Part II MASTER PLAN

2.1 Demand Forecast

2.1.1 Socio-Economic Framework for the Target year

(1) Population

The Population of India is 916.0 million in 1995 based on the mid-year estimated of "Statistical outline of India 1996-97". The population will reach 1.121 billion in 2007 and 1.276 billion in 2017.

(2) Gross Domestic Products (GDP)

GDP is shown in Table 2.1.1-1.

Table 2.1.1-1 Projected GDP

(Unit: Rs. million)

Item \ Year	1994	2007	2017
GDP Annual Growth Rate	2,560,950	5,597,831 6.2%	10,507,898 6.5%
GDP(Agriculture) Annual Growth Rate	785,900	1,392,769 4.5%	2,162,928 4.5%

Note: Figures at 1980-81 constant price

2.1.2 Methodology of Demand Forecast

There are two different methods of forecasting future port traffic in the target year. One is the so-called macro forecast method and the other is the so-called micro forecast method.

In the first step of the port traffic projection, the total volumes through the ports of Mumbai and Jawaharlal-Nehru are forecast taking account of the overlap of their hinterlands to a great extent. Next, cargo volume is allocated to the two ports according to the basic concept of the functional allocation between the two ports.

2.1.3 Macro forecast

Macro forecast method is which estimates the cargo volume as a group including entire commodities regardless of the volume of each commodity. In the macro forecast method, the total cargo volume in the target year is forecast by relating the past records of the total cargo volume to socio-economic indices such as GDP(Gross Domestic Products) and/or population and using future estimates of these indices.

(1) Import

GDP is used as an index in the correlation analysis of the macro forecast in this study. The resulting figures of the estimation is shown in Table 2.1.3-1.

(2) Export

The total export volumes in the target years are estimated by the past growth rate of cargo handled at MBP and JNP from 1986 to 1995 . The result of Macro Forecast of Import and export is shown in Table 2.1.3-1.

Table 2.1.3-1 The Result of Macro Forecast

(Unit: thousand tons)

Year / Item	1995	2007	2017
Import Cargo Volume	20382	31,698	52,478
Export Cargo Volume	18,416	23,356	28,751
Total	38,798	55,054	81,229

2.1.4 Micro forecast

In the micro forecast, the cargo volumes of major commodities in the target year are forecast individually based on the correlation analyses between cargo volumes and the corresponding indices of the historical records. The result of micro forecast, showing import and export cargo volume by major commodity groups are shown in Table 2.1.4-1 and 2.1.4-2.

Table 2.1.4-1 Summary of Forecast Volume (Import)

(Import) (Unit: thousand tons)

Commodity \ Year	1995-96 MBP	1995-96 JNP	2007-08 MBP	2007-08 JNP	2017-18 MBP	2017-18 JNP
Containerizable Cargo						
Agricultural,Fishery & Forest Products *	192	106	553	304	1,382	761
Paper and Paper Product *	580	319	2,072	1,142	6,266	3,451
Light Industry Products *	2,289	1,261	4,929	2,715	9,606	5,291
Containerizable Subtotal	3,061	1,686	7,554	4,161	17,254	9,503
Containerizable Total	4,747		11,715		26,757	
Statistically Mixed cargo in Containerization						
Agricultural,Fishery & Forest Products	1,181	0	2,003	0	3,110	0
Wood Pulp	170	0	215	0	252	0
Fertilizers and its row material *	838	1,895	1,591	3,044	2,471	4,728
Iron and Steel Material	1,871	0	2,608	0	3,419	0
Scrap and Dross	173	0	178	0	178	0
Motor Vehicles and Miscellaneous	49	0	310	0	310	0
Mixture Cargo Sub-total	4,282	1,895	6,905	3,044	9,740	4,728
Mixture Cargo Total	6,177		9,949		14,468	
Non-containerizable Cargo	89	0	280	0	280	0
Non-containerizable Cargo Sub-total	89	0	280	0	280	0
Non-containerizable Cargo Total	89		280		280	
Petroleum (POL)						
Crude oil	4,554	0	8,891	0	8,891	0
Refined petroleum products	4,815	0	7,375	0	15,192	0
Petroleum Sub-total	9,369	0	16,266	0	24,083	0
Petroleum Total	9,369		16,266		24,083	
Total	16,801	3,581	31,005	7,205	51,357	14,231
Grand Total	20,382		38,210		65,588	

Source) Administration report of MBPTand JNPT)

	1995-96 MBP	1995-96 JNP	2007-08 MBP	2007-08 JNP	2017-18 MBP	2017-18 JNP
Non-containerizable						
Chemical products (liquid)	94	0	200	0	386	0
Non-containerizable Sub-total	94	0	200	0	386	0
Non-containerizable Total	94		200		386	

Source) Traffic Department of MBP)

Remark) * : Forecast voliume of MBP and JNP at 2007-08 and 2017-18 are divided from the tatal forecasting volume by the refering volume of MBP and JNP at 1995-96.

Table 2.1.4-2 Summary of Forecast Volume (Export)

(Export) (Unit: thousand tons)

Commodity \ Year	1995-96 MBP	1995-96 JNP	2007-08 MBP	2007-08 JNP	2017-18 MBP	2017-18 JNP
Containerizable cargo						
Agricultural,Fishery & Forest Products *	845	849	1,177	1,183	1,612	1,621
Light Industry Products *	1,526	1,535	7,354	7,394	19,073	19,178
Containerizable cargo Sub Total	2,371	2,384	8,531	8,577	20,685	20,799
Containerizable cargo Total	4,755		17,108		41,484	
Statistically Mixed Cargo in Containerization						
Agricultural Products	1,394	0	1,942	0	2,661	0
Metal and Metal Products	276	0	285	0	285	0
Mixture Cargo Sub-total	1,670	0	2,227	0	2,946	0
Mixture Cargo Total	1,670		2,227		2,946	
Petroleum (POL)						
Crude oil	9,994	0	10,000	0	10,000	0
Refined petroleum products	1,607	0	2,413	0	2,413	0
Petroleum Sub-total	11,601	0	12,413	0	12,413	0
Petroleum Total	11,601		12,413		12,413	
Total	15,642	2,384	23,171	8,577	36,044	20,799
Grand Total	18,026		31,748		56,843	

Source) Administration report of MBPT)

	1995-96 MBP	1995-96 JNP	2007-08 MBP	2007-08 JNP	2017-18 MBP	2017-18 JNP
Non-containerizable Sub-total						
Chemical products (liquid)	5	0	7	0	7	0
Non-containerizable Sub-total	5	0	7	0	7	0
	5		7		7	

Source) Traffic Department of MBP)

Remark) * : Forecast voliume of MBP and JNP at 2007-08 and 2017-18 are divided from the tatal forecasting volume by the refering volume of MBP and JNP at 1995-96.

2.1.5 Forecast of Cargo Volume (Container, Conventional, Dry Bulk and Liquid Bulk)

Actual port cargo statistics have some cargo items containing both containerizable and non-containerizable cargoes. Port cargoes statistics are compiled according to the three categories, viz. Containerizable cargo, non-containerizable cargo and statisticaly mixed cargo in containerization and cargo forecast is conducted according to these categories. The result of forecast by commodity-wise are counted into package type-wise volume using the present share of package type for each commodity. The result of forecast volume is shown in Table 2.1.5-1

Table 2.1.5-1 Forecast Volume by Package Type of MBP and JNP

	Packing Type	2007-08		2017-18	
		MBP	JNP	MBP	JNP
Container					(Unit: thousand TEUs)
[Import]	Container	500	799	500	2,468
[Export]	Container	500	799	500	2,468
Container total		**1,000**	**1,598**	**1,000**	**4,936**
Conventional cargo					(Unit: tons)
[Import]	Pulses (Bag)	378,200	0	587,355	0
	Sugar (Bag)	38,159	0	59,262	0
	Paper products	371,976	0	453,230	0
	Iron and steel	1,865,776	0	2,445,970	0
	Miscellaneous	728,033	0	678,301	0
Import total		3,382,144	0	4,224,118	0
[Export]	Pulses (Bag)	81,497	0	163,422	0
	Rice (Bag)	449,279	0	569,768	0
	Sugar (Bag)	28,559	0	36,218	0
	Oil cakes (Bag)	319,023	0	437,137	0
	Iron and steel	89,804	0	89,804	0
	Miscellaneous	633,880	0	540,514	0
Export total		1,602,042	0	1,836,863	0
Conventional cargo Total		**4,984,186**	**0**	**6,060,981**	**0**
Dry Bulk Cargo					(Unit: tons)
[Import]	Salt	40,703	0	0	0
	Fertilizer (JNP)	0	3,043,885	0	4,727,238
	Phosphate rock	551,219	0	856,058	0
	Sulphur	566,446	0	879,706	0
	Scrap	118,706	0	118,706	0
Dry Bulk Cargo Sub-total		**1,277,074**	**3,043,885**	**1,854,470**	**4,727,238**
Dry Bulk Cargo Total		**4,320,959**		**6,581,708**	
Liquid Bulk					(Unit: tons)
[Import]	Edible oil	805,303	0	1,250,658	0
	Crude oil	8,891,000	0	8,891,000	0
	POL	7,375,000	0	15,192,000	0
	Chemical liquid	200,000	0	386,000	0
Import total		17,271,303	0	25,719,658	0
[Export]	Edible oil	64,034	0	87,742	0
	Crude oil	10,000,000	0	10,000,000	0
	POL	2,413,000	0	2,413,000	0
Export total		12,477,034	0	12,500,742	0
Liquid Bulk total		**29,748,337**	**0**	**38,220,400**	**0**

Note: Figures are deducted the volume which are converted to the new port in Gujarat State.

2.1.6 Forecast of Passenger Volumes

As to the inter-harbor passenger traffic, there are six service routes between Mumbai and the opposite-side port in Mumbai Bay; Rewas, Mora, Mandowa, Elephant island, JNP and Vashi.

The number of passengers for the target years is estimated using the annual growth rate of population of destination region of each route and clasticity of passenger growth to oppotunity growth for the route the route between Munbai and Mora which has been most stable in the past. The forecast can be conducted by the following equation. The result of forecast is shown Table 2.1.6-1.

Table 2.1.6-1 Number of Passenger by Route

(Unit: thousand)

Rout Target year	Mora	Rewas	Mondwa	Elephanta	JNP	Vashi
2017	1,472.3	1,506.0	443.4	1,007.8	887.6	268.9

2.2 Potential and Constraints of the Future Development

2.2.1 Future Development Potential of MBP and JNP

The total container traffic through MBP and JNP, whose hinterlands overlap each other, has shown high growth since the opening of JNP. The annual growth rate has been 14.7% on average, reaching 984,000 TEUs in 1996-97. Along with the economic growth and further progress of containerization in India and its trade partners towards the next century, a huge capacity for handling containers is expected to be required for the two ports towards the foreseeable future. The two ports, MBP and JNP, are expected to share the future capacity requirement on optimum manner from the standpoint of the national economy of India.

MBP which handled 583,000 TEUs with an average berth occupancy rate of 82.5% at dedicated container berths in 1996-97 seems to be almost saturated in container handling so long as the present operational way remains without any physical and institutional improvement. On the other hand, a total annual container handling capacity of JNP is said to be one million TEUs including the P&O terminals to be constructed adjacent to the existing terminal operated by JNPT. Considering the conditions of MBP and JNP mentioned above, it is necessary to increase container handling capacity with additional investment in the foreseeable future.

Given its spacious reserved areas, JNP has a great potential as the site for future additional container terminals and hence is expected to share a major portion of the incremental capacity requirement for container handling in the future. On the other hand, MBP is also expected to share some portion of the incremental capacity requirement by making the most of its existing port facilities through redevelopment and modernization. This option at MBP could meet the requirement to increase capacity while minimizing investment costs compared to a full-scale development of JNP which could be beneficial to the national economy.

2.2.2 Preliminary Estimation of Dredging Volume in case of Deepening Channels

1) Capital dredging volume in channels and basin

The capital dredging volume in case of deepening and widening the access channels in Bombay Harbour was approximately estimated for several cases; for example, as for Main Channel from Section I to JWD, the capital dredging volume estimated was 16.6 million m^3 (including extra dredging volume) in case of deepening the channel to -12.0 m with the width of 500 m through the total channel length of 25.3 km. Based on the same assumption, the capital dredging volume in case of construction of the proposed offshore container berth and basin was estimated.

2) Maintenance dredging volume in channels and basin

Firstly, temporal bathymetric records have been analyzed. Secondly, a rate of siltation was approximately predicted by assuming a simple mathematical model for deepened channels, and thirdly the maintenance dredging volume was roughly estimated by using this assumed rate of siltation.

Bathymetric charts for the latest five years, or during the 1992-1997 period were analyzed. According to the present analysis of those sounding data in each section of Main Channel, an estimated average annual rate of siltation, for example, at Channel Section IV, was 0.26 meter per year. While, in Indira Dock Approach Channel, it was 0.46 meter per year.

An approximate estimation of annual rate of siltation in case of deepening the channels was attempted on an assumption that the Bijker's theory could be applicable. On the same assumption, a preliminary estimation of annual rates of siltation along the jetty and at the basin of the proposed offshore container berths was carried out.

Using these estimated annual rates of siltation, a preliminary estimation of maintenance dredging volume was carried out for the channels and the basin.

3) Dredging implementation

Capital dredging in channels: Judging from the seabed soil characteristics, a drag suction dredger is most suitable for deepening and widening of the navigation channels without disturbing other sailing ships. As far as local widening of the channel is concerned, a grab dredger with a large-sized grab bucket capacity is applicable.

Capital dredging at the proposed berth and basin: Dredging by a large-sized grab dredger accompanied by hopper barges will be a reasonable and practical method, because there is no dredged soils dumping area near the dredging site.

Maintenance dredging in the access channels: A drag suction dredger is most suitable.

Maintenance dredging at the proposed berth and basin: It will be reasonable and practical to select a hydraulic or grab type dredger for maintenance dredging along the jetty and a drag suction dredger for at the basin area.

4) Environmental countermeasures during dredging

Drag suction dredger: The most simple and reliable method to prevent diffusion of turvidity due to overflow from her hopper is to stop loading the mixture in the hopper at the overflow level of the hopper.

Grab dredger: A flexible curtain type turbidity diffusion protector may be provided around the excavation area, particularly in front of the bow of the grab dredger.

As for environmental countermeasures at the time of land reclamation of Victoria Dock, diffusion of turbidity shall be minimized by employing a hopper barge dumping method well protected by a flexible curtain type turbidity diffusion protector around the dock gate and providing a suitable waste way.

2.2.3 Land Use

The land owned by MBPT is by - and - large land reclaimed on the foreshore from 1873 onwards while setting up wharves and cargo handling facilities on waterfront. These facilities also got buried under subsequent reclamation when the facilities had to be re-developed in accordance with requirements of the trade and shipping. Some of the areas still bear the names of the original wharves, such as Jackeria Bunder, Tank Bunder.

One of the most extensive and ambitious reclamation projects (covering 234 ha) undertaken by Mumbai Port was in 1909 -17 when Mazagaon - Sewri Reclamation (MSR) was carried out by pumping dredged material from the harbour. MSR had been planned for "Depots" for separate cargoes such as Cotton Depot, Grain Depot, Coal Depot, Manganese Ore Depot.

MBPT at one time was the biggest landlords in the Island City of Mumbai virtually owning 1/8th of the area of the Island, comprising the Port on its eastern side which constituted the commercial harbour, some islands, and small pockets of land on the west coast (such as

Chowpatty / Worli / Mahim Bunders). The total land under MBPT's control is about 753 ha (1860 acres). This land which is contiguous with the land of the city of Mumbai has become a part and parcel of the city's land due to which the authorities vested with redevelopment of the city have covered this area also, care being taken that the Port's operations, functions and land usage are not substantially violated.

2.2.4 Law and Regulation System Concerning Redevelopment

The State Govt. of Maharashtra is empowered to plan developments regionwise, citywise, townwise, from macro to micro level. The Act under which the State enjoys such powers is the "Maharashtra Regional Town Planning Act, 1966" together with the "Development control Rules" enacted separately.

Within the State Govt. these powers are vested with their Urban Development Dept., who in turn have delegated authority to Regional Development Authorities, one example is the Mumbai Metropolitan Region Development Authority (MMRDA). MMRDA prepare macro level plans. Micro level planning is relegated to other authorities such as Brihan Mumbai Mahanagar Palika (Municipal Corporation of Greater Mumbai, MCGB). It is under this authority vested in MCGB that they have prepared plans for planned redevelopment of the Metropolis to improve the quality of life and services in Mumbai. These plans also cover the area of Mumbai Port's property and are thus legally binding on the Port Trust. The plans presently valid are for the period 1981 - 2001.

2.2.5 Land to be Possibly Converted from Existing Use to Port Related Use in MBP

The land estate owned by Mumbai Port Trust are generally distributed over the east coast of City of Mumbai, specifically, in a strip of land, extending over 10 Km north and south and 1 Km wide on the average, lying along the shoreline from the Indira Dock to Wadara District. However, the areas directly contributing to port functions at present is less than a half of the area. Larger than a half of the area is being utilized as part of commercial, industrial districts, and petrochemical industrial districts, or let to private enterprises.

As this report is intended to frame an authoritative port plan, the study team carried out investigations within such districts where the lots in the districts can practically be encroached without much difficulty into the plan for land use, which are shown in Table 2.2.5-1. Also shown in Table 2.2.5-2 are sites in use at present by MBPT for handling containers and go downs.

Table 2.2.5-1 Districts Expected for New Port Plan Near Future

Name of Districts	Area (m2)	Remarks
Gamadia Road Area	45,000	The eviction is expected to complete by the end of 2000
Cotton Depot West	90,000	- do -

Table 2.2.5-2 Sites or Areas for Handling Containers and Godowns owned by MBPT

No.	Name of Area	Covered Area (m2)	Yard Area (m2)	Container Slots (TEUs)
	Container Handling Area			
1	Docks area (Indira, Victoria, Prince's)	-	135,500	2,991
2	Frere basin	10,336	32,180	676
3	Manganese ore depot	10,238	125,200	1,200
4	Cotton depot	11,003	28,850	200
5	Timber pond	14,020	185,990	2,565
6	Wadala area	2,890	57,960	820
	Warehouse Area			
1	Frere area	13,218	12,400	300
2	Manganese ore depot area	-	37,635	-
3	Cotton depot area	2,924	59,325	490
4	Timber pond area	34,000	26,940	-
5	Hay bunder and Haj bunder area	6,375	32,400	500
6	Wadara area	-	95,670	1,360

2.3 Functional Allotment of MBP and JNP

2.3.1 World Container Throughput and Trends[1]

East Asia provided an estimated 43.7 percent of world container port throughout (up from 25 percent in 1980) by 1995, Europe contributed 23.3 percent (31.6 percent in 1980) and North America accounted for 15.4 percent (27.3 percent in 1980). The remaining regions made up an estimated 17.5 percent of 1995 world container port throughput, compared with 16.1 percent in 1980.

With growing global containerization, rising trade volumes have come via increasingly large vessels. These have placed demands on ports to continually update their capabilities in terms of quay length and strength, container gantry crane specifications, berth depth and storage space. The economics of operating large vessels requires port calls to be limited to large-volume ports, and kept to the minimum length of stay possible. To remain competitive, major ports have had to become extremely efficient, and new technology is being employed increasingly at all stages of port operation, to rationalize, automate and accelerate processes.

2.3.2 Development of Neighboring Hub-Ports

(1) Port of Singapore

Container traffic through the Port of Singapore has reached 10.8 million TEUs in 1995, a growth of 15% from the previous year. Transhipment traffic from the Indian ports is reported to have increased by 19%. The port is believed to be carrying out the most efficient port operations in the Asia and Pacific region.

The capacity of the existing container terminals is estimated at 13.7 million TEUs and will be exceeded by 1997. To accommodate the increase in container cargo throughput, PSA is building a new container terminal, Pasir Panjang. When the first two phases are completed, there will be a total of 26 berths and a capacity of 18.3 million TEUs, which is about 1.3 times

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[1] Baskaran V. "The World Container Port Market to 2010", NIPM (National Institute of Port Management) News (1997-III)., pp. 25-31.

of the present capacity of the Port of Singapore.

(2)Port of Dubai

Dubai stands at a major crossroads of the worlds routes, it has achieved the status of being the leading hub-port between Europe and the Far East, and serves not the Gulf and Indian subcontinent but, increasingly, the emerging C.I.S. republics and South and East African ports. It is also ideally placed to handle cargo to and from Iraq, when re-open.

The twin terminals also handle 2.07 million TEUs of containers in 1995, representing 10.1 % increase, along with a growing capacity for non-containerized cargo such as mineral, timber, steel products and frozen foods. Dubai is now the only port in the Middle East which has eight post-Panamax type quay side cranes which accommodate the most modern ships, while two new quay side cranes have been installed on October 1996.

(3) Port of Colombo

Port of Colombo is a south Asian shipping hub, which has a surge in transhipment traffic since it upgraded its facilities to accommodate bigger container vessels. There are two major container terminals, i.e. Queen Elizabeth Container Terminal (QCT) and Jaya Container Terminal (JCT) in Port of Colombo.

Port of Colombo handled 1.04 million TEUs in 1995. 73 % of those container is transhipment containers. Almost 60% of the total tonnage handled at Port of Colombo is containerized cargo. Container handling capacity is said to be at 1.2 million TEUs and to increase up to 1.6 million TEUs shortly.

2.3.3 Future Plan of Major Ports along the West Coast of India

In order to examine functional allotment of MBP and JNP among ports along the west coast of India, it is necessary to understand a general picture of the present cargo movement in India and features of the major ports along the west coast of India. The important features of those ports are dominant commodities of cargo handled through them and their hinterland, and their future development plans. Those features of Port of Cochin, Port of New Mangalore, Port of Mormugao and Port of Kandla are studied.

There are 11 major ports in India. Five of them, Calcutta (Haldia), Visakhapatnam, Chennai and Tuticorin are located along the east coast. The remaining six major ports are located along the west coast; Cochin, New Mangalore, Mormugao, JNP, MBP and Kandla. In addition, there are also about 140 operable intermediate/minor ports.

The total cargo handled through major ports in India in 1995/96 is 215.33 million tons whereas all minor ports put together handled just 20.30 million tons. Major ports handle more than 90% of the sea-borne traffic of India and the minor ports account for lee than 10%.

105.6 million tons of cargo (49.0% of the total traffic through the major ports) was handled through major ports along the east coast and 109.7 million tons (51.0%) was handled through those along the west coast. Those figures reveal that major ports in India are well allocated along the coast especially between the east and west coast.

2.3.4 World Container Fleet

(1) World Container Fleet to be able to Enter Indira Dock at MBP

There are approximately two thousand container vessels in the world. When preparing alternative plan to modernize Indira Dock at MBP, it is necessary to know how much of the existing container vessels in the world can enter Indira Dock through the lock gate. Dimensions of the lock gate are as follows; length of 229.0 m, width of 30.5 m and depth of 10.7 m. 51.6% and 61.7% of the world container vessels are able to enter Indira Dock through the lock gate in terms of LOA and Breadth respectively. Only one half of the container vessels in the world can currently enter Indira Dock through the lock gate.

(2) Growing Size of World Container Fleet

When preparing alternative plans to develop new container berths at MBP, water depth of the container berths would be the most important key factor to compete with other container ports' draft in and around India. It is also essential to understand the current distribution of container vessels and growing trend of their draft.

Container berth with water depth of 10.0 meter only accommodates 11% and 35% of container vessels in the world in terms of loading capacity and number of vessels respectively Container berth with water depth of 12.0 meter only accommodates 25% and 55% of container vessels in the world in terms of loading capacity and number of vessels respectively. Container berth with water depth of 13.0 meter accommodates 41% and 69% of container vessels in the world in terms of loading capacity and number of vessels respectively.

2.3.5 A Basic Functional Allotment of MBP and JNP along the West Coast of India

(1) MBP for Conventional Break Bulk, Liquid Bulk and Container Cargo

According to the historical background of the past development of MBP, MBP is a specialized port for handling conventional break bulk cargo and liquid bulk cargo. In addition, MBP has increased its volume of handling containers due to the rapid progress of containerization in the world. Since the last major development which dates back to the early 1970s excluding the volume of cargo handling at MBP has increased continuously along with the economic growth of India, which has resulted in serious port congestion.

(2) JNP for Dry Bulk and Container Cargo

JNP was constructed at Sheva Island in the Mumbai harbour and opened in 1989 as a deep-sea port specialized for handling dry bulk and container cargo so as to receive overflowed container cargo from MBP.

(3) Over-lapped Function for Containers between MBP and JNP

As mentioned above, the functions of MBP and JNP for handling containers are over-lapped at present. It is necessary to identify respective hinterlands, trading partners and vessel size on the shipping network, so as to identify the functional allotment of handling containers between MBP and JNP. They are studied in the following sections focusing on the function of handling container cargo.

2.3.6 Hinterland of Container Cargo through MBP and JNP

Distribution of the final destinations of containers through MBP and JNP shows that Maharashtra State accounts for the largest share of 44% and the northern region of India also accounts for 42% consisting of Gujarat (14%), Rajasthan (1%), Haryana (5%), Punjab (5%), Delhi (13%) and Uttar Pradesh (4%). When focusing on shares of cities within Maharashtra State, Mumbai with the largest share of 28% is followed by New Mumbai (5%), Pune (4%) and Thane (2%).

2.3.7 Trading Partners of Container Cargo through MBP and JNP

Concerning the trading partners of containers through MBP and JNP, Europe ranks first accounting for 36.9% of the total trade in 1995/96, followed by the Middle East (19.8%), Southeast Asia (15.2%), North America (7.2%), South Asia (6.3%), East Asia (5.8%) and Africa (5.3%). These containers are transported by direct shipping services (approximately 70% of the total trade) and by feeder services (approximately 30%). As to feeder services, containers are transhipped mainly at Singapore, Colombo and Dubai.

2.3.8 Economical Size of Container Vessels Calling at MBP by Shipping Route

Main factors to determine economical size of container vessels on some shipping route connecting specified ports are navigational distance, the maximum permissible limits of vessel drafts at the ports and the sum of container traffic volume during a certain period in view of viability of direct shipping services.

If deeper container berths are prepared off the Indira Dock, containers are transported more economically by direct shipping services rather than feeder services operated with larger container vessels than small ones in operations at present on the above long distance routes.

In international shipping circles, average feeder vessel size is said to increase up to 1,200 - 1,500 TEUs in loading capacity from the present level of 600 TEU. In addition, according to the cost analyses in the case of short distance routes from/to MBP, the most economical feeder vessel size is estimated in the range of 1,500 - 2,000 TEUs in loading capacity. Hence, if deeper container berths are prepared at MBP, feeder vessels of larger size than currently in operations will call.

To estimate an economical size of container vessel by shipping routes from/to Mumbai in the stage of the Master Plan, a water depth along container berths needs to be assumed as a given condition. For this purpose, the six alternative plans with different water depths in the range of 9.8 - 13.5m (below C.D.) are considered. In the case new container berths with a water depth of 13.5m are constructed, the economical vessel size is estimated to be 2,500 TEUs in loading capacity (40,000 DWT) in both direct and feeder services, the same as the maximum vessel size which can be permitted by the berth in fully-loaded condition.

According to the results of the comparison, the plan to prepare a new container terminal with a water depth of 13.5m is considered to be the most economical.

2.3.9 Functional Allotment of Container-Handling between MBP and JNP

To handle a large amount of containers through the two ports, MBP and JNP, in the year 2017 which is estimated to be 5.9 million TEUs as a total, the amount needs to be allocated to MBP and JNP adequately considering various factors including potential capacity of container handling, hinterlands and transport costs from the stand point of the Indian national economy.

As to potential capacity in container-handling, the capacity of MBP is estimated to be approximately one million TEUs on the condition of preparing a new container terminal with off-shore jetty-type berths with a water depth of 13.5m connected to land by bridges and converting the existing land being used for conventional cargo at present into a container stacking yard without creating additional land by open-sea reclamation.

28% of the total containers through MBP and JNP originates from or is destined to Mumbai City at present. Assuming the same percentage will be kept in the future, 1.7 million containers in TEU are estimated to originate from or be destined to Mumbai City. To reduce the detour transport of containers originating from or destined to Mumbai City through JNP, it is necessary to receive such containers at MBP as much as possible in terms of avoiding excessive road traffic congestion and consequent air and noise pollution caused by intricate hauling of tractor-trailer units for containers. In addition, not only from environmental point of view but from economical point of view, it is justified to make the most of MBP in container-handling.

2.4 Master Plan for MBP

2.4.1 The Basic Concept of Master Plan for MBP

The purpose of the Master Plan (target year 2017) is to serve as a target and a guideline for phase plans including the Short-Term Plan (target year 2007). The Master Plan shall be an integrated plan covering the layout plans for additional container handling facilities, modernized existing facilities and effective management and operation systems. In making the Master Plan for the MBP, the following various aspects are recognized.

(1) Container-Handling

1) Insufficient Water Depth along the Existing Container Berths

Since the major container berths at MBP are located inside the docks connected with the open sea through the lock gates, maximum depth of those berths is only -9.8m. On the other hand, JNP started its container handling operation with new deeper berths of -13.5m deep in 1989/90.

Large container vessels provide a relatively low transportation cost, especially for long distance routes such as India-Europe, India-East Asia and India-East Coast of America. Deeper container berths are required so as to reduce transportation costs to/from those countries at a long distance from India. In addition, even on short distance routes such as India-the Middle East, India-Southeast Asia and India-South Asia where containers are transported mainly by feeder services, feeder vessel size has shown an increasing trend. Thus, deeper berths are required.

2) Excessively-low Container-Handling Productivity due to the Current Operational Manner

A marine container terminal is generally operated and controlled by a single terminal operator who takes full responsibility of containers from the gate to container vessels within the terminal in export and vice versa in import. The modernized terminal operation system has not yet been introduced to the container terminals at MBP. Container terminals at MBP should be managed and operated by a single terminal operator so as to increase container handling productivity and secure efficient and safety operations.

3) Shortage of Container Handling Equipment

As to container handling machines, two quay-side gantry cranes are installed only at Ballard Pier Station and ship's cranes are used to lift containers alongside at the remaining container berths of Indira No. 1-5. The shortage of quay-side container gantry cranes is one of the major reasons of the seriously-low container handling productivity at Indira No. 1-5. Average productivity at Indira No. 1-5 is only 3.2 boxes per hour per gang, which is much less than 11.6 boxes per hour per gang at Ballard Pier Station (BPS) in 1995/96.

Moreover, only three RTGs (Rubber-Tired Gantry) are installed on the container park behind BPS. On the other hand, reach-stackers are mainly used on the remaining container parks inside the docks. Although reach-stackers are conventionally used in narrow space, they require more spacious maneuvering space compared with RTGs. That means stacking yard is less utilized due to shortage of efficient handling machines such as RTGs.

4) Effective Utilization of the Existing Facilities

In making the Master Plan, the effective utilization of the existing facilities to meet port requirements needs to be examined so as to save investment cost for a new project as much as possible along with improvement and operation systems of the port aiming at efficient cargo-handling.

5) Potential Capacity of MBP in Container Handling

The potential capacity in container-handling of MBP is estimated to be approximately one million TEUs in the condition of preparing a new container terminal with off-shore jetty-typed berths and converting the existing land being used for conventional cargo at present into a container stacking yard without creating a land by open-sea reclamation in the consideration of making the most of the existing facilities.

6) Future Port Requirements and Functional Allotment of Container Handling between MBP and JNP

One million containers out of the total forecast traffic of 5.9 million TEU containers through the two ports, MBP and JNP, in the year 2017 is assigned to MBP and the remaining 4.9 million TEUs to JNP considering various factors including potential capacity of container handling, hinterlands and transport costs which would be beneficial to the Indian national economy.

7) Economical Transportation

In making the port investment plan, it is necessary to put an emphasis on economical transportation, considering both the investment cost for port facilities and ship transportation cost from the standpoint of the Indian national economy.

8) Generation of Employment Opportunity

Considering a number of employees of MBPT and the high unemployment ratio over 40% in India at present, port activities at MBP are expected to generate employment opportunities in the future, while the modernization of the port results in job losses of the dock workers. In this view, MBP needs to attract more port traffic through strengthening competitiveness in the international shipping market.

9) Environmental Impact on Areas around the Port Induced by the Port Development

In the port development, environmental impact on the area both during the periods under construction and after the start of operations must be considered.

Based on the above issues, the following concept of modernizing container-handling of MBP is proposed for the purpose of achieving safe, efficient and reliable operations for the customers.

1) Establishment of a Full-Scale New Container Terminal with Deeper Berths

To receive one million TEU containers assigned to MBP on the stage of the Master Plan, a full-scale new container terminal with deeper berths will be required.

2) Introduction of a Closed Terminal System to the New Container Terminal

It is advisable to introduce a closed terminal system controlled by a terminal operator that takes the responsibility of receipt, storage and delivery of containers at the terminal by conducting yard planning and inventory control of containers which is indispensable for modernized container terminal.

3) Deepening the Approach Channel to MBP

To receive larger container vessels approaching to the new container terminal with deeper berths than the existing ones inside Indira Dock, it is necessary to deepen the existing approach channel from currently maintained level.

4) Preparation of the Off-Dock Container Depots within the Landed Estate of MBPT

To back up the container-handling operations at the new container terminal within a limited space, it is indispensable to prepare off-dock container depots as back-up facilities to be placed within the landed estate of MBPT. For this purpose, it is necessary to evict the leased lands which are no longer used for port-related activities within its estate.

(2) Conventional Cargo Handling

The volume of non-containerized break and dry bulk cargoes through MBP and JNP has steadily increased from 5.4 to 7.7 million tons in the period of 1989/90 to 1995/96 showing an average annual growth rate of 6.2%. 7.7 million tons mainly comprises finished fertilizer in dry bulk of 2.8 million tons accounting for 36.4% of the total volume. Future volume of break and dry bulk cargo to be handled at MBP in 2017 is estimated at 7.9 million tons.

In making the Master Plan for the existing conventional cargo handling facilities, the following aspects concerning the port modernization are recognized.

1) Seriously Mixed Use of Berths in the Docks

Various conventional cargoes are not well classified and assigned to the specified berths in Indira, Victoria and Prince's Docks. Conventional cargo handling conditions at present is in chaos.

2) Shortage of Forklift Trucks in Number and Lifting Capacity for Long and Heavy Cargo

In handling heavy cargo such as coils, pipes and plates of steel products on dock-side, a shortage of forklift trucks is found in number and lifting capacity. In addition, suitable attachments of forklift trucks designed to lift above-specified cargo efficiently and safely are not well prepared.

Based on the above issues, the following concept of modernizing conventional cargo-handling of MBP is proposed for the purpose of achieving safe, efficient and reliable operations for the customers. Conventional cargo is required to be well classified and assigned to specified berths in Indira, Victoria and Prince's Docks, in order to achieve safe and efficient operations.

(3) Marine Oil Terminal

MBP is playing various roles in petroleum handling by supplying imported crude petroleum to the refineries at Trombay or POL to the storage tanks there, and by conversely shipping Bombay High Crude produced at off-shore oil wells or POL to the other coastal regions.

1) Increasing Volume of POL handled at JD-1 to JD-3 and Old Pir Pau Pier

The demand of POL (refined petroleum products and lubricant) distributed from Mumbai to its hinterland by land has already exceeded the refining capacity of 12 million tons per annum which is the total of the two refineries at Trombay. The shortage of supply is balanced by the imported POL from overseas.

POL of 1.6 million tons was shipped in 1995/96 by coastal shipping due to inter-regional supply-demand imbalance in terms of POL grades, although the shipped volume showed a downward trend recently in inverse proportion to an increase of imported POL. POL has been discharged/loaded from/onto petroleum tankers mainly at jetties of JD-1 to JD-3, and to a lesser extent at the berth of Old Pir Pau Pier along with chemical products.

2) Shortage of Discharging Capacity of Pipeline of JD Nos. 1 to 3

The shortage of discharging capacity of pipelines is a present bottleneck to handle petroleum, connecting the JD jetties Nos.1 to 3 at Butcher Island and the refineries at Trombay which were designed to meet the original refining capacity of 3.5 million tons per annum. The pipelines have been left without replacement even after the expansion of refining capacity up to 12 million tons per annum. The bottleneck is found in discharging and loading petroleum through the jetties, resulting in excessively long berth waiting times of petroleum tankers, indicating 5.2 days per vessel in average in 1995/96. A large increase in the traffic volume of POL tankers which need much longer berthing times than crude petroleum tankers aggravates the congestion. MBPT has a plan to replace the existing pipelines of 12 to 24 inches in diameter by larger-sized pipelines of 30 to 42 inches along with the installation of discharging / loading facilities at the JD Nos. 1-3 jetties including loading arms.

Phase-I project of replacing the pipelines will start from April, 1998.

Based on the above issues, on-going replacement project of pipelines needs to be examined if the target volume of POL at the year 2017 can be handled by replaced pipelines and New Pir Pau berth.

(4) Port Traffic Facilities

When planning the container yards and depots inside and outside the docks, it is necessary to put an emphasis on connecting separated yards and depots by dedicated fly-over type and elevated port roads with adequate capacity compared with planned container flows. In addition, as the connection of the port roads to the common roads outside the port already congested, it is also necessary to plan the connection points as far as possible from the city center from the environmental point of view.

(5) Main Channel, Approach Channel and Basin

The tidal range of the MBP and JNP is 5.2 m. If the depth of the main channel is 2.6 m less than that of the berths, vessels with maximum draft matching to the berth's dimension are theoretically able to enter/depart the port during approximately 50% of the year.

The depth of the existing main channel ranges from -10.8 m to -11.0 m. The difference of depths between the channel (-10.8 m) and JD-4 (-14.3 m) for crude oil is 3.5 m. Similarly, the difference of the depths between the main channel (-10.8 m) and the existing container berths at JNP (-13.5 m) is 2.7 m. Those differences imply that MBP and JNP identified the most cost-effective depth for the development project in the past.

Deepening the main channel is required to serve larger tankers of crude oil visiting JD-4 and larger container vessels visiting JNP with less time constraints when entering/departing the ports as long as the project of deepening the main channel is feasible.

2.4.2 The Master Plan for Container-Handling

(1) Land Preparation for the Future Port Activities

There is a certain amount of land which will be possibly converted from existing use to port-related use by MBPT in a couple of years. Total area of the land is about 14 hectares. The scale of two areas is about 5 and 9 hectares, which enables an efficient use of the land for an off-dock container stacking yard, empty container stacking yard or CFSs.

Any development activities within the coastal zone are regulated by the *"Coastal Regulation Zone Notification" (dated 19th February, 1991)* in India. According to the notification, no reclamation except for *"operational construction"* which actually needs waterfront for port-related activities is permissible.

(2) Required Additional Container Handling Facilities

1) Target Volume of Containers to be handled at MBP in 2017

Total volume of container cargo at the year 2017 through two ports, MBP and JNP is estimated to be 5,934,000 TEUs. One million TEUs of containers are estimated to be handled through MBP.

2) Dimensions of Required Additional Container Handling Facilities

Total number of four berths are required to handle one million TEUs at MBP, which gives berth occupancy rate of 58.1% and average pre-berthing time per vessel of 2.3 hours.

3) Preparing Alternative Plans for Container-Handling

Six different alternative plans are prepared for the container-handling of the Master Plan (M/P). When making those alternatives to meet facility requirement, space limitation in MBP is taken into account. Major features of six alternative plans are summarized in Table 2.4.2-1.

One alternative plan (Alternative-1) utilizes the existing Indira Dock Nos.2 to 5 berths as new container berths of which water depth is -9.8m with quay-side gantry cranes. These new container berths accommodate container vessel of about 800 TEUs in loading capacity, which remains as the status quo (Figure 2.4.2-1). Four alternative plans (Alternative-2 to 5) seek deeper container berths toward the open sea without full-scale reclamation, taking above-mentioned environmental constraints into account. Optimum water depth for proposed container berths is evaluated so as to balance capital and maintenance costs with benefit in the following section (Figures 2.4.2-2 and 2.4.2-3).

The remaining alternative plan (Alternative-6) also seeks deeper container berths toward the open sea without full-scale reclamation (Figure 2.4.2-4). However, this alternative converts Victoria Dock into container yard by reclamation of which impact on environment is considered significantly small.

(3) Evaluation of the Alternative Plans, Berth and Approach Channel Depths

1) Alternative Dimensions of Proposed Container Berth

When planning the container berth, dimensions of standardized container vessels and standardized container berths are essential information (Table 2.4.2-2). Alternative berth depths of -9.8m, -11.0m, -12.0m, -13.0m and -13.5m are examined for new container berth at MBP in this study, taking dimensions of the existing facilities and increasing trend of container vessel size in the future into account.

Table 2.4.2-2 Dimensions of Standardized Container Vessels and Standardized Container Berths

Dimensions of Container Vessels					Dimensions of Container Berth		
Loading Capacity	DWT	Full Draft	LOA	Breadth	Berth Depth	Berth Length	Remarks
(TEU)	(tons)	(m)	(m)	(m)	(m)	(m)	
500	12,000	8.0	140	21.0	9.0	170	
800	16,000	9.0	170	23.0	10.0	200	
1,200	22,000	10.0	210	31.0	11.0	250	
1,500	27,000	11.0	230	32.2	12.0	280	
2,000	35,000	12.0	260	32.2	13.0	300	
2,500	40,000	12.5	260	32.2	13.5	300	
3,000	50,000	13.0	290	32.2	14.0	350	Panamax
4,500	60,000	13.5	290	39.4	15.0	350	Post-Panamax

2) Total Cost

Total cost to build and maintain three additional container berths with various berth depths and various approach channel depths are estimated, assuming Alternative-6 is a best layout plan. A combination of -13.5 meters of berth depth and -11.0 meters of approach channel depth gives the minimum total cost.

Table 2.4.2-1 Major Features of Six Alternatives Plans for Container Handling

Features	Unit	Alternative-1	Alternative-2	Alternative-3	Alternative-4	Alternative-5	Alternative-6
1.Existing Container Berth							
1.Number of Berths		1	1	1	1	1	1
2.Berth Depth	(m)	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
3.Berth Length	(m)	244	244	244	244	244	244
4.Berth Location		BPS	BPS	BPS	BPS	BPS	BPS
2.Proposed Container Berth							
1.Number of Berths		3	3	3	3	3	3
2.Berth Depth	(m)	-9.8	-11 to -13	-11 to -13	-11 to -13	-11 to -13	-11 to -13.5
3.Berth Length	(m)	210	250 to 300	250 to 300	250 to 300	250 to 300	250 to 300
4.Berth Location		ID-2 to 5	ID-HW	800 m off ID-HW	800 m off ID-HW	800 m off ID-HW	800 m off ID-HW
3.Container Marshaling Yard	(G.slots)	3,446	3,446	3,446	3,446	3,446	3,446
1.Existing Yard	(G.slots)	516	516	516	516	516	516
2.Proposed Yard	(G.slots)	2,930	2,930	2,930	2,930	2,930	2,930
1.ID-1	(G.slots)	240	240	240	240	240	0
2.ID-2 to 5	(G.slots)	1,224	0	0	0	2,184	0
3.ID-HW	(G.slots)	0	2,376	2,376	2,376	0	0
4.Victoria Dock	(G.slots)	0	0	0	0	0	2,930
5.CDW	(G.slots)	972	0	0	0	506	0
6.TPS	(G.slots)	494	314	314	314	0	0
7.CRS	(G.slots)	0	0	0	0	0	0
4.Empty Container Yard	(G.slots)	3,341	3,341	3,341	3,341	3,341	3,341
1.Existing Yard	(G.slots)	0	0	0	0	0	0
2.Proposed Yard	(G.slots)	646	1,798	1,798	1,798	1,606	3,154
1.ID-1	(G.slots)	0	0	0	0	0	240
2.Victoria Dock	(G.slots)	0	0	0	0	0	802
3.CDW	(G.slots)	0	972	972	972	466	972
4.TPS	(G.slots)	646	826	826	826	1,140	1,140
5.CRS	(G.slots)	0	0	0	0	0	0
3.Shortage of Yard	(G.slots)	2,695	1,543	1,543	1,543	1,735	187
5.Container Freight Station	(sq.m)	67,687	67,687	67,687	67,687	67,687	67,687
1.Existing CFS	(sq.m)	48,487	48,487	48,487	48,487	48,487	48,487
2.Proposed CFS	(sq.m)	19,200	19,200	19,200	19,200	19,200	19,200
CDW	(sq.m)	19,200	19,200	19,200	19,200	19,200	19,200
6. Dedicated Road for Containers							
1. No. of Lanes	(lanes)	4	4	4	4	4	4
2. Ground Length	(m)	1,200	2,200	2,200	2,200	3,100	1,000
3. Elevated Length	(m)	2,000	2,200	2,200	2,200	3,100	700

Remarks) BPS: Ballard Pier Station, ID-1: Indira Dock No.1, ID-2 to 5: Indira Dock Nos.2 to 5, ID-HW: Indira Dock Harbour Wall, Victoria Dock: Reclamed Victoria Dock, CDW: Cotton Depot West, TPS: Timber Pond South, CRS: Central Railway Stores

Figure 2.4.2-1 Layout Plan of Major Facilities for Alternative-1

Summary of Alternative Projects for Container Handling Facilities at MBP

Facilities	Unit	Alternative-1
1.Existing Container Berth		
1.Number of Berths		1
2.Berth Depth	(m)	-9.8
3.Berth Length	(m)	244
4.Berth Location		BPS
2.Proposed Container Berth		
1.Number of Berths		3
2.Berth Depth	(m)	-9.8
3.Berth Length	(m)	210
4.Berth Location		ID-2 to 5
3.Container Marshaling Yard	(G.slots)	3,446
1.Existing Yard	(G.slots)	516
2.Proposed Yard	(G.slots)	2,930
1.ID-1	(G.slots)	240
2.ID-2 to 5	(G.slots)	1,224
3.ID-HW	(G.slots)	0
4.Victoria Dock	(G.slots)	0
5.CDW	(G.slots)	972
6.TPS	(G.slots)	494
7.CRS	(G.slots)	0
4.Empty Container Yard	(G.slots)	3,341
1.Existing Yard	(G.slots)	0
2.Proposed Yard	(G.slots)	646
1.ID-1	(G.slots)	0
2.Victoria Dock	(G.slots)	0
3.CDW	(G.slots)	0
4.TPS	(G.slots)	646
5.CRS	(G.slots)	0
3.Shortage of Yard	(G.slots)	2,695
5.Container Freight Station	(sq.m)	67,687
1.Existing CFS	(sq.m)	48,487
2.Proposed CFS	(sq.m)	19,200
CDW	(sq.m)	19,200
6. Dedicated Road for Containers		
1. No. of Lanes	(lanes)	4
2. Ground Length	(m)	1,200
3. Elevated Length	(m)	2,000

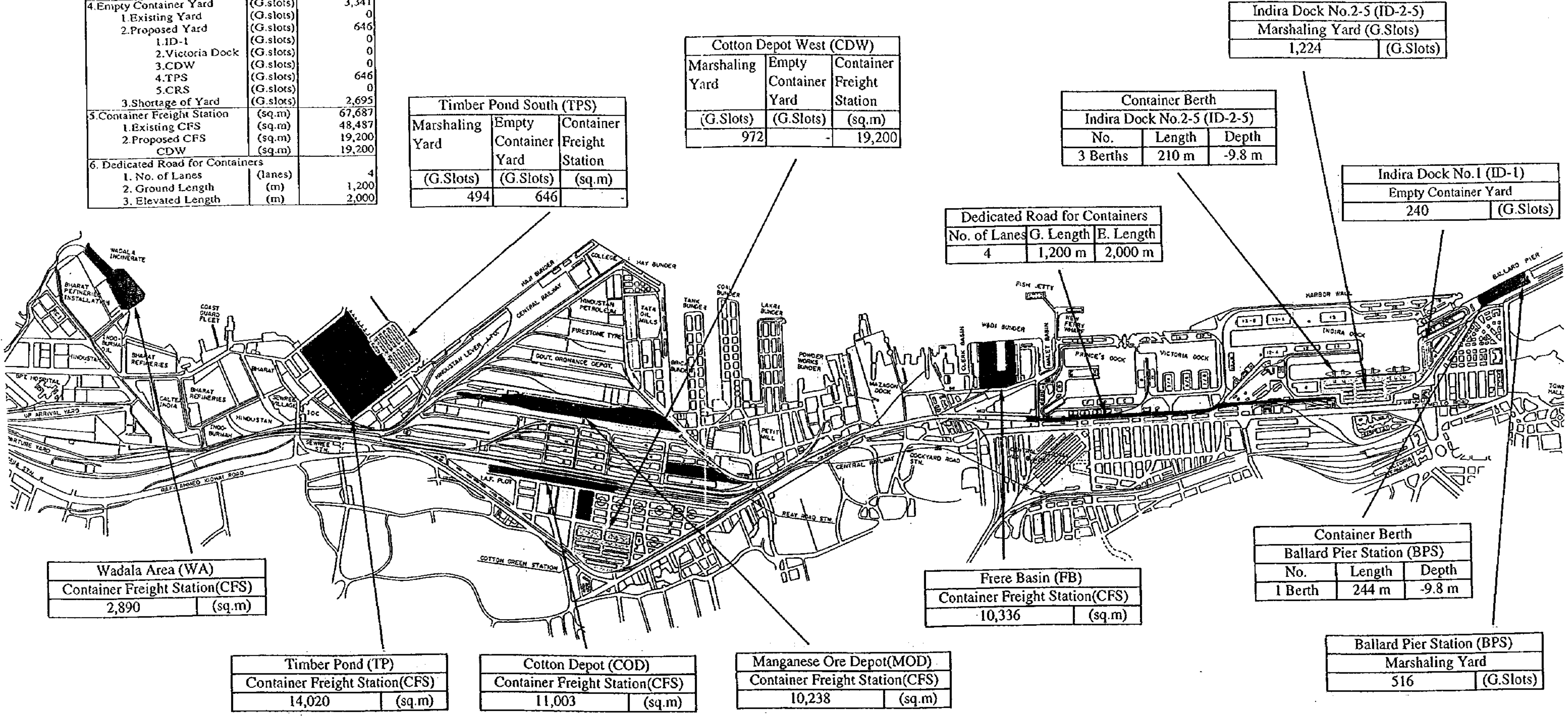


Figure 2.4.2-2 Layout Plan of Major Facilities for Alternative-2 to 4

Summary of Alternative Projects for Container Handling Facilities at MBP

Facilities	Unit	Alternative-2 / 3 / 4
1.Existing Container Berth		
1.Number of Berths		1
2.Berth Depth	(m)	-9.8
3.Berth Length	(m)	244
4.Berth Location		BPS
2.Proposed Container Berth		
1.Number of Berths		3
2.Berth Depth	(m)	-11 to -13
3.Berth Length	(m)	250 to 300
4.Berth Location		ID-HW / 800m off HW
3.Container Marshaling Yard	(G.slots)	3,446
1.Existing Yard	(G.slots)	516
2.Proposed Yard	(G.slots)	2,930
1.ID-1	(G.slots)	240
2.ID-2 to 5	(G.slots)	0
3.ID-HW	(G.slots)	2,376
4.Victoria Dock	(G.slots)	0
5.CDW	(G.slots)	0
6.TPS	(G.slots)	314
7.CRS	(G.slots)	0
4.Empty Container Yard	(G.slots)	3,341
1.Existing Yard	(G.slots)	0
2.Proposed Yard	(G.slots)	1,798
1.ID-1	(G.slots)	0
2.Victoria Dock	(G.slots)	0
3.CDW	(G.slots)	972
4.TPS	(G.slots)	826
5.CRS	(G.slots)	0
3.Shortage of Yard	(G.slots)	1,543
5.Container Freight Station	(sq.m)	67,687
1.Existing CFS	(sq.m)	48,487
2.Proposed CFS	(sq.m)	19,200
CDW	(sq.m)	19,200
6. Dedicated Road for Containers		
1. No. of Lanes	(lanes)	4
2. Ground Length	(m)	2,200
3. Elevated Length	(m)	2,200

Container Berth		
Indira Dock Harbor Wall(ID-HW)		
No.	Length	Depth
3 Berths	250 m to 300 m	-11.0m to -13.0m

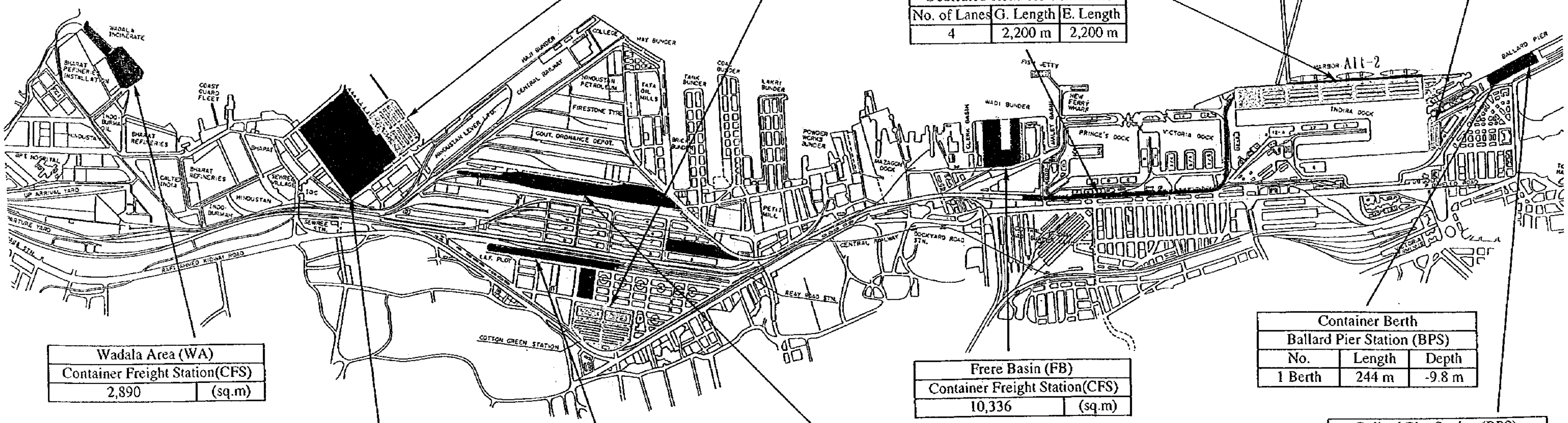
Indira Dock No.1 (ID-1)	
Empty Container Yard	
240	(G.Slots)

Cotton Depot West (CDW)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
-	972	19,200

Timber Pond South (TPS)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
314	826	-

Indira Dock Harbor Wall(ID-HW)	
Marshaling Yard (G.Slots)	
2,376	(G.Slots)

Dedicated Road for Containers		
No. of Lanes	G. Length	E. Length
4	2,200 m	2,200 m



Wadala Area (WA)	
Container Freight Station(CFS)	
2,890	(sq.m)

Container Berth		
Ballard Pier Station (BPS)		
No.	Length	Depth
1 Berth	244 m	-9.8 m

Frere Basin (FB)	
Container Freight Station(CFS)	
10,336	(sq.m)

Ballard Pier Station (BPS)	
Marshaling Yard	
516	(G.Slots)

Timber Pond (TP)	
Container Freight Station(CFS)	
14,020	(sq.m)

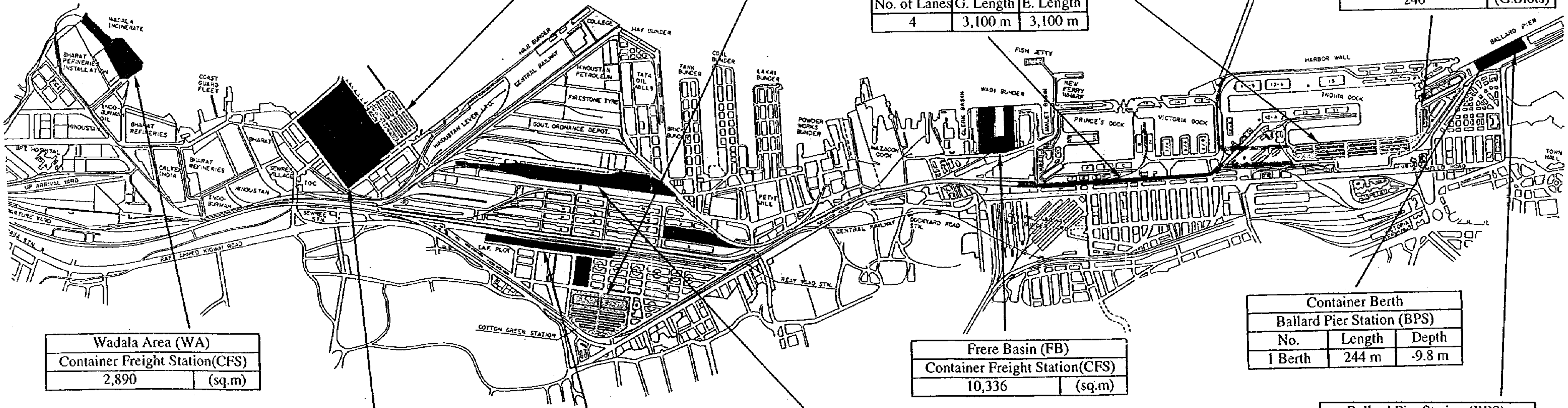
Cotton Depot (COD)	
Container Freight Station(CFS)	
11,003	(sq.m)

Manganese Ore Depot(MOD)	
Container Freight Station(CFS)	
10,238	(sq.m)

Facilities	Unit	Alternative-5
1.Existing Container Berth		
1.Number of Berths		1
2.Berth Depth	(m)	-9.8
3.Berth Length	(m)	244
4.Berth Location		BPS
2.Proposed Container Berth		
1.Number of Berths		3
2.Berth Depth	(m)	-11 to -13
3.Berth Length	(m)	250 to 300
4.Berth Location		800 m off HW
3.Container Marshaling Yard	(G.slots)	3,446
1.Existing Yard	(G.slots)	516
2.Proposed Yard	(G.slots)	2,930
1.ID-1	(G.slots)	240
2.ID-2 to 5	(G.slots)	2,184
3.ID-HW	(G.slots)	0
4.Victoria Dock	(G.slots)	0
5.CDW	(G.slots)	506
6.TPS	(G.slots)	0
7.CRS	(G.slots)	0
4.Empty Container Yard	(G.slots)	3,341
1.Existing Yard	(G.slots)	0
2.Proposed Yard	(G.slots)	1,606
1.ID-1	(G.slots)	0
2.Victoria Dock	(G.slots)	0
3.CDW	(G.slots)	466
4.TPS	(G.slots)	1,140
5.CRS	(G.slots)	0
3.Shortage of Yard	(G.slots)	1,735
5.Container Freight Station	(sq.m)	67,687
1.Existing CFS	(sq.m)	48,487
2.Proposed CFS	(sq.m)	19,200
CDW	(sq.m)	19,200
6. Dedicated Road for Containers		
1. No. of Lanes	(lanes)	4
2. Ground Length	(m)	3,100
3. Elevated Length	(m)	3,100

Figure 2.4.2-3 Layout Plan of Major Facilities for Alternative-5

Summary of Alternative Projects for Container Handling Facilities at MBP



Container Berth		
800 m off ID-HW]		
No.	Length	Depth
3 Berths	250 m to 300 m	-11.0m to -13.0m

Cotton Depot West (CDW)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
506	466	19,200

Timber Pond South (TPS)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
0	1,140	-

Indira Dock No.2-5 (ID-2-5)	
Marshaling Yard (G.Slots)	
2,184	(G.Slots)

Indira Dock No.1 (ID-1)	
Empty Container Yard	
240	(G.Slots)

Dedicated Road for Containers		
No. of Lanes	G. Length	E. Length
4	3,100 m	3,100 m

Wadala Area (WA)	
Container Freight Station(CFS)	
2,890	(sq.m)

Container Berth		
Ballard Pier Station (BPS)		
No.	Length	Depth
1 Berth	244 m	-9.8 m

Frere Basin (FB)	
Container Freight Station(CFS)	
10,336	(sq.m)

Ballard Pier Station (BPS)	
Marshaling Yard	
516	(G.Slots)

Timber Pond (TP)	
Container Freight Station(CFS)	
14,020	(sq.m)

Cotton Depot (COD)	
Container Freight Station(CFS)	
11,003	(sq.m)

Manganese Ore Depot(MOD)	
Container Freight Station(CFS)	
10,238	(sq.m)

Figure 2.4.2-4 Layout Plan of Major Facilities for Alternative-6

Summary of Alternative Projects for Container Handling Facilities at MBP

Ficilities	Unit	Alternative-6
1.Existing Container Berth		
1.Number of Berths		1
2.Berth Depth	(m)	-9.8
3.Berth Length	(m)	244
4.Berth Location		BPS
2.Proposed Container Berth		
1.Number of Berths		3
2.Berth Depth	(m)	-11 to -13.5
3.Berth Length	(m)	250 to 300
4.Berth Location		800 m off HW
3.Container Marshaling Yard	(G.slots)	3,446
1.Existing Yard	(G.slots)	516
2.Proposed Yard	(G.slots)	2,930
1.ID-1	(G.slots)	0
2.ID-2 to 5	(G.slots)	0
3.ID-HW	(G.slots)	0
4.Victoria Dock	(G.slots)	2,930
5.CDW	(G.slots)	0
6.TPS	(G.slots)	0
7.CRS	(G.slots)	0
4.Empty Container Yard	(G.slots)	3,341
1.Existing Yard	(G.slots)	0
2.Proposed Yard	(G.slots)	3,154
1.ID-1	(G.slots)	240
2.Victoria Dock	(G.slots)	802
3.CDW	(G.slots)	972
4.TPS	(G.slots)	1,140
5.CRS	(G.slots)	0
3.Shortage of Yard	(G.slots)	187
5.Container Freight Station	(sq.m)	67,687
1.Existing CFS	(sq.m)	48,487
2.Proposed CFS	(sq.m)	19,200
CDW	(sq.m)	19,200
6. Dedicated Road for Containers		
1. No. of Lanes	(lanes)	4
2. Ground Length	(m)	1,000
3. Elevated Length	(m)	700

Container Berth		
800 m off ID-HW		
No.	Length	Depth
3 Berths	250 m to 300 m	-11.0m to -13.5m

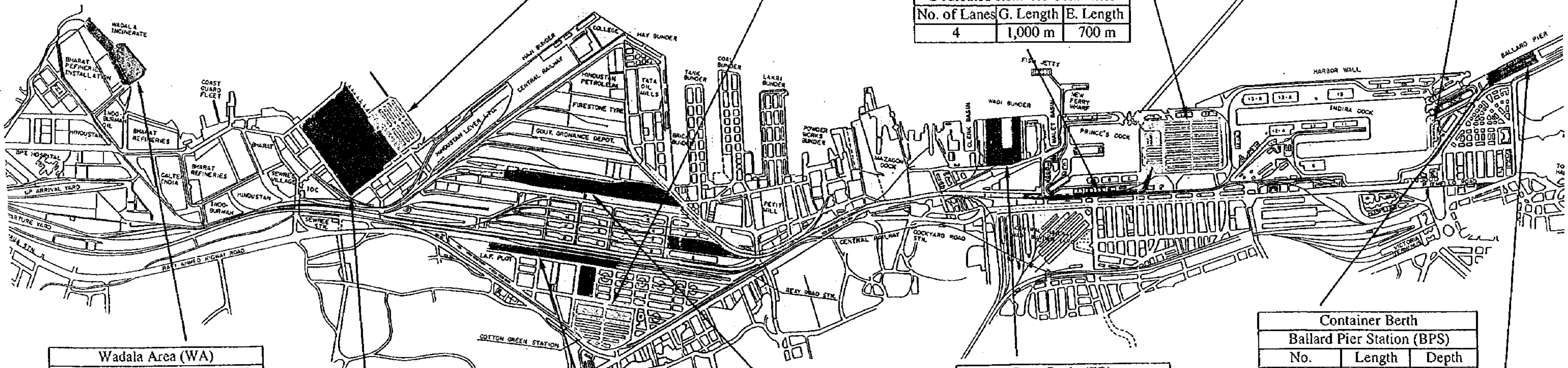
Cotton Depot West (CDW)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
0	972	19,200

Victoria Dock Container Yard		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
2,930	802	-

Timber Pond South (TPS)		
Marshaling Yard	Empty Container Yard	Container Freight Station
(G.Slots)	(G.Slots)	(sq.m)
0	1,140	-

Indira Dock No.1 (ID-1)	
Empty Container Yard	
240	(G.Slots)

Dedicated Road for Containers		
No. of Lanes	G. Length	E. Length
4	1,000 m	700 m



Container Berth		
Ballard Pier Station (BPS)		
No.	Length	Depth
1 Berth	244 m	-9.8 m

Wadala Area (WA)	
Container Freight Station(CFS)	
2,890	(sq.m)

Frere Basin (FB)	
Container Freight Station(CFS)	
10,336	(sq.m)

Ballard Pier Station (BPS)	
Marshaling Yard	
516	(G.Slots)

Timber Pond (TP)	
Container Freight Station(CFS)	
14,020	(sq.m)

Cotton Depot (COD)	
Container Freight Station(CFS)	
11,003	(sq.m)

Manganese Ore Depot(MOD)	
Container Freight Station(CFS)	
10,238	(sq.m)

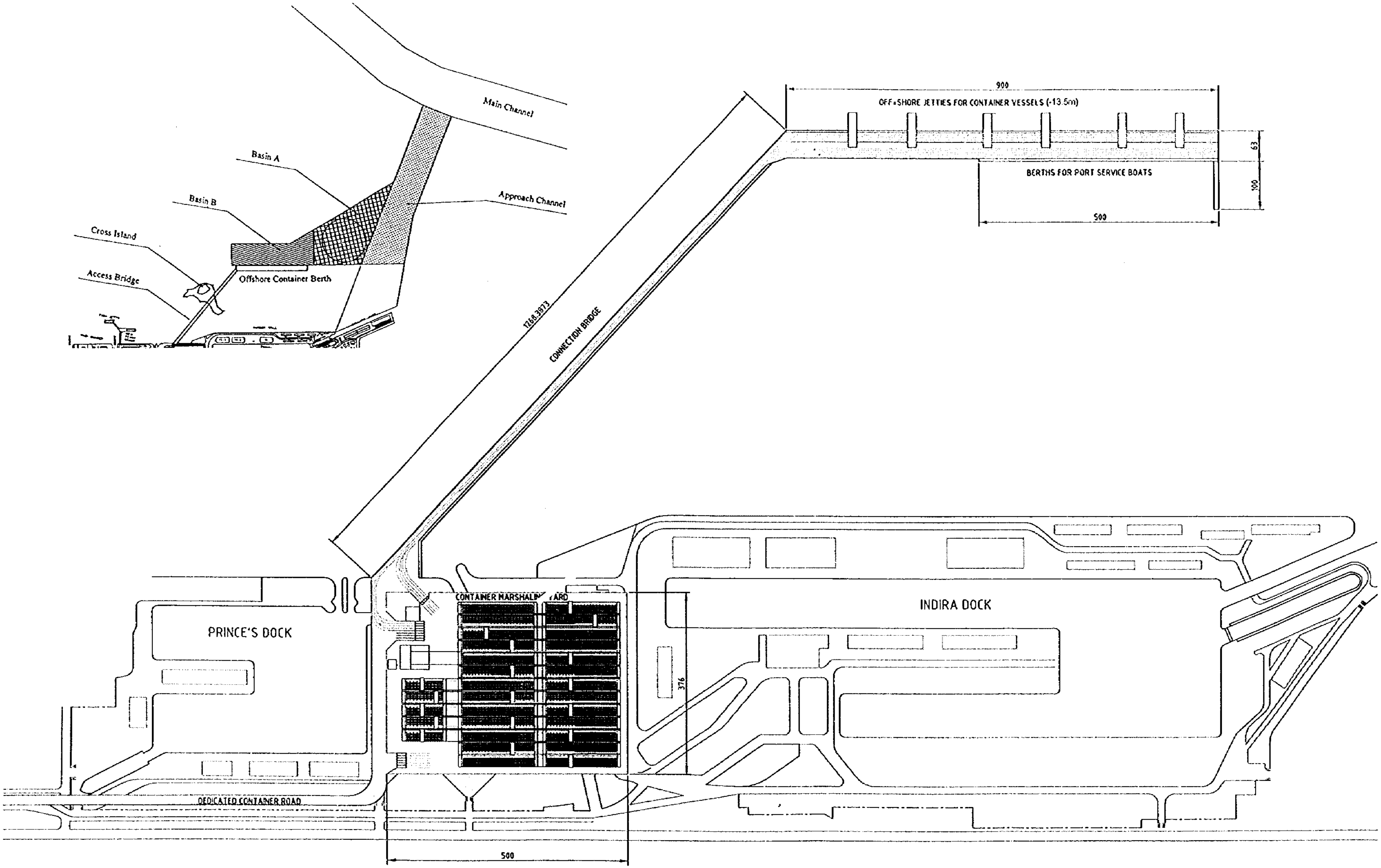


Figure 2.4.2-5 Layout Plan of A New Container Terminal at Victoria Dock (Alternative-6) SCALE1:7,000

3) Layout the Proposed Plan(Alternative-6)

On-dock layout of the proposed plan is shown in Figure 2.4.2-5, including 1) three new off-shore jetty-type container berths connected to Victoria Dock Container Yard by access bridge, 2) 2,930 G. slots of container marshaling yard and 802 G. slots of empty container yard on Victoria Dock Container Yard, 3) dedicated road for container traffic between on-dock container yard and off-dock CFS and empty container yard and 4) Deepening both the basin of the proposed container berths, whose berthing area is deepened to -13.5m, and the Approach Channel to -11.0m.

Turning circle for the container vessels departing from the proposed container berths is designed for 2,500 TEU-size container vessels with a diameter of 520m which is equal to twice as long as LOA of 2,500 TEU-size container vessel. This turning circle is located a little apart from the corner of the Approach Channel and the basin. Designed depth of the Approach Channel and the basin is planned as -11.0m, taking into account the tidal range of 5.2m at MBP as mentioned above.

Since the designed depth of the proposed container berths is -13.5m, however, the container berth front area is planned to be deepened up to -13.5m within the berthing pocket area of 65m wide which is equal to twice as wide as Molded Breadth of 2,500 TEU-size container vessel.

2.4.3 The Master Plan for Modernizing Existing Conventional Cargo Handling Facilities

(1) Modernizing Existing Conventional Cargo Handling Facilities

1) Target Volume of Handling Break and Dry Bulk Cargo

Target volume of break bulk cargo and dry bulk cargo are estimated as 6.1 million tons and 1.9 million tons for the year 2017 respectively.

2) Scenario for Modernizing the Existing Conventional Cargo Handling

Since off-shore jetty-type container berths are planned as the Master Plan for container handling which are connected with Victoria Dock Container Yard by access bridge, Victoria Dock will no longer be able to be used as conventional cargo berths. Prince's Dock should be mainly used for ship repair activities, idling etc., because berths in Prince's Dock are so shallow (berth depth: -6.4m) that Prince's Dock is inconvenient for larger conventional cargo vessels.

Table 2.4.3-1 Summary of Conventional Cargo Handling Conditions in 2017

Package Style	Annual Cargo Volume	Unit Load per Vessel	Annual Vessel Calls	Net Productivity	No. of Gangs	Operational Factor	Dwelling Time in Storage Space
	(thousand tons/yr.)	(ton/vessel)	(vessels/yr.)	(ton/gang/hr)	(gangs)		(days)
1. Bagged Cargo	1,853	---	174	---	---	---	---
1) Pulses	751	11,324	66	34.7	3	0.8	3
2) Rice	570	10,357	55	31.9	3	0.8	3
3) Sugar	95	13,124	7	34.7	3	0.8	3
4) Oil Cakes	437	9,421	46	31.9	3	0.8	3
2. Iron and Steel	2,536	12,795	198	50.0	3	0.8	3
3. Miscellaneous	1,672	3,900	429	28.0	2	0.8	3
4. Dry Bulk Cargo	1,855	---	168	---	---	---	---
1) Phosphate	856	17,192	50	43.2	3	0.8	0
2) Sulfur	880	8,000	110	43.2	3	0.8	0
3) Scrap	119	14,868	8	50.0	3	0.8	3
Total	7,916	---	969	---	---	---	---

The required dimensions of the sheds and open yards are summarized in Table 2.4.3-2, assuming the future productivity of each cargo at internationally reasonable level.

Table 2.4.3-2 Summary of Required Dimensions of the Shed and Open Yard at MBP in 2017

Type of Storage Space	Type of Cargoes	Required Area of Shed / Open Yard
1. Open Yard	Iron and Steel, Miscellaneous Cargo and Scrap	95,000 (sq. m)
2. Shed	Bagged Cargo, Miscellaneous Cargo, Paper Products	125,000*(sq. m)

Remarks) * One fourth of the cargo volume is assumed to be handled by direct loading/unloading.

(2) Usage Plan for the Existing Conventional Cargo Handling Facilities

1) Conventional Cargo Handling Facilities

Each berths are planned to be used by specific type vessels taking account of berth characteristics such as with/without shed, warehouse and open yard behind them. The detailed conventional cargo vessel assignment plan is shown in Figure 2.4.3-1.

2) Waiting Space for Conventional Cargo Trucks

Since there is uncertainty of ship arrivals especially for break bulk cargo and dry bulk cargo at MBP, conventional cargo trucks need to wait some time for ship arrival which carries the cargo to be unloaded. Many conventional cargo trucks are currently seen parking along both sides of P D' Mello Road, which may accelerate traffic congestion on the road.

Gamadia Road Area of 45,000 sq. m will probably be evicted and be able to be used for port-related activities. Since there are some buildings which need to be demolished within Gamadia Road Area, however, sheedule of the eviction is still uncertain. Gamadia Road Area should be used as a parking and/or waiting space for conventional cargo trucks so as to utilize partly evicted area step by step. This will also relieve traffic congestion to a certain extent along P D'Mello Road due to unauthorized parking on both sides of the road.

2.4.4 The Master Plan for Modernizing Marine Oil Terminal

(1) Target Volume of Liquid Bulk Cargoes to be handled at MBP in 2017

Target volumes of crude oil, POL and chemicals are estimated as 18.9 million tons, 17.6 million tons and 0.4 million tons respectively for the year 2017.

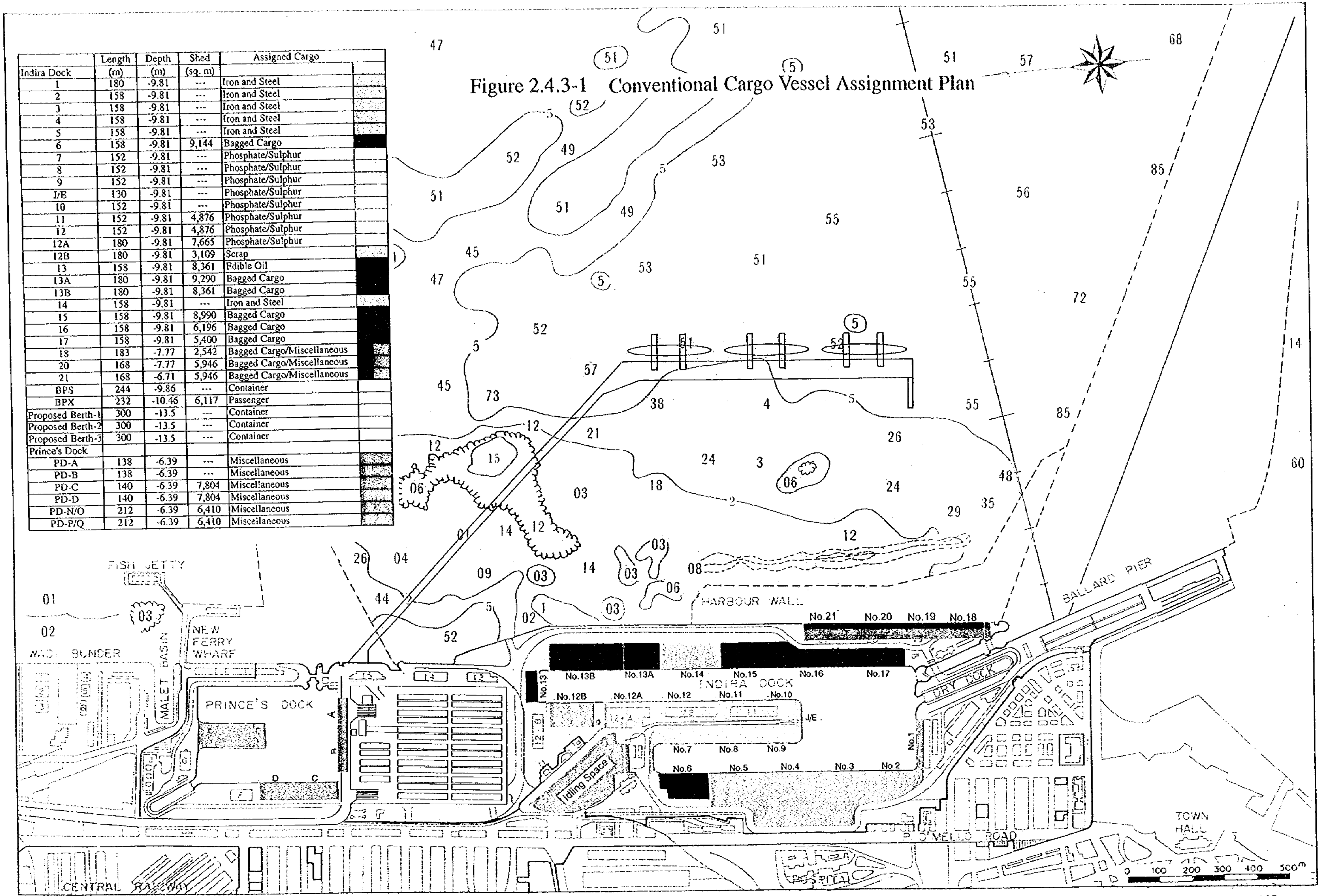
(2) Examination of MOT Capacity in 2017 with Replaced Pipelines

Total MOT works out with JD Nos. 1 to 3, JD-No.4 and New Pir Pau. The number of pipelines linking JD manifold and Pir Pau manifold should be adequate to serve all the possible usage combination of three berths, JD Nos. 1 to 3 by crude oil tankers, POL (black oil) tankers and POL (white oil) tankers. Theoretically required number of the pipelines is nine; three for crude oil, three for POL (black oil) and three for POL (white oil) so as to accommodate three same type tankers simultaneously. However, MBPT examined the minimum possible number of pipelines with acceptable inconvenience within the limited budget and resulted in five pipelines; one for crude oil, one for POL (black oil) and three for POL (white oil).

Annual numbers of crude oil tankers, POL tankers and chemical tankers are estimated as 310, 530

Figure 2.4.3-1 Conventional Cargo Vessel Assignment Plan

	Length	Depth	Shed	Assigned Cargo	
Indira Dock	(m)	(m)	(sq. m)		
1	180	-9.81	---	Iron and Steel	
2	158	-9.81	---	Iron and Steel	
3	158	-9.81	---	Iron and Steel	
4	158	-9.81	---	Iron and Steel	
5	158	-9.81	---	Iron and Steel	
6	158	-9.81	9,144	Bagged Cargo	
7	152	-9.81	---	Phosphate/Sulphur	
8	152	-9.81	---	Phosphate/Sulphur	
9	152	-9.81	---	Phosphate/Sulphur	
J/E	130	-9.81	---	Phosphate/Sulphur	
10	152	-9.81	---	Phosphate/Sulphur	
11	152	-9.81	4,876	Phosphate/Sulphur	
12	152	-9.81	4,876	Phosphate/Sulphur	
12A	180	-9.81	7,665	Phosphate/Sulphur	
12B	180	-9.81	3,109	Scrap	
13	158	-9.81	8,361	Edible Oil	
13A	180	-9.81	9,290	Bagged Cargo	
13B	180	-9.81	8,361	Bagged Cargo	
14	158	-9.81	---	Iron and Steel	
15	158	-9.81	8,990	Bagged Cargo	
16	158	-9.81	6,196	Bagged Cargo	
17	158	-9.81	5,400	Bagged Cargo	
18	183	-7.77	2,542	Bagged Cargo/Miscellaneous	
20	168	-7.77	5,946	Bagged Cargo/Miscellaneous	
21	168	-6.71	5,946	Bagged Cargo/Miscellaneous	
BPS	244	-9.86	---	Container	
BPX	232	-10.46	6,117	Passenger	
Proposed Berth-1	300	-13.5	---	Container	
Proposed Berth-2	300	-13.5	---	Container	
Proposed Berth-3	300	-13.5	---	Container	
Prince's Dock					
PD-A	138	-6.39	---	Miscellaneous	
PD-B	138	-6.39	---	Miscellaneous	
PD-C	140	-6.39	7,804	Miscellaneous	
PD-D	140	-6.39	7,804	Miscellaneous	
PD-N/O	212	-6.39	6,410	Miscellaneous	
PD-P/Q	212	-6.39	6,410	Miscellaneous	



and 39 respectively. The computer simulation is used to estimate ship-waiting time and berth occupancy ratio when handling the target volume of liquid bulk cargo. Additionally, JD-1 and 3 are assumed to be used by both crude oil tankers and POL tankers, JD-2 is assumed to be used by POL tankers only, and JD-4 is assumed to be used by larger crude oil tankers only.

Table 2.4.4-1 Summary of the Liquid Bulk Cargo Handling Productivity

	Crude Oil		POL		Chemical
	JD-4	JD-1,-2,-3	JD-1,-2,-3	New Pir Pau	New Pir Pau
1. Target Volume in 2017 (thousand tons/yr.)	18,891		17,605 (white:13,093, black:4,512)		393
	12,940	5,951			
2. Forecast Number of Vessel Calls in 2017 (vessels/yr.)	200	110	530		39
	Tankers are assumed to arrive based on Poisson's distribution.				
3. Average Loaded Volume per Vessel (tons/vessel)	65,000	54,000	33,000	33,000	10,000
4. Nominal Productivity (tons/hr./vessel)	5,000	5,000	2,000	2,000	800
5. Effective Factor	0.85	0.85	0.75	0.75	0.75
6. Berthing/un-berthing Time (hrs./vessel)	12	12	12	12	12
7. Gross Productivity (tons/hr./vessel)	2,186	2,186	971	971	349

Remarks) (1) One crude oil tanker can be handled simultaneously at JD-1,-2 and -3. (2) One POL (black) tanker can be handled simultaneously at JD-1,-2 and -3. (3) Three POL (white) tankers can be handled simultaneously at JD-1,-2 and -3.

Ship-waiting time for crude oil tankers, POL tankers and Chemical are estimated as 55.0 hours/vessel, 9.0 hours/vessel and 7.2 hours/vessel respectively. Since JD-4 is only a deep berth which can accommodate 120,000 DWT-class tankers and there is no alternate berth for larger crude oil tankers, this results in longer ship-waiting time of 55.0 hours/vessel for larger crude oil tankers.

Average berth occupancy ratio for JD-1, -2 and -3 is estimated as 65.0%. Berth occupancy ratios for JD-4 and New Pir Pau are 67.5% and 51.0% respectively.

Both ship-waiting time and berth occupancy ratio estimated by computer simulation remain within a reasonable range. Therefore, no additional change is required for Marine Oil Terminal as a long-term basis.

2.4.5 The Master Plan for Port Traffic Facilities

(1) Present Port-related Cargo Traffic in and around MBP

The present flow pattern of port-related cargo in and around MBP is presented in Figure 2.4.5-1. Average daily traffic volume of vehicles at each monitoring points are summarized in Table 2.4.5-1.

Table 2.4.5-1 Average Daily Traffic (Two-Directional) of Port-related Cargo by Vehicle Type

(unit: vehicles/day)

Monitoring Point	Trucks + Lorries	Containers	Tempos	Cars + Taxi	Auto Rikshaw	Two-Wheelers	Buses	Grand Total
1. P D'Mello Road	**11,616**	**2,157**	4,703	10,020	594	5,478	907	35,475
2. Link Road	**2,064**	**4,898**	49	5,272	0	3,865	4	16,152
3. Cotton Green	**11,461**	**966**	3,277	3,277	155	4,390	52	23,578
4. Wadala Flyover*	**5,901***	**2,131***	1,143*	10,123*	235*	4,241*	1,344*	25,118*
5. Everard Nagar Jnc. (Cembur Point)	**22,697**	**3,308**	8,570	26,424	10,833	9,763	12,270	93,865

Remarks) * represent data on 29th of September, 1997, because data on 13th of October seems outlier.

(2) Forecast Port-related Cargo Traffic and Flow Assignment in and around MBP

Peaking daily traffic volume of port-related cargo in 2017 is estimated by using computer simulation based on the future volume of container cargo, break and dry bulk cargo to be handled at MBP taking account of modal split between road and rail, and assigned to each roads. All the port-related cargo traffic is assigned to container-dedicated road, Link Road and Anik-Everard Nagar Road up to Everard Nagar Junction without merging city traffic (Figure 2.4.5-2). Estimated results are summarized and compared with the counted daily traffic volume in Table 2.4.5-2.

(3) Dedicated Road to Evacuate Containers from Dock Area

Dedicated road for container traffic would be essential to smoothly flow container traffic between on-dock container yard and off-dock CFS and empty container yard. The dedicated road starts from the gate of Victoria Dock Container Yard and extends to and connects with the Link Road. The fly-over structure is adopted for the dedicated road to cross over Malet Road so as to smoothly evacuate containers out of the dock area. Heavy traffic congestion currently seen at the junction of Dock Expressway and Malet Road is expected to be reduced drastically by fly-over road.

Table 2.4.5-2 Estimated Peaking Daily Traffic (Two-directional) in 2017 in and around MBP

(unit: vehicles/day)

	Estimated Volume	① PD'Mello	② Link Road	③ Cotton Green	④ Wadala Fly-over	⑤ Everard Nagar Junction (Chembur)
1. Container-trailer (LCL) (Off-dock CFS⇔Docks)	4,206	-	4,206	-	-	-
2. Container-trailer (FCL) (Out-of-port⇔Docks)	3,744	-	3,744	-	-	3,744
3. Loose Cargo Trucks to/from CFS (Out-of-port⇔Off-dock CFS)	4,214	-	-	-	-	4,214
4. Break and Dry Bulk Cargo Trucks (Out-of-port⇔Docks)	10,184		10,184	-	-	10,184
5. POL Lorries (Out-of-Port⇔Wadala)	4,861	-	-	-	-	4,861
Number of Containers in 2017		-	7,950	-	0	3,744
Number of Containers in 1995-96		-	4,898	-	2,131	0
Number of Trucks and Lorries in 2017		0	10,184	0	0	19,259
Number of Trucks and Lorries in 1995-96		11,616	2,064	11,461	5,901	0
Number of Port-related Traffic in 2017			18,134	-	-	23,003
Number of Port-related Traffic in 1995-96		-	6,962	-	-	0

Dedicated road for ordinary port-related traffic along the container-dedicated road is planned within the port area to flow port-related traffic including general cargo trucks. This could also reduce traffic congestion on P D'Mello Road where heavy congestion by both port-related traffic and city traffic is always seen currently.

However, Mumbai Metropolitan Region Development Authority (MMRDA) is planning to build "East Island Freeway" along the Link Road and Dock Expressway within the MBPT's landed estate as an extension of Eastern Express Highway to the Gateway of India. "East Island Freeway" is planned basically to flow city traffic rather than port-related traffic. Since the above-mentioned container-dedicated road could reduce city traffic congestion and MBPT's landed estate has to be utilized basically for dealing port-related activities, precious space for the container-dedicated road should be reserved for this Master Plan.

Additionally, the numbers of lanes of container-dedicated road, Link Road and Anik-Everard Nagar Road are examined to be adequate for serving the projected traffic volume for the year 2017.

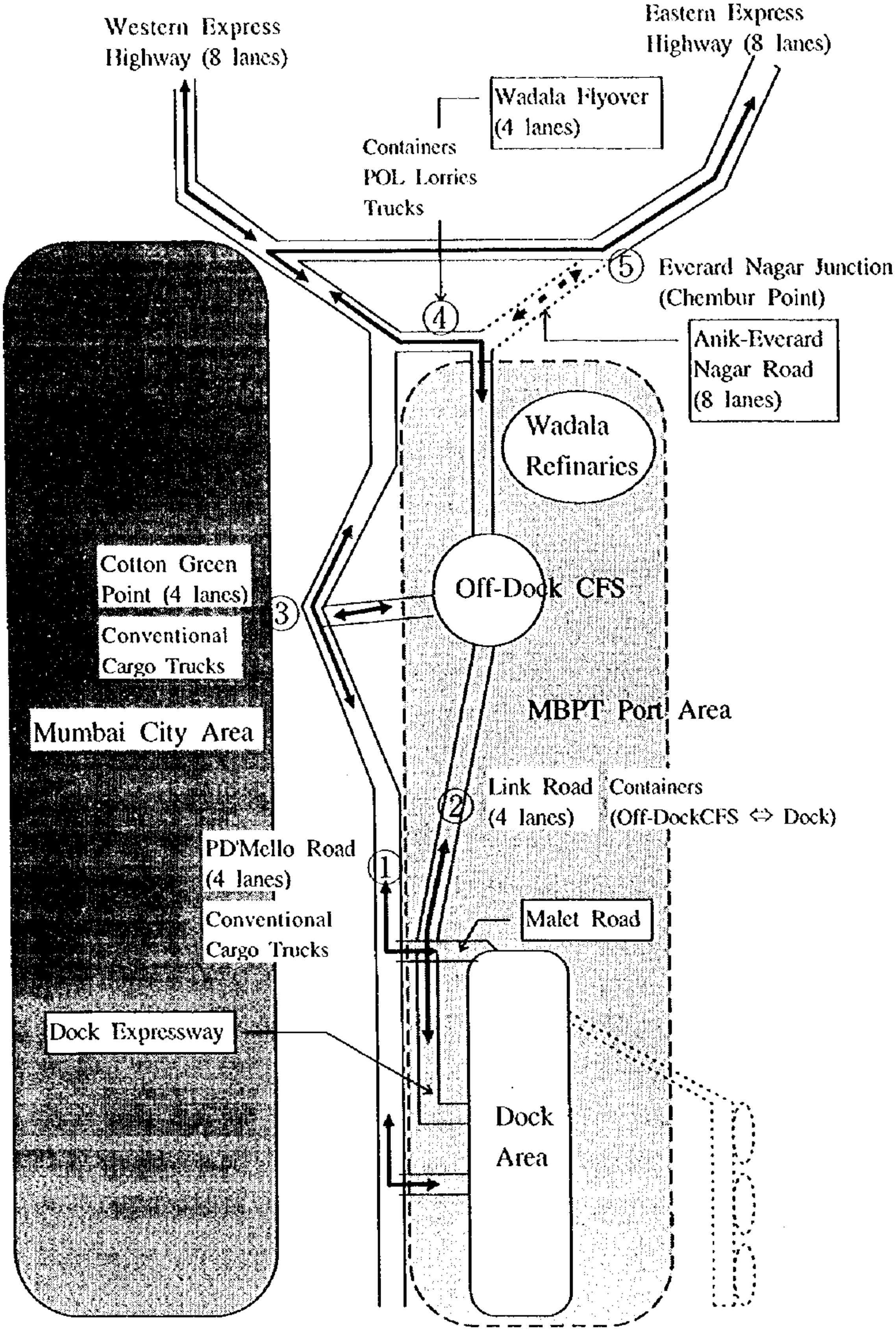


Figure 2.4.5-1 Present Port-related Cargo Traffic Flow Pattern in and around MBP

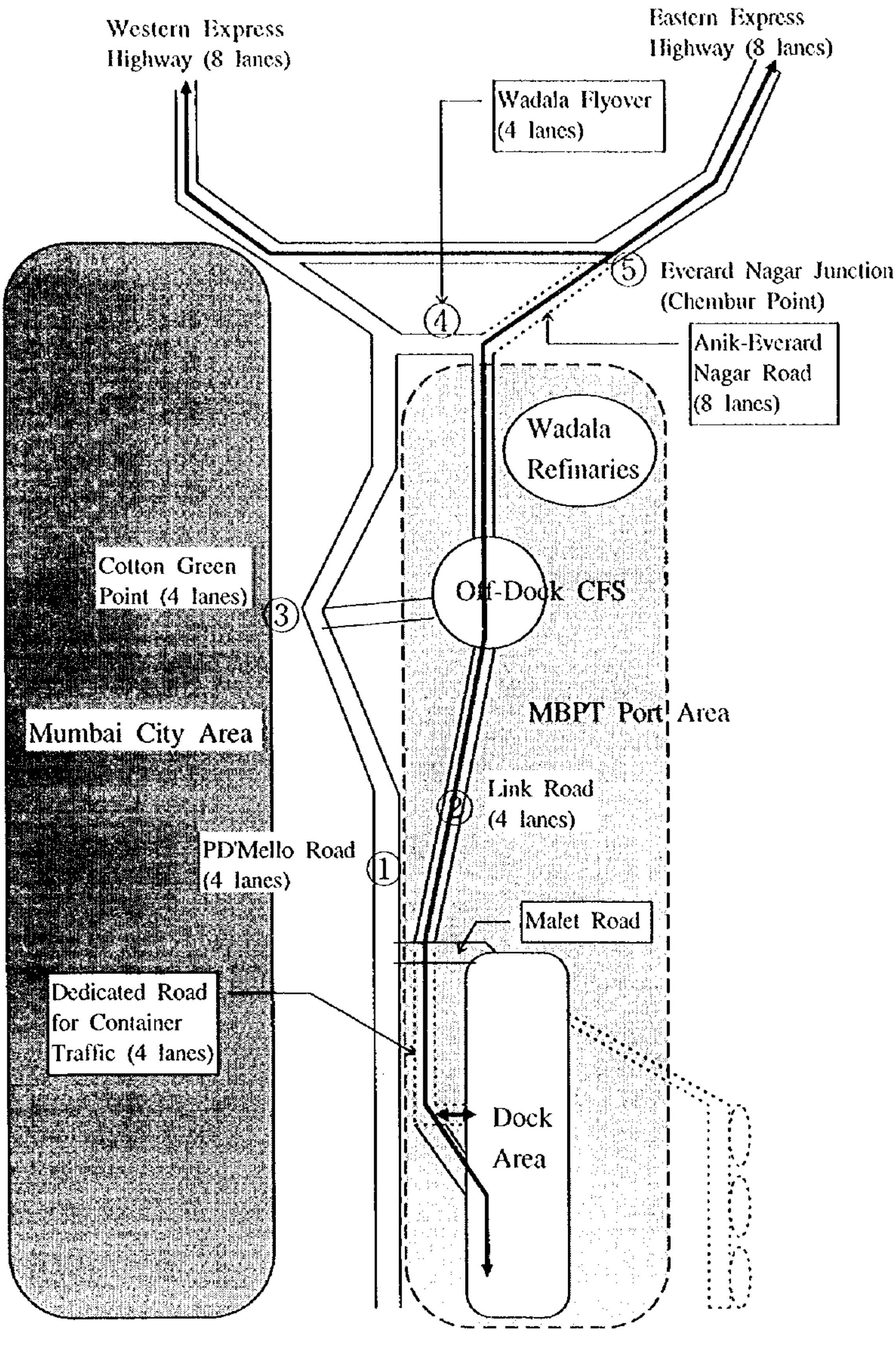


Figure 2.4.5-2 Port-related Cargo Traffic Flow Assignment Plan in and around MBP

2.4.6 The Master Plan for the Main Channel, Approach Channel and Basin

The purpose of deepening the main channel is to serve larger tankers of crude oil visiting JD-4 and larger container vessels visiting JNP with less time constraints when entering/departing the ports as long as the project of deepening the main channel is feasible.

(1) Preparing Alternative Depths of Deepening the Main Channel

Four alternative plans are prepared for deepening the main channel.

Table 2.4.6-1 Alternative Plans for Deepening the Main Channel

Alternative Plan	Alternative Depth of the Main Channel	Depth of JD-4	Depth of Additional Container Berths at JNP	Arriving Max. Draft of Tankers at JD-4	Arriving Max. Draft of Container Vessels at JNP
Alternative-1	-10.8 m	-14.3 m	-13.5 m	-12.2 m (50,000DWT)	-12.8 m (3,000TEUs)
Alternative-2	-12.0 m	-14.3 m	-13.5 m	-13.6 m (75,000DWT)	-12.8 m (3,000TEUs)
Alternative-3	-12.0 m	-14.3 m	-14.5 m	-13.6 m (75,000DWT)	-13.6 m (4,500TEUs)
Alternative-4	-12.5 m	-14.3 m	-14.5 m	-13.6 m (75,000DWT)	-13.6 m (4,500TEUs)

Remarks) DWT in parentheses shows maximum DWT in fully-loaded condition.

Table 2.4.6-2 Number of Container Vessels to JNP and Tankers to MOT in 2017

	Annual Number of Container Vessels to JNP					Annual Number of Tankers to MOT			
	4,500 TEUsize	3,000 TEUsize	2,000 TEUsize	1,500 TEUsize	Total	Crude Oil	POL	Chemical	Total
	(container vessels/year)					(tankers/year)			
Alternative-1	---	1,036	1,019	194	2,249	310	530	39	879
Alternative-2	---	1,036	1,019	194	2,249	310	530	39	879
Alternative-3	586	596	1,019	194	2,395	310	530	39	879
Alternative-4	586	596	1,019	194	2,395	310	530	39	879

(2) Evaluation of the Alternatives

Total costs to receive oil tankers at JD-4 are estimated for each alternatives and the main channel depth of -10.8 m (Alternative-1) gives the minimum total costs.

Furthermore, the total costs are also estimated for each alternatives of the main channel and the approach channel to the future container berths at JNP and the combination of -12.0 m of the main channel depth and -14.5 m of the future container berths' depth (Alternative-3) gives the minimum total costs. Alternative-3 is a plan to deepen the main channel by 1.2 m up to -12.0 m, which assumes that oil tankers with maximum draft of 13.6m calling JD-4 and container vessels of over-panamax type with a full-draft of approximately 13.6m visit JNP in 2017.

2.4.7 The Master Plan for the Navigation Safety

(1) Equipping the Channels with Navigational Aids

With the partial widening and deepening of the channels, a series of navigational aids should be provided at due positions of the new channels.

(2) Reinforcement of Tug Fleet

The ocean going vessel that reduces her speed under several knots in approaching a berth, normally loses almost all of her rudder function, consequently, the assistance of tug boat(s) is indispensable for turning/berthing the vessel. Furthermore, the geographical features at Mumbai Port should be taken in account, i.e., the location of some turning basins lies in close proximity to the channel and/or inroads into the channel, and most of the maneuvering circles are small (two L of expected vessel in diameter) which means that a mother vessel is unable to maneuver without tug assistance.

(3) Additional Pilots

Assuming that the working conditions in terms of service frequency of each pilot will be the same as heretofore, the regular staff of pilots will have to be increased as shown in Table 2.4.7-1.

Table 2.4.7-1 Regular Number of Pilots and Piloting Services

Year	No. of Vessel	Frequency of Piloting	No. of Pilots	Frequency/Pilot
1996	2,264	4,528	44	103
2007	2,292	4,584	45	103
2017	2,748	5,496	54	103

2.4.8 The Master Plan for Passenger Traffic

(1) Present Routes and Schedule of Inter-Harbour Passenger Services

Relatively small passenger boats of about 22 to 250 persons in capacity are presently used for the inter-harbour transport. Navigational Routes of Services to/from Ferry Wharf is presented in Figure 2.4.8-1.

(2) Target Volume of Passenger Traffic to embark/disembark at MBP in 2017

Table 2.4.8-1 Estimated Number of Passenger Boat Services for Inter-Harbour Traffic in 2017

Route	Target Volume in 2017	Capacity of Passenger boat	Load Factor	Peaking Factor to Average Daily Services	Peaking Daily Number of Services (One-direction)
	('000 passenger)	(persons/ boat)			(services/day)
1. Mumbai - Mora	1,472	200	0.6	1.26**	22
2. Mumbai - Rewas	1,506	200	0.6	1.26**	22
3. Mumbai - Mandwa	443	100	0.6	1.26**	13
5. Mumbai - Elephanta	1,008	100	0.6	2.0***	46
6. Mumbai - JNP	487	100	0.6	1.26**	14
7. Mumbai - Vashi*	269	50	0.6	1.26**	15
Grand Total		---	---		132

Remarks) * indicates hovercraft services are necessary due to inadequate water depth in Thane Creek to/from Vashi.

** is calculated with actual data between Mumbai and JNP for August, 1997.

*** is assumed taking into account of interview survey by the Study Team.

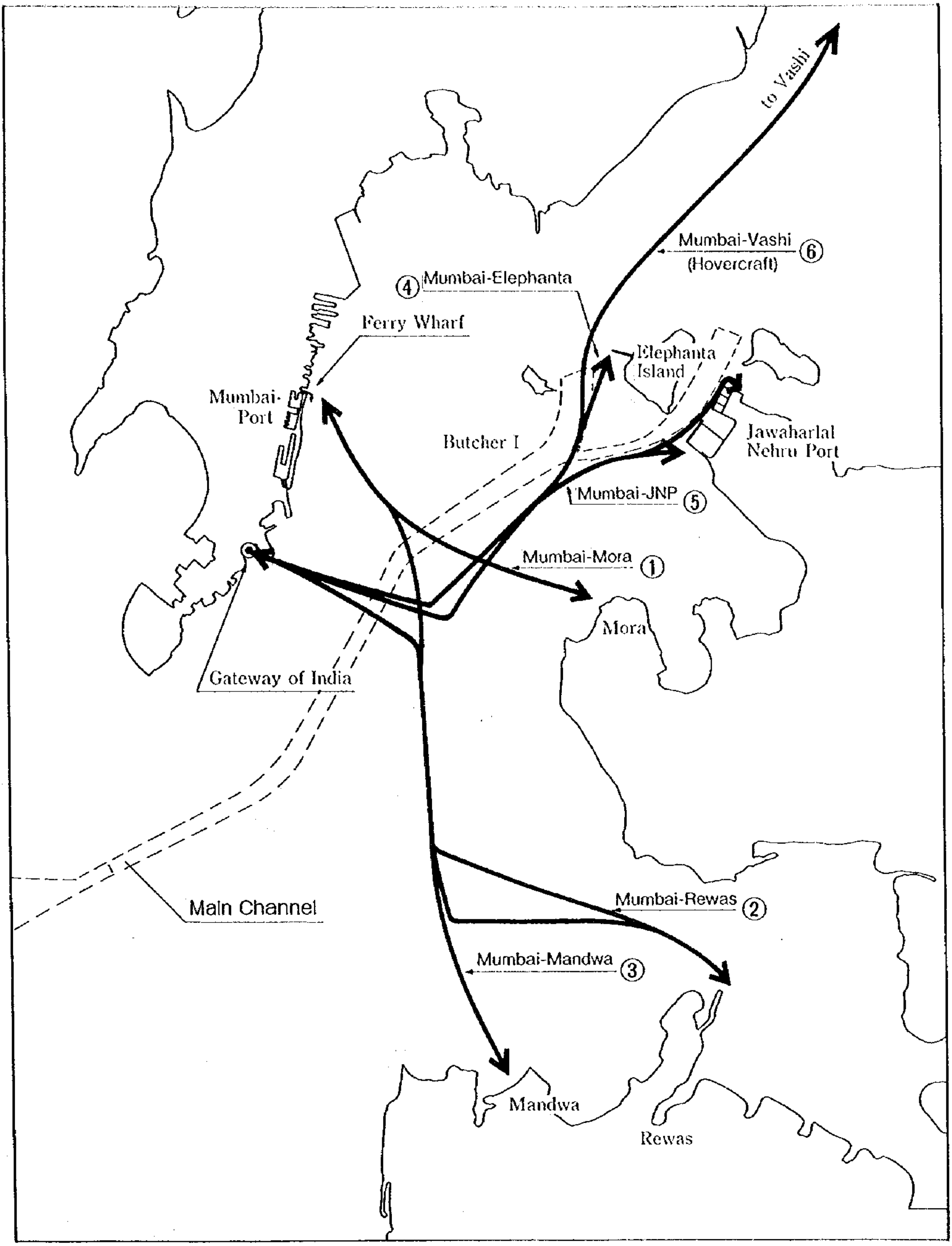


Figure 2.4.8-1 Present Navigational Routes of Inter-Harbour Passenger Services

The number of passenger boat services in 2017 is estimated as 5.2 million tons peasons. Capacities of passenger boats are assumed as 200 and 100 persons/boat for the routes of more than and less than 1 million passengers/year respectively in this study. Although the capacity of Hover-craft for the present services is 22 seats, some larger-sized Hover-craft (50 seats) is assumed in this study for handling the future traffic volume taking into account of the present frequency of services and doubled demand in 2017.

(3) Possible Navigational Problems to be Resolved

A continuous increase of vessel traffic until 2017 within Mumbai port area is projected. In this connection, owing to the heavy vessel traffic in future, risky situations in which vessels meet or cross one another, at intersections in particular, may arise.

Therefore, it is desirable to set up new standards on vessel traffic within the Port area by the Authority concerned to avoid possible sea accidents, i.e.:

1) A vessel proceeding along the course of the designated channels(Main/Approach/JNP) shall keep as near to the outer limit of the channel which lies on her starboard side as is safe and practicable.
2) A vessel of less than 40 m in length shall not impede the passage of a vessel which can safely navigate only within the designated channels.
3) A vessel of less than 40 m in length shall not cross the specified area of the designated channels (for example; in close proximity of the joint of the Main and the Approach channel)
4) A vessel shall not cross the designated channels if such crossing impedes the passage of a vessel which can safely navigate only within such channels.
5) A vessel proceeding along the course of the designated channels shall not overtake any other vessel proceeding in the same direction.
6) A vessel proceeding along the course of the designated channels shall keep less than 6 knots so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions such as visibility, traffic density, and vessel maneuverability.

7) Any vessel shall, if the circumstances admit, avoid anchoring in the designated channels.

8) A vessel of larger than 10,000DWT carrying dangerous cargo shall be escorted by a patrol boat.

9) A vessel proceeding along the course of the designated channels shall keep the minimum distance of eight times of her length to the vessel going ahead. If the vessel is larger than 10,000 DWT and carrying dangerous cargo, the minimum distance shall not be less than one sea mile regardless her length.

10) Vessels in the Port area shall comply at all times with the instructions of Harbor Master.

11) Matters related to inter-harbor passenger liners such as the deployed boats, the life-saving /fire-fighting/communicating equipment, the license of Captain/Engineer, the service frequency/time tables, the regularly routes and other specified matters by the Authority shall be subject to the Authority's approval.

12) To carry into effect " Port State Control".

2.4.9 The Phase Plan for Developing and Modernizing MBP

In the framework of the proposed Master Plan to meet the port requirements on the stage of the short-term plan up to the target year 2007, the first phase projects to be completed by the target year 2007 are proposed (see Table 2.4.9-1) together with the following second phase project up to the target year 2017.

Table 2.4.9-1 Summary of Projects of the Phase Plan

Phase Plan	Project Name
First Phase Plan (up to 2007)	1. Container Terminal Project
	2. Deepening Approach Channel Project
Second Phase Plan (up to 2017)	3. Deepening Main Channel Project

2.5 Design and Cost Estimation

2.5.1 General

A preliminary design is developed for those onshore and offshore civil engineering structures which are of primary importance in the Master Plan. The comparative evaluations when we design the facilities must take full account of specific service conditions, cost effectiveness, durability, relative ease of construction and maintenance, construction time involved, compatibility with the future expansion / improvement plans, and other pertinent factors. Based on the preliminary designs and the results of comparative evaluation, preliminary construction costs and scheduling of construction works shall be carried out.

2.5.2 Preliminary Structural Design

The following facilities are taken up for the preliminary structural design of Master Plan and detail examination of designs and typical cross sections are compiled in the study report.

(1) New offshore container berth

(2) Expansion of existing Harbour Wall Berth

(3) Expansion of existing Indira Dock Berth

(4) Access bridge connects proposed offshore berth and shore side container yard

(5) Paving work of new container yard

(6) Elevated container road in Port Premises to avoid interference from other traffic

2.5.3 Cost Estimation

(1) Construction Work

Preliminary cost estimates have been worked out in respect to the Master Plan targeted for the year 2017. The cost estimates are primarily based on the basic prices and rates in Mumbai derived from a construction material and equipment price survey conducted by the Study Team in early 1997, and they are adjusted on the basis of market prices in Southeast Asian countries in recent years.

The cost estimates have been arrived at on a quantification basis for major types of work with due consideration given to local conditions and expected construction restraints.

The preliminary project cost estimates with respect to the Master Plan 2017 under the condition of eight alternatives including the navigational improvement scheme of Approach Channel to Indira Dock and the construction plan of offdock container yards are summarized in Table 2.5.3-1.

The construction cost of Navigational Improvement Scheme for Main Channel is estimated and given in Table 2.5.3-2.

(2) Cost Estimation of Maintenance Dredging

1) Main Channel

The maintenance Dredging cost is estimated depending on the combination of different maintenance depths and the relevant siltation rates which are discussed in the foregoing chapter in the Study. The detail calculation of cost estimate is shown in Table 2.5.3-3.

2) Indira Dock Container Terminal

The calculation of estimated maintenance cost for the Approach Channel and Basin of Indira Dock Container Terminal is also indicated in Table 2.5.3-4.

Table 2.5.3-1 Comparison Table of summarized Project Cost among Alternatives

No.	Main Facility	Construction Cost (Million Rs.)							
		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 6A	Alternative 6B
1	Dock Container Terminal	3,674	13,495	13,118	13,611	13,023	14,502	16,338	18,535
1-1	Container Berth	662	9,722	9,112	9,572	9,104	9,705	3,041	3,049
1-2	Container Yard	463	1,004	1,004	1,004	884	1,762	11,530	13,716
1-3	Container Handling Equipment	2,549	2,769	3,002	3,035	3,035	3,035	1,767	1,770
2	Approach Channel	0	784	611	611	611	611	750	936
3	Road Improvement	2,125	2,371	2,371	2,371	3,317	809	808	808
4	Cotton Depot Container Yard	782	782	782	782	782	782	782	782
5	Timber Pond South Container Depot	186	186	186	186	186	186	186	186
6	**Total**	**6,767**	**17,618**	**17,068**	**17,561**	**17,919**	**16,890**	**18,865**	**21,247**
Remarks									
1	Container Berth	Indira 2 to 5	Harbour Wall	Offshore-1	Offshore-2	Offshore-1	Offshore-1	Offshore-1	Offshore-1
2	Depth of Berth	-10.0 m	-13.0 m	-13.0 m	-13.0 m	-13.0 m	-13.0 m	-13.5 m	-14.0 m
3	Depth of Basin and Channel	-7.6 m	-10.5 m	-10.5 m	-10.5 m	-10.5 m	-10.5 m	-11.0 m	-11.5 m
4	Dock Container Yard	Indira 2 to 5	Harbour Wall	Harbour Wall	Harbour Wall	Indira 2 to 6	Victoria	Victoria	Victoria
5	Length of Elevated Container Road	2,000 m	2,200 m	2,200 m	2,200 m	3,100 m	700 m	700 m	700 m

Table 2.5.3-2 Navigation Improvement Scheme for Main Channel - Capital Dredging

No.	Description	Unit	Alternatives			
			Alt-1	Alt-2	Alt-3	Alt-4
I	**Capital Dredging**					
1	Proposed Depth					
	(1) Main Channel	m	-10.8	-12.0	-12.0	-12.5
	(2) JNPT Channel	m	-10.8	-12.0	-12.0	-12.5
	(3) JNPT Berth	m	-13.5	-13.5	-14.5	-14.5
2	Dredging of Main Channel					
	(1) Volume					
	1) Present Area	m3	0	14,471,000	14,471,000	20,616,000
	2) Widening Area	m3	0	2,106,000	2,106,000	2,834,000
	3) Total Volume	m3	0	16,577,000	16,577,000	23,450,000
	(2) Dredging Cost	000Rs.	0	2,954,850	2,954,850	4,179,963
3	Dredging of JNPT Channel					
	(1) Dredging Volume					
	1) Present Area	m3	0	2,552,000	2,552,000	3,900,000
	2) Widening Area	m3	0	566,000	566,000	885,000
	3) Total Volume	m3	0	3,118,000	3,118,000	4,785,000
	(2) Dredging Cost	'000Rs.	0	788,854	919,468	1,492,608
4	**Total Dredging Cost**	**'000Rs.**	**0**	**3,743,704**	**3,874,318**	**5,672,571**

No.	Description	Unit	Quantity	Rate (Rs.)	Amount ('000Rs.)	Remarks
II	**Navigation System**					
1	Tug Boat	No.	8	143,910,000	1,151,280	
2	Navigation Buoy	No.	57	4,000,000	228,000	
3	Sub Total				1,379,280	
4	Engineering Service	sum	1		68,964	5%
5	Contingency	sum	1		41,378	3%
6	**Total**				**1,489,622**	
7	**Annual Maintenance Cost**	**Year**	**1**	7,400,000	7,400	57 Buoys

Table 2.5.3-3 Cost Estimation for Annual Maintenance Dredging of Main Channel

No.	Description	Unit	Alternatives			
			Alt-1	Alt-2	Alt-3	Alt-4
1	Proposed Depth					
	1) Main Channel	m	-10.8	-12.0	-12.0	-12.5
	2) JNPT Channel	m	-10.8	-12.0	-12.0	-12.5
	3) JNPT Berth	m	-13.5	-13.5	-14.5	-14.5
2	Main Channel					
	1) Dredging Volume	m3	1,947,000	6,132,000	6,132,000	7,391,000
	2) Unit Rate	Rs./m3	70	70	70	70
	3) Dredging Cost	Rs.	136,290,000	429,240,000	429,240,000	517,370,000
	4) Contingency	Rs.	20,443,500	64,386,000	64,386,000	77,605,500
	5) Total Cost	Rs.	156,733,500	493,626,000	493,626,000	594,975,500
3	JNPT Channel					
	1) Dredging Volume	m3	305,000	459,000	459,000	522,000
	2) Unit Rate	Rs./m3	70	70	70	70
	3) Dredging Cost	Rs.	21,350,000	32,130,000	32,130,000	36,540,000
	4) Contingency	Rs.	3,202,500	4,819,500	4,819,500	5,481,000
	5) Total Cost	Rs.	24,552,500	36,949,500	36,949,500	42,021,000
4	**Total Cost**	**Rs.**	**181,286,000**	**530,575,500**	**530,575,500**	**636,996,500**

Table 2.5.3-4 Maintenance Dredging of Indira Dock Container Terminal (Annually)

No.	Description	Unit	Basin	Approach	Total
1	**Case 1 (Estimated maintenance dredging volume under present Depth)**				
	Maintenance Depth	m	-	-7.6	
	Dredging Volume	m3	-	433,000	
	Silt Rate	m	-	0.43	
2	**Case 2**				
	Maintenance Depth of Basin and Channel	m	-10.0	-10.0	
	Maintenance Depth of Berth	m	-13.0	-13.0	
	Dredging Area	m2	891,000		
	Silt Rate	m	0.47	1.27	
	Maintenance Volume	m3	418,770	1,274,000	
	Unit Rate	Rs./m3	70	70	
	Dredging Cost	Rs.	29,313,900	89,180,000	
	Contingency (15%)	Rs.	4,397,085	13,377,000	
	Total	Rs.	33,710,985	102,557,000	136,267,985
3	**Case 3**				
	Maintenance Depth of Basin and Channel	m	-10.5	-10.5	
	Maintenance Depth of Berth	m	-13.0	-13.0	
	Dredging Area	m2	900,400		
	Silt Rate	m	0.52	1.40	
	Maintenance Volume	m3	468,208	1,418,000	
	Unit Rate	Rs./m3	70	70	
	Dredging Cost	Rs.	32,774,560	99,260,000	
	Contingency (15%)	Rs.	4,916,184	14,889,000	
	Total	Rs.	37,690,744	114,149,000	151,839,744
4	**Case 4**				
	Maintenance Depth of Basin and Channel	m	-11.0	-11.0	
	Maintenance Depth of Berth	m	-13.5	-13.5	
	Dredging Area	m2	909,000		
	Silt Rate	m	0.55	1.51	
	Maintenance Volume	m3	499,950	1,542,000	
	Unit Rate	Rs./m3	70	70	
	Dredging Cost	Rs.	34,996,500	107,940,000	
	Contingency (15%)	Rs.	5,249,475	16,191,000	
	Total	Rs.	40,245,975	124,131,000	164,376,975
5	**Case 5**				
	Maintenance Depth of Basin and Channel	m	-11.5	-11.5	
	Maintenance Depth of Berth	m	-14.0	-14.0	
	Dredging Area	m2	918,000		
	Silt Rate	m	0.60	1.62	
	Maintenance Volume	m3	550,800	1,668,000	
	Unit Rate	Rs./m3	70	70	
	Dredging Cost	Rs.	38,556,000	116,760,000	
	Contingency (15%)	Rs.	5,783,400	17,514,000	
	Total	Rs.	44,339,400	134,274,000	178,613,400
6	**Case 6**				
	Maintenance Depth of Basin and Channel	m	-13.0	-13.0	
	Maintenance Depth of Berth	m	-13.0	-13.0	
	Dredging Area	m2	990,000		
	Silt Rate	m	0.72	2.00	
	Maintenance Volume	m3	712,800	2,116,000	
	Unit Rate	Rs./m3	70	70	
	Dredging Cost	Rs.	49,896,000	148,120,000	
	Contingency (15%)	Rs.	7,484,400	22,218,000	
	Total	Rs.	57,380,400	170,338,000	227,718,400

2.6 Preliminary Economic Analysis

2.6.1 Purpose and Methodology of Economic Analysis

(1) Purpose

The purpose of the economic analysis is to appraise the feasibility of the master plan for the studied port before conducting a feasibility study of the short term plan. The preliminary economic evaluation of a project should show whether the project is justifiable from the viewpoint of the national economy by assessing its contribution to the national economy.

(2) Methodology

An economic analysis will be carried out according to the following method. Master plan will be defined and compared with the "Without-the-project case". All benefits and costs in market price of the difference between "With-the-project case" and "Without-the-project case" will be calculated and evaluated.

The economic internal rate of return (EIRR) and the benefit /cost ratio (B/C ratio) based on a cost - benefit analysis are used to appraise the feasibility of the project in this study.

The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal. The benefit /cost ratio based on the present value of benefits and costs is obtained by dividing the benefits by the costs. A ratio greater than one implies that the project is acceptable.

2.6.2 Prerequisites for the Economic Analysis

(1) Base Year

The "Base Year" here means the standard year in the estimation of costs and benefits. Taking into consideration the base year in the estimation of construction cost, 1997 is set as the "Base Year" of the study.

(2) Project Life

The period of calculation (project life) in the economic analysis is assumed to be 30 years from the time of construction.

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = Rs 35.10 = ¥ 113.80 (as of May 1997), the same rate as used in the cost estimation.

(4) "With-the-project" case and "Without-the-project" Case

A cost-benefit analysis is conducted on the difference between the "With-the-project" case where investment is made and the "Without-the-project" case where no investment is made. In this study, the two projects, Container Terminal Project (Alternative-6) and Main Channel Deepening Project (Alternative-3) are assessed individually.

Following conditions are adopted as the "Without-the-project" case for each project.

1) Container Terminal Project

a) No investment is made for construction of new berth in front of Indira Wall.

b) When handling volume of container cargo in Mumbai Port reaches the maximum volume of handling capacity, the container cargo which can not be handled in Mumbai Port is assumed to divert to Jawaharlal-Nehru Port.

c) The new berth for handling containers overflowing from Mumbai Port is assumed to be constructed in JNP.

d) Conventional cargo and dry bulk cargo are handled at Mumbai Port as they are at present.

e) The size of vessels and the working efficiency of cargo handling are not the same as "With-the-project" case.

2) Main Channel Deepening Project

a) Main channel is not deepened from present level.

b) The size of vessels and the working efficiency of cargo handling are not the same as "With-the-project" case.

2.6.3 Benefits of the Project

(1) Benefit Items

As benefits brought about by the master plan of the studied port, the following items are identified.

1) Savings in ship waiting costs at an offshore anchorage
2) Savings in sea transportation costs
3) Saving in ship staying costs at a berth
4) Savings in land transportation cost
5) Savings in the new investment for construction of new berth for handling the container cargoes in another port

The results of benefits are shown in Table 2.6.3-1 and 2.6.3-2

Table 2.6.3-1 Result of Benefits Calculation of Container Terminal Project

Type of Benefit	Rs million
Savings in waiting costs of ship	30,299.5
Savings in sea transportation costs	48,620.0
Savings in land transportation costs	12,875.0
Savings in construction costs for new berth	6,965.6
Total	**98,760.1**

Table 2.6.3-2 Result of Benefit Calculation of Main Channel Project

Type of Benefit	Rs million
Savings in waiting costs of ship	688.0
Savings in sea transportation costs	36,297.2
Total	**36,985.2**

2.6.4 Costs of the Project

The following items are identified as costs for Master Plan.

(1) Construction costs of container terminal project

(2) Maintenance costs of container terminal project

The result of costs are shown in Table 2.6.4-1 and 2.6.4-2.

Table 2.6.4-1 Result of Cost Calculation of Container Terminal Project

Type of Cost	Rs million
Construction costs	14,941.6
Dredging costs	7,061.1
Maintenance costs	10,367.2
Total	**32,370.0**

Table 2.6.4-2 Result of Cost Calculation of Main Channel Project

Type of Cost	Rs million
Dredging costs	18,602.0
Total	**18,602.0**

2.6.5 Result of Economic Analysis

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost -benefit analysis is used to appraise the economic feasibility of the project.

The EIRR is a discount rate which makes the costs and benefits of a project during the project life equal. The results of EIRR are shown in Table 2.6.5-1.

Table 2.6.5-1 Result of EIRR calculation

Project	EIRR
Container Terminal Project	17.9%
Main Channel Deepening Project	11.9%

(2) Calculation of the Benefit /Cost Ratio

The benefit / cost ratio is obtained by dividing the benefit by the cost. The result of the B/C is shown in Table 2.6.5-2

Table 2.6.5-2 Result of B/C calculation.

Project	B / C
Container Terminal Project	1.53
Main Channel Deepening Project	1.11

Note: Discount rate using for calculation of B/C is adopted 10% in this study.

The resulting EIRR of two projects exceeds 10% and B/C ratio is greater than one. Therefor the proposed project are justifiable from the viewpoint of the national economy.

2.7 Improvement Plan of Management and Operation System

2.7.1 General Principles of Port Management and Operation

Port Authorities should focus on the following three points for port management and operation to attract port users.

(1) Efficient services

High productivity of cargo handling, seamless smooth operation and speedy procedure for cargo clearance are necessary.

(2) Reliability and availability of port facilities

Port facilities and cargo handling equipment must be well maintained so that port users can make full use of facilities and equipment. Storage facilities should be well-designed to prevent cargo damages. Security measures for cargoes must be taken effectively. Cargo handling operation is accurate, careful and safe.

(3) Reasonable tariff

Port charges should be competitive but must cover the cost of construction, management and maintenance of port facilities. Furthermore, tariff structure should encourage port users to use port facilities efficiently.

2.7.2 Future Port Management and Operation System for MBP

(1) Container Terminal Management

MBPT should adopt the closed container terminal system. In a closed container terminal surrounded with fences, gate clerks at the terminal gates check inflow/outflow of containers. A terminal operator controls container traffic in the terminal and takes full responsibility of containers within its own terminal after receiving through a terminal gate till loading onto a container vessel in export and vice versa in import. It is possible to increase capacity and efficiency of container handling by adopting the closed container terminal system. In the highly competitive international shipping business of today, it is necessary to upgrade services to port users or the national economy of India will suffer.

(2) Principles of Container Terminal Operations

1) Operation time

Container loading/discharging, container handling at CY in the Victoria Dock

24 hours operation 3 shifts

No holidays but workers can take holidays in turn. (13 days)

2) Prohibition of direct loading/delivery at quay side

As mentioned above direct loading/delivery causes congestion of quay sides and must be prohibited.

3) Delivering/receiving empty containers at CY in the Victoria Dock is prohibited. Empty containers may be picked up / returned only at CFS or Container depot.

(3) Terminal operator

Terminal operator is required to supervise overall operation and control the container traffic within the dock area (from quay side to CY). The candidates to serve as terminal operator of CY in the Victoria Dock are showed the following table.

Table 2.7.2-1 The Candidates of the Terminal Operator

Alternative	Victoria Dock I	Victoria Dock II	Ballard Pier
1	MBPT		MBPT
2	The New Company		MBPT
3	Private Sector	Private Sector	MBPT
4	Private Sector	MBPT	MBPT
5	Private Sector	The New Company	MBPT

In comparing the five alternatives mentioned above, the following points should be considered.

a) Efficiency of container handling

b) Efficiency of land use of CY in the Victoria Dock

c) Fairness of berth assignment

d) Impact on employment of dock workers

e) Investment cost of MBPT

f) Control of container traffic inside the port area

g) Consistency with the Government policy, private participation in the port sector

2.7.3 Simplified Tariff System to be Proposed for MBP

To simplify the present tariffs MBPT should consider the following items.

(1) Pilotage and towage (tug assistance)

Though pilotage and towage (tug assistance) are merged at present, it is necessary to separate them into different categories. Pilotage should be charged on the GRT of the vessel and the operation time. Towage and tug assistance fee should be charged on the time of tug operation and the horse power of tugs.

(2) Berth hire fee

Berth hire fee should be charged every 12 hours for container vessels on condition that container handling efficiency is improved and berthing time of a vessel is shortened.

(3) Charges on container handling and movement

MBPT should introduce the charges for handling and movement of containers if MBPT becomes the terminal operator. For example, it is necessary to charge for the following movement of containers based on container size (20 feet, 40 feet or else) and type (normal, reefer or dangerous etc.).

a) From ship to CY or vice versa

b) From CY to CFS (container depot) or vice versa

c) From CY to railway flat or vice versa

d) From CY to truck or vice versa

It is necessary to introduce volume discount rate besides standard rate to encourage shipping lines to load/discharge containers in the port of Mumbai.

(4) Container Storage Charge (Demurrage)

It is necessary to modify the container storage charge suitable for the closed container terminal system. By shortening the dwelling time of containers in CY, the handling capacity of container yard will increase. In case of import containers, free days should be calculated from the date of discharging rather than GLD. MBPT should shorten the free time for export containers to seven days prior to the date of shipment. The period of storage at CY in the Victoria Dock and CFS (or Container Depot) should be included in this free time.

Demurrage should be more expensive than storage fees of warehouses outside the port. Otherwise the consignees use CY as their own storage facilities. Most consignees are likely to make efforts to pick up the containers by the expiration of free time to avoid paying demurrage.

It is expected that the number of containers handled in the Port of Mumbai will increase and that the container yard in the Victoria Dock will become congested in future. In such a case MBPT should shorten the period of free time and encourage consignees to pick up their containers earlier.

2.7.4 Simplified Documentation and Information Systems

To simplify documentation, it is necessary to introduce an open information system involving the private sector. But the following points should be considered before introduction of new computer system.

- Amendment of relevant laws and regulations
- Consensus and cooperation among related official organizations and private sector

Introduction of a computer information system inevitably results in job losses, so it is essential to consider a method which minimizes conflicts with trade unions in the port, it is also necessary to retrain workers so that they may find work elsewhere.

(1) Concept of New Systems

Following figures show the concept of the new systems.

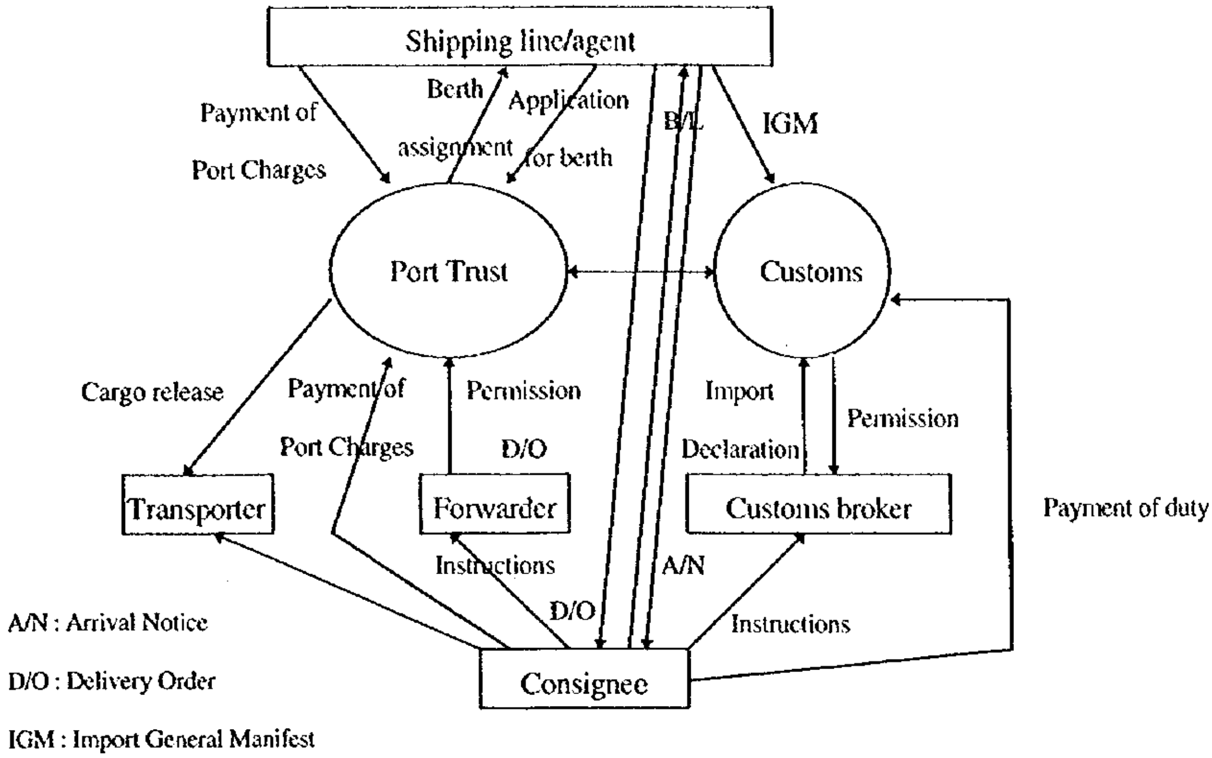


Figure 2.7.4-1 Import Procedures

All the transactions between the participants are settled by electronic fund transfer from one party's account to another party's account.

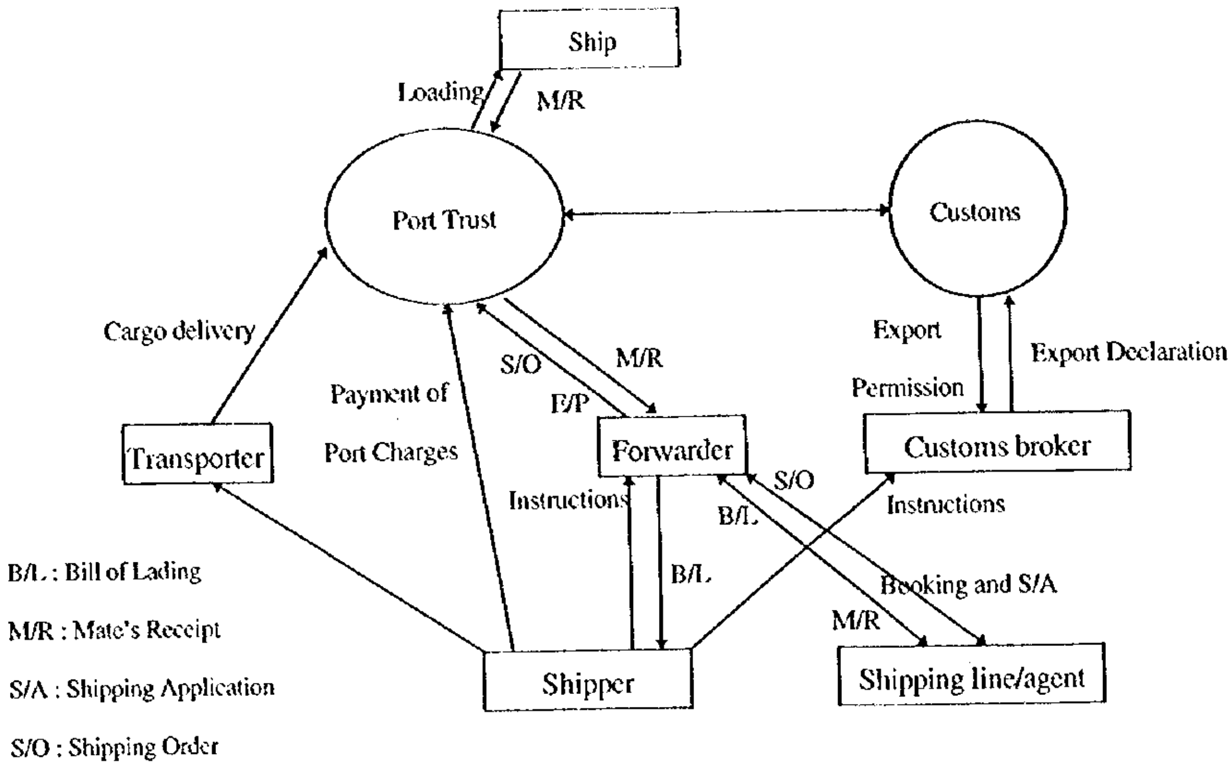


Figure 2.7.4-2 Export Procedures

(2) Berth assignment

A shipping line/agent inputs necessary information into terminal computers in the office before arrival of the vessel. MBPT allots a suitable berth to the vessel considering the dimensions of the vessel, cargoes to be discharged/loaded and vessel's arrival order. MBPT informs the shipping line/agent of the berth allotted to the vessel through the computer network.

(3) Import procedure

A shipping line/agent informs consignees of a vessel's arrival. A consignee gets D/O in exchange of B/L at the office of the shipping line/agent. The custom broker inputs necessary data for import clearance into its terminal computer. The information is transferred to the computers in Customs. After getting import permission from Customs, the consignee instructs a forwarder to submit necessary documents to MBPT to pick up the cargo from the customs (bonded) area in the Port.

MBPT has information about cargo to be discharged and exchanges information on cargoes with Customs through the network.

A forwarder inputs information of import permission and D/O into the terminal computer and transmits this information to MBPT. MBPT releases the consignment after confirming the payment of port charges.

(4) Export procedure

A shipper instructs a forwarder to book space on the vessel and submits the Shipping Application to the shipping line/agent. Shipping line/agent issues Shipping Order to the forwarder. The shipper instructs a customs broker to file the Export Declaration with Customs. After getting Export Permission, the forwarder transmits the data of S/O and E/P to MBPT through the computer network. After verifying the information from Customs and the forwarder, MBPT loads cargo onto the ship. After loading cargoes, Chief Officer of the vessel issues and hands over Mate's Receipt to MBPT. MBPT transmits the information of loading to forwarder and sends M/R to the forwarder. The forwarder gets Bill of Lading in exchange for M/R at the office of the shipping line/agent. The shipper gets B/L from the forwarder.

(5) Customs clearance

A customs broker inputs necessary data for clearance into terminal computers and transmits them to the host computer in customs through the network. Customs receives the data and makes risk assessment of goods based on the customs' information stored in the database. Customs designates the method of examination of import/export cargoes based on the result of the risk assessment. Computers form the price range using the import history of a specific commodity stored in the database and customs officers can easily check the importer's declared value of cargo. Computer calculates the amount of duty payable automatically. At payment of duties, importers do not need to go to banks. It is possible to withdraw the amount of duty from the importers' or customs brokers' accounts through electronic fund transfer.

By introducing this open system, it is possible to shorten the time from filing Bill of Entry to receiving permits of import dramatically.

2.7.5 Personnel Management

Modernization of port facilities is necessary for the Port of Mumbai but mechanization and computerization inevitably result in job losses for dock workers. On the other hand, it is very important for MBPT to maintain its employment and thus MBPT can not reduce the number of dock workers drastically. If it did, social unrest would occur. India is suffering from a high unemployment rate, over 40 %, and it is very difficult to find a job as a permanent worker elsewhere. MBPT is expected to sustain employment opportunities until other sectors can absorb the work force in accordance with the development of the Indian economy.

Introduction of the closed container terminal systems decreases the necessary number of dock workers involved in container handling at quay side, whereas it needs more operators of quay side gantry cranes and RTGs, drivers of chassis trailers, gate clerks and workers in CFSs or container depots. In the future MBPT should re-allocate surplus workers to the section in which labor shortage will occur subject to the agreement with the unions in the port and retraining programs for workers.

To generate job opportunities, establishing a joint venture company to operate new businesses related to port activities, for example, transporter, distribution center, refrigerated warehouse, is an option to be considered.

2.8 Initial Environmental Examination (IEE)

2.8.1 Brief Project Description

Master Plan for MBP are proposed and summarized in Table 2.8.1-1.

Table 2.8.1-1 Summary of Projects Proposed in the M/P of MBP

	Project Name	Project Components
Long-term Plan (up to 2017)	1. Container Terminal Project	1. Additional Three Container Berths 2. Victoria Dock Container Yard 3. Off-Dock CFS and Container Depot 4. Container Handling Equipment 5. Dedicated Road for Containers
	2. Re-location of Conventional Cargo Handling Facilities	6. Re-assignment of Conventional Cargo Berths
	3. Deepening Access Channel Project	7. Deepening Access Channel

2.8.2 Initial Environmental Examination

The Initial Environmental Examination (IEE) has been assessed in a tabular form recommended in the publication of "Environmental Assessment Handbook for Port Development Projects", MOT, 1993. The potential major impacts could be as follows:

1) Dredging Sediment

2) Disturbance due to Dredging

3) Air Pollution due to the Increased Vehicle Traffic

4) etc.

Proposed additional three container berths are to be constructed approximately 800 meters off the Indira Dock Harbour Wall. They are proposed as off-shore jetty-type berths of water-through structure so as to minimize the adverse effect of tidal currents. Since the degree of the impact is classified as minor, an examination is only needed in the further study.

Since the total volume of containers to be handled at MBP generates additional vehicle traffic, a certain degree of impact on air quality is anticipated especially along the road. A degree of those impacts is further examined in EIA.

2.8.3 IEE Overview

Initial Environmental Examination (IEE) is carried out based on the checklist of adverse effects of the Master Plan, and three major points of 1) Dredging sediments, 2) Disturbance due to dredging, and 3) Air quality due to the future traffic in and around MBP are selected and should be included in the Environmental Impact Assessment (EIA) for the Short-term Plan.