan of Yangon Port Area by MPA, expansion of existing berth for container cargoes were planned and the necessities of improvement of rapid carvature and enlargement of small width of Monkey Point channel are considered to be inevitable in accordance with the increase of ship calls. Because the continuous execution of annual maintenance dredging volume of 1 to 2 million m3 at Monkey Point seems not to be sustainable from the viewpoint of ensuring the dumping site and reducing adverse impact on environment, consideration of permanent countermeasure facilities such as employment of training dike to reduce the amount of channel sedimentation might also be necessary. In order to propose the efficient countermeasures , understanding of the sand bar formation mechanism at Monkey Point and verification of its efficiency by field and laboratory experimental study and numerical simulation study are inevitable. For the understanding of the sand bar formation mechanism, understanding of the bottom sediment properties and river bed topographical change by periodical bathymetric survey, measurement of current profile and SS distributions are necessary. Tidal flow is considered to be the major forces for sediment transportation and consecutive one month measurement of river flow at both rainy and dry season are also necessary.

Necessary Survey Items for Understanding the Sand Bar Formation Mechanism

Measurement Item	Specification of Measurement	Remarks
Bathymetric Survey		2 times/year before and after monsoon season
Current and SS	5 points	One month consecutive measurement at both rainy and dry season
Bottom Sediment Sampling Survey	Sampling by 200m x 200m grid location	

The issues about the navigational channel safety assisting facilities and equipments are mentioned in the previous section.

(2) Navigation Channel Plan

MPA has not officially specified any passage routes toward Yangon port or Thiwala district yet because the river passage occasionally changes the water depth and it makes MPA difficult to specify the fixed passage route. The large vessels are accessible to Thiwala district if the passage is dredged and the restriction to the vessel size is relaxed. This survey examines its economical effect and therefore considered a passage plan for the two - lane passage route with the necessary conditions

shown in the following table.

1) Conditions

Table 3.5-5 Setting conditions for the examined navigation channel

Items	Conditions	Reasons
Start and End	Pilot Station at estuary to Thilawa district	Target area in this survey
Traffic	Two way traffic passage	Present condition
Dredging	Dredging area is minimized	Present condition
Depth	Accessible for the 9m draft vessels during the high tide	Present condition
Width	Enough width for encountering other vessels	International standard
Facilities	Preparing tugboats, VTS, and Fixed Pilot Station	Improved safety & efficiency

(Prepared by the Study Team)

2) Considering Navigation Channel

The examined navigation channel is based on the currently applied passage and assumed to be accessible for the 9m draft vessels during the high tide. The channel is in a river and expected to get shallower soon after dredging. The restrictions for the vessels calling at the Thilawa direct in this examination is consequently kept in the same condition as the currently applied channel.

The channel width follows the standard of IAPH (International Association of Ports and Harbors).

Large vessels: Two Way 1.5L (L: Length of a vessel) 1.5 x 200m＝300m
Container vessels: Two Way 7.8B (B: Width of a vessel) 7.8 x32.2m＝256m
LNG vessels: Two Way 10.4B 10.4 x 32.2m＝333m

The channel width is considered 300m for the long and straight passage route. The width for the two elbows in the passage located at Western Channel and off Elephant Point is considered 405m and 390m respectively. They are respectively 35% and 30% wider than the width of the straight passage. The passage width at the way point near D'Silva Shoal is also considered 390m.

Reference Information

IAPH Approach Channels A Guide for Design

- 5.2.5 Bends

The ship 'sideslips' as it turns and so sweeps out a path which than its beam. This excess can vary from about 30%-40%, at a depth/draught ratio of 1.10, to 100%-160% in deep water of beam depending on the depth of water

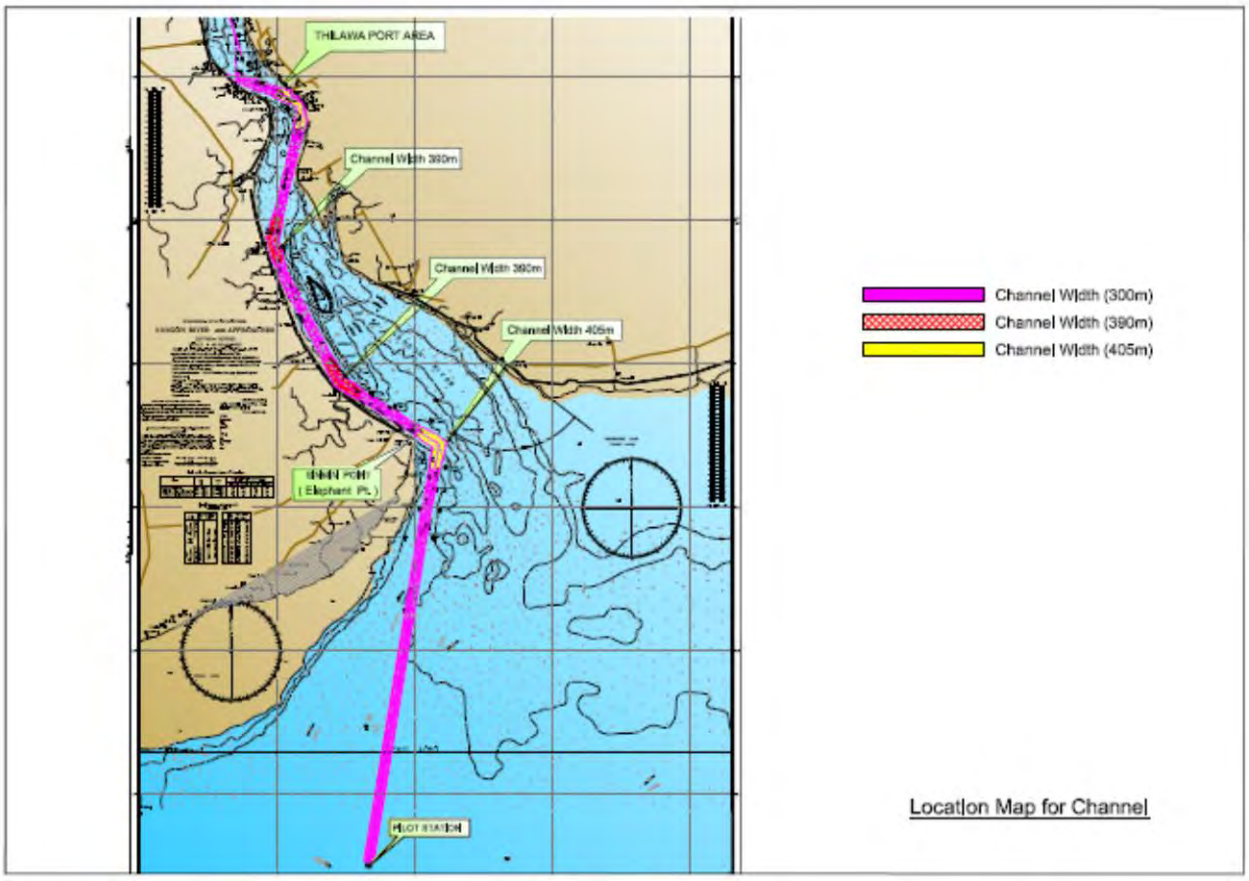
- 6.4.1 Channel Width General

The design tool which will assist in satisfying these requirements in Detailed Design is the ship

maneuvering simulation model. It is in the determination of channel width (and alignment) that it provides a powerful tool.

3) Passage from the estuary to Thilawa district

The examined navigation channel based on the condition above is shown as follows.



Prepared by the Study Team

Figure 3.5-6 Examined Navigation Channel

4) Ship Handling Simulation Study

The study team has carried out rough experiments using Ship Handling Simulator in order to check channel width at near the Elephant Point on the following conditions:

Study Conditions

Kind and size of the vessel

1,200TEU Container Vessel,
DWT 15,315, Gross Tonnage 14,278, Length overall 158.7m, Draught 9.0m

Considered Water Area

Off Elephant Point of Western Channel

Designed Channel Width

Two way traffic 150m x 2=300m (Though our plan is 405m as referred above, we applied 300m width in this rough experiments)

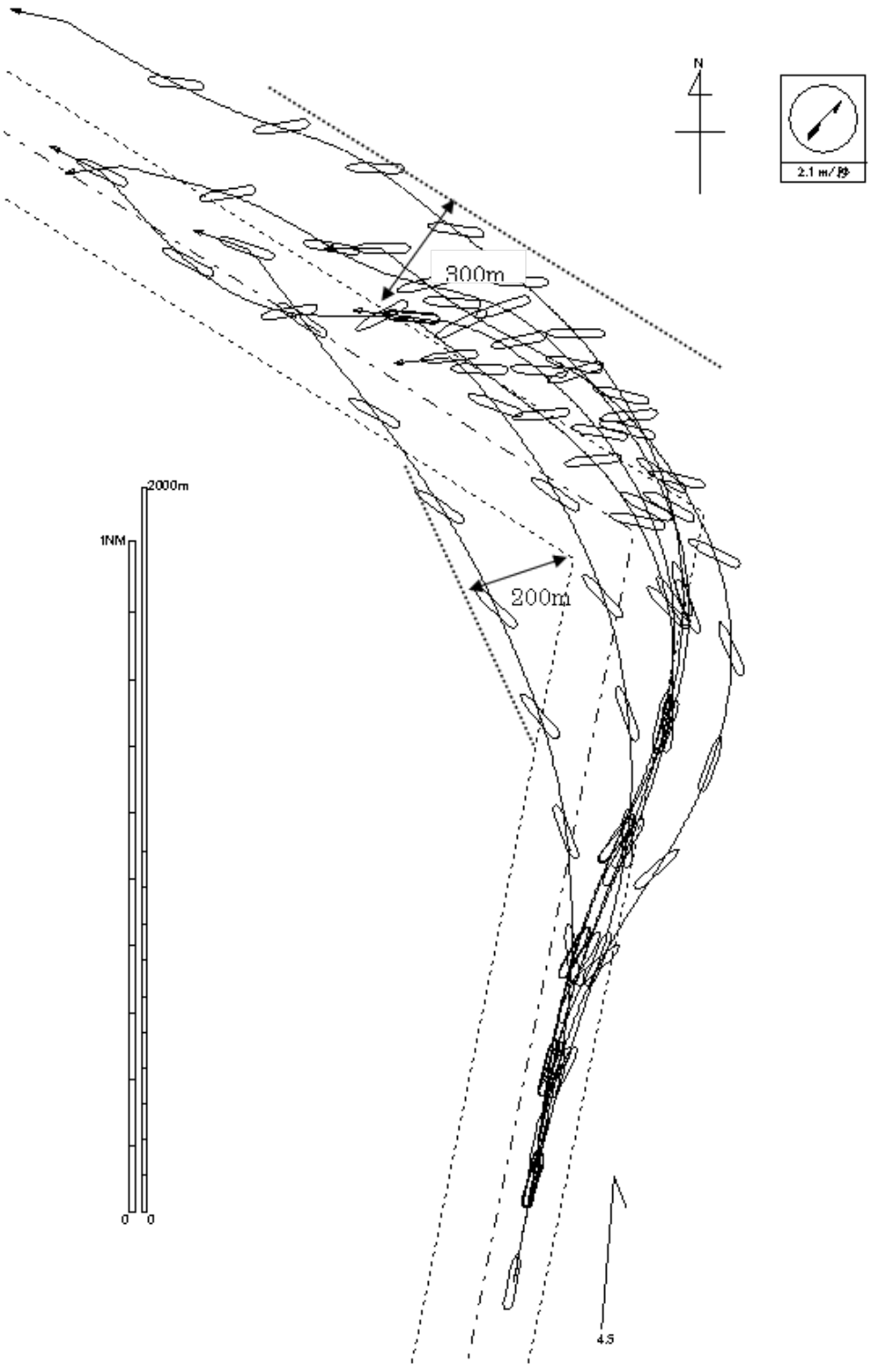
Wind and Tidal Current

Wind direction: SW Wind speed:4knots(2m/sec)

Tidal Current: Set North, NNW and NW Speed: 4.5knots

Shiphandler

Captain of Oceangoing Vessel



Prepared by the Study Team

Figure 3.5-7 Trajectory of Navigation Maneuver (6 cases)

Evaluation:Figure 3.5-7 shows 6 cases of a container vessel's tracks predicted by a ship maneuvering simulator on condition that the flood tide speed is 4.5 knot. Can be seen in the figure, it

is obvious that maneuvering a container vessel within the navigation channel, two-way and 300m width(one-way and 150m width), on the flood tide is quite difficult. As long as the maximum draft is restricted within 9.0m, almost 1000m width of navigation channel will be available for large vessels and they will be able to safely navigate on the channel. If the vessels with the draft deeper than 9.0m is allowed to navigate on the channel in future, however, the additional 300m or 200m dragging will be required on the right or left side of the planned 300m width channel respectively. The ship maneuvering examination such above should be executed by the MPA pilots when the maximum draft is revised to more than 9.0m in future.

(3) Channel Maintenance Dredging

No significant issues for the maintenance of the current conditions of navigation channel were reported by MPA except for the renewal of aging dredgers which were currently used for the maintenance dredging at Inner Bar and Outer Bar. Natural water depth of Yangon River channel except for the above mentioned two bar location are deep enough for the navigational channel and necessity of maintenance dredging is low. According to the MPA, annual maintenance dredging volume of 1 million to 2 million m3 at Inner Bar and 0.2 million to 0.4 million m3 at Outer Bar have been done as were shown in Table 3.5-6.

Table 3.5-6 Annual Maintenance Dredging Volume of Navigation Channel

Location	Annual Dredging Volume (Million m^3 /year)
Monkey Pt. (Inner Bar)	1.0～2.0
Elephant Pt.(Outer Bar)	0.2～0.4

MPA owned 4 Trailing Suction Hopper Dredger (TSHD) and 9 Grab Dredger for maintenance dredging of navigational channel and dredging of harbor area. TSHD owned by MPA were used for the above mentioned maintenance dredging at Monkey Point and Elephant Point. According to MPA, sea bottom sediment at Outer Bar was sand and MPA owned TSHD and/or equivalent dredger could be applied for future maintenance dredging for maintaining current water depth. Although no significant adverse effect has been so far seen for maintaining current water depth and channel width, annual maintenance dredging volume of 1 to 2 million m3 are quite large and future assessment of environmental and river bottom profile change might be necessary

In case of the deepening and widening of navigational channel, increase of maintenance dredging should have been studied, especially at the open sea part of navigation channel where the significant initial dredging were necessary and enormous amount of sedimentation due to severe wave condition should have been expected. Due to the current stable deep river bottom profile condition, little maintenance dredging work except at Inner Bar was considered to be necessary at the Yangon River portion for deepening and widening the navigational channel.

Navigation channel at the section from Outer Bar to the entrance faces directly to the outer

ocean of Gulf of Martaban and severe high wave condition during rainy season are expected to continue. In order to estimate the deposition rate of navigational channel due to wave and current, wave and current conditions with the information of periodically obtained sea bottom profile and sediment property are necessary. Currently there is no available wave and current observation data and sea bottom sediment data. In case the deepening and widening of navigation channel is considered to be necessary for the future development, detailed consideration and study of wave and current conditions at Gulf of Martaban should have been prepared. Detailed study of some countermeasures against excessive channel deposition might also be necessary in some situation. Table 3.5-7 shows the necessary survey items and its specifications.

Table 3.5-7 Survey Items and Specification for Channel Deepening and Widening

Survey Item	Specification	Remark
Bathymetric Survey (Channel)	cross section @200m along the channel	2 times/year before and after monsoon season
Bathymetric Survey (Broad Area)	@500m	Broad area survey including channel
Wave and Current (Off-shore, Elephant Point)	2 location at Elephant Point and offshore with water depth of more than 20m.	Long term measurement
Wave, Current and Turbidity	More than 2 location at Elephant Point and at other locations along the channel. Multilayer survey of current and turbidity at each location.	During the high wave conditions of monsoon season with offshore wave measurement above
Bottom Sediment Sampling Survey	Sampling by 500m x 500m grid location	Same area with Batymetric Survey (Broad Area)

For the consideration of selection of dumping site should also be considered in order for avoiding the environmental negative impact and from the view point of execution work efficiency.

3.6. Port Security

3.6.1. Background of port security

On September 11, 2001, world were shocked by the terrorist attack in the United States. A decisive blow had a very serious impact on the world economy and society. Due to this incident, international counterterrorism efforts have been required more than ever. Although port facilities are the center of the logistics and supporting the world economy, they have never been the target of terrorism directly up to now and security was not as strict as the airport. By its nature, terrorism occurs where regulations are loose or counterterrorism is not so strict. Hence, discussion on strengthening anti-terrorism on maritime field is superimposed at the IMO (International Maritime Organization) in order to prevent harmful acts in international maritime transport. The 5th conference by contracting

party convention of the international convention for the SOLAS (Safety of Life at Sea) was held at the IMO headquarters in London in December 2002. At the conference, amendment of the SOLAS Convention and the ISPS Code (International Ship and Port Security Code) was adopted to apply at the ports where more than 500 tonnage international trade ship call to mandate implementation of the PFSA (Port Facility Security Assessment), planning of the PFSP (Port Facility Security Plan) and the reporting names of complied ports to the IMO. This requires the implementation of security measures including the development of the PFSP to the international port of each country. It is assumed to have such a strong force that may be subject to have a port call control where the ship comes from insufficient security measured port. This convention was issued on 1 July 2004 and required more strengthening of ship security and international port security.

3.6.2. Port security relations of Japan and Myanmar

International terrorist organization is working across borders taking full advantage of the characteristics of modern society, such as highly developed information and communication technology and international transportation network. Therefore, it is necessary to cooperate closely in various fields by all countries of the international community.

Globally intensifying measures against international terrorism by the member states of G8, APEC and ASEAN has been declared. Japan has an important mission to strengthen counter-terrorism cooperation with the country concerned. Of particular note is that at Japan-ASEAN Transport Ministers' Meeting, marine traffic safety was one of the four key issues, together with logistics, environment and common infrastructure, that Japan would need to engage actively to ASEAN countries for supporting national counter-terrorism.

Under such circumstances, ASEAN-JAPAN Joint Communication Exercise was conducted in February 2007 and Myanmar conducted exercises at Asia World Port Terminal. And in March, ASEAN-JAPAN Port Security Experts Meeting was held in Jakarta and high official of the DMA (Department of Marine Administration) attended from Myanmar.

Moreover, officials from the DMA and MPA (Myanma Port Authority) are joining every year the port security seminar conducted by the JICA and the MLIT since 2007 for the ASEAN port security officers at the JICA training center. The seminar covers introduction of the SOLAS Convention, such as establishment of the SOLAS Convention and what is the ISPS Code, procedure for access control, type, purpose and specific method of use for monitoring systems, introduction of Japan and world's port security efforts, and implementation of exercises on port security. The contents of the seminar are very practical after participants go back to their country.

3.6.3. Port security measures

(1) Piracy

The piracies in Southeast Asia are significant at off the coast of Indonesia. Few events are associated with Myanmar. However, Myanmar has signed the ReCCAP (Regional Cooperation

Agreement on Combating Piracy and Armed Robbery against Ships in Asia), the framework to deal with piracy, as a member of ASEAN.

(2) Theft case at the pier

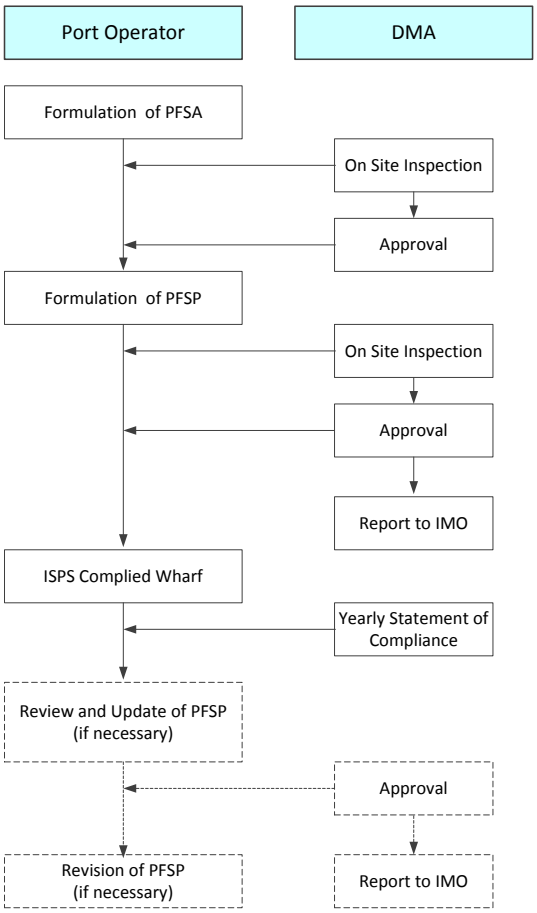
The recent tendency of the theft case at the Yangon Port is not a large scaled theft nor stealing things by trespassing in the pier, but stealing parts of imported used cars stored at the pier. Recently, used car importation have increased and number of visitor at the pier to pick up those cars have increased and accordingly many examples of part of the car taken away.

(3) Port security system and role

1) The DMA

The DMA is the DA (Designated Authority) in Myanmar. Hence they have the authority to approve the PFSP, PFSO, RSO (Recognized Security Organization) and may change security levels. For the approval of PFSP and PFSO, three inspectors will go to the site and conduct inspection. Port Security Officials shall conduct inspections on-site when approval of PFSA and PFSP. The DMA has been conducting PFSO (Port Facility Security Officer) training course 7 times since 2004 and number of trainees are more than 150. The instructors are from the IMO, USCG (United States Coast Guard), Singaporean security company and the DMA officials. There is only 1 RSO (Recognized Security Organization) for port security in Myanmar and they make the PFSA and the PFSP at the request of terminal operator.

Procedures for approval of the PFSP are shown below.



(Prepared by the Study Team)

Figure 3.6-1 Procedures for Approval of PFSP

2) MPA

The utilization of the wharf, pilotage, navigation and stevedore are controlled by MPA. However, once something happens at the cargo wharf, together with the Shipping Agency Department of MPA and the DMA shall deal with the incident. MPA has authorization to check the PFSP of the wharf at that time. And also, MPA is operating Sule Pagoda Wharf which is dealing with general cargo. The PFSA and the PFSP were formulated by foreign RSO at the beginning and as a port security, numbers of gates were reduced and monitoring by CCTV was conducted. As same as other wharves, mid-term report are sent to the DMA every year to report the condition of port security

3) Customs

Terrorism is associated with transnational crime and also is a multifaceted phenomenon. Hence international cooperation is necessary for a comprehensive approach. For this reason, it is necessary to conduct border management to prevent the terrorists and their goods and capital across borders. So, the role of customs became very important.

The amount of container cargo at ports in the world has tripled in last ten years. The risk has been closed up suddenly that the weapons of mass destruction, especially nuclear materials for

weapons are not being brought into the territory by missiles or military aircraft, but they are hidden in a container and being brought by normal legitimate way by international trade. Furthermore, there is a high-risk that these weapons of mass destruction will be exported to the dangerous countries through a third country and it became important to identify high-risk container and conduct inspection.

In such a situation, the WCO (World Customs Organization) formulated the SAFE (Security and Facilitation in a Global Environment) Framework to secure safety and smooth international trade and was adopted by the general assembly in June 2005. Core elements of the SAFE Framework are:

1) International standardization of advanced electronic cargo information requirements.

2) Employing a consistent risk management approach to address security threats.

3) Perform an outbound inspection of high-risk containers and cargo, preferably using non-intrusive detection equipment such as large-scale x ray machines and radio detectors.

4) Clarification of customs incentives for private companies that meet certain criteria.

Myanmar became a member of the WCO in 1991 and expressing intent of the implementation of the SAFE Framework.

Basically, the roles of customs agency were to collect tax and check the international flow of people and goods in order to prevent smuggling of goods such as stimulants, narcotics and weapons that could give major impact on public safety. On the other hand, the roles of amended the SOLAS Convention are to check the goods for preventing the threat of terrorism to reach the port of destination and ship. Because the possibility of terrorism by weapons of mass destruction have been become more likely, customs became involved in counter-terrorism, which has been solely responsible for the judicial police agencies.

On the other hand, the United States has taken the strategy of expanding the front-line to prevent the inflow of terrorists and weapons of mass destruction in abroad far away from the borders including airports and ports and conducting CSI (Container Security Initiative) since 2002. This initiative is to dispatch U.S. customs officials to foreign ports where containers are exported to the U.S. and cooperate with foreign customs to select high-risk containers that may be used for terrorism. It is necessary to have more than a certain amount of container cargo directly to the U.S. and have X-ray inspection system in order to be certified as a CSI port. Countries neighboring Myanmar, Singapore, Malaysia and Thailand are participating this program. In the future when the trade between Myanmar and the U.S. has started and handling more than a certain amount of container cargo, it is desirable for Myanmar to join this program. Hence it is essential to have x-ray inspection system.

Moreover all four ports handling container (AWPT, Bo Aung Kyaw Wharf, Myanmar Industrial Port, and MITT) have x-ray inspection system.

3.6.4. Current state of port security measure

(1) Target wharf for port security

As a member country of the IMO, Myanmar ratifies the SOLAS Convention and the ISPS Code and strengthening counter-terrorism measures in the marine field. There are 12 port facilities in Yangon and 5 port facilities in region reported to the IMO as the ISPS complied facilities. However, only 10 facilities in Yangon and 1 facility in region are handling international cargo in actual.

Table 3.6-1 International Ports in Myanmar

Location	Terminal Name	Description
Yangon	Asia World Port Terminal (AWPT)	Container
	Bo Aung Kyaw Wharf	Container/General Cargo
	*Htee Dan Rice Berth	General Cargo
	Myanmar Oil and Gas Enterprise Jetty	General Cargo
	Myanmar Industrial Port	Container
	Myanmar Integrated Port Ltd. (MIP)	Edible Oil
	Myanmar International Terminal Thilawa (MITT)	Container/General Cargo
	Myanmar Petrochemical Enterprise Jetty	Oil Terminal
	*Nanthitar Jetty	Passenger
	Sule Wharf	General Cargo
	Thaketa Wharf	General Cargo/Passenger
	Yuzana Edible Oils Port Facility	Refinery and Dry Fractionation Plant
Akyab	*Sittwe Main Wharf	General Cargo
Bassein	*Pathein General Cargo Wharf	General Cargo
Kan Pauk	Kadike Wharf	Oil and Gas
Mawlamyine	*Mawlamyine Jetty	General Cargo
Myeik	*Myeik Myothit Jetty	General Cargo

Source: IMO home page

Remarks: Terminals with "*" marks are registered in the IMO, but not in operational as an international port.

(2) MITT

1) General

MITT wharf is located in Thilawa at 5 to 9, handling containers, general cargo and vessels by RORO ship. The main destination is India and there are transshipment cargos to Singapore and also

have a few containers to Africa

2) Current state of port security measure

Access control for personnel, cars and cargos are conducted properly and monitoring by personnel and CCTVs also conducted properly.

Table 3.6-2 Current state of port security measure at MITT

Restricted Area	Surrounded by around 2 m height fence with spikes and barbed wires.
Security Equipment	There are 4 fixed type CCTV and 5 dome type turning CCTV with 6 monitors watching 24 hours. and capacity of image disc recorder is 3month of all camera data. All data is stored in the server.
Security System	There are 4 deputy PFSOs under PFSO. They stand by at each watch and 104 security guards in 3 shifts and conducting irregular patrol.
Access Control	At the office side gate, security guard confirms the reservation and issues vehicle gate pass and visitor gate pass.
Cargo Control	At the cargo gate, security guard confirms delivery slip and controlling in and out by bar code of entrance gate pass. Empty container is always opened and checked.
Others	The PFSP was revised in March 2010.

Figure 3.6-2 Gate Pass for visitor and vehicle

(3) Bo Aung Kyaw Wharf

1) General

Bo Aung Kyaw Wharf is located in the middle of Yangon Port, which Lann Pyi Marine Co., Ltd. has been operating since July 2010 that MPA had operated until then. Handling cargos are container and general cargo and destination is India and Malaysia and also has transshipment cargo to Singapore.

2) Current state of port security measures

Monitor control is conducted by personnel and CCTVs for 24 hours, but the procedure of access control is not sufficient.

Table 3.6-3 Current state of port security measure at Bo Aung Kyaw Wharf

Restricted Area	The restricted area is surrounded by fence
Security Equipment	Mechanical monitoring control is conducted by 4 fixed type CCTV and 3 dome type turning CCTV with 4 monitors watching 24 hours.
Security System	There are 1 exclusive PFSO and 3 officials double as PFSO and 68 security guards in 3 shifts.
Access Control	Access control is conducted at gate, but not using gate pass. Handy type metal detector and mirror to check under vehicle are utilized for access control.
Others	Prior to the operation, made PFSO by them and approved by the DMA.

(4) Sule Pagoda Wharf

1) General

This terminal is located at Yangon Port and operated by MPA. Handling cargos are general cargos such as wood, rice, cement and used cars and construction equipment. This wharf is not handling any container cargos.

2) Current state of port security measure

Consciousness of PFSO is very high and security system is the best among the surveyed wharves. PFSO has attended the training of JICA security course and the documents used were translated in Myanmar language and utilized.

Table 3.6-4 Current state of port security measure at Sule Pagoda Wharf

Restricted Area	The restricted area is surrounded by fence
Security Equipment	CCTV cameras are currently out of order, so the number of security guards has been increased.
Security System	There are 1 PFSO and 2 deputy PFSOs and 90 security guards in 3 shifts.
Access Control	Access control by category of entrance, such as port users, crews, ship stores, cargo drivers, have been established and implemented. Handy type metal detector is applied at the entrance gate. Entrance permit for car is controlled by color-coding. They are categorized into three types, such as parking only, up to the warehouse and up to the apron.
Security Level	All security guards carry ready-to-use cards with security procedures for each security level. And arrangement of security guards corresponding to each security levels has been established.
Training	Exercise is conducted every three month.
Others	Emergency procedures have been established.

Figure 3.6-3 Three Types of Car Passes

Figure 3.6-4 Security Procedure Cards

(5) AWPT and MIP

Although these two wharves are handling container cargos, entrance of wharves and hearings for port security are not approved by the operators.

3.7. Port Hinterland Development

3.7.1. Growth of Yangon Urban Area and City Planning

(1) Development Vision and Structure of the Greater Yangon

A development vision is an ideal future image of a city to be materialized through addressing problems and issues, catering to the citizens' needs, and integrating foresight of the stakeholders.

According to JICA Study "The Project for the Strategic Urban Development Plan of the Greater Yangon", future's development vision of the Greater Yangon which include Thilawa Area Port and Thilaw SEZ was set with four (4) pillars as shown in following figure.

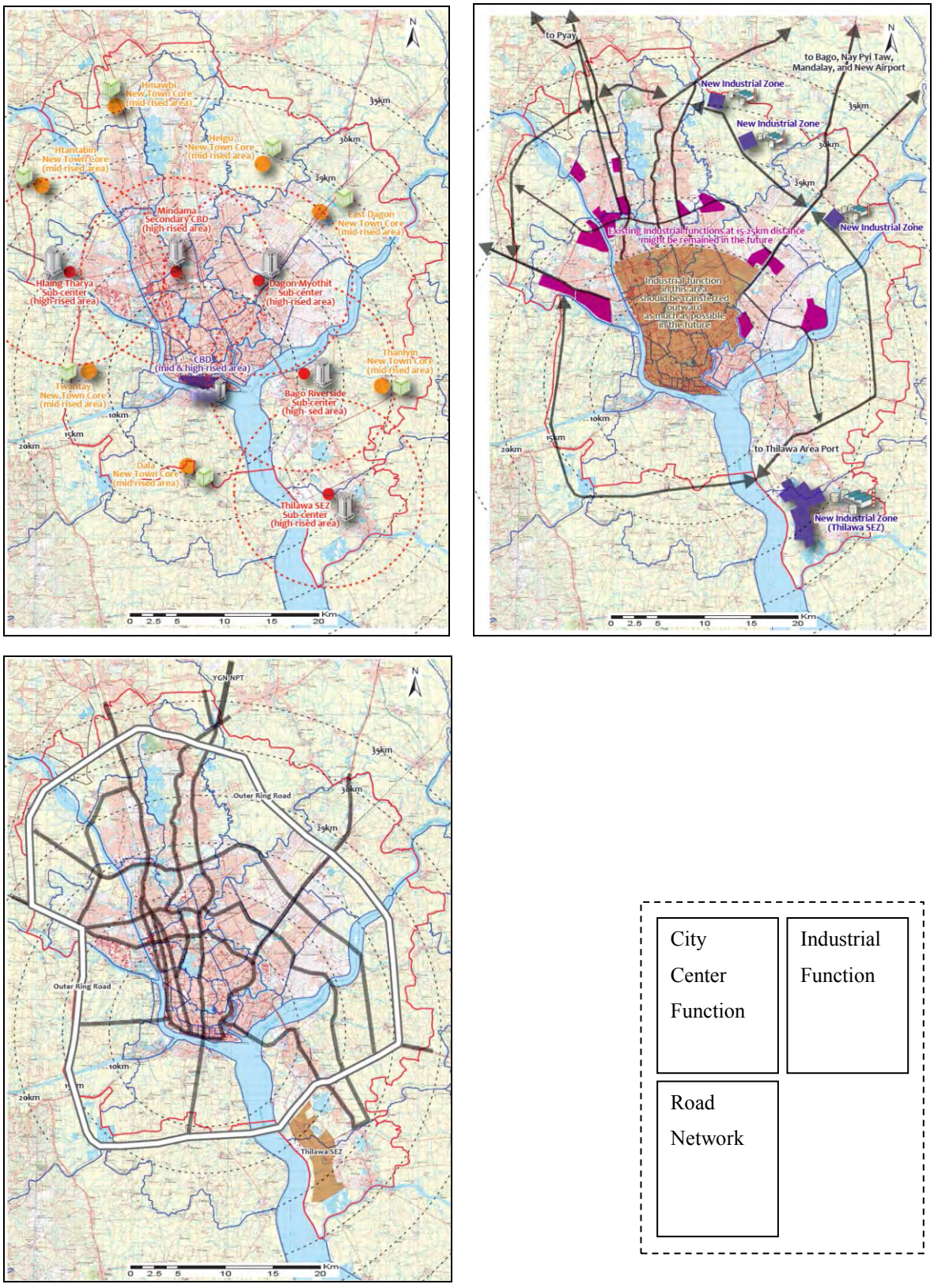
Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-1 The Development Visions of the Greater Yangon for 2040

Based on the development visions, structure plans of the future's Greater Yangon was examined as shown in the figure 3.7-2.

Considering the future logistics, it is obvious that Thilawa Area (Port and SEZ) will play more important role than at present in the Greater Yangon. Regarding city center function, not only CBD but also other new areas centers will play a role of city centers in the future to accommodate a large population. In the proposal of "The Project for the Strategic Urban Development Plan of the Greater Yangon", five (5) sub-centers including secondary CBD are proposed. One of those sub-centers, Thilawa SEZ sub-centers was recommended.

Regarding road network, the existing road network cannot handle such large magnitude of traffic demands which will be generated from more than 10 million of population. New road network is proposed, characterized by construction of an outer ring road which is a circular highway, passing Thilawa Area (Port and SEZ).

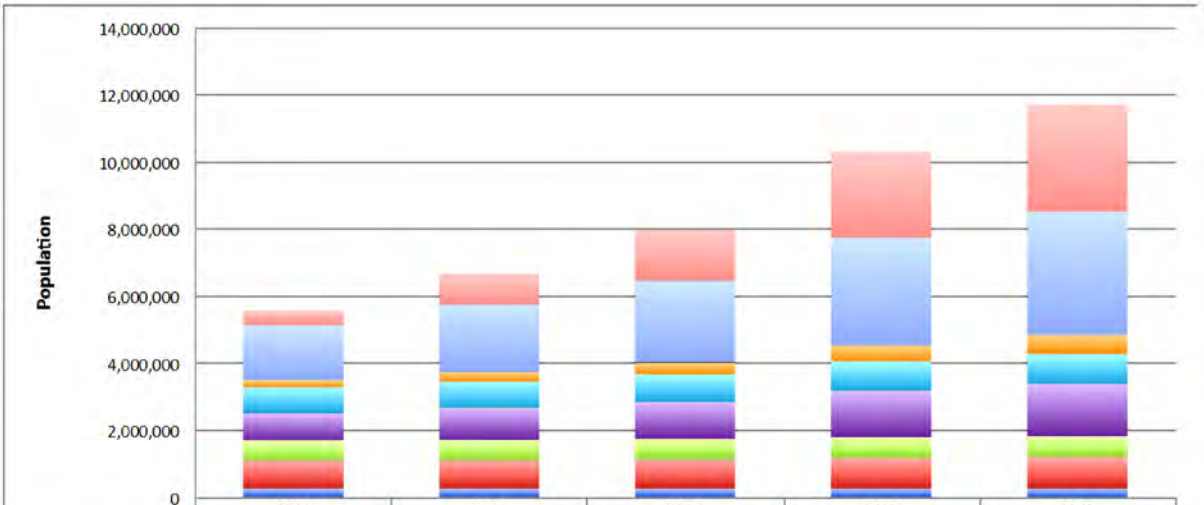


Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-2 The Structure Plans of the Greater Yangon for 2040

(2) Development Framework of the Greater Yangon

The population projection was calculated based on three scenarios in the JICA Study, "The Project for the Strategic Urban Development Plan of the Greater Yangon". Among three scenarios, the 'Middle Scenario' was selected as recommendable scenario of the Greater Yangon. The future population was estimated to be 11.73million in 2040 of which 10.82 million will be in Yangon City. Kyauktan and Thanlyin Townships are located in periphery area mentioned in following figure.

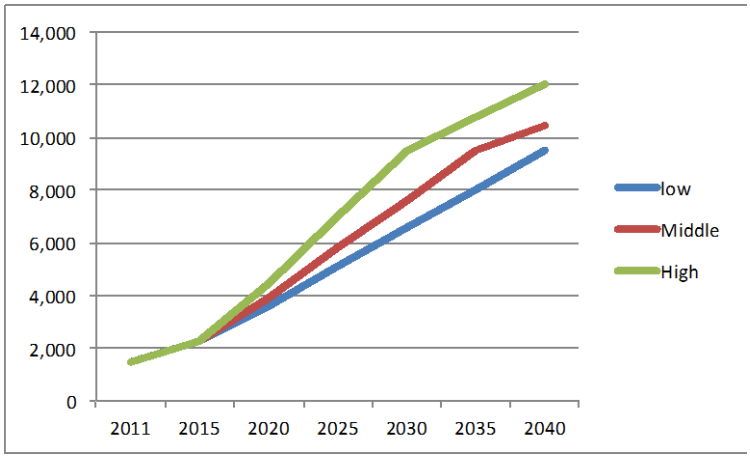


	2011	2018	2025	2035	2040
Periphery Area	430,114	925,343	1,518,047	2,572,677	3,210,619
New Suburbs	1,642,030	2,003,702	2,436,562	3,206,771	3,672,669
South of CBD	219,512	280,948	354,477	485,310	564,451
Older Suburbs	778,156	800,059	826,274	872,919	901,134
Northern Suburbs	805,461	938,484	1,097,689	1,380,971	1,552,328
Outer Ring	596,425	603,370	611,682	626,472	635,418
Inner Urban Ring	848,152	864,179	883,360	917,491	938,136
CBD	252,392	252,926	253,566	254,703	255,391

Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-3 Population Projection of the Greater Yangon

It was also examined that future GRDP and GRDP/CAPITA as preliminary economic framework. It was assumed that the GDP per Capita of the Greater Yangon would reach the current Thailand level in 2035 in the middle case. As a result, GRDP of the Greater Yangon will be 112,596 million USD in 2040 in the middle case.



Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-4 GDP/ CAPITA Projection in Target Area (Unit: US$)

(3) Future Forecast

Future forecasts of population and land use for industry in this study follow other studies' results. In regional level, JICA Study namely "The Project for the Strategic Urban Development Plan of the Greater Yangon" shall be referred. In local level, METI-FS namely "The Basic Master Plan for the Thilawa" shall be referred.

Table 3.7-1 Population Forecast

Target Area	Target Year		Current	2015	2020	2025	2030
Local Level	Thilawa SEZ		0	(6,000)	(19,000)	(78,000)	156,000
Region Level	Located Townships	Thanlyin	181,959	285,850	431,650	597,416	785,881
		Kyauktan	48,473	58,745	73,160	89,549	108,183
	The Greater Yangon		5,572,242	6,174,750	7,020,309	7,981,656	9,074,649

Note: Population forecast of Thilawa SEZ are set as 156,000 at "Final Phase" in the master plan. As exact target year of the "Final" is not defined in the plan, the target year is set 2030 at the Final in this study temporarily. Based on the trend, populations at 2015, 2020 and 2025 are also estimated in this study.
Target area of Thanlyin and Kyautan Townships corresponds to the area of the Greater Yangon, not whole area of these townships.
Source: METI Study, DFR of "The Basic Master Plan for the Thilawa", and JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Table 3.7-2 Development Forecast for Industrial Land Use

Target Area	Target Year		Current	2015	2020	2025	2030
Local Level	Thilawa SEZ		0ha	(150ha)	(450ha)	(717ha)	1,434ha
Region Level	Located Townships	Thanlyin	306ha	(no change)	(no change)	(no change)	(no change)
		Kyauktan	179ha	(no change)	(no change)	(no change)	(no change)
	The Greater Yangon		1,872ha	2,788ha	3,704ha	4,620ha	5,536ha

Note: Target Areas of industrial use of Thilawa SEZ is set as 1,434ha at "Final Phase" in a master plan of Thilawa SEZ formulated by the Governments of Myanmar and Japan. As exact target year of "Final" is not defined in the plan, the target years is set 2030 at the Final in this study temporarily. Based on the trend, target areas at 2015, 2020 and 2025 are also estimated in this study.
Note: Target Areas of industrial use of the Greater Yangon is set as 7,365ha at the year of 2040 in a master plan. Based on the target area of 2040 and the trend, target areas at 2015, 2020, 2025 and 2030 are estimated in this study.

Target area of Thanlyin and Kyautan Townships corresponds to the area of the Greater Yangon, not whole area of these townships.
Source: METI Study, DFR of "The Basic Master Plan for the Thilawa", and JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

3.7.2. SEZ Development

(1) Development Visions and Goals

At Thilawa Area Port's hinterland, METI (Ministry of Economy, Trade and Industry) Japan is now conducting a study, namely "Thilawa SEZ Development Study" in order to formulate a master plan of Thilawa SEZ where is just located at the hinterland of the port. This basic master plan is formulated based on article II. 1 of "Memorandum of Intent on the Cooperation for the Development of the Master Plan for the Thilawa" which was exchanged between the Ministry of National Planning and Economic Development of the Republic of the Union of Myanmar and the Ministry of Foreign Affairs and the Ministry of Economy, Trade, and Industry of Japan on 21st April 2012. Referring to the MOI, Myanmar side and Japan side exchanged "Memorandum of the Cooperation for the Development of the Thilawa SEZ" on 21st December 2012.

In the METI study, visions and goals are set as below;

Visions

1. *Growth Center by inducing FDI and utilizing the resources of Greater Yangon Area*
2. *Trigger to create non-traditional industries in the nation by absorbing new technologies from FDI and transferring them to local business society*
3. *Core to diversify the industries of Myanmar by accumulating various types of industries in SEZ*
4. *International gateway in regional and global supply chain by building up firm manufacturing base and creating efficient logistics system*

Goals

1. *Various economic activities will take place and promoted: manufacturing, logistics, commerce, services, etc.*
2. *FDI will be accumulated not only in manufacturing but also other industries.*
3. *Forward and backward linkages will be established between FDI providers and local business societies.*
4. *Local business societies will start engaging in non-traditional industries.*
5. *Integrated and efficient logistics services will be established for contributing to the regional and global supply chain.*
6. *Thilawa SEZ will contribute to the rapid economic growth of Greater Yangon Area (then to nation-wide) through earning the foreign currencies and creating the job opportunities.*

(2) Potential Investment Attracting Industries in Thilawa SEZ

To share the foreseeable future of industrial agglomeration in Thilawa SEZ, a list of potential industries is proposed, as shown in the table 3.7-3. Every industry appears to have a large potential, since this table shows only the industries of large potential. Potential industries are expected to change in time. Therefore, the proposed potential industries are examined as follows for every three-period, namely, short-term (five years after the start of the special economic zone operation), medium-term (up to 10 years after the beginning of the sixth year of the special economic zone operation), and long-term (up to 20 years from 11 years after the beginning of the special economic zone operation) based on the situation of Myanmar's manufacturing industries, the process of industrial development in neighboring countries, and the reporting of investment intentions during each period.

Table 3.7-3 Potential Industries in Thilawa SEZ

Industrial Categories	Short-term -5 year	Mid-term 6-10 year	Long-term 11-20 year
Resource-based Industry			
Food & Beverage	○	○	○
Wood Product /Wooden Furniture	○	○	○
Labor Intensive Export-oriented Industry			
Wearing Apparel	○	○	
Footwear	○	○	
Sports Goods and Toys	○	○	○
Electrical, Electronic & Optical Products			
Electric Household Appliance	○	○	○
Computer & Peripheral Equipment		○	○
Electronic Components and PCB		○	○
Digital Camera		○	○
Lenses & Prism	○	○	○
Electric Motors	○	○	○
Transport Equipment			
Motor Vehicle Assembly	○	○	○
Motor Vehicle Parts	○	○	○
Motorcycle Assembly	○	○	○
Motorcycle Parts	○	○	○
Building Material-related Industry			
Fabricated Metal Products	○	○	○
Electric Wires and Cables	○	○	○
Ceramic Sanitary Wear	○	○	○
Distribution Processing of Steel Products	○	○	○
Transshipment Station of Cement	○	○	○
Others			
Plastic Resins Processing	○	○	○
Can, Glass Bottle, and PET Bottle	○	○	○
Paper Containers	○	○	○
Resource-based Industry			
Food & Beverage	○	○	○
Wood Product /Wooden Furniture	○	○	○
Labor Intensive Export-oriented Industry			
Wearing Apparel	○	○	
Footwear	○	○	
Sports Goods and Toys	○	○	○

Electrical, Electronic & Optical Products			
Electric Household Appliance	○	○	○
Computer & Peripheral Equipment		○	○
Electronic Components and PCB		○	○
Digital Camera		○	○
Lenses & Prism	○	○	○
Electric Motors	○	○	○
Transport Equipment			
Motor Vehicle Assembly	○	○	○
Motor Vehicle Parts	○	○	○
Motorcycle Assembly	○	○	○
Motorcycle Parts	○	○	○
Building Material-related Industry			
Fabricated Metal Products	○	○	○
Electric Wires and Cables	○	○	○
Ceramic Sanitary Wear	○	○	○
Distribution Processing of Steel Products	○	○	○
Transshipment Station of Cement	○	○	○
Others			
Plastic Resins Processing	○	○	○
Can, Glass Bottle, and PET Bottle	○	○	○
Paper Containers	○	○	○

Legend: ○ high potential, (no mark) low potential
Source: METI Study, DFR of "The Basic Master Plan for the Thilawa"

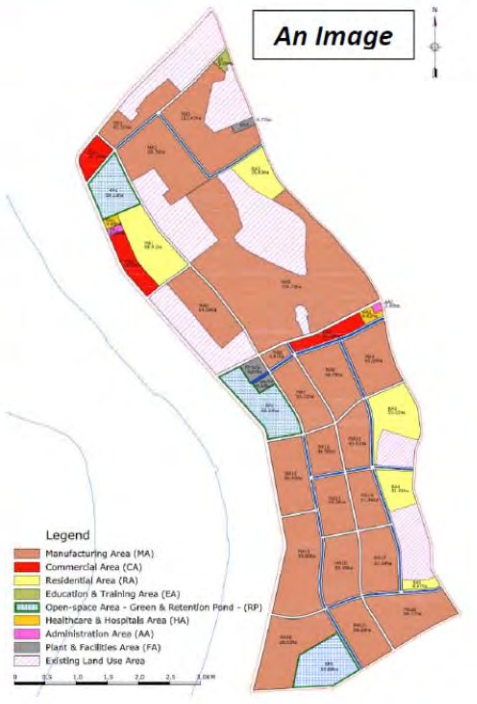
(3) Development Framework

In METI Study, a multi-purpose development scenario including manufacturing, residential and commercial land uses was proposed as one of future development scenarios to be adopted. Additionally, future expected industries, population forecast, infrastructure demands, and facilities construction plan of Thilawa SEZ were also examined in the METI study.

4. Development Framework

A Land Use Scenario (tentative)

Land Use	Total Area
1. Manufacturing Area	1,434ha (60.4%)
2. Logistic Area	20ha (0.8%)
3. IT Software and R&D Area	100ha (4.2%)
4. Commercial Area	60ha (2.5%)
5. International Wholesale Area	10ha (0.4%)
6. Residential Area	200ha (8.4%)
7. Healthcare & Hospitals Area	10ha (0.4%)
8. Education Area	5ha (0.2%)
9. Open-space & Recreation Area	178ha (7.5%)
10. Administration Area	5ha (0.2%)
11. Infrastructure	354ha (15.0%)
Total Area	*2,376ha (100.0%)*

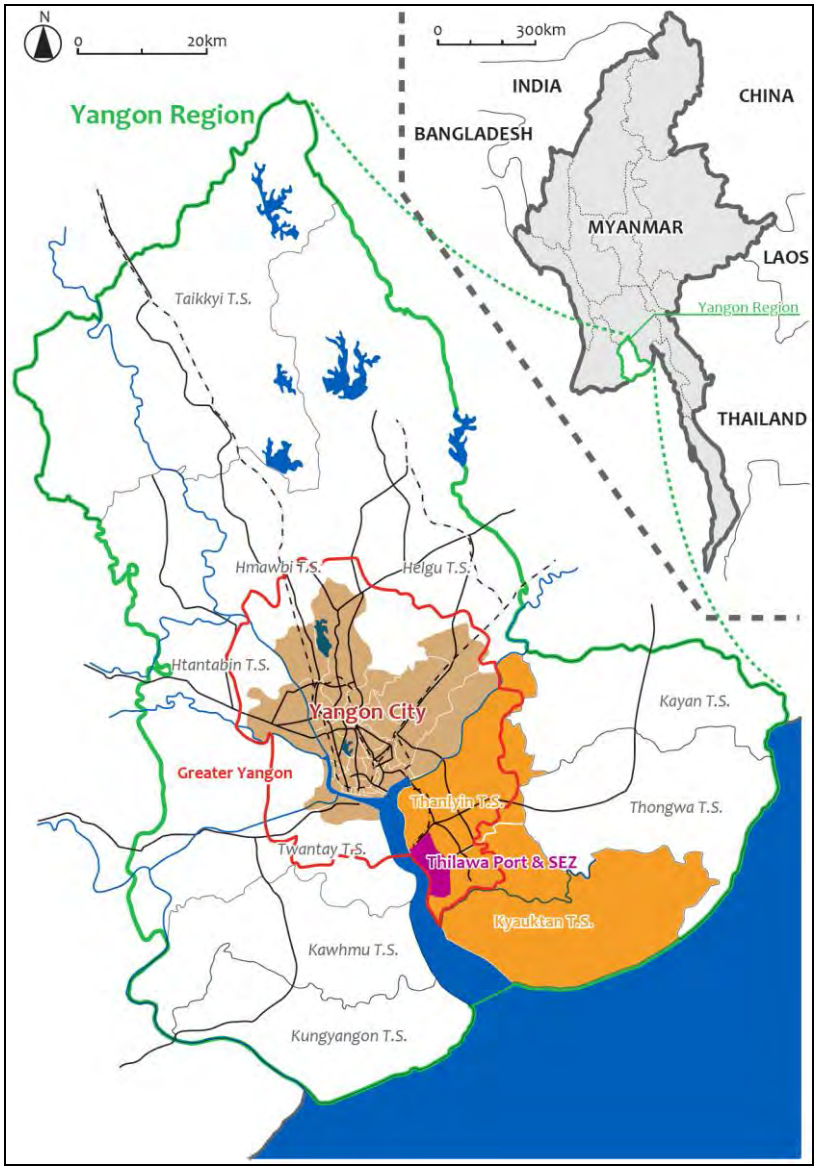


Source: METI Study, DFR of "Study on the Possibility of Implementation Smart-Community in Myanmar "

Figure 3.7-5 A Land Use Scenario of Thilawa SEZ

3.7.3. A Geographical Location of the Port

Thilawa Area Port is located at the place which is the focal node of the Greater Mekong Subregion (GMS) economic corridors, namely East-West Economic Corridor, Western Economic Corridor, and Southern Economic Corridor, and Asian Highway. Thilawa Area Port is belong to Yangon Region which is consisted of totally 46 townships as shown in Figure 3.7-6. Although 33 townships are under YCDC (Yangon City Development Committee)'s jurisdiction, Thanlyin Township and Kyauktan Township, in which Thilawa Area Port is located, are outside of YCDC's jurisdiction.



(Prepared by the Study Team)

Figure 3.7-6 Location of Thilawa Area Port in Yangon Region

3.7.4. Regional Level Development Plan <Greater Yangon>

(1) Overview of Current Conditions

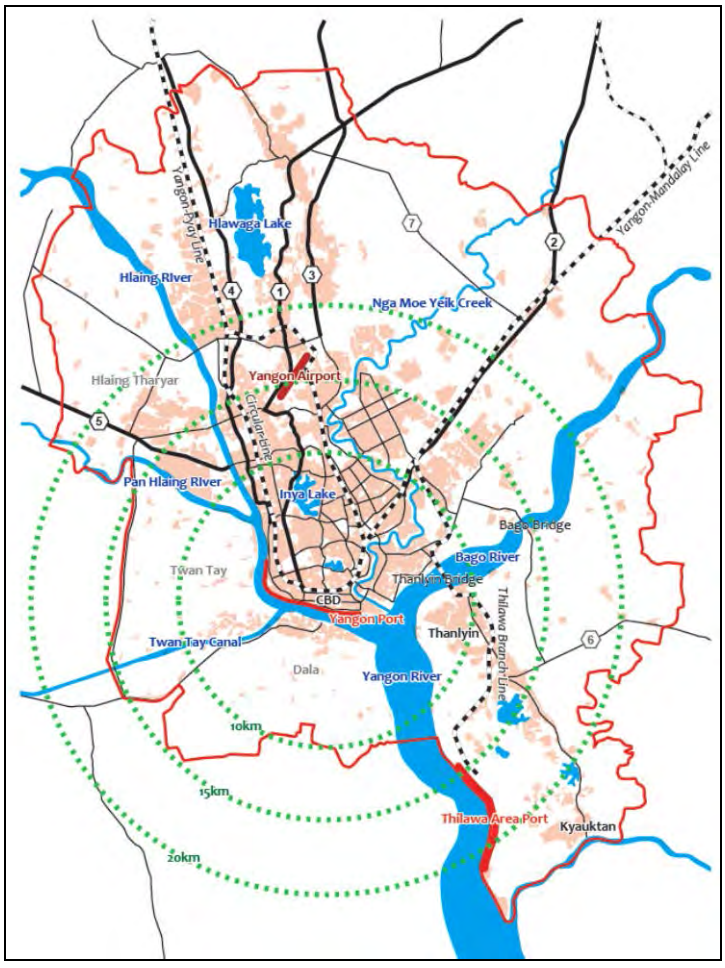
The future urban area of Greater Yangon is estimated to have total 39 townships, which are consisted of 33 townships under YCDC's jurisdiction and parts of 6 periphery townships, including Thanlyin and Kyauktan Township. In 2002 Greater Yangon has an urbanized area which expands with an area of approximately 505 km2. Looking at an overall spatial structure of Greater Yangon as shown in Figure 3.7-7, urbanization of Greater Yangon tends to have expanded northwards and eastwards rather than southwards and westwards. Currently, approximately the area in the radius of 15-20km from the CBD (Central Business District) has been urbanized except in the south and west.

Considering the urbanization trend, existence of the rivers must be focal constraints for buffering, and crossing bridge shall play more or less a trigger for urbanization. In Yangon, there are six (6) main rivers or creeks which affect urbanization trend, namely the Yangon River, Twan Tay Canal, Pan Hlaing River, Hlaing River, Nga Moe Yeik Creek, and Bago River, (clockwise order).

Urban transport network of Greater Yangon is developed mainly to form radius roads. The radius roads are No.5 Main Road (to west), No.4 Main Road (to north), No.1 Main Road (to north), No.3 Main Road (to north), No.2 Main Road (to northeast), and No.6 Main Road (to Thilawa).

Turning now to Thilawa situation, although Bago River flows between CBD and Thilawa, two (2) bridges, namely Thanlyin Bridge and Bago Bridge, and one railway line, namely Thilawa Line, play important role for logistics, economic activities and urbanization in Thilawa Area Port and its hinterland development.

At 2011 Greater Yangon has a population of approximately 6,214,186. The average growth rate of population between 1998 and 2011 is 2.58% annual (only YCDC).



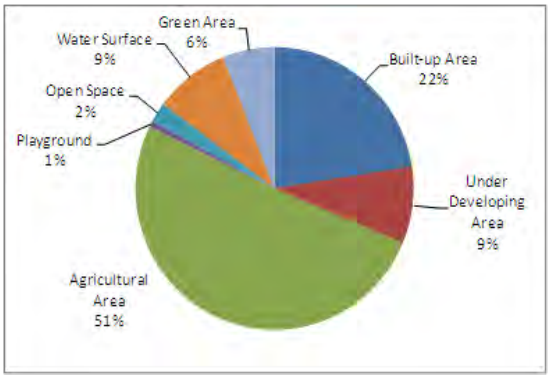
(Prepared by the Study Team)

Figure 3.7-7 Spatial Structure of Greater Yangon and Thilawa

(2) Present Land Use

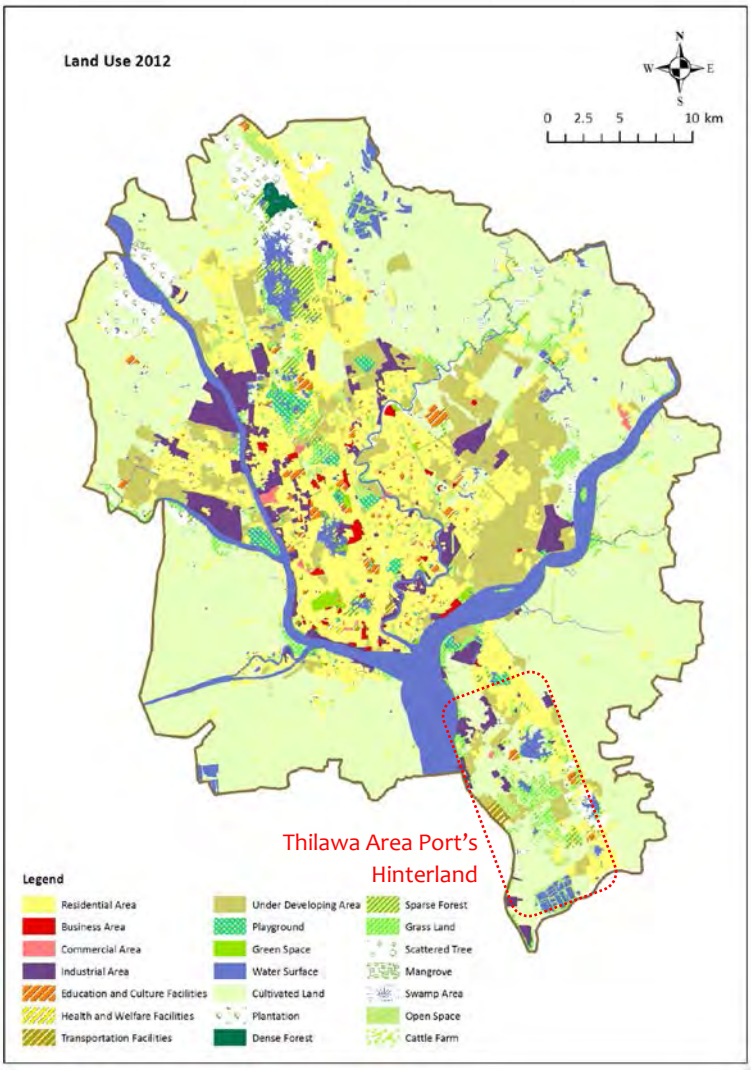
Looking first at the land use share of Greater Yangon in 2012 in Figure 3.7-8, a dominant land use type was agricultural area, which occupied about 51% of total area, followed by 33% of urbanized areas, which is consisted of 22% of built-up area and 9% of under developing area.

Looking next at land use distribution in map of Greater Yangon in Figure 3.7-9, although both Thanlyin and Kyauktan Townships are mainly dominated by agricultural lands, residential area and urban developing area seem to prominent north to south probably along a trunk road.



Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-8 Land Use Share of 2012



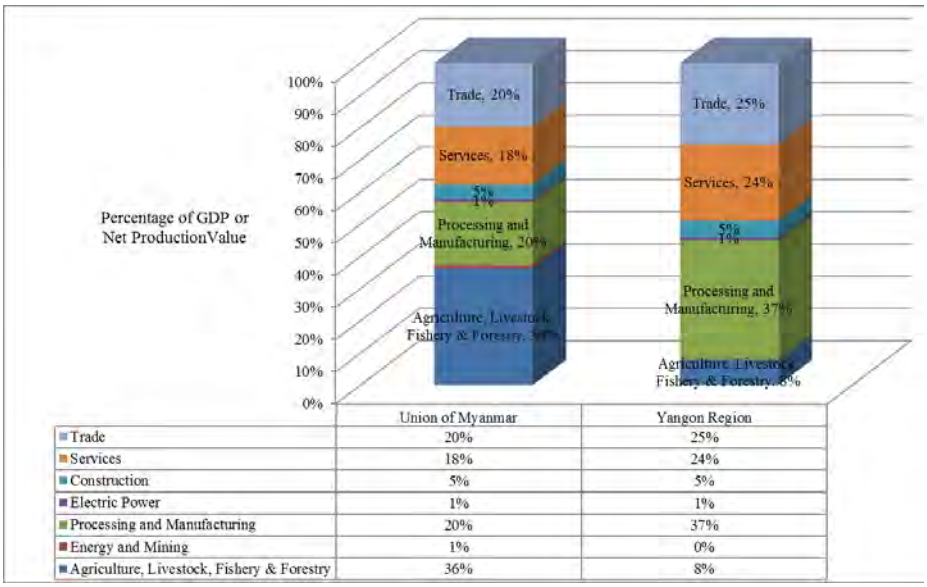
Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-9 Greater Yangon Land Use Map of 2012

(3) Industrial Activities

1) Industrial Structure

Figure 3.7-10 compares the industrial structure in Yangon Region with that of Myanmar on a basis of GDP in 2010-2011. The industrial structure in Myanmar was composed of the agriculture, livestock, fishery, and forestry sector (36%); the trade sector (20%); the process and manufacturing sector (20%); and the services sector (18%). Meanwhile, the industrial structure in Yangon Region was composed of the processing and manufacturing sector (37%); the trade sector (25%); and the services sector (24%). The agriculture, livestock, fishery, and forestry sector accounted for only 8% of the total production value.



	Union of Myanmar	Yangon Region
Trade	20%	25%
Services	18%	24%
Construction	5%	5%
Electric Power	1%	1%
Processing and Manufacturing	20%	37%
Energy and Mining	1%	0%
Agriculture, Livestock, Fishery & Forestry	36%	8%

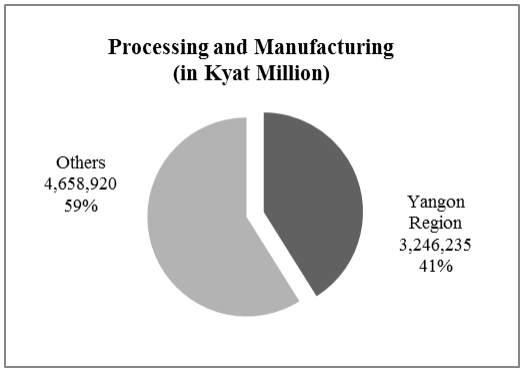
Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-10 Industrial Structure in Myanmar and Yangon Region

2) Industrial Activities Conditions

The processing and manufacturing sector accounted for 20% of the national economy in 2010-2011. Figure 3.7-11 shows the contribution ratio of Yangon Region to the national net production values of the processing and manufacturing sector based on the data in 2010-2011. Yangon Region largely contributed to the processing and manufacturing sector in the country by 41% that is the largest in all economic sectors.

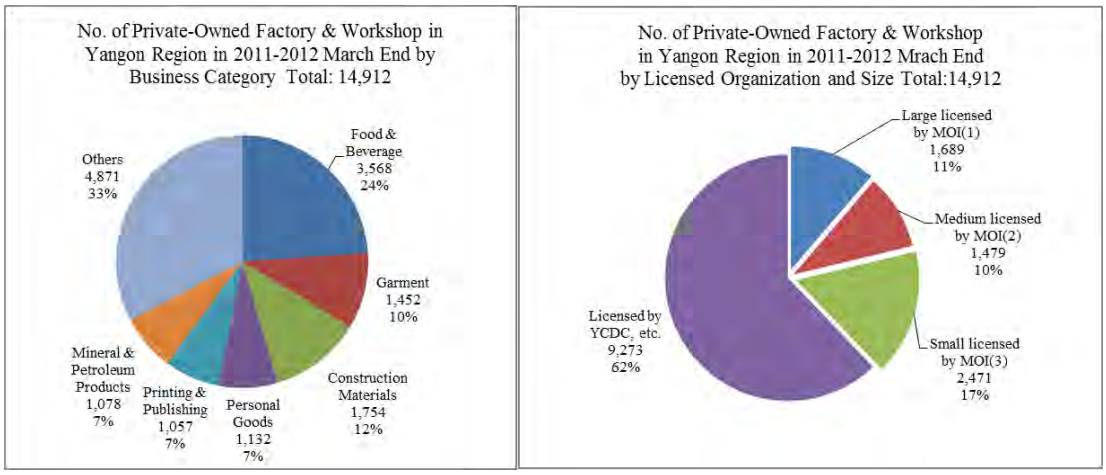
According to the data from Yangon regional office of Planning Department, Ministry of National Planning and Economic Development (MNPED), there were 30 industrial zones and a total of 15,089 factories or workshops in Yangon Region in 2010-2011, which were composed of 111 state-owned, 66 cooperative-owned, 14,912 private-owned.



Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-11 Contribution Ratio of Yangon Region in Processing and Manufacturing Sector

Figure 3.7-12 shows the 14,912 private-owned factories or workshops in Yangon Region (as of the end of 2011-2012) by business category and by size. By business category, the food and beverage is the largest category accounting for 24%, followed by construction materials (12%) and garment (10%). Out of 14,912 private-owned factories or workshops in Yangon Region, 5,639 are supervised by Directorate of Industrial Supervision and Inspection, Ministry of Industry (1) and they are divided into the large-size (1,689), the medium-size (1,479), and the small-size (2,471). The rest 9,273 of factories or workshops are mostly supervised by YCDC. Since YCDC supervises only the small business in Yangon City, the factories or workshops supervised by YCDC are added to small-size. As a result, the large, medium, and small sized factories or workshops are 1,689 (11%), 1,479 (10%) and 11,754 (79%), respectively.

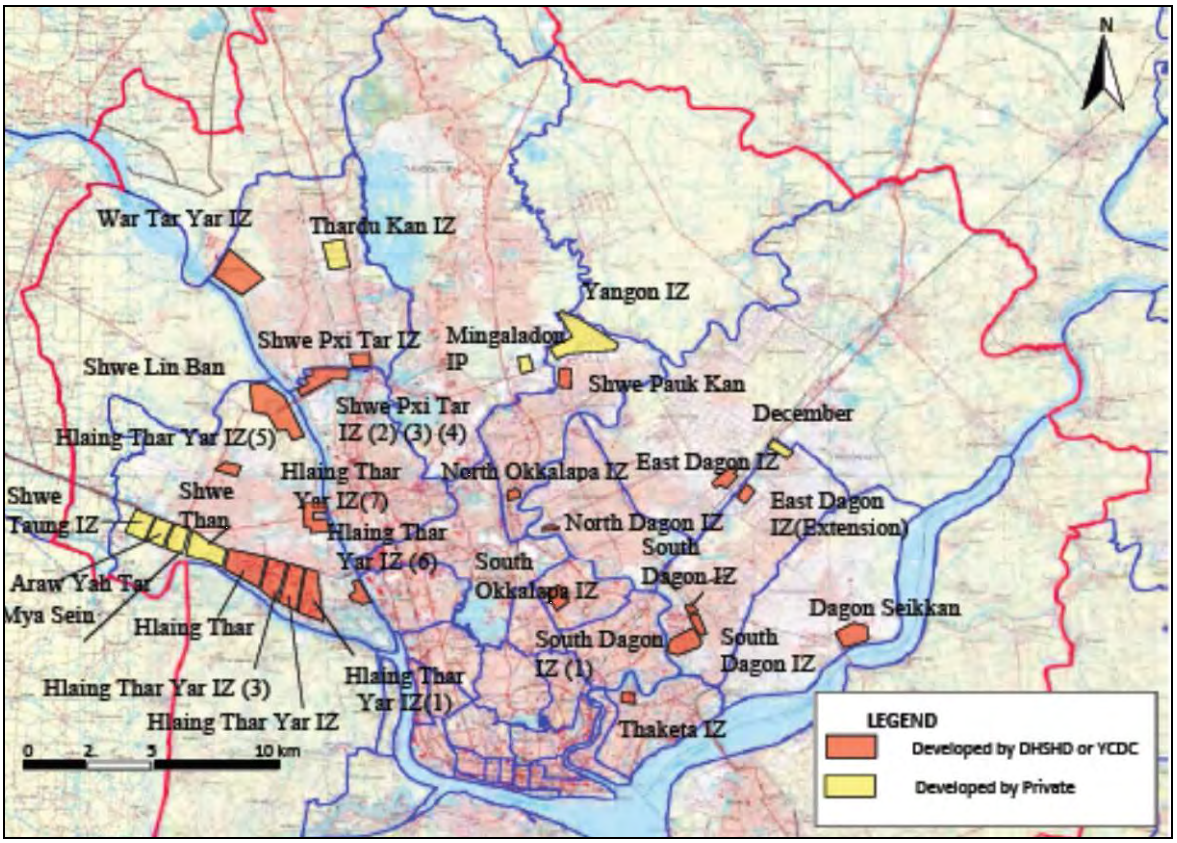


Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-12 Private-owned Factory & Workshop in Yangon Region by Business Category and by Size

Figure 3.7-13 shows the location of 24 industrial zones in Yangon City with a total land area about 6,700 ha. There are still large land spaces unused in several industrial zones that have already developed. In the industrial zones which are operated by tenants, Management Committees have

responsibility of operation and maintenance, and of additional investment for internal infrastructure. Management Committees have been collecting management fees and social contribution fees from tenants to use for maintenance. Currently foreign investors are short of industrial land supply. Government has allowed foreign investors to rent land from private companies by the presidential decree No. 39 dated 30th September 2011 and the revised foreign investment law dated 2nd November 2012. By the revision, investment incentives have been improved (extension of tax exemption period). Additionally the power and authority of Myanmar Investment Committee (MIC) has been expanding, however a lot of matters are still in unclear conditions depending on the bylaws and operations.



Source: JICA Study, ITR2 of "The Project for the Strategic Urban Development Plan of the Greater Yangon"

Figure 3.7-13 Location of Industrial Zones

3.7.5. Local Level Development Plan< Thanlyin Township and Kyauktan Townships >

(1) Overview of Current Conditions

Thilawa Area Port and its hinterland are located in Thanlyin Township and Kyauktan Township. According to YCDC data, Thanlyin Township has a population of 204,486 in 2011 and an area of 36,859, and Kyauktan Township has a population of 123,565 in 2011 and an area of 58,607 as shown in Table 3.7-4.

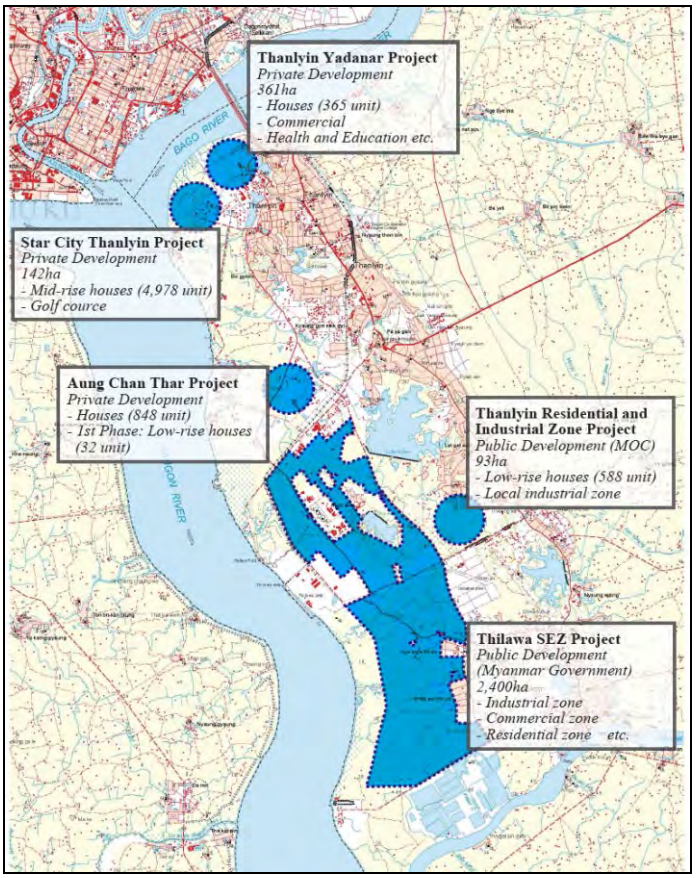
Table 3.7-4 Basic Information of Thanlyin and Kyawktan Townships

	Thanlyin Township	Kyauktan Township
Population	204,486	123,565
Area (ha)	36,859	58,608
Population Density (persons/ha)	5.5	2.1
Household No.	44,119	29,676

Source: JICA Study Team based on YCDC and Division statistical data in 2011

(2) Relevant Development Projects

Thanlyin Township and Kyauktan Township accept a lot of urban development projects, especially housing projects, other than Thilawa SEZ project recently.



Source: METI Study, DFR of "Study on the Possibility of Implementation Smart-Community in Myanmar "

Figure 3.7-14 Relevant Development Projects in Local Level

1) Star City Thanlyin Project

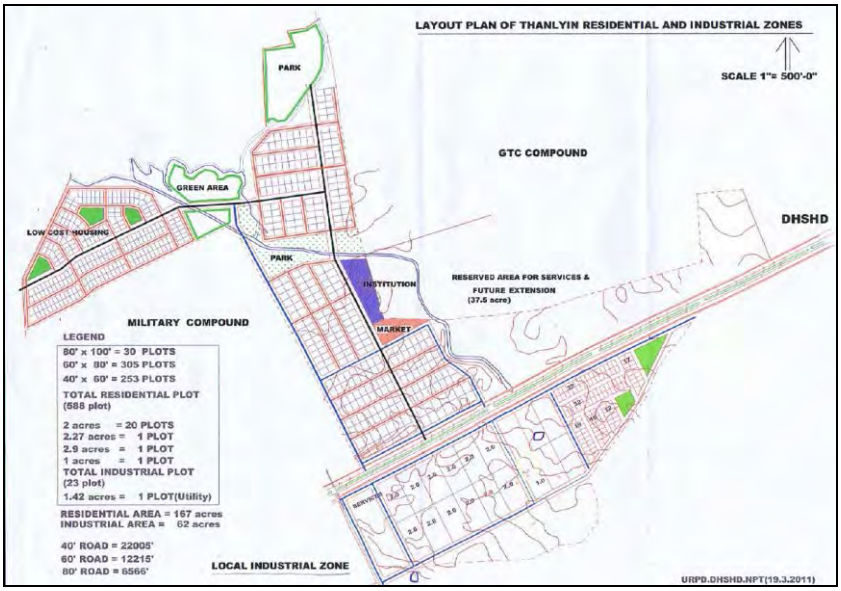
Star City Thanlyin Project by FMI private company is now under-construction. This project is consisted of middle-rise housing, golf course and commercial use (see Figure 3.7-15).

Source: Star City Thanlyin Project Brochure

Figure 3.7-15 Star City Thanlyin Project

2) Thanlyin Residential and Industrial Zone Project

Thanlyin Residential and Industrial Zone Project is conducted by Ministry of Construction with an area of approximately 93 ha and 588 units of housing nearby Thilawa SEZ (see Figure 3.7-16).

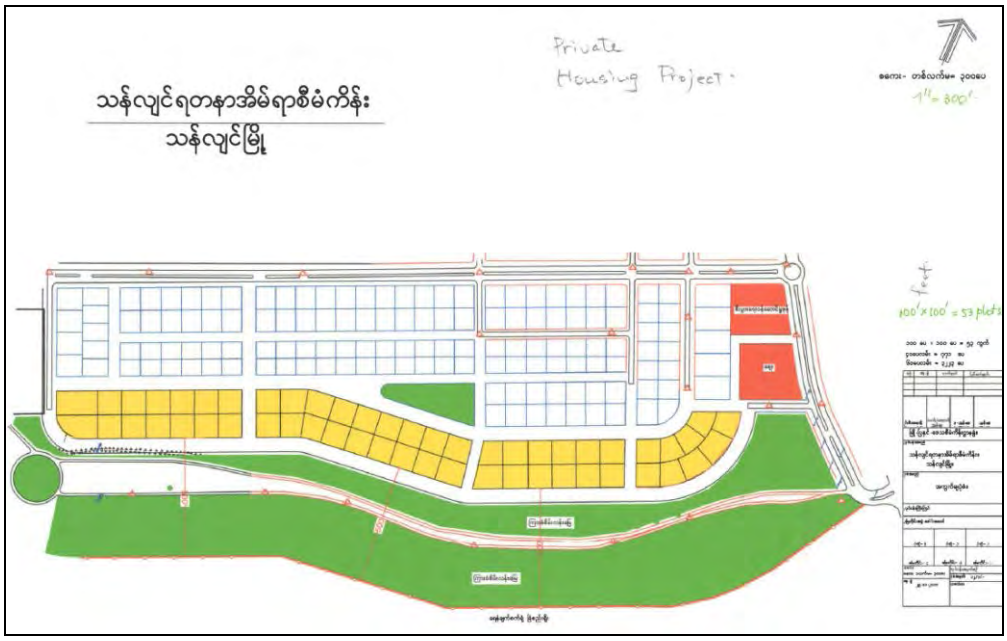


Source: Thanlyin Residential and Industrial Zone Materials

Figure 3.7-16 Thanlyin Residential and Industrial Zone Project

3) Thanlyin Yadanar Project

Thanlyin Yadanar Project is housing development by private sector nearby Thanlyin Bridge. This project has 365 unit housing, commercial, etc (see Figure 3.7-17).



Source: Thanlyin Yadanar Project Materials

Figure 3.7-17 Thanlyin Yadanar Project

4) Aung Chan Thar Project

Aung Chan Thar Project is also housing development by private sector. 1st phase development is under construction (see Figure 3.7-18).

Source: Aung Chan Thar Project Materials

Figure 3.7-18 Aung Chan Thar Project

4. Basic Concept and Plan of Yangon Port Development

4.1. Basic Concept

4.1.1. Present Situation of Yangon Port

MPA manages 9 ports in the country. Among those, Yangon Port handles about 90% of waterborne transport cargo of Myanmar. General cargo handling facilities at the ports except Yangon Port are constructed in shallow water areas where deepening is considered difficult. Therefore, port cargo transport in Myanmar will likely continue to be concentrated in Yangon Port and delivered to local destinations by domestic transport means. Accordingly, Yangon Port should keep its function as a gate way for the waterborne cargo transport of Myanmar in the future.

Major port facilities at Yangon Port are spread through Yangon Main Port and Thilawa Area Port. Among those, port facilities at Yangon Main Port extend over about 9 km in a narrow area adjacent to Yangon city. Therefore, port yard areas are very narrow and consequently cargo handling productivity is very low. Further, land transport traffic generated from port cargo causes traffic congestion in the city. On the other hand, an ample area of 7.4 km in length and 750 m in width is available in Thilawa Area for port terminal construction. Some areas are in operation and others are under construction.

From the view point of city planning, generally it is desirable to use waterfront area in the vicinity of an urban area for facilities which related directly to the lives of citizens such as passenger terminals, domestic transport terminals, promenades, shopping centers and office buildings. However, relocating the existing large size port terminals which are developed at Yangon Port for such purposes would incur an economic loss to the country.

4.1.2. Coordination between Land and Inland Waterway Transport

A distribution pattern of goods in the whole of Myanmar is forming in the center of the Yangon port shown in Figure 2.3-1 and 2.3-2. Almost all imported goods are transported to eight local ports in Myanmar. In addition, they are transported to northern inland area by inland water transport, roads and railways. Annual transport volume of each of transport in Yangon city region is as follows; Inland water transport is about 600,000 tons. Road is about 3.4 million tons. Railway is about 1 million tons. Rice and beans for export are carried to Yangon port by inland water transport and transported overseas.

In this way, cargo transport in Myanmar is dependent on Yangon port and cooperation with inland water transport, roads and railways. Transport by inland water transport, roads and railways connecting port and inland is becoming increasingly important. From such a point of view, It have to consider next points for each sector cooperation with Yangon port.

1) Roads

Traffic in Yangon has been increasing since the restrictions on possessing automobiles were relaxed. And traffic congestion has been normalizing in the morning and evening. Yangon port is situated in a narrow space between the city area and Yangon river and the road network behind it is insufficient. To transport cargoes to the hinterland efficiently the port road needs to be extended further to avoid interference with traffic in Yangon. And the port road development should be included in a city development plan.

2) Railways

A railway network has been constructed in Yangon but transportation capacity is insufficient. To strength the cooperation of the port and railway, development of the railway is required. In addition, there is a railway behind the Yangon main port but it can't connect smoothly with the port and railway because land is narrow. Railway is an appropriate means for long (about 500 km) haul and large volume cargo transport. The future use of railway transport for port cargo should be examined carefully taking into account the trend of cargo transport volume between Yangon and inland cities, development situation of railway network and the degree of railway dependancy of cargo transport in land transport.

3) Inland Water Transport

In Myanmar inland water transport plays an important role in the transport of passengers and cargoes. Passengers and cargoes are handled at the many pontoon piers in Yangon port. However, it is necessary to change pontoon piers to fixed piers which allow mechanical cargo handling for the improvement of cargo handling efficiency. Inland water transport is an effective means of transport for large quantities of cargo that doesn't adversely affect the environment. There is a need to promote the use of inland waterway transport in the future.

In order to increase efficiency of rice and bean export, large barges should be employed to transport containers and a container loading system from barges to container ships needs to be established. (see Figure 4.1-1).

Source：City of Yokohama HP

Figure 4.1-1 Example of Transport by Barges (image)

4.1.3. Deep Sea Port Development

(1) Necessity of Deep Sea Port in Myanmar

The current population of Myanmar (2011) is about 60 million. Assuming the container producing factor is 0.025 (same with Cambodia), the nationwide container throughput of Myanmar can be calculated as follows:

60 million TEUs x 0.025 = 150 million TEUs

Thus, the local container throughput to from Myanmar can reach the line of 150 million TEUs in the near future, as is shown in Table 5.3-1.

Table 4.1-1 shows all the shipping lines operating the feeder service between Singapore, Port Klan and Yangon. 16 vessels are currently deployed to the service, and the largest size ships of all are: Bienda Freighter of CSCL and Sinar Bima of Samudera Shipping. Both of them are 1,118 TEU Type.

The remaining are: 1,064TEU x 1, 954 TEU x 1, 907 TEU x 2, 700TEUs x 2, 600TEUs x 6, 500TEUs x 2. Of all these ships, up to 700TEUs can enter and sail out wharfs comparatively easily without heavily interrupted by Sand Bars (Elephant Point, Monkey Point etc.). However, the bigger size vessels are often facing difficulties to access the terminals, affected by the tide condition.

Table 4.1-1 List of Feeder Service Lines between Singapore, Port Klan and Yangon

	Shipping Lines	Deployed Vessel	Service Route	Terminal at YG	Share (%)
1	ACL (Advance Container Line)	Kota Tegap 907 TEU Kota Machan 728 TEU Kota Tampan 907 TEU Kota Tabah 756 TEU	YG-PK-SP YG-SP YG-SP YG-PK-SP	AWPT	32
2	MFSL (Myanmar five Star Line)	Han Linn 502 TEU	YG-PK-SP	BSW	4.
3	CSCL	Biendong Trader 610 TEU Biendong Freighter 1,118 TEU	YG-PK-PGU -SP	AWPT	12
4	Samudera	CTP Fortune 1,064 TEU Sinar Bima 1,118 TEU	YG-PK-SP YG-PK-SP	AWPT	11
5	RCL (RCL+MOL)	Ora Bhum 628 TEU	YG-SP	MIP	10
6	IAL (Intra-Asia Line)	Dan Jing 562 TEU GW Beychevell 618 TEU	YG-PK YG-PK	AWPT BSW	na
7	KMA(Local Line)	KMA-1 684 TEU KMA-2 684 TEU	YG-PK-SP YG-PK-SP	MIP	na
8	TS (Taiwan)	West Scent 954 TEU	YG-PK-SP	AWPT	na
9	Jindal (Local Line)	Jindal Tara 671 TEU	YG-PK	BSW	na

SP; Port of Singapore, YG; Yangon Port, PK; Port Kelan, PGU; Pasir Gudang

Source: Singapore Liner Service Lines Association, EFR

According to the voice of the shipping lines serving Yangon Port, assuming the drought of 11.3 meter is constantly maintained, the maximum size of the deployed ship will be 2,000 TEU. Because the demand forecast for the period of coming 10 years is 10% increase every year, it is most likely that every 2,000 TEU ships will be fully loaded.

Thus, the increase of earning of the upgrading of the deployed ship size is calculated as follows based on the ocean freight charge level assumption as per Table 4-1-2.

Based on Table 4.1-2, the average freight for the import container (40') is about US$1,000, and export container US$ 500.

Table 4.1-2 Service Route-wise Export/Import Container Freight (in US$)

Service Route (from)	To Yangon	From Yangon
Japan	1,150	1,050
HK/China	1,000	500
Korea	1,000	-
Singapore	600	300
Thailand	900	650
Vietnam	850	550
India/Pakistan	-	850

Prepared by the; JICA Study Team

Assuming the shipping lines currently deploying 1,000TEU ships replace her by 2,000 TEU ships, the net increase of the loading capacity of containers is 1,000 TEU, producing about US$ 78

Million (US$ 1,500,000 x 52 weeks)

Import: 1,000 TEU x US$ 1,000 = US$ 1,000,000/week
Export: 1,000 TEU x US$ 500=US$ 500,000/week

Likewise, assuming the shipping lines currently deploying 600 TEU ships replace her by 2,000 TEU ships, the net increase of the loading capacity of containers is 1,400 TEU, producing about US$ 109Million (US$ 2,100,000 x52 weeks)

Import: 1,400 TEU x US$1,000=US$ 1,400,000/week
Export: 1,400 TEU x US$ 500 =US$ 700,000/week

The economic benefit above will produce the room for the shipping lines serving Myanmar to reduce the ocean freight level encouraging the trade activities to/from Myanmar.

Shipping Lines opine that the following conditions will occur simultaneously in order to deploy 2,000 TEU ships on the Current Service Route.

- Necessary dredging
- Upgrading the Infrastructure
- Industrial Park established as scheduled

By the end of 2012, about 200 ULCSs will be on the ocean route and “Cascading effect” is un-escapable, aside from the local need for the larger-size ships in the region. According to a major shipping line serving Myanmar to/from Singapore, the largest inter-connecting port in the region, the current maximum size of feeder ships, 1,000 TEUs, is a clear bottleneck of the Singapore/Myanmar service route. The export and import cargo, especially import cargo, is heavily stagnated at Singapore and other feeder connecting ports resulting in the slow economic development of shipping. If 2,000 TEU type vessels could be deployed in the service route, the container throughput would surely double. This is the common outlook shared by all major shipping lines

Due to the limited water depth of 9 m at the Yangon Port channel, only feeder container ships of 1,000 TEU from Singapore can call Yangon Port. Taking into account the economic development of Myanmar, the country should develop ports which can accommodate container ships of about 40,000 DWT which are sailing in intra-Asia shipping routes. Taking into account the trends of the changes in container ship size in the world and Asian region, Myanmar needs to develop deep sea ports of 14 m deep which are able to accommodate container ships of 4,000 TEU (50,000 DWT, 13 m draft) in the vicinity of the Yangon area in the future.

Based on the above, the basic policy of Yangon Port development can be summarized as below:

- No additional large terminal development at Yangon Main Port should be conducted but the existing port facilities for international trade cargo should be utilized as extensively as possible.

- The remaining water front areas should be used for facilities which directly benefit the lives of citizen such as passenger terminals, domestic transport terminals, promenades, shopping centers and office buildings.
- Port facilities which will handle future increasing international trade cargo should be constructed in Thilawa Area Port.
- Promotion of a new road network development connecting Thilawa area and the city and other areas should be contemplated in order to improve the existing poor road network.
- The north part of Thilawa area should be utilized for facility development needed after the completion of the whole planned facilities at Thilawa area

4.1.4. Role Sharing between Yangon Main Port and Thilawa Area Port and Basic Development Policy of Yangon Port

Based on the above, the basic policy of Yangon Port development can be summarized as below:

① No additional large terminal development at Yangon Main Port should be conducted but the existing and planned port facilities for international trade cargo should be utilized as extensively as possible.
② The remaining water front areas should be used for facilities which directly benefit the lives of citizen such as passenger terminals, domestic transport terminals, promenades, shopping centers and office buildings.
③ Port facilities which will handle future increasing international trade cargo should be constructed in Thilawa Area Port.
④ Promotion of a new road network development connecting Thilawa area and the city and other areas should be contemplated in order to improve the existing poor road network.
⑤ The north part of Thilawa area should be utilized for facility development needed after the completion of the whole planned facilities at Thilawa area.

4.2. Basic Plan

4.2.1. Demand Forecast

(1) Target Year of Port Development

Study team set up the target years of port development are 2015, 2020, 2025.

(2) Setting of Socio-economic Framework

Study teams set up the socio-economic framework to the year 2025 as below.

Economic growth rate

High Case 7.7 % (President's target and ADB's best scenario)

Low Case 5.3% (Average of 7 years with past 4 year record from 2007 to 2010 and IMF estimation from 2011 to 2013)

Population growth rate

1.29% （from Statistical Yearbook 2010 ）

(3) Cargo Demand Forecast

1) Cargo Demand Forecast for Whole Myanmar

a) Correlation between Cargo Volume and Trade Value

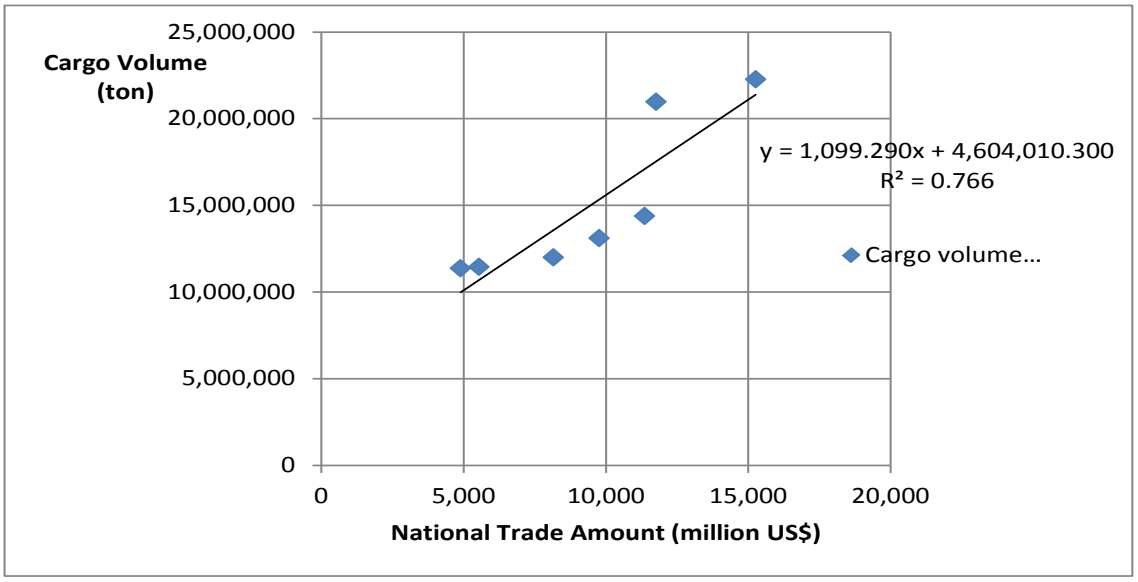
Table 4.2-1 shows foreign trade volume and value throughput of Myanmar.

Table 4.2-1 Foreign Trade Amount and Cargo Volume Throughput in Myanmar

	2004	2005	2006	2007	2008	2009	2010
Export Amount							
Million Kyat	16,697	20,647	30,026	35,297	37,028	41,289	49,107
Million US$	2,915	3,554	5,223	6,414	6,793	7,569	8,856
Import Amount							
Million Kyat	11,338	11,514	16,835	18,419	24,874	22,837	35,509
Million US$	1,979	1,982	2,928	3,347	4,563	4,187	6,404
Total Amount							
Million Kyat	28,035	32,161	46,861	53,716	61,902	64,127	84,615
Million US$	4,894	5,536	8,151	9,761	11,356	11,756	15,260
Cargo Volume (ton)	9,794,319	10,023,012	10,315,344	11,353,897	13,857,959	20,319,024	19,055,026

Source：MPA, Statistical Yearbook 2010

Figure 4.2-1 shows correlation between foreign trade amount and cargo volume of Myanmar. Foreign trade cargo volume increases in proportion to increase of foreign trade amount.



(Prepared by the Study Team)

Figure 4.2-1 Foreign Trade Amount and Cargo Volume Throughput in Myanmar

b) Forecast of Economic Scale

Study team estimate economic scale of targets year as scale of year 2020 is 1.0. Table 4.2-2 shows economic scale and estimated population in each target year.

Table 4.2-2 Estimated Economic Scale and Population of Target Years

Target year			2015	2020	2025
Economic growth rate	High Case	7.7%	1.38	2.00	2.90
	Low Case	5.3%	1.32	1.71	2.21
Population		1.29%	63,857,000	68,083,000	72,589,000

(Prepared by the Study Team)

c) Forecast of Trade Value with GTAP Model

Trade value in target yeas is forecast using GTAP (Global Trade Analysis Project) model. GTAP model is balanced general appreciation model programmed by GTAP (Global Trade Analysis Project) established in 1992 for the purpose of grasping the impact of trade policy quantitatively for member nations of the Uruguay Round and GATT.

Table 4.2-3 shows the forecast results using GTAP model for Myanmar trade value in each target year. The base year economic scale of 2010 is 1.0.

Table 4.2-3 Projected Trade Scale by GTAP Model

		2010	2015	2020	2025
High Case	Export	1.00	1.40	1.94	2.69
	Import	1.00	1.46	2.01	2.78
Low Case	Export	1.00	1.33	1.75	2.31
	Import	1.00	1.39	1.84	2.46

(Prepared by the Study Team)

d) Result from two trial Calculation

Calculation results of two cases show that estimated economic scale and trade value in target years (2015, 2020 and 2025) are almost same scale compared with that of 2010. The economic scale of Myanmar increases in proportion to the increase of trade value. Therefore, Increase of total trade cargo volume of Myanmar is in proportion to economic scale of Myanmar.

e) Port Cargo Volume Forecast with Future Economic Scale

As cargo volume increases in proportion to economic scale, study team forecasts cargo volume in target years based on the expected economic scale.

Total cargo volume and container cargo volume of Myanmar sea ports are 21,455,574 tons and 335,346 TEU respectively. However, present container cargo handling volume is rather small compared with the size of Myanmar's economy.

Cargo volume forecast for each target year

Year 2015

（High Case） Total cargo volume：21,455,574 x 1.38＝29,608,692 tons
Container cargo volume ：335,346 x 1.38＝462,777 TEU

（Low Case） Total cargo volume ：21,455,574 x 1.32＝28,321,358 tons
Container cargo volume：335,346 x 1.32＝442,657 TEU

Year 2020

（High Case） Total cargo volume：21,455,574 x 2.00＝42,911,148 tons
Container cargo volume：335,346 x 2.00＝670,692 TEU

（Low Case） Total cargo volume：21,455,574 x 1.71＝36,689,031 tons
Container cargo volume：335,346 x 1.71＝573,442 TEU

Year 2025

（High Case） Total cargo volume：21,455,574 x 2.90＝62,221,165 tons
Container cargo volume：335,346 x 2.90＝972,503 TEU

（Low Case） Total cargo volume：21,455,574 x 2.21＝47,416,818 tons
Container cargo volume：335,346 x 2.21＝741,115 TEU

Result of Myanmar port's cargo forecast volume is shown in Table 4.2-4.

Table 4.2-4 Result of Cargo Volume Projection of Myanmar Port

unit : ton

	2015	2020	2025
High Case	29,607,000	42,999,000	62,221,000
Low Case	28,321,000	36,689,000	47,417,000

(Prepared by the Study Team)

2) Container Cargo Volume Forecast for Whole Myanmar

a) Correlation between GDP per capita and TEU per capita in ASEAN Countries

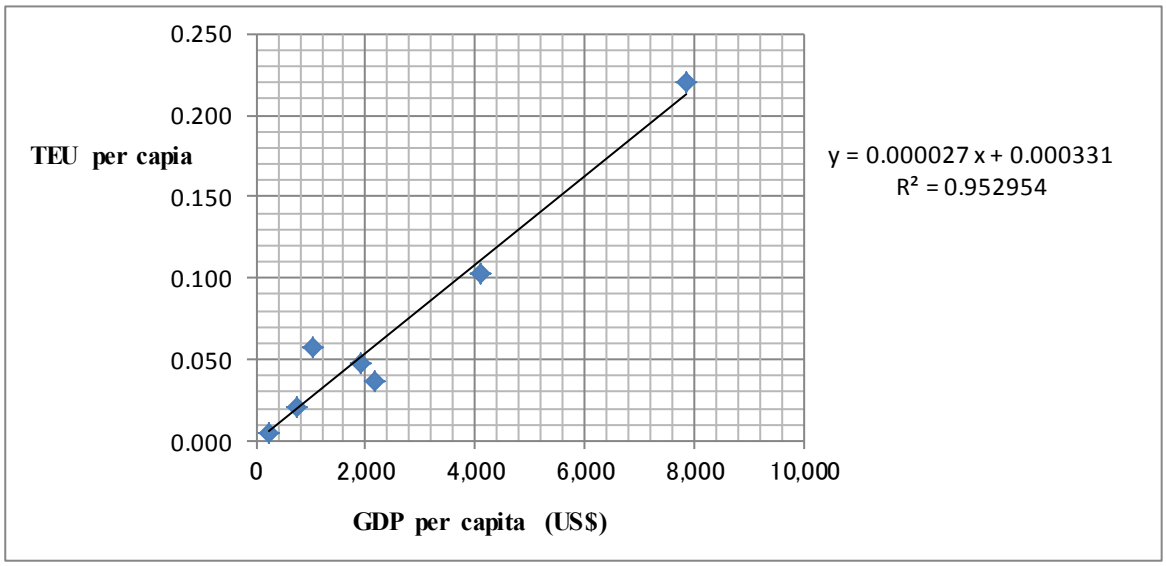
Table 4.2-5 show and Figure 4.2-2 correlation between GDP per capita and local container cargo volume with TEU per capita in ASEAN countries in year. 2008. Data source are JICA studies "The Study on Guidelines for Assessing Port Development Priorities including Acceptable Performance Level in ASEAN, February 2010" and "The Study on Project Priorities to Upgrade Performance and Capacity of ASEAN Network Ports, March 2011".

The economic development pattern of ASEAN countries is generally the same; there can be seen a shift from agriculture to manufacturing together with FDI. Container cargo handling volume tends increase in line with economic development. Container cargo handling volume per capita varies widely among ASEAN countries because economic growth levels are different. Correlation between GDP per capita and container cargo volume TEU per capita in AESAN countries shall be examined to forecast future container cargo volume in Myanmar with economic growth to some degree. Singapore and Brunei are excluded from this comparison because their huge GDP per capita is in a different class with other countries. Transship container cargo volume in Malaysian ports is also excluded.

Table 4.2-5 Correlation between GDP per capita and TEU per capita in ASEAN Countries in 2008

Country	GDP per capita (US$)	TEU per capita
Thailand	4,099	0.103
Malaysia	7,867	0.221
Philippines	1,908	0.048
Indonesia	2,181	0.036
Vietnam	1,047	0.058
Myanmar	233	0.004
Cambodia	742	0.021

(Prepared by the Study Team)



(Prepared by the Study Team)

Figure 4.2-2 Correlation between GDP per capita and TEU per capita in ASEAN Countries

Correlation between GDP per capita and TEU per capita is shown by the following formula.
TEU/capita = 0.000027 X + 0.000331 (R2 = 0.952)
X : GDP per capita

b) Projection of future GDP per capita and Population in Myanmar

i) GDP

Year 2015

(High Case) GDP per capita : 702 x 1.38＝969 US$
(Low Case) GDP per capita : 702 x 1.32＝927 US$

Year 2020

(High Case) GDP per capita : 702 x 2.00＝1,404 US$
(Low Case) GDP per capita : 702 x 1.71＝1,200 US$

Year 2025

(High Case) GDP per capita : 702 x 2.90＝2,036 US$
(Low Case) GDP per capita : 702 x 2.21＝1,551 US$

Table 4.2-6 shows projection result of Myanmar GDP per capita in each target year.

Table 4.2-6 Projection Result of Future GDP per Capita of Myanmar in Each Target Year

unit : US$

		2015	2020	2025
GDP	High Case	969	1,404	2,036
	Low Case	927	1,200	1,551

(Prepared by the Study Team)

ii) Population

Table 4.2-7 shows projection result of population of Myanmar in each target years.

Table 4.2-7 Projection Result of Population of Myanmar in Each Target Years

	2015	2020	2025
Population	63,857,000	68,083,000	72,589,000

(Prepared by the Study Team)

c) Container Cargo Volume Forecast in Target Years

Year 2015

(High Case) (0.000027 x 969+0.000331) x 63,857,000 = 1,691,827 TEU
(Low Case) (0.000027 x 927+0.000331) x 63,857,000 = 1,619,414 TEU

Year 2020

(High Case) (0.000027 x 1,404+0.000331) x 68,083,000 = 2,603,426 TEU
(Low Case) (0.000027 x 1,200+0.000331) x 68,083,000 =2,228,425 TEU

Year 2025

(High Case) (0.000027 x 2,036+0.000331) x 72,589,000 =4,014,389 TEU
(Low Case) (0.000027 x 1,551+0.000331) x 72,589,000 = 3,063,837 TEU

d) Disparity between Current Economy Scale of Myanmar and Potential Container Cargo Volume

Forecast container cargo volume in the target year of the preceding paragraph is the potential container cargo volume based on the estimated economic scale and population of Myanmar.

Potential container cargo volume in year 2010 is 1,155,036 TEU.

(0.000027 x 702+0.000331) x 59,893,000 = 1,155,036 TEU

However, actual container cargo handling volume in 2010 is 335,346 TEU which is only 29 % of the potential volume.

The present gap between the actual container cargo handling volume and the potential cargo handling volume is big, however, this gap can be bridged in a relatively short period of time. Economic development is expected to accelerate with the increase of FDI. As economic growth speed up, more effective distribution system becomes essential, necessitating that general cargo is containerized.

Vietnam had industrialized rapidly in the latter half of 1990s, with introduction of FDI by the Doi-moi policy. As shown in Table 4-2-5 and Figure 4-2-2, TEU per capita of Vietnam is well over the line of correlation formula. Therefore, the study team assumes that as Myanmar economic development will be rapid with the aggressive introduction of FDI, actual container cargo handling volume will catch up with potential container cargo handling volume by 2025.

Therefore, study team assumes diminish rate of year 2025 is 0%, which adjust potential container cargo volume to appropriate container cargo volume. Diminish rate of each target year is calculated with in proportion between 71% of year 2010 and 0% of year 2025.

Diminish Rate of Container Cargo volume in each Target Year

Year 2025　0 %
Year 2020　71% x 5÷15＝23.7%
Year 2015　71% x 10÷15＝47.3%

e) Revised Forecasted Container Cargo Volume with Diminish Ratio

Year 2015　Diminish ratio 47.3%

(High Case)　1,691,827 x (1－0.473) = 891,593 TEU

(Low Case)　1,619,414 x (1－0.473) = 853,431 TEU

Year 2020　Diminish ratio 23.7 %

(High Case)　2,603,426 x (1－0.237) = 1,986,414 TEU
(Low Case)　2,228,425 x (1－0.237) = 1,700,288 TEU

Year 2025　Diminish ratio 0 %

(High Case)　4,014,389 x 1.0= 4,014,389 TEU
(Low Case)　3,063,837 x 1.0 = 3,063,837 TEU

Table 4.2-8 shows forecast volume of container cargo in Myanmar.

Table 4.2-8 Result of Container Cargo Volume Forecast of Myanmar

unit : TEU

	2015	2020	2025
High Case	892,000	1,986,000	4,014,000
Low Case	853,000	1,700,000	3,064,000

(Prepared by the Study Team)

3) Estimation of Cargo Handling Volume of Yangon Port

The study team estimates the cargo handling volume of Yangon port.

a) Total Cargo Handling Volume Forecast (Macro Estimation)

Result of port cargo forecast volume (Foreign trade and coastal trade) of Myanmar is shown in the Table 4.2-9.

Table 4.2-9 Result of Cargo Volume Projection of Myanmar Port

unit : ton

	2015	2020	2025
High Case	29,607,000	42,999,000	62,221,000
Low Case	28,321,000	36,689,000	47,417,000

Source : Study Team

Table 4.2-10 shows that cargo handling volume of Yangon port accounts for 91.5 % in 2010 and 2011 of the total cargo handling volume of Myanmar port. Study team assumes that Yangon port's share of the total cargo volume of Myanmar port will remain the same in 2025.

Table 4.2-10 Cargo Handling Volume Share of Yangon Port in Myanmar（2010－2011）

			2010		2011	
			ton	%	ton	%
Myanmar	Foreign Trade	Export	5,847,856		7,117,270	
		Import	11,908,660		14,225,240	
		total	17,756,516		21,342,510	
	Coastal Trade	Loading	1,372,667		1,309,746	
		Unloading	1,027,881		1,101,651	
		total	2,400,548		2,411,397	
	Total		20,157,064		23,753,907	
Yangon Port	Foreign Trade	Export	5,664,285	96.9%	6,861,974	96.4%
		Import	11,707,684	98.3%	13,811,916	97.1%
		total	17,371,969	97.8%	20,673,890	96.9%
	Coastal Trade	Loading	466,960	34.0%	399,036	30.5%
		Unloading	599,712	58.3%	649,417	58.9%
		total	1,066,672	44.4%	1,048,453	43.5%
	Total		18,438,641	91.5%	21,722,343	91.4%

Source : Study Team

Note: Sea sand export volume of Myeik port and Kawthaung port is excluded.

Rough total cargo handling volume estimation

High Case : 62,221,000 x 0.915 ＝ 56,932,215 tons

Low Case : 47,417,000 x 0.915 ＝ 43,386,555 tons

b) Forecast by Main Commodities (Micro Estimation)

Main import commodities in Yangon port are containerized cargo, liquid fuel (gasoline, diesel and jet fuel), cement, cooking oil, iron material (billet) and steel products, car and general cargo. On the other hand, main export commodities are containerized cargo, timber and rice.

Border trade with neighboring countries is active, especially with Yunnan province in China and Thailand. It is said border trade accounts for 20% of Myanmar's total international trade in money base. Study team assumes that import cargo except for containerized cargo will continue to come from border trade even in 2025 as border trade will not decline for the time being.

i) Import Main Commodity

① Containerized Cargo Volume

Study team converts container cargo volume (TEU) into containerized cargo volume. Table 4.2.11 shows result of container cargo volume forecast of Myanmar reproduced from Chapter 4.

Table 4.2-11 Result of Container Cargo Volume Forecast of Myanmar

unit : TEU

	2015	2020	2025
High Case	892,000	1,986,000	4,014,000
Low Case	853,000	1,700,000	3,064,000

Source : Study Team

Forecast container cargo volume in the target year is the potential container cargo volume based on the estimated economic scale and population of Myanmar.

Containerized Cargo Volume Estimation

Study team examines containerized cargo volume assuming the following.

Ratio of export container box and import container box 1:1
Ratio of empty container box : Import 10%, Export 25%
Weight of Container cargo : Import 13.9 ton / TEU, Export 10.6 ton / TEU

High Case : Total Container Cargo 4,014,000 TEU
Import container volume：2,007,000 TEU
Containerized cargo volume : 2,007,000 x 13.9 x 0.9 = 25,107,570 tons
Export container volume：2,007,000 TEU
Containerized cargo volume : 2,007,000 x 10.6 x 0.75 = 15,955,650 tons
Low Case : Total Container Cargo 3,064,000 TEU
Import container volume：1,532,000 TEU
Containerized cargo volume : 1,532,000 x 13.9 x 0.9 = 19,165,320 tons
Export container volume：1,532,000 TEU
Containerized cargo volume : 1,532,000 x 10.6 x 0.75 = 12,179,400 tons

As almost all container cargo of Myanmar has been handled at Yangon port, study team assume all of forecast container cargo volume of Myanmar will be handled in Yangon port.

② Fuel (Gasoline, Diesel and Jet Fuel)

Fuel cargo volume is examined by the following procedure.

Estimation of Necessary Primary Energy Volume in Tone of Oil Equivalent (TOE)
↓
Estimation of Local Energy Production Volume
↓
Local Energy Production Volume Conversion into TOE
↓
Estimation of Necessary Import Oil Volume

Estimation of Primary Energy in Tone of Oil Equivalent

To estimate Myanmar's consumption energy in 2025, study team refers to approximate correlation formula between primary energy consumption volume per capita and GDP per capita prepared by Professor Takeishi of Tokyo International University based on the World Bank "World Development Indicators, 2008".

Y = (X - 419.36) / 3.1586
Y：Energy consumption volume per capita （TOE : kg/capita）
X： GDP per capita(US$)

Year 2025
High Case : GDP per capita 2,036 US$
Y= (X - 419.36) / 3.1586 = 511.82 kg/capita
Necessary Primary Energy in TOE
0.512 ton / capita x 72,589,000 ＝ 37,165,568 ton
Low Case : GDP per capita 1,551 US$
Y= (X - 419.36) / 3.1586 = 358.27 kg/capita
Necessary Primary Energy in TOE
0.358 ton / capita x 72,589,000 ＝ 25,986,862 ton

Estimation of Myanmar's Local Energy Production

Myanmar is rich in natural resources. Study team estimates future supply volume of natural gas, coal, hydro-power and oil.

✓ **Natural Gas**

According to the JOGMEC (Japan Oil, Gas and Metals National Corporation) Report 2012/5, Myanmar government estimate that the demand for natural gas in 2020 will be 500～900MMcfd and that the supply volume will be able to meet the demand as new gas fields will be exploited. Study team assumes demand volume of natural gas in 2025 is 1.45 times the volume in 2020.

Tone of Oil Equivalent (TOE)
High Case
900 x 1.45 MMcfd = 1,305 x 1,000,000 x 365 ÷ 35.315 ÷ 1,000 x 1.06 = 14,297,168 ton
Low Case
500 x 1.45 MMcfd = 725 x 1,000,000 x 365 ÷ 35.315 ÷ 1,000 x 1.06 = 7,942,871 ton

✓ **Oil**

Existing oil refineries in Myanmar and their capacities are as bellows.

Thanbayakan Refinery	25,000 BPD
Chauk Refinery	6,000 BPD
Thanlyin Refinery	20,000 BPD
Total Capacity	51,000 BPD

Present refined volume is only about 20,000 BPD because import facilities for crude oil are insufficient. Almost 50% of oil products for local consumption are imported from Singapore.

In the suburbs of Mandalay, there is a new refinery development plan along the crude oil pipeline which connects Kyaukpyu to Yunnan province. New refinery will have a capacity of the 56,000 BPD and be under joint management of Myanmar and China. (JPEC Report, 2011 No.6, No.10)

Available maximum domestic consumption volume after completion of new refinery:

(51,000 +56,000) x 0.159 x 365 ＝ 6,209,745 tons

Study team regards this 6,209,745 ton as the maximum supply volume of the High Case and assumes that 50% of existing capacity will work in Low Case.

(56,000 + 51,000 x 1/2) x 0.159 x 365 = 4,729,853 tons

✓ **Coal**

According to the JCOAL (Japan Coal Energy Center) report, 4,590,000 tons of coal output is expected in 2025.

Study team regards this 4,590,000 ton as the maximum local production volume of the High Case and assumes that production volume of the Low Case will be 20% loss.

Tone of Oil Equivalent (TOE)

High Case 4,590,000 ton x 0.69 = 3,167,100 tons

Low Case 4,590,000 ton x 0.8 x 0.69 = 2,533,680 tons

✓ **Hydro Power**

Generated electrical power volume in 2011 is 9,710,000,000 kWh and hydroelectric power accounts for 75% of the total volume.

Myanmar is rich in water power because of large rivers, for example, Ayeyarwady river and Thanlwin river flow from north to south with many tributaries.

World Energy Council (WEC) estimates that Myanmar has 139TWh of annual hydroelectric power potential, which is more than ten times the present generated volume.

According to the “Project finding report for small scale hydroelectric power development for agricultural production improvement” by Agricultural Development Consultants Association (ADCA), another hydroelectric power facility of 9,950 MW capacity is expected to be available sometime from 2020 to 2025.

Additional power volume （24hrs）

9,950MW x 24 x 365 = 87,162,000,000 kWh

Tone of Oil Equivalent (TOE) (12hrs)

(87,162,000,000 x 0.5 + 9,710,000,000 x 0.75) ÷ 1.16 ÷ 10,000 ＝ 4,384,784 tons

✓ **Local Energy Production Volume Conversion into TOE**

High Case :

14,297,168 ＋ 6,209,745 ＋ 3,167,100 ＋ 4,384,784 ＝ 28,058,697 tons

Low Case :

7,942,871 ＋ 4,729,853 ＋ 2,533,680 ＋ 4,384,784 ＝ 19,591,188 tons

Necessary Import Volume

High Case : 37,165,568 – 28,058,697 = 9,106,871 tons

Low Case : 25,986,862 – 19,591,188 = 6,395,674 tons

Import Volume at Ports

High Case : 9,106,871 x 0.80 = 7,285,497 ton

Low Case : 6,395,674 x 0.80 = 5,116,539 ton

③ **Cement**

Study team estimates demand volume of cement consumption. Study team assumes the correlation between the GDP per capita and cement consumption volume per capita from the report of Professor Ouchi of Kochi University of Technology.

High Case : GDP per capita : 2,036 US$

Cement consumption volume per capita : 210kg

Total Volume : 0.21 ton / capita x 72,589,000 ＝ 15,243,690 tons

Low Case : GDP per capita : 1,551 US$

Cement consumption volume per capita : 170kg

Total Volume : 0.17 ton / capita x 72,589,000 ＝ 12,340,130 tons

Annual domestic consumption volume in 2012 is about 4,000,000 tons of which 3,000,000 tons are locally produced while the remaining 1,000,000 tons are imported.

There is a new cement plant development plan which is expected to start operation in 2016 financed by a cement company of Thailand in Mon state. Annual capacity will be 1,800,000 tons.

Besides the company from Thailand, German, French, Swiss, Chinese and Indian cement companies are said to be in talks with the Myanmar government concerning cement production. Therefore, domestic production capacity is expected to greatly increase with the introduction of advanced technology from abroad.

Study team assumes that above foreign cement companies shall develop same scale cement plants similar to Thailand's and commence operation by the time of 2025.

Domestic Production Volume Estimation in 2025

High Case : 1,800,000 x 6 ＋ 3,000,000 = 13,800,000 tons

Low Case : 1,800,000 x 5 ＋ 2,000,000 = 11,000,000 tons

Necessary Import Volume

High Case : 15,243,690 – 13,800,000 = 1,443,690 tons

Low Case : 12,340,130 – 11,000,000 = 1,340,130 tons

Import Volume at Port

High Case : 1,443,690 x 0.80 = 1,154,952 tons

Low Case : 1,340,130 x 0.80 = 1,072,104 tons

④ Cooking Oil

Cooking oil annual consumption volume per capita is 12.4 kg in Myanmar.

Total consumption volume in 2025

0.0124 ton x 72,589,000 ＝ 900,104 ton

Peanut oil and sesame oil used to be the main cooking oils, however, palm oil consumption volume has increased and it now accounts for over 50% of the consumption volume. Annual domestic production volume of cooking oil is about 500,000 tons.

Local palm oil production volume is expected to increase in line with the palm oil cultivation plan in Tanintharyi Region by Myanmar Government. On the other hand, import volume of palm oil may increase from Malaysia when ASEAN Free Trade Area comes into force.

Study team assumes the domestic cooking oil production volume will increase by 30% to 650,000 tons in 2025.

Import Volume : 250,000 ton

⑤ Iron Material (Billet) and Steel Product

In general, consumption volume of steel products increases to a certain level for the development of social infrastructure, houses, office buildings and factories in accordance with economic development.

Steel products demand volume in Myanmar is expected to increase for the time being as Myanmar requires improvement and development of many social assets.

Study team examines the correlation formula between steel products consumption per capita and GDP per capita from the consumption record of Indonesia, the Philippines, Thailand and Vietnam (source: South East Asia Iron & Steel Institute)

Y= 0.000030 X + 0.02173

Y : Steel Product Consumption Volume per capita (ton)

X : GDP per capita（US$）

Year 2025

High Case : GDP per capita 2,036 US$

Consumption Volume per capita: (0.00003 x 2,036 + 0.02173) = 0.083 tons

Total Volume : 0.083 x 72,589,000 ＝ 6,024,887 tons

Low Case : GDP per capita 1,551 US$

Consumption Volume per capita: (0.00003×1,551 + 0.02173) = 0.068 tons
Total Volume : 0.068 x 72,589,000 ＝ 4,936,052 tons

Steel products production volume is expected to increase to meet local demand from now on.

However, there are many problems in expanding the steel industry business in a developing country, such as the small scale domestic market, difficulty of fundraising, insufficiency of technical experts and so on.

Study team refers to the share of steel products import volume of the total consumption volume of Vietnam to estimate the future import volume share of Myanmar.

The ratio of import steel products and local products is almost 1:1 in Vietnam. Therefore, study team assumes that 50% of steel products consumption volume will be imported in future.

Study team examines the import volume of steel products and iron material assuming the following.

Ratio of import steel products volume and iron material volume 1:1
50 % of steel products volume will be imported as containerized cargo

High Case: Total import volume : 6,011,095 x 1/2 = 3,005,548 tons
Import volume at port : 3,005,548 x 0.80 =2,404,438 tons
Iron material (billet): 1,202,219 tons
Steel Products : 1,202,219 x 1/2 = 601,110 tons
Low Case: Total import volume : 4,954,925 x 1/2 = 2,477,463 tons
Import volume at port : 2,477,463 x 0.80 = 1,981,970 tons
Iron material (billet): 990,985 tons
Steel Products : 990,985 x 1/2 = 495,493 tons

⑥ Car

In accordance with economic growth, the number of cars will be increase in general. Al most all imported cars of Myanmar are used cars from Japan, however, it is expected that the market for new cars will improve in the near future. Generally, when GDP per capita exceeds US$ 4,000, the number of cars tends to sharply increase.

Study team forecast the number of cars from the correlation between GDP per capita and the number of cars per 1,000 people. (from the data of Japan Automobile Manufacturers Association, Inc, World car hold number in 2009)

Year 2020
High Case : GDP per capita 1,404 US$
Number of cars per 1,000 people : 30.9 units
Total numbers: 30.9/1000 x 68,083,000 ＝ 2,103,765 units
Low Case : GDP per capita 1,200US$
Number of cars per 1,000 people : 26.4 units
Total numbers: 26.4/1000 x 68,083,000 ＝ 1,797,391 units

Year 2025

High Case : GDP per capita 2,036 US$

Number of cars per 1,000 people : 44.8 units

Total numbers: 44.8/1000 x 72,589,000 ＝ 3,251,987 units

Low Case : GDP per capita 1,551 US$

Number of cars per 1,000 people : 34.1 numbers

Total numbers: 34.1/1000 x 72,589,000 ＝ 2,475,285 units

Table 4.2-12 shows forecast result of number of annual increase cars and number of trade-in cars from 2020 to 2025. Study team assumes that the average life of an imported car is 15 years in Myanmar for trade volume forecast.

Table 4.2-12 Forecast Result of Number of Annual Increase and Trade –in Cars

unit:unit

		2020	2021	2022	2023	2024	2025
High Case	Numbers of cars	2,103,765	2,333,409	2,563,054	2,792,698	3,022,343	3,251,987
	Number of annual increase		229,644	229,644	229,644	229,644	229,644
	Number of trade-ins		155,561	170,870	186,180	201,490	216,799
	Increase total numbers		385,205	400,515	415,824	431,134	446,444
Low Case	Numbers of cars	1,797,391	1,932,990	2,068,589	2,204,187	2,339,786	2,475,385
	Number of annual increase		135,599	135,599	135,599	135,599	135,599
	Number of trade-ins		128,866	137,906	146,946	155,986	165,026
	Increase total numbers		264,465	273,505	282,545	291,585	300,624

Source : Study Team

It is expected that the domestic car production number will increase in Myanmar in future. Study team assumes that the domestic car production in 2020 and 2025 is 10,000 and 50,000 units respectively. The conversion weight is 1 ton/ unit.

Year 2025 Import volume

High Case 396,444 tons

Low Case 250,624 tons

⑦ General Cargo

The average containerized ratio of import containerizable cargo from 2009 to 2012 is 15% at Yangon port. Study team assumes that the containerized ratio of import is 90% and that of export is 100% in 2025 as containerization is expected to accelerate. Study team forecast the general cargo volume in 2025.

High Case : Import Volume 21,494,970 x 10/90 ＝ 2,388,330 tons

Low Case : Import Volume 16,407,720 x 10/90 ＝ 1,823,080 tons

Import Volume at Port

High Case 2,789,730 x 0.80 = 2,231,784 tons

Low Case 2,129,580 x 0.80 = 1,703,584 tons

ii) Export Main Commodity

① Containerized Cargo

High Case : 4,014,000 TEU

Export : 2,007,000 TEU

2,007,000 x 10.6 ×0.75 = 15,955,650 ton

Low Case : 3,064,000 TEU

Export : 1,532,000 TEU

1,532,000 x 10.6 ×0.75 = 12,179,400 ton

② Timber

Myanmar government will place an embargo on timber exports from 2015. Therefore, study team assumes that there are no timber exports in 2025.

③ Rice

As rice is a staple food, the average annual rice consumption volume per capita is over 100 kg in Asia. According to the FAO Food Balance Sheet 2007, Myanmar's average annual rice consumption volume is estimated as 157 kg per capita.

Domestic Consumption Volume in Year 2025

Foodstuff	0.157 ton/capita x 72,589,000	=	11,396,473 tons
Animal food	4,000,000 ton		
Seed	670,000 ton		
Total	16,066,473 ton		

Production Volume （from FAO report 2008-2010 average）

Cultivation area 8,040,000 ha

Production Volume 32,820,000 ton （Chaff） 19,690,000 ton （Polished）

Unit production volume 4.08 ton/ha

There may be 2,000,000 – 3,000,000 tons remaining that could be exported, however, the average export volume of rice is about 700,000 tons from 2007 to 2010.

It is difficult to forecast a large increase in the rice export volume because of severe price competition, foreign exchange fluctuations and so on. Therefore, study team assumes that the export rice volume is within the range of 700,000 ton to 1,000,000 ton.

iii) Coastal shipping cargo volume and Inland water transport cargo Volume

Coastal and inland waterway transport cargo demand forecast of Yangon Port can be estimated by using the same method applied in 4.4.4 5) **Port Cargo Volume Forecast with Future Economic Scale**. The estimation results are shown in Table 4.2-13.

According to Table 3.5-1, the coastal shipping cargo increased only 3% in 2011 in comparison with the volume in 2006. The volume of inland waterway transport cargo is decreasing since 2004 and the volume in 2011 is only 50% of 2004. The coastal/inland waterway transport cargo is expected to increase in accordance with the economic development of Myanmar, however, it is assumed that the growth rate of inland and coastal cargo volume will be only a half of the whole cargo of Myanmar namely 3.8% per annum.

Table 4.2-13 Coastal/Waterway Transport Cargo Demand Forecast of Yangon Port

Unit; Thousand Tons

	2010	2015	2020	2025
Coastal Shipping Transport Cargo	1,070	1,370	1,650	2,000
Inland Waterway Transport Cargo	590	760	920	1,110

(Prepared by the Study Team)

iv) Result of Forecast

Table4.2-14 shows result of forecast by main commodity.

Table 4.2-14 Forecast Result by Main Commodity of Yangon Port in 2025

unit:ton

		2025	
		High Case	Low Case
Foreign Trade			
Import	Containerized Cargo	25,108,000	19,165,000
	Non Contaierized Cargo		
	Fuel	7,285,000	5,117,000
	Cement	1,155,000	1,072,000
	Cooking Oil	250,000	250,000
	Iron Mterial (Billet)	1,202,000	991,000
	Steel Product	601,000	496,000
	Car	396,000	251,000
	General Cargo	2,232,000	1,704,000
	total	13,121,000	9,881,000
	Total	38,229,000	29,046,000
Export	Containerized Cargo	15,956,000	12,180,000
	Non Containerized Cargo		
	Rice	1,000,000	700,000
	Total	16,956,000	12,880,000
total		**55,185,000**	**41,926,000**
Coastal Trade		**2,000,000**	**2,000,000**
Total		**57,185,000**	**43,926,000**

Source : Study Team

v) Inland Water Transport Passenger

Table 4.2-15 shows Inland Water Transport Passengers numbers at Yangon port from 2005 to 2010.

Table 4.2-15 Inland Water Transport Passenger at Yangon Port (2005~2010)

	2005	2006	2007	2008	2009	2010
Passenger	25,345,000	26,328,000	26,886,000	27,418,000	27,109,000	27,571,000

Source : IWT

The growth rate of Inland water transport passengers number at Yangon port between 2005 and 2010 is 8.78%, therefore, study team assumes that same growth rate will continue to 2025.

Passenger numbers at 2025

27,571,000 x 1.0878 x 1.0878 x 1.0878 ＝ 35,489,483

4) Forecast of Container Cargo Related to SEZ

There are two types of SEZ related cargo, those generated by SEZ operation and those generated by the development of SEZ factories. Cargoes generated by SEZ operation are products and material.

Overseas operation of manufactures is for the purpose of lowering the cost of products, operations are standardized to secure the same quality no matter which country. Therefore, productivity with unit rate of factory area shall be almost same even in Japan or in foreign countries.

Study team sets up the cargo volume unit rate of a factory area by converting the production value amount of Japanese industrial parks to obtain production volume and material volume with unit rate of general factory area. Unit rate of material volume shall be calculated using the comparison ratio of total value amount of production and material of Japan in industrial statistics data.

a) Container Cargo Volume Generated with SEZ Operation

There are many industrial parks all over Japan, however, scale, character and production amount value are different depending on regional conditions and tenant factories. Study team selects some sample industrial parks for SEZ cargo volume estimation based on the scale and tenant type of industry expected to make inroads into Myanmar in future.

i) Sample of Japanese Industrial Park

① K Industrial Park （ I Prefecture ）

Tenant Industry： Medicines, Semiconductor, Automobile, etc.
Total Area： 311.0ha
Factory Area：： 264.4ha
Production Amount： JP¥ 417,200,000,000 （ Year 2005 ）
Unit Rate of production amount by area： JP¥1,577,920,000 / ha

② M Industrial Park （ T prefecture ）

Tenant Industry: Automobile, Construction machinery, Housing material, etc.
Total Area： 175.4ha
Factory Area ： 156.8ha
Production Amount： JP¥ 258,700,000,000 （ Year 2010 ）
Unit rate of production amount by area： JP¥ 1,649,870,000 / ha

Average unit rate of production amount by area of these two industrial park is JP¥ 1,613,890,000 /ha.

ii) Unit Rate of Material Amount by Area in Japanese Industrial Park

From the result of Industrial statistics in 2010, total amount of industrial products and material in the cities designated by ordinance are JP¥ 42 trillion 170 billion 1 million and JP¥ 24 trillion 868 billion 2 million respectively. That ratio is 1 and 0.59. Therefore, unit rate of material amount of industrial park is JP¥ 952,200,000 /ha.

iii) Conversion from Production and Material Value to Cargo Volume

Study team refers to the conversion rate of products and material amount to cargo volume from the Study report "Cargo distribution movement study result for Port of Tokyo and New Tokyo International Airport in 2010" by Tokyo Custom House. There is export and import container cargo volume and value amount of Tokyo port and New Tokyo International Airport.

Conversion from Production Amount to Cargo Volume

Study team assumes that almost of all production shall be containerized. Therefore, study team converts production amount to cargo volume with unit rate of export container cargo value of Tokyo Port. Materials value is also converted to cargo volume as same way of import cargo value of Tokyo Port.

Production amount	JP¥ 1,613,890,000 / ha	÷ JP¥ 868,132 /ton	= 1,859 ton / ha
Material amount	JP¥ 952,200,000 / ha	÷ JP¥ 527,708 /ton	= 1,804 ton / ha
Total			3,663 ton / ha

iv) Cargo Volume Forecast at each Target Year

① Target Year 2015

Operational Factory Area : 150ha

Export cargo volume	:	1,859＊150＝278,850 tons
Import cargo volume	:	1,804＊150＝270,600 tons
Total		549,450 tons

Conversion to Container cargo (conversion rate is from Tokyo Port data)

Export container cargo volume	: 278,850 tons ÷7.4 tons/TEU ＝37,682 TEU
Import container cargo volume	: 270,600 tons÷14.4 tons/TEU = 18,792 TEU
Total	56,474 TEU（75,364 TEU empty container included）

② Target Year 2020

Operational Factory Area : 450ha

Export cargo volume	:	1,859＊450＝836,550 tons

Import cargo volume : 1,804＊450＝811,800 tons
Total 1,648,350 tons

Conversion to Container cargo (conversion rate is from Tokyo Port data)
Export container cargo volume : 836,550 tons ÷7.4 tons/TEU ＝113,047 TEU
Import container cargo volume : 811,800 tons÷14.4 tons/TEU = 56,375 TEU
Total 169,422 TEU（226,094TEU empty container included）

③ **Target Year 2025**

Operational Factory Area : 780ha
Export cargo volume : 1,859＊780＝1,450,020 tons
Import cargo volume : 1,804＊780＝1,407,120 tons
Total 2,857,140 tons

Conversion to Container cargo (conversion rate is from Tokyo Port data)
Export container cargo volume : 1,450,020 tons ÷7.4 tons/TEU ＝195,949 TEU
Import container cargo volume : 1,407,120 tons÷14.4 tons/TEU = 97,718 TEU
Total 293,667 TEU（391,898TEU empty container included）

Table 4.2-16 Forecast of Cargo Volume Generated with SEZ Operation

	2015	2020	2025
Ton	549,000	1,648,000	2,857,000
TEU	75,000	226,000	392,000

(Prepared by the Study Team)

b) Container Cargo Volume for SEZ Factories Construction Material

Factory structure for labor intensive industry is mainly steel frame and reinforced concrete. On the other hand, structure for device equipped industry is mainly reinforced concrete. Table 4-2-17 shows standard construction material volume per unit area for both structures. 'Others' include roof material, heat insulator, flooring, wall panel, window, M&E, etc.

Study team assumes that construction ratio of labor intensive type and device equipped type is 1:1.

Table 4.2-17 Unit Rate of Factory Construction Material (ton/m2)

	Labor intensive type	Device equipped type
Steel frame	0.05	0.02
Reinforced concrete	0.8	0.9
Others	0.04	0.07

(Prepared by the Study Team)

i) Target year 2015

Study team assumes factory area is 85 % of SEZ operational area.

Factory area : 150ha ×0.85 = 127.5 ha
Average the building –to- land ratio : 50%
Amount of floor space : 127.5ha ×0.50 = 637,500 m2

① Steel frame

0.05 t/m2 ×637,500×0.5+ 0.02×637,500×0.5＝22,313 ton

② Reinforced concrete

0.8 t/m2 ×637,500×0.5 + 0.9 ×637,500×0.5＝541,875 ton
Cement 541,875÷2.4×0.25＝56,445 ton
Re-bar 541,875÷2.4×0.12＝27,094 ton

③ Others

0.04 t/m2 ×637,500×0.5+0.07 t/m2 ×637,500×0.5＝35,063 ton

ii) Target year 2020

Factory area : 300ha ×0.85 = 382.5 ha
Average the building -to- land ratio : 50%
Amount of floor space : 382.5ha ×0.50 = 1,912,500 m2

① Steel frame

0.05 t/m2 ×1,912,500×0.5+ 0.02×1,912,500×0.5＝66,938 ton

② Reinforced concrete

0.8 t/m2 ×1,912,500×0.5 + 0.9 ×1,9127,500×0.5＝1,625,625 ton
Cement 1,625,625÷2.4×0.25＝169,336 ton
Re-bar 1,625,625÷2.4×0.12＝81,281ton

③ Others

0.04 t/m2 ×1,912,500×0.5+0.07 t/m2 ×1,912,500×0.5＝105,188 ton

iii) Target Year 2025

Factory area : 780ha ×0.85 = 663 ha
Average the building -to- land ratio : 50%
Amount of floor space : 663 ha ×0.50 = 3,315,000 m2

① Steel frame

0.05 t/m2 ×3,315,000×0.5+ 0.02×3,315,000×0.5＝116,025 ton

② Reinforced concrete

0.8 t/m2 ×3,315,000×0.5 + 0.9 ×3,315,000×0.5＝2,817,750 ton
Cement 2,817,750÷2.4×0.25＝293,516 ton
Re-bar 2,817,750÷2.4×0.12＝140,888 ton

③ Others

0.04 t/m2 ×3,315,000×0.5+0.07 t/m2 ×3,315,000×0.5＝182,325 ton

Table 4.2-18 Forecast of Cargo Volume for SEZ Factory Construction Material

unit : ton

	2014 -2020	2020 -2025
Steel Frame	8,900	9,800
Cement	22,600	24,000
Re-bar	10,800	11,900
Others	14,000	15,400
Total	56,300	61,100

(Prepared by the Study Team)

Import container cargo volume is converted to TEU unit with same ratio of 14.4 tons /TEU as used in 5.1.1.-5).

Table 4.2-19 Forecast of Container Cargo Volume for SEZ Factory Construction Material

unit : TEU

	2014 -2020	2020 -2025
Container Cargo	3,910	4,243

(Prepared by the Study Team)

c) Total Container Cargo Forecast Volume Related to Thilawa SEZ

Table 4.2.20 shows forecast result of container cargo volume related to Thilawa SEZ.

Table 4.2-20 Forecast of Container Cargo Related to SEZ

Year	2015	2020	2025
TEU	79,000	230,000	396,000

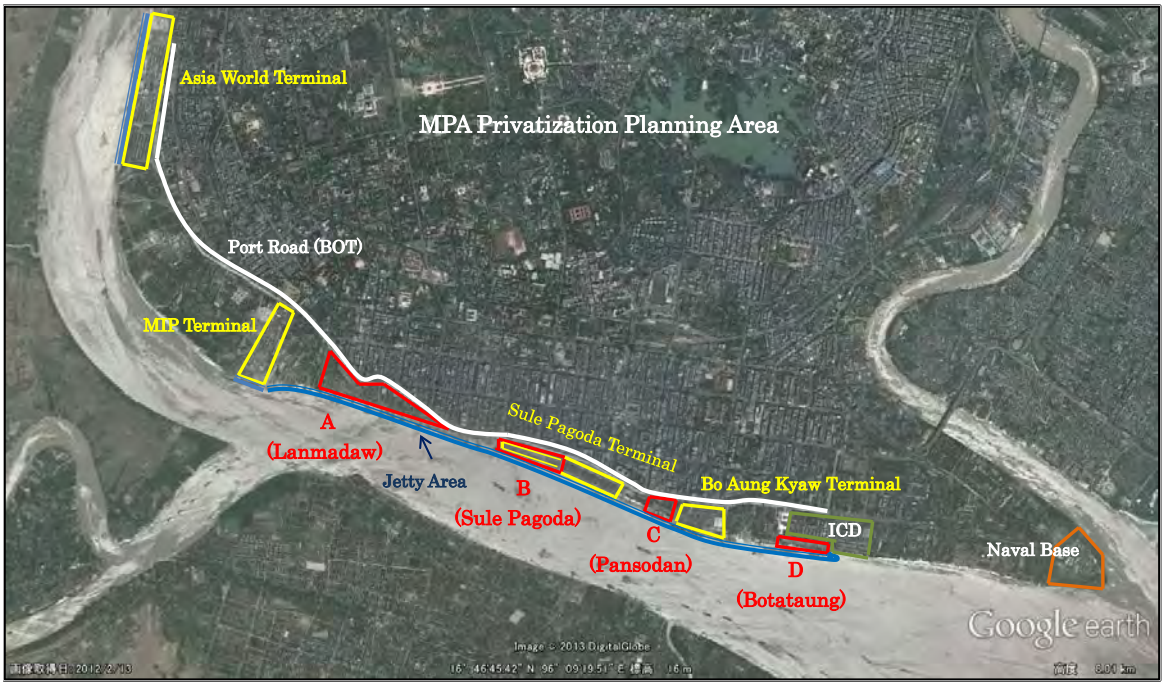
(Prepared by the Study Team)

Study team regards those forecast container cargo volume related to Thilawa SEZ shall be included in the forecast container cargo volume of Myanmar which is shown in Table 4.2-8.

4.2.2. Yangon Port Development Plan

(1) Future Port Development Project Planned by MPA in Yangon Main Port

MPA is promoting privatization of the port sector activities by the introduction of private funds as explained in **2.4.3 Privatization of the Port Sector,** In connection with this strategy, MPA is floating 4 projects (A, B, C and D) described in Figure 4.2-3 to the public. Some privatization proposals from private companies are being evaluated by MPA. MPA intends to establish joint ventures with eligible private companies for the implementation of privatization schemes.



A:Lanmadaw Foreshore Area

B:Sule Pagoda Wharf Area

C:Nanthida and Pansodan Area

D:Botataung Foreshore Area

Source：MPA

Figure 4.2-3　Future Development Projects at Yangon Main Port by MPA

The scope of the projects is shown in Table 4.2-21

Table 4.2-21 Scope of the Privatization Projects

A : Lanmadaw Foreshore Area	Upgrading of the local jetties as international standard inland port terminals, development and reconstruction of infrastructures as modernized commercial buildings at Lanmadaw Foreshore Area , between Ywarthit Creek and Sintoodan Jetty.
B : Sule Pagoda Wharf Area	Upgrading and renovation of Sule No(1), (2), (3) and (4) wharves as a multi-purpose terminal to accommodate international general/ container cargo vessels which shall include renovations and strengthening of wharf structures, installation of cargo handling equipment, construction of port related facilities at the back-up area.
C : Nanthida and Pansodan Area	Upgrading of the Nanthidar and Pansodan-Dala passenger jetties as modernized passenger terminals, development and construction of modernized commercial buildings at back-up area.
D : Botataung Foreshore Area	Expansion of back-up area of Botataung foreshore by constructing new revetment and reclamation for implementation of the recreational and commercial buildings at the project area.

Source : MPA

Basic concept of the future development plan of Yangon Main Port can be summarized as follows

1) Introduction of private funds through a joint venture formed with MPA
2) Upgrading and renovation of the existing terminals
3) Utilization of the water front area for the recreational and commercial use

The above basic concept of MPA is in conformity with the policy recommended by the Study Team given in **4.1.4 Basic Policy Yangon Port development** which states that the remaining water front areas should be used for facilities which directly benefit the lives of citizens such as passenger terminals, domestic transport terminals, promenades, shopping centers and office buildings.

(2) Port Facilities for Coastal/Inland Waterway Transport

1) Cargo Handling Productivity

Inland waterway transport ships (Figure 3.2-11) mainly berth at pontoon type jetties. Based on the observation and measurement of cargo handling operations, cargo manual cargo handling productivity can be estimated at about 17,300 tons/berth/year (=0.020 x 60 x 60 / 10 x 8 x 300) .

- Unit carrying weight : 20 Kg/person/time
- Manual transport interval : time/10 seconds
- Daily working hours : 8 hours
- Number of ships berthing for one year : 300 ships/year/berth

In case a pontoon jetty is to be replaced with a fixed type jetty which allows the use of cranes for cargo handling, cargo handling productivity is expected to reach about 57.600 tons/berth/year.（=2x60/5x8x300）.

- Unit hanging weight by crane : 2 tons/time
- Cycle time of hanging : 5 minutes/time
- Daily working hours : 8 hours
- Number of ships berthing for one year : 310 ships/year/berth

Coastal shipping ships (Figure 3.2-11) berth at fixed piers and pontoon type jetties. The cargo handling is conducted by using equipment. The cargo handling of the coastal ships can be estimated at about 100 thousand tons/berth/year (=5x60/7.5x8x310） when cranes of 5 ton capacity are used for the handling.

- Unit hanging weight by crane : 5 tons/time
- Cycle time of hanging : 7.5 minutes/time
- Daily working hours : 8 hours
- Number of ships berthing for one year : 310 ships/year/berth

2) Facility Planning

Coastal/inland waterway traffic and passenger transport which play important roles in waterborne transport at Yangon Port is undertaken at many pontoon jetties which is able to adapt to the tidal changes of about 6 m (see Figure 3.2-9). Pontoon jetties at Lanmadaw extended over a distance of about 1.5 km are the major coastal/inland waterway transport facilities. Due to the construction of a port road in addition to the original narrow land space the cargo handling

productivity has become worse.

There are a total of 36 berths of the coastal/inland waterway transport in Yangon Main Port.. Manual handling operations are conducted at pontoon type jetties which are used for handling coastal/inland waterway cargo. As mentioned above, it is difficult to meet demand estimated in Table 4.2-9. Instead of increasing the number of berths, it will be possible to meet the handling capacity increase by changing pontoons to fixed type jetties which allow efficient mechanical handling operations. The mechanical cargo handling productivity will become 3.3 times of the manual cargo handling productivity as given in 1) Cargo Handling Productivity. By the year 2015, 2020 and 2025, about 20 %, 30 % and 40 % of pontoon jetties are recommended to be changed to fixed type jetties respectively to meet the future cargo handling demand.

As a lot of heritage buildings exist in CBD which is the hinterland of Yangon Port, comprehensive redevelopment of CBD including the water front area of Yangon River should be done by making good use of those heritage buildings. Lanmadaw and Botahtaung areas which are used for coastal/inland waterway transport including passenger transport are too narrow for efficient cargo handling. Thus these areas should be used for passenger terminals, promenade, shopping centers and office buildings as valuable waterfront areas.

In accordance with the expected development of land transport means, the number of water borne transport passengers is not expected to increase on a large scale. As shown in (1) Future Port Development Plan of Yangon Port Prepared by MPA above, the passenger terminal development project is expected to be implemented. Accordingly, capacity of passenger transport will be increased to meet the increase of passenger transport demand (although the increase is estimated to be minimal).

(3) Yangon Port Development Plan

International cargo will be handled at existing port facilities such as Asia World Terminal, MIP Terminal, Sule Multi-purpose Terminal, Bo Aung Kyaw Terminal and Inland Container Depots in Yangon Main Port. However, due to limited land, expansion of facilities in addition to the ongoing expansion is not possible in Yangon Main Port area. It will not be possible to handle the entire portion of Yangon Port containers at Yangon Main Port alone in 2015 because it will take time to complete container terminal expansion projects which are prepared by the existing terminals. Thus port facilities needed to handle future increasing cargo should be constructed at Thilawa Area Port which has deep water and a wide land area (Figure 4.2-14). Additional facilities will be needed even after the completion of the whole planned container terminals in Yangon Main Port and Thilawa Area Port after 2022 which is indicated in Figure 5.2-2.

Additional berth needs in Yangon Port in 2025 is estimated taking into account cargo demand estimate which is shown in Table 4.2-14and Table 4.2-22 and the total number of available berth including the existing and planned in 2025. The results are shown in Table 4.2-23. A new terminal development with berths of 6,600m in total length will be needed after the completion of the whole

Thilawa area port.

Table 4.2-22 Required Berth Number in Yangon Port and Thilawa Area Port in 2025

	Cargo volume (2025)		Existing berth			Current expansion plan			Objective ship		Annual handling capacity		Required berth		Additional berth	
									Size	Draft						
General cargo(cement, metal, other GC)	5,441,000	ton	Sule	1,026	m	MEC	600	m	Yangon 15,000DWT	9m	200,000	t/B	5,500	m	2,651	m
			Bo Aung Kyaw	223	m	MSPL(Plot 10,11)	400	m			(1,000)	(t/m)	28	B	13	B
			MIPL(Plot 4)	200	m	UMEHL(Plot 12,13)	400	m	Thilawa 20,000DWT	9m						
			Hteedan Oile	1	B											
			Sub-total	1,449	m	Sub-total	1,400	m								
Vehicle	396,000	unit /ton	Exclusive use	0	m	Exclusive use	0	m	54,000GT	9m	200,000 (4,300)	unit/B (unit/ship)	2	B	2	B
Grain	1,000,000	ton				Thilawa (Plot 20, 21, 28, 29, 30)	1,000		15,000DWT	9m	200,000 (1,000)	t/B (t/m)	5	B	0	B
Petroleum	7,285,000	ton	MED	2	B	Plot 1,2	2	B	15,000DWT	8m	720,000	t/B	10	B	-3	B
						Plot 3	1	B								
						Plot 14-19	6	B								
						Plot 32-33	2	B								
			Sub-total	2	B	Sub-total	11	B								
Container			Hteedan(3)	640	m				1,000TEU (15,000～20,000DWT)	9m	206,000	TEU/B	37	B	12	B
			AWPT(4)	841	m											
			MIP(2)	310	m	MIP(2)	390	m								
	(4,014,000)	TEU	Bo Aung Kyaw (1)	224	m	Sule (3) (conversion from GC berth)	548	m								
	41,063,000	ton	MITT(5) (Plot5-9)	1,000	m	MPA(5) (Plot22-26)	1,000	m								
			Sub-total	3,015	m	Sub-total	1,938	m								
				15	B		10	B								
Coastal shipping	2,000,000	ton		8	B	Re-development			1,000DWT	4.2m	100,000	t/B	20	B	12	B
Inland waterway	1,000,000	ton		36	B	Re-development				2.4m	21,600	t/B (manual)	32 (manual)	B	0	B
											79,200	t/B (mechanical)	4 (mechanical)	B	0	B
Passenger (IWT, Private)	35,490,000	pax	Pansodan jetty (ferry)	2	B	Re-development				2.4m			2	B	0	B
			Botahtaung jetty	4	B	Re-development							4	B	0	B
			Wardan jetties	Cargo-cum-passenger ship use	B	Re-development										
			Shin O Tan jetties			Re-development										
Total cargo	58,185,000	ton														

Source: Study team

1) Shortage of Berthing Facility

In 2025, Yangon port's cargo handling facilities will be insufficient to cope with the increasing cargo volume. Shortage of berthing facilities at Yangon port is shown in Table 4.2-23.

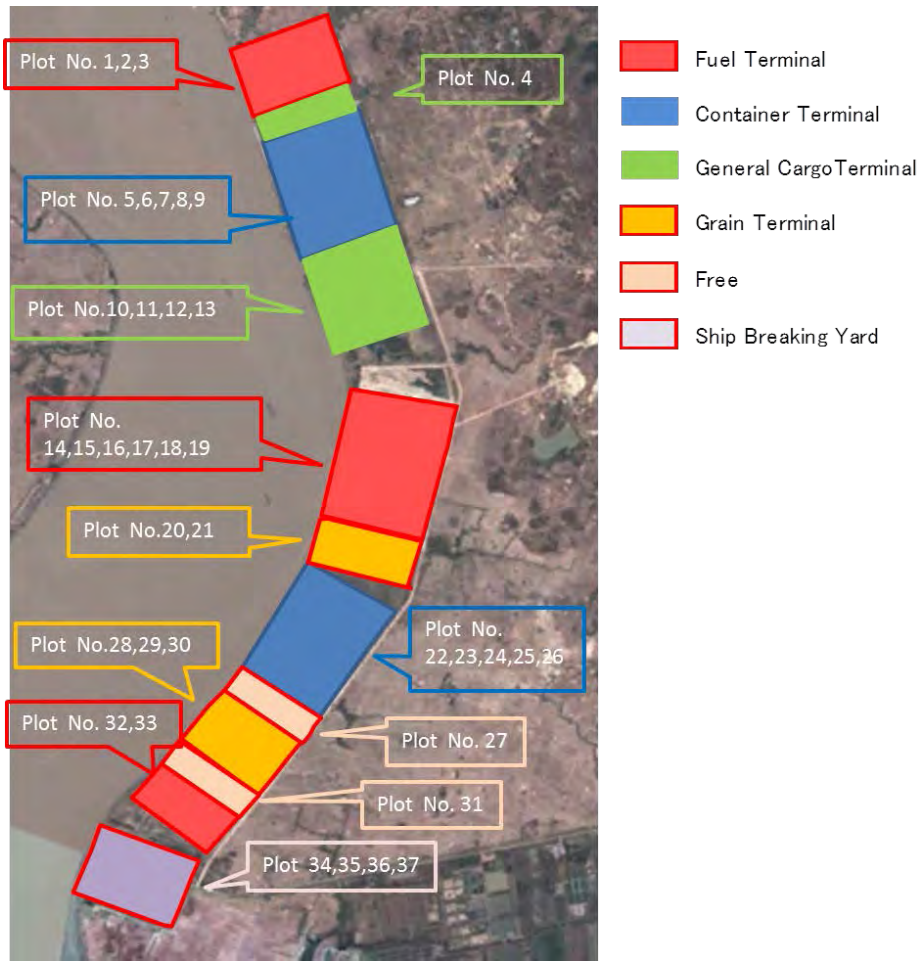
Table 4.2-23 Shortage of Berthing Facilities at Yangon Port in 2025

Type of Cargo	Required number of Berths	Total length (m)	Depth (m)
General Cargo	13	2,600	9
Container Cargo	12	2,400	9
Auto Mobile	2	400	9
Coastal Cargo	12	1,200	5

Source: Study Team

2) Container Berth Development in Thilawa Area

Figure 4.2-4 shows current use of Thilawa area 37 plots managed by MPA.



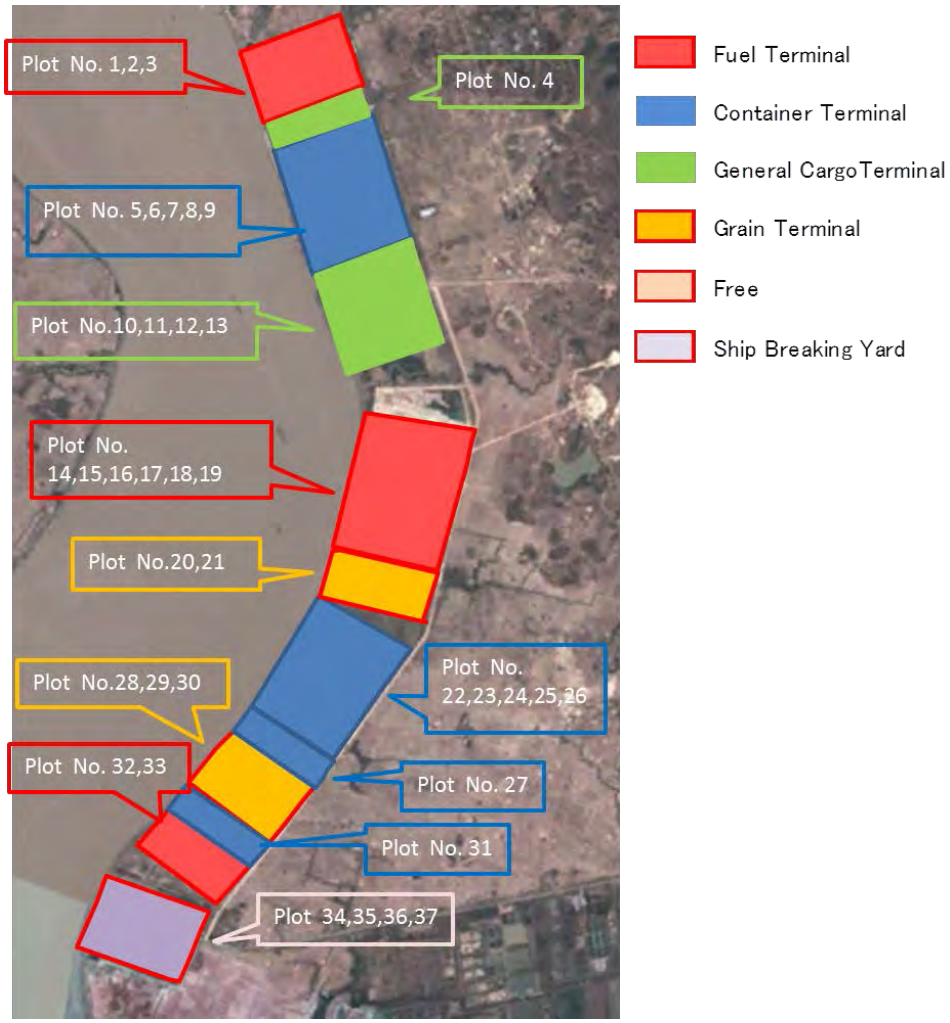
Source: Study team

Figure 4.2-4 Current Use Plan of Thilawa Area 37 Plots

As use of Plot No.27 and No.31 has not been decided, the study team recommends that both plots

should be developed as container cargo berths. In addition to these two plots, it is necessary to develop 37 new berths with a total length 6,200m, including rearrangement of present use plan of 37 plots to cope with the increasing cargo volume.

Figure 4.2-5 shows use plan of plot No.27and No.31as container terminal.



Source: Study team

Figure 4.2-5 Use Plan of Plot No.27and No.31 as Container Terminal

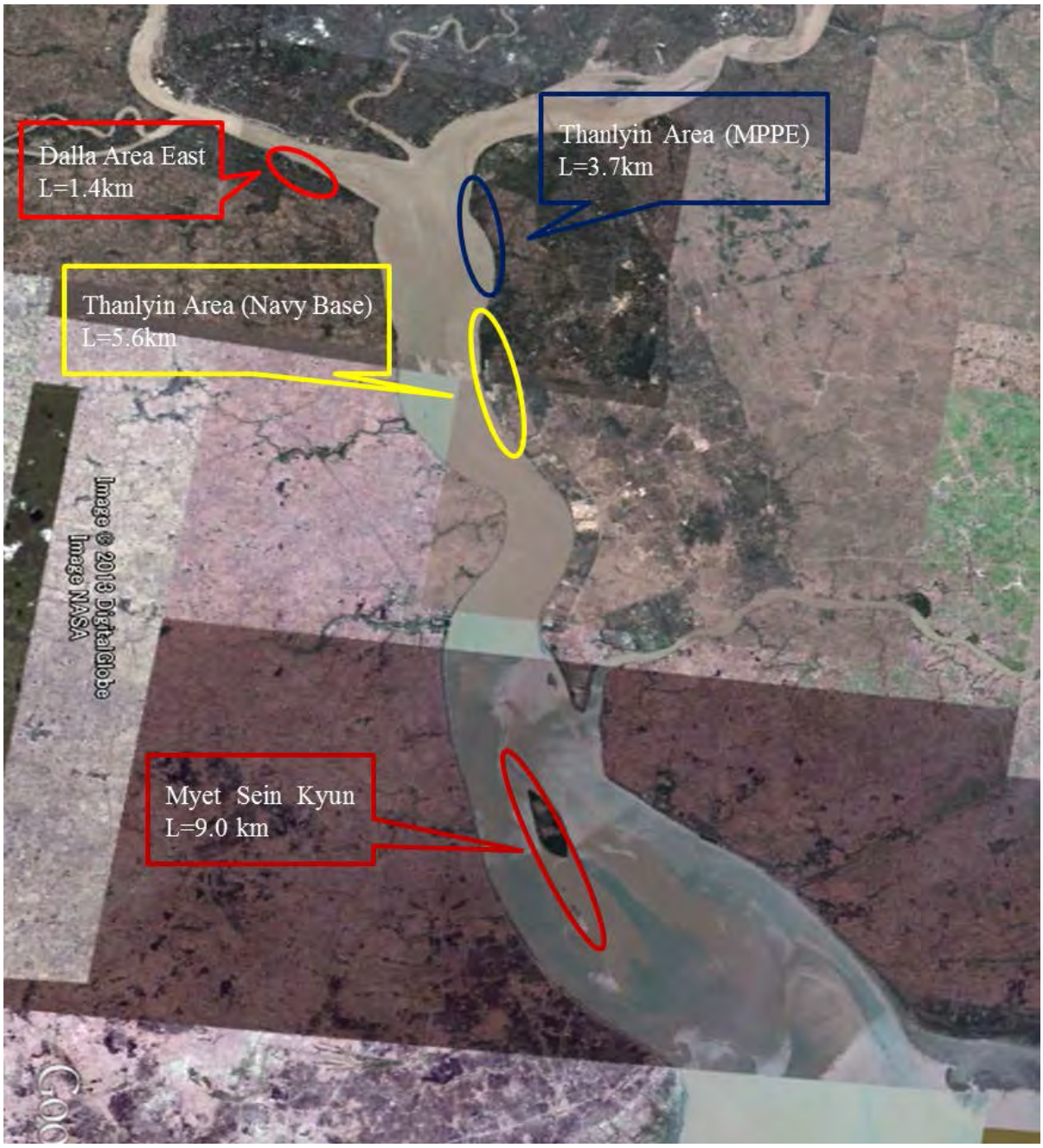
3) Candidate for Future Port Expansion Area

There are four candidate areas for future port expansion in Yangon port where the necessary water depth is available.

- Shoreline and hinterland occupied by MPPE in Thanlyin area (available shoreline is about 3.7 km)
- Shoreline and hinterland occupied by Navy Base in Thanlyin area adjoining above MPPE area (available shoreline is about 5.6 km)
- East side of Dalla area, MPA's land (available shoreline is about 1.4km)
- Shoal of Myet Sein Kyun, sandbank of Yangon river, south of Thilawa area (available

shoreline is about 9.0km)

Figure 4.2-6 shows four candidate areas for future port expansion.



Source: Study team

Figure 4.2-6 Four Candidate Areas for Port Expansion

4) Outline and Evaluation of Four Candidate Areas

- Shoreline and hinterland occupied by MPPE in Thanlyin area (available shoreline is about 3.7 km)

  MPPE occupies shoreline and hinterland currently. There are five fuel jetties along the approx.

3.7km shoreline and some oil tanks are scattered on shore. Hinterland is flat and wide, and residents are few.

There are two bridges across Bago River, Thanlyin Bridge and Bago Bridge. New bridge construction beside Thanlyin Bridge is in the planning stage. It is expected that road transportation will become more convenient after completion of the new bridge.

As new fuel terminals are being developed in Thilawa area, old MPPE facilities will eventually cease to be used for import fuels.

- Shoreline and hinterland occupied by Navy Base in Thanlyin area adjoining above MPPE area (available shoreline is about 5.6 km)

  Navy base occupies shoreline and hinterland currently. There are four fuel jetties and shipyard along the approx. 5.6km shoreline. Hinterland is flat and wide, and residents are few.

  There are two bridges across Bago River, Thanlyin Bridge and Bago Bridge. New bridge construction beside Thanlyin Bridge is in the planning stage. It is expected that road transportation will become more convenient after completion of the new bridge.

  As to Navy Base's use change, high level decision-making within the government that takes into account national economic development is necessary when contemplating the conversion of the Navy Base for other purpose.

- East side of Dalla area, MPA's land (available shoreline is about 1.4km)

  Land is owned by MPA. There are two jetties and some shipyards along the approx. 1.4km shoreline. Hinterland is flat, however, many people reside in the hinterland about 200m from shoreline.

  There is no bridge in Yangon River and Road development is insufficient in Dalla area. Bridge which connects Yangon main port and Dalla area, and road development is necessary.

- Shoal of Myet Sein Kyun, sandbank of Yangon river, south of Thilawa area (available shoreline is about 9.0km)

  Present condition is sandbank from Myet SEin Kyun to Middle Bank. Prior to port development, land development by reclamation and access bridge from Thilawa side and road development is necessary.

Table 4.2-24 shows comparison of land use condition of the four candidate areas for port expansion.

Table 4.2-24 Comparison of Land Use Condition of Four Candidate Areas for Port Expansion

	Dalla	Thanlyin MPPE	Thanlyin Naval Base	Myet Sein Myun
Shore Line length (km)	1.4	3.7	5.6	9.0
Water Depth (m)	9	7 - 10	8.5	5 - 10
Land Owner	MPA	MPPE	Navy	
Land Use	Shipyard, Factory	Fuel Base	Naval Base	
Present Facilities	Jetty, Shipyard, Factory	Fuel jetty, Fuel tank	Navy Jetty, Shipyard	
Residents	Few residents within 200m from shoreline	no	no	no
Transportation Network	Small ferry boat	Road	Road	Nothing
Issues	Need of Yangon river cross bridge (air draft 50m) and road connnection, residents removal,	Insufficient water depth at some areas	Alteration of naval base use, Insufficient water depth atsome areas	Large land preparation by reclamation, Need of Yangon river cross bridge (special air draft is not neccesary) and road connection
Others	Yangon river cross bridge is in the planning stage			
Total Evaluation	○	◎	○	△

Source: Study team

4.2.3. Actions to be taken by MPA

The following projects are deemed necessary based on the findings of the above study but are assumed not to be carried out under the Urgent Development Plan.

(1) Channel Improvement

There is a size restriction on vessels which can enter Yangon Port due to difficulty in the channel depth maintenance as described on Table 5.4-34 Size Restriction on Vessels in Yangon Port in 5.4.5 Navigation Planning Safety. If the channel depth can be increased and maintained, ships can enter the port any time regardless of tide (tidal range of about 6m) and large size ships can enter the port. As a result, effective utilization of the port facilities can be expected. However, there are many technical problems to be resolved for the dredging and maintenance of channel in Yangon River which is rich in suspended soil. Therefore, the study was made on the present size restriction of vessels in Yangon Port.

Additional studies showing in Table 4.2-25 and Table 4.2-26 are needed on the channel improvement which is an important issue to be resolved for realizing effective use of Yangon Port.

Table 4.2-25 Survey Items and Specification for Sand-spit Formation System Study

Survey Item	Specification	Remark
Bathometric survey		2 times/year before and after monsoon season
Current and sedimentation	5 points	One month during monsoon and dry seasons respectively
Bottom Sediment Sampling Survey	Sampling by 200m x 200m grid location	

Prepared by the Study Team

Table 4.2-26 Survey Items and Specification for Channel Deepening and Widening

Survey Item	Specification	Remark
Bathymetric Survey (Channel)	cross section @200m along the channel	2 times/year before and after monsoon season
Bathymetric Survey (Broad Area)	@500m	Broad area survey including channel
Wave and Current (Off-shore, Elephant Point)	2 locations at Elephant Point and offshore with water depth of more than 20m.	Long term measurement
Wave, Current and Turbidity	More than 2 locations at Elephant Point and at other locations along the channel. Multilayer survey of current and turbidity at each location.	During the high wave conditions of monsoon season with offshore wave measurement above
Bottom Sediment Sampling Survey	Sampling by 500m x 500m grid location	Same area with Bathymetric Survey (Broad Area)

Prepared by the Study Team

(2) Navigation Safety

Present problems and countermeasures of the safety navigation are summarized in Table 4.2-27 of **5.4.5 Navigation Safety Planning.** In order to secure the navigation safety, it is necessary to develop the navigation safety system (VTMS) urgently.

The VTMS consists of the radar site for tracking the echoes from vessels navigating in the port waters and coastal waters, and the VHF radio transmission/receiving stations for communications with navigating vessels, and the AIS allowing vessels to identify the attribute information on other vessels. This system will support the safety of navigation for vessels, monitoring of off-route vessels, provision of dangerous information, anchorage management and management of vessels entering and leaving

ports.

Table 4.2-27 Present problems and countermeasures of the safety navigation

Subjects	Problems	Countermeasures
Aids to navigation Electrical nautical charts (Objective) • Improving the aids to navigation so that the vessels are capable to navigate at night.	Vessels calling at the port are restricted to navigating at only daytime due to the deficiency of lighthouses and aids of navigation, and the absence of electrical nautical charts. Those problems causes casualties.	Defining the improvement plan of aids to navigation and installing the lighthouses, buoys, and leading lights according to the plan. The plan excludes the electrical nautical charts because they are controlled by Myanmar Navy.
Vessel Traffic Management System (VTMS) (Objective) • Improving the port operation efficiency and defining the safety navigation measures at Outer Bar, Yangon river navigation channel, and Thilawa Area Port .	All vessels calling at Thilawa Area Port Area Port must navigate through Outer Bar and the Yangon river navigation channel where the water depth is critically shallow. The deficient of aids to navigation such as lighthouses and buoys and the strong tidal current of the channel are the critical problems of the safety navigation. The problems restrict the vessels to navigating at daytime and the restriction is a crucial factor decreasing the port operation efficiency.	In order to improve the safety navigation and the port operation efficiency corresponding to the vessels increasing rapidly, it is requisite to introduce and install the VTMS composed of a radar, AIS base, camera equipment, and VHF.
Improving Pilot Service (Objective) • Improving the safety and efficiency • Constructing a fixed pilot station at Outer Bar and replacing the pilot boats	• Pilots get on board the small pilot boats from the pilot vessels for providing the pilot services. During the monsoon season, it is too danger for the pilots to get on board the boats because the motion of the pilot vessel is violent due to the rough weather.	• Replacing the pilot vessels to the fixed pilot station. • Examining and executing the replacement of the present pilot boats to the larger, faster, and safer offshore boats. Additionally, introducing a helicopter should be considered.

Prepared by the Study Team

(3) Introduction of a port EDI

The Port EDI is a system to handle port activity relevant declaration or reporting such as port entry document and mooring facility use request document by electric means

Table 4.2-28 Effect of the introduction of the Port EDI

Before Port EDI introduction	After Port EDI introduction
➢ Documents preparation is needed for each relevant administrative organ ➢ Duplicated data are required from each administrative organ ➢ Heavy work load is required for documentation	➢ Document submission to several offices can be performed simultaneously by one time input and transmission ➢ Document submission can be made any time and any place where internet connection is available ➢ Substantial work simplification can be achieved

Prepared by the Study Team

In order to achieve effective port management and operation, it is necessary to introduce an Electric Data Interchange system including the documentation relevant to port entry and exit, database and accounting.

(4) Enactment of a New Port Act

1) Necessity of Port Development Plan

Effective use of waterfront area is very important issue for any nation. In this respect, waterfront in the port area plays an important role in socio-economic development of the country as well. A long-term approach to managing and utilizing the water and land area adjacent to the waterfront is required for the orderly development of national territory.

In Japan, the Minister of Land, Infrastructure, Transport and Tourism shall formulate a Basic Policy for the development, utilization and preservation of ports in accordance with the Port and Harbor Act. The following items are included in the Basic Policy.

① Matters concerning the direction of the development, utilization and preservation of ports
② Basic matters concerning the location, functions and capacities of ports
③ Basic matters concerning the preservation of environment to be considered in the development, utilization and preservation of ports
④ Basic matters concerning the need to ensure cooperation among ports which have a close relationship from economic, natural or social viewpoints
⑤ Basic matters concerning effective port operation including the utilization of the capacity of private sector

Subsequently, a port authority formulates a Port Plan based on the Basic Policy. The port authority shall hear opinions of a Local Council for Port Plan in the formulation of Port Plan. The Minister of Land, Infrastructure, Transport and Tourism shall hear opinions of Transport Policy Council for the Minister of Land, Infrastructure, Transport and Tourism for the Port Plan. Port development is to be implemented based of the Port Plan.

Currently, The Rangoon Port Act, The Port Act and Outports Act which were enacted in 1905, 1908 and 1914 respectively are acts relevant to ports in Myanmar. There are no clause covering the formulation of port master plan. Although harbor area is designated, water and land area of the port are used in a disorderly fashion by each property owner because MPA does not have any right to control usage of water area in the port. Under this situation, orderly use of water and land area in the port cannot be achieved because cargo distribution function and urban function are forced to coexist.

The following measures are expected to assist in establishing the orderly development of the harbor and thereby support the socio-economic development of Myanmar.

(1) Formulate a Port Act which regulates planning, development and operation of port in general
(2) Formulate a Port Plan which is authorized by a Port Act
(3) Conduct orderly development and management of a port in accordance with a Port Plan

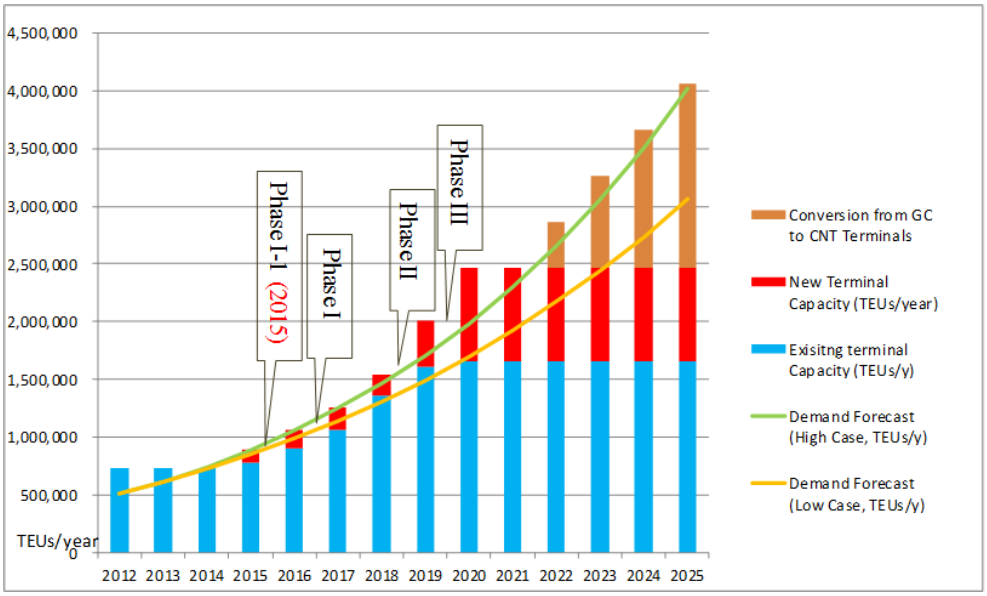
(5) Development of a Port Master Plan

Land use plan which is able to cope with future cargo transport demand shall be examined in order to formulate the regally authorized Port Plan. Following matters shall be considered in making a land use plan.

① Securing of water area and water depth
② Securing of land
③ Land ownership

In order to formulate a Port Plan, it is required to make several alternative plans of water and land use from national development view point without considering current restriction on land use resulting from ownership issues and the current land use situation. Thereafter, advantage and disadvantage of the alternative plans shall be evaluated. A Port Mater Plan shall be established through additional study on the alternative plans and consultation with a Steering Committee composed of stakeholders of the plans.

As shown in Figure 4.2-7, even after the completion of planned container terminals in Yangon main port and Thilawa area port in 2022, container terminals are not sufficient to handle the future demand



Prepared by the Study Team

Figure 4.2-7 Demand Forecast and Phased Development Program of Thilawa Area Port Terminal

(6) Development of Deep Sea Ports

As described in **4.1.3 Deep Sea Port,** due to the limited water depth of 9 m at the Yangon Port channel, only feeder container ships of 1,000 TEU from Singapore can call Yangon Port. Taking into account the economic development of Myanmar, the country should develop ports which can accommodate container ships of about 40,000 DWT which are sailing in intra-Asia shipping routes. Taking into account the trends of the changes in container ship size in the world and Asian region, Myanmar needs to develop deep sea ports of 14 m deep which are able to accommodate container ships of 4,000 TEU (50,000 DWT, 13 m draft) in the vicinity of the Yangon area in the future.

For the development of deep sea port plan, a detailed study including demand forecast and selection of the construction site is needed.

The necessity of deep-sea port and preliminary examination results are shown in the study report titled “Preliminary Study on National Port Development Plan in Myanmar” prepared by the Port and Harbour Bureau, Ministry of Land Infrastructure, Transport and Tourism of Japan in February 2013. In the report, it is concluded that the development of a deep-sea port with a depth of 14m which is capable of accommodating 3,000 to 5,000 TEU container ships is needed in the vicinity of Yangon and the first priority candidate location of the deep-sea port is 35km off the left bank of Yangon River estuary.

(7) Schedule of the Action Plan

Development plans given in **5. Development Plan of Thilawa Area Port, 5.4 Development Plan of Facilities and Equipment** and program of the future studies and projects given in **4. Basic Concept and Plan of Yangon Port Development Plan, 4.2 Basic Plan** are shown in Table 4.2-29.

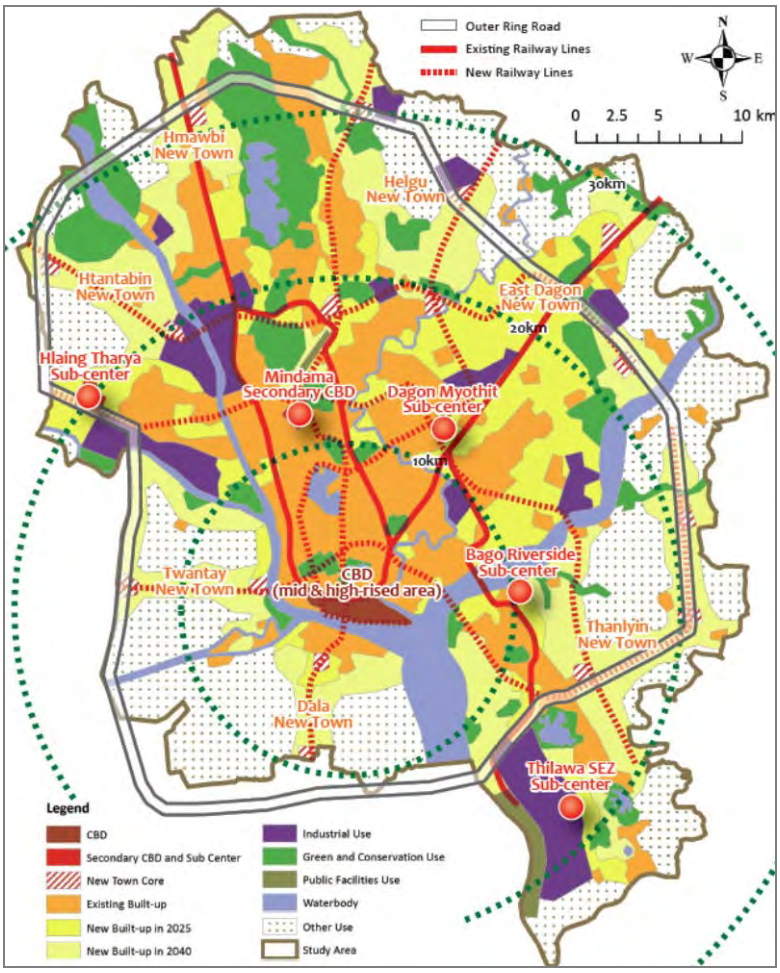
Table 4.2-29 Effect to the introduction of the Port EDI

			2014	2015	2016	2017	2018	2019	2020	2021
1	Thilawa Area Terminal	Phase I -1	■	■						
		Phase I	■	■	■					
		Phase II				■	■			
		Phase III			■	■	■	■		
2	Channel Improvement	Study	■	■						
		Implementation			■	■	■	■	■	
3	Navigation Safety(VTMS)	Implementation		■	■					
4	Port EDI	Study	■							
		Implementation		■	■					
5	Drafting of Port Act	Study	■	■						
6	Port Master Plan	Formulation		■	■	■				
7	Deep Sea Port	Study				■	■	■		

Prepared by the study team

4.2.4. Long Term Port Development Concept (After 2025)

Medium and long term new town projects are planned at Twatay Area and Dalla Area which is opposite of Yangon Port as shown in Figure 4.2-8 and Yangon Development Concept Plan (2040) by JICA. However, urban development in the short term is expected to extend to the north and the north-east of CBD and Thilawa Area in this order.



Source : JICA Study Team (The Project for Strategic Urban Development Plan of the Greater Yangon)

Figure 4.2-8 Yangon Development Concept Plan (2040)

A future MRT development plan which intends to construct new 5 railway lines (232 km) as shown in Figure 4.2-9 is also being examined. Tunnel construction of about 800 m over the Yangon River will be necessary to accommodate railway line which is included in the underground railway development in the future.

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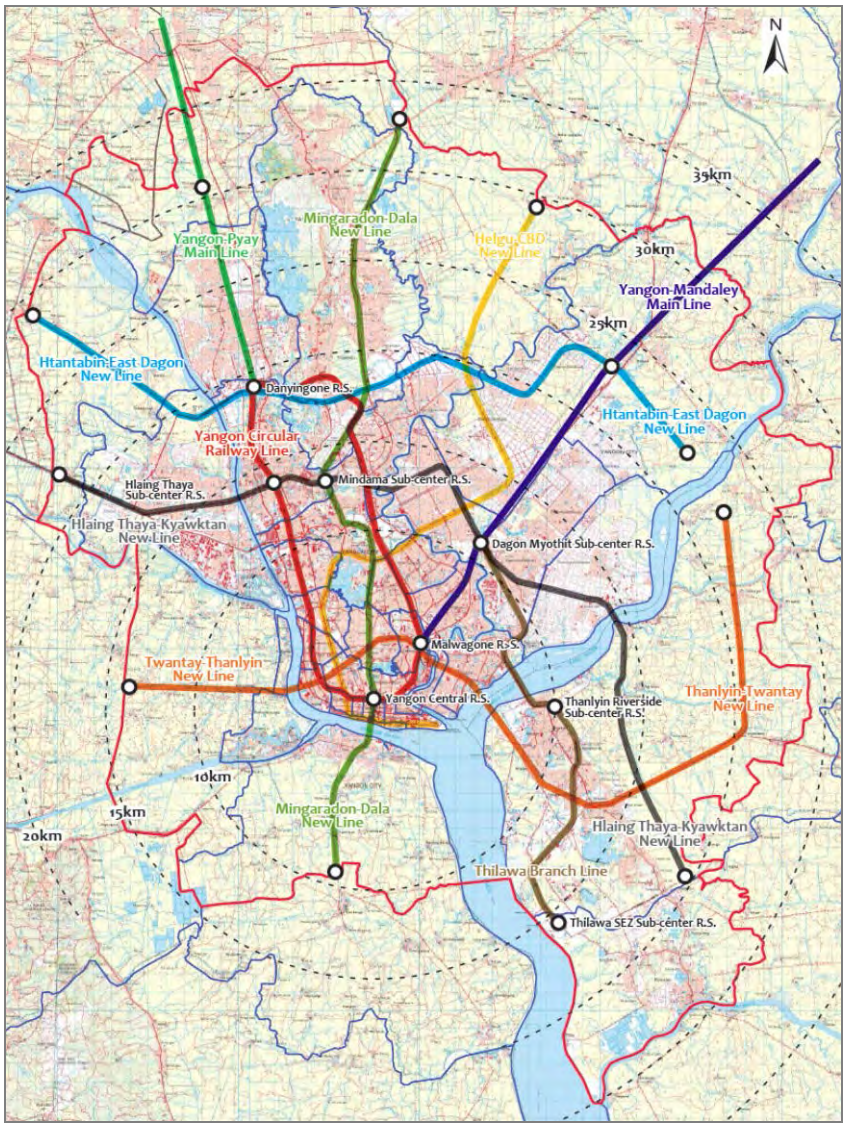

Source : JICA Study Team (The Project for Strategic Urban Development Plan of the Greater Yangon)

Figure 4.2-9 Urban Transport System Development Concept Plan

Necessary air draft of the bridge will be about 50 m taking into account the maximum size of ship (30,000 DWT) which navigates in this area. Approach roads of about 1,300 m in length are needed at both sides assuming that the vertical gradient of the approach roads is 4 %. In case of tunnel, the depth of rail surface elevation will be about -20 m taking into account the depth of river bottom and vertical height of the tunnel element. Assuming that the maximum vertical gradient of railway is 3.5 %, approach sloping of about 600 m in length will be required at both sides.

As described in **4.1.3 Deep Sea Port, (1) Necessity of Deep Sea Port in Myanmar,** it is assumed that Myanmar needs to develop deep sea ports of 14 m deep which are able to accommodate container ships of 4,000 TEU (50,000 DWT, 13 m draft) in the vicinity of the Yangon area in the future. Forth development of a deep see port, a detailed study including demand forecast and selection of the construction site is heeded.

The necessity of deep-sea port and preliminary examination results are showen in the study report titled “Preliminary Study on National Port Development Plan in Myanmar” prepared by the Port and Harbour Bureau, Ministry of Land Infrastructure, Transport and Tourism of Japan in February 2013. In the report, it is concluded that the development of a deep-sea port with a depth of 14m which is capable of accommodating 3,000 to 5,000 TEU container ships is needed in the vicinity of Yangon and the first priority candidate location of the deep-sea port is 35km off the left bank of Yangon River estuary.