37. The SLPA needs to control the increasing payroll to keep financial soundness. The SLPA should reduce the number of employees by setting a mandatory retirement age and not filling vacancies left by retiring employees, and should promote the transfer of employees to private companies through privatization of port activities. Profitability of the SLPA will be retrieved in case that causes of inefficiency of container handling are solved to add to payroll control.

38. With the improvement of cargo handling efficiency, the SLPA will be able to raise the tariff level because users consider that cost-performance is important. And the SLPA should pay a part of profit to competent cargo handling operators as an incentive allowance. In addition, the SLPA should introduce a system in which users can enjoy tariff discounts if cargo is transhipped quickly as at the port of Singapore, because accumulation of cargo impedes efficiency of port activities.

4.7 Stage Plan for the Development

39. Most urgent requirement for the port of Colombo is to enable QCT to accommodate mother container vessels, with which the flexibility of berthing arrangements will be increased considerably. In this connection, priority of the development is given to the rehabilitation of QEQ and the expansion of QEQ container terminal to the outside of the present S-W Breakwater.

40. Construction of the new S-W seawall and breakwater makes the approach channel calm, which allows easy manoeuvring to the present port. After the completion of new S-W seawall, the present S-W Extension Arm can be removed and the West Entrance can be widened accordingly. The new S-W Breakwater can also shelter the north of the port and enable the development of North Container Terminal.

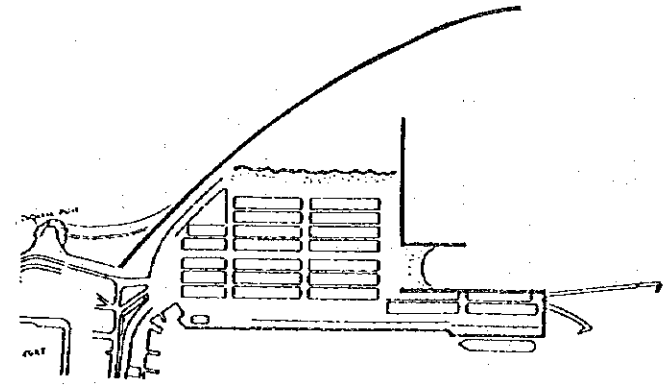
41. Development is planned to start from the new South-West seawall and the extension of QEQ No.6 berth. Shortly after the commencement of the construction, back yard of QEQ can be expanded and be utilized as a container yard. After the completion of QEQ No. 6 extension and the rehabilitation of QEQ No.2 and No.3, cargo handling capacity of QEQ will reach to 0.9 million TEUs subject to the expansion of the back yard.

42. Completion of the new berths, QEQ Nos.7-8, will expand the capacity of QEQ terminal to 2 million TEUs in the year 2005, which implies the total capacity of the Port will reach 3.5 million TEUs. After the completion of the South Port, QEQ Nos.6-11, total capacity of the Port of Colombo will increase to 4.9 million TEUs. Stage-wise development plans are shown in Table 4.7 and Figure 4.7.

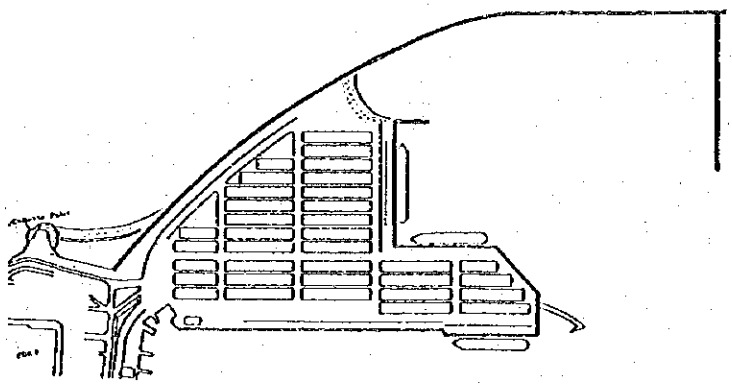
TABLE 4.7 Stage Plan for the Development

Development Site \ Year	1997	2000	2005	2010	2015
QEQ Inner Harbour Development					
North Channel Dredging					
Bandaranaike Quay Renovation					
QEQ Outer Terminal (2 berths)					
South Port Development	Low Growth Case				
	High Growth Case				
North Port Development	Low Growth Case		none		
	High Growth Case				

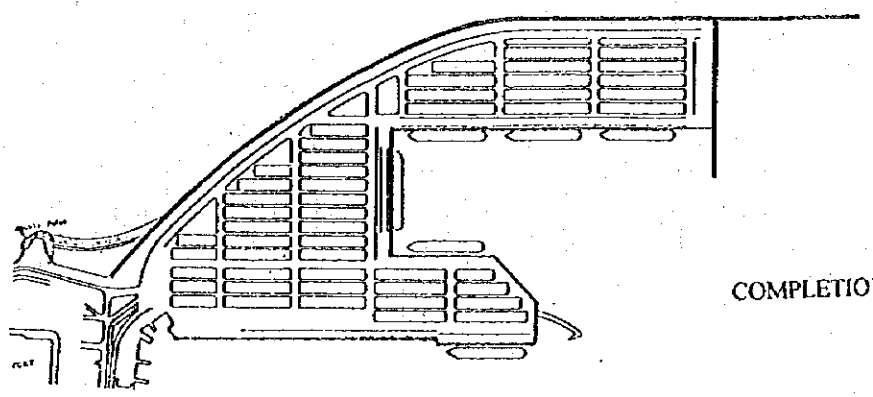
FIGURE 4.7 STAGE PLAN FOR SOUTH PORT DEVELOPMENT



ABOUT 5 YEARS



ABOUT 10 YEARS



COMPLETION

Chapter 5 SHORT-TERM DEVELOPMENT PLAN

5.1 Alternative Plans for the Short-term Development

1. Three plans for the short-term development are furnished in connection with master plan alternatives, i.e. South Port Development (QEQ Outside Development) and North Port Development (Crow Island Offshore Development and PVQ North Development). Details of three plans are listed in the Table 5.1.1.

2. Priority shall be given to the South Port Development at the first stage and then to the North Port. New South-West Seawall and Breakwater will enable the development of the North Port by providing a shelter from rough south-west waves. Without the South Port, the development of the North Port is not feasible in terms of construction period and cost.

TABLE 5.1.1 Optional Development Plans

Facilities	South Port Development	North Port Development	
	(QEQ Outside Dev.)	Alternative 1 (Crow Island Offshore)	Alternative 2 (PVQ North Dev.)
Breakwater	210 m	2,800 m	3,690 m
Seawall	2,920 m	2,150 m	600 m
Quaywall	2,370 m	1,650 m	3,320 m
Revetment	390 m	1,810 m	0 m
Total=	5,890 m	8,410 m	7,610 m
Berths	Main: 3 (6) Feeder: 3 (3)	Main: 3 (5) Feeder: 1 (2)	Main: 3 (5) Feeder :2 (4)
Terminal Area	73 ha (120.4 ha)	66 ha (110.8 ha)	57 ha (101.2 ha)
Capacity	2.0 (3.5) million TEUs	1.5 (2.8) million TEUs	1.7 (2.8) million TEUs
All port =	3.5 (4.9) million TEUs	3.4 (4.7) million TEUs	3.6 (4.7) million TEUs
Est. Cost	US$ 840 million	US$ 1,030 million	US$ 1,010 million
Completion Milestone	First berth and yard in 5 years	First berth and yard in 10-12 years	First berth and yard in 8-10 years
Others	New S-W Seawall can be utilized to establish construction work site.	Relocation of oil pipeline and sewer outfall necessary.	- ditto

Note: 1/ ( ) indicates the final stage of each development
2/ Est. cost is exclusive of the redevelopment cost of JCT, BQ and Inter-terminal Road and inclusive of the relocation cost of Crude Oil pipeline and Sewer Outfall.

5.2 Short-term Development Projects

3. In view of the coming 10 years, following projects are selected for the short-term development to meet the requirements for the Port of Colombo (See Figure 5.2(1)).

1) Development of Queen Elizabeth Quay (QEQ) Outer Terminal;
2) Redevelopment of Bandaranaike Quay (BQ);
3) Facilitation of Navigational Aids;
4) Widening the West Entrance;
5) Dredging North Channel;
6) Inter-terminal Road Improvement; and
7) Renovation of JCT Cargo Handling Equipment (under E/S).

(1) QEQ Outer Terminal

4. QEQ Outer Development is the shortest and most economical way to increase the capacity of container handling. The short-term development plan of QEQ Outer Terminal consists of three main berths and three feeders with a terminal area of 73 ha, with a design capacity of 2 million TEUs. Summary of the short-term development plan of QEQ Outer Terminal is shown in Table 5.2(1).

TABLE 5.2(1) QEQ Outer Terminal Short-term Development

Facilities	Quantity
Breakwater/Seawall/Quaywall	5,890 m
Dredging Reclamation	5,260,000 m3 5,100,000 m3
Berths Terminal Area	Main: 3, Feeder: 3 73 ha
Capacity	2.0 million TEUs
Completion Milestone	10 years
Equipment	Container Cranes: 17 (incl. 11 post Panamax) Transfer Cranes: 45 Trailer Chassis: 180 Tug Boats: 6 (Additional)
Others	CFS, Gates, Maintenance Shop, Administration Buildings, Power Station
Est. Cost	US$ 840 million

(Container Handling System for New the Terminal)

5. Rubber-tired gantry crane system (RTG), rail-mounted gantry crane system (RMG) and automated storage and retrieval system (ASR) are reviewed by comparing the advantages and disadvantages of these systems. For the short-term development, RTG system was adopted as the technically and economically appropriate one for yard operation taking into account following characteristics. Future review is recommended before final adoption in view of rapid technological changes.

a) Nearly half of transhipment containers discharged change their loading vessels or their destination, which increases tier shuffling and shifting manipulation.

b) The effectiveness of the RMG system has not yet been verified. While the ports of Singapore and Hong Kong are introducing this system, it is not confirmed whether the automatic operation system can actually attain the intended high accuracy, speed and reliability. RMG and ASR systems are still in the process of development.

(2) Redevelopment of Bandaranaike Quay

6. Bandaranaike Quay (BQ) was developed in the early 1950s to serve conventional cargo ships with five berths and four warehouses for break-bulk cargo. Breakbulk cargo has shown a decrease for the last 10 years so that warehouses in the Bandaranaike Quay are not used for breakbulk but used for unstuffing LCL containers. Open storage yards for timber, steel, vehicles and containers have a shortage in the port in spite of warehouses.

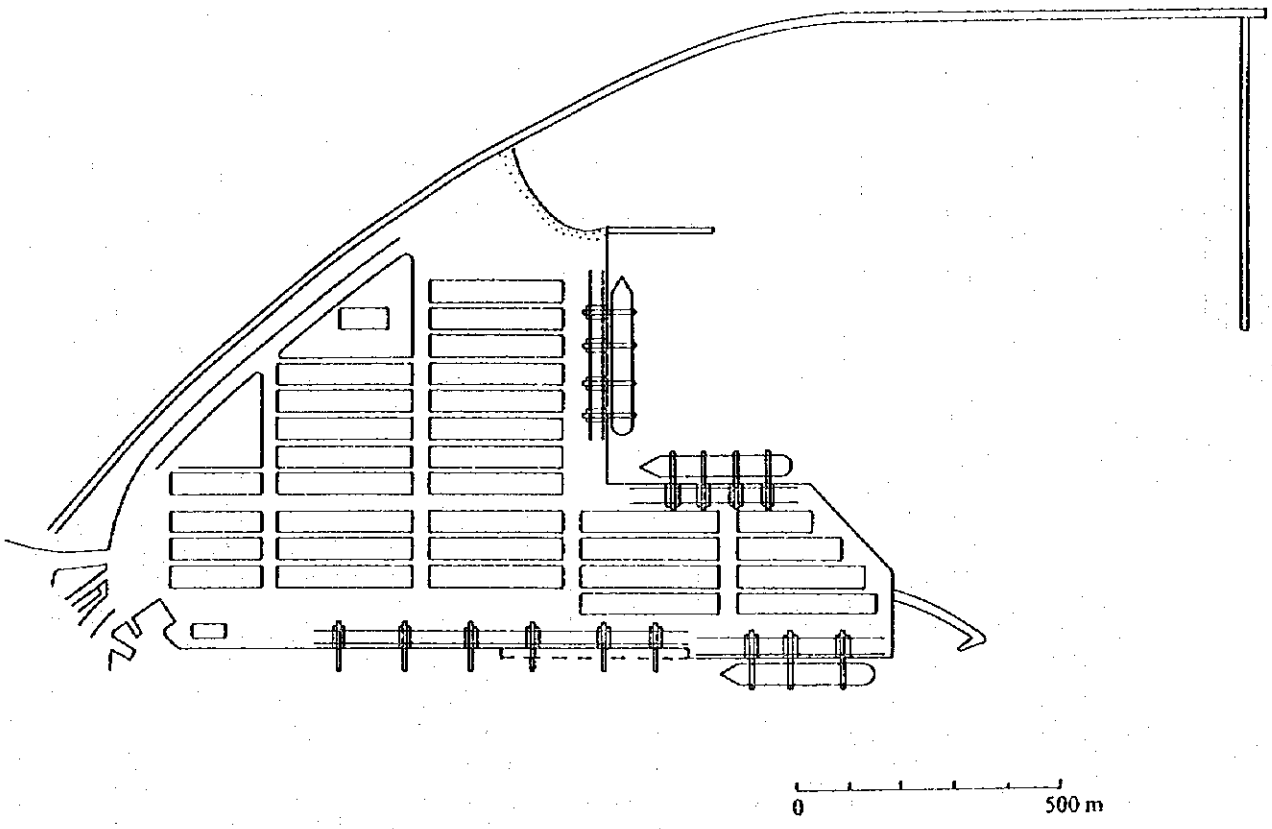
7. As Bandaranaike Quay is located in the centre of the port, redevelopment as a passenger berth is an appropriate way to utilize the quay. In the long-term development, BQ No.1-2 berths shall be redeveloped as a Ro/Ro terminal and BQ No.3-4 as a passenger berth with a depth of minus 12 meters. However, in the short-term development, BQ shall be rehabilitated for Ro/Ro and conventional berths with a view to catering to car carriers, semi-container and conventional cargo vessels.

8. Development plan for the short-term is shown in Figure 5.2(2) and rehabilitation works are listed in Table 5.2(2).

TABLE 5.2(2) Bandaranaike Quay Short-term Redevelopment

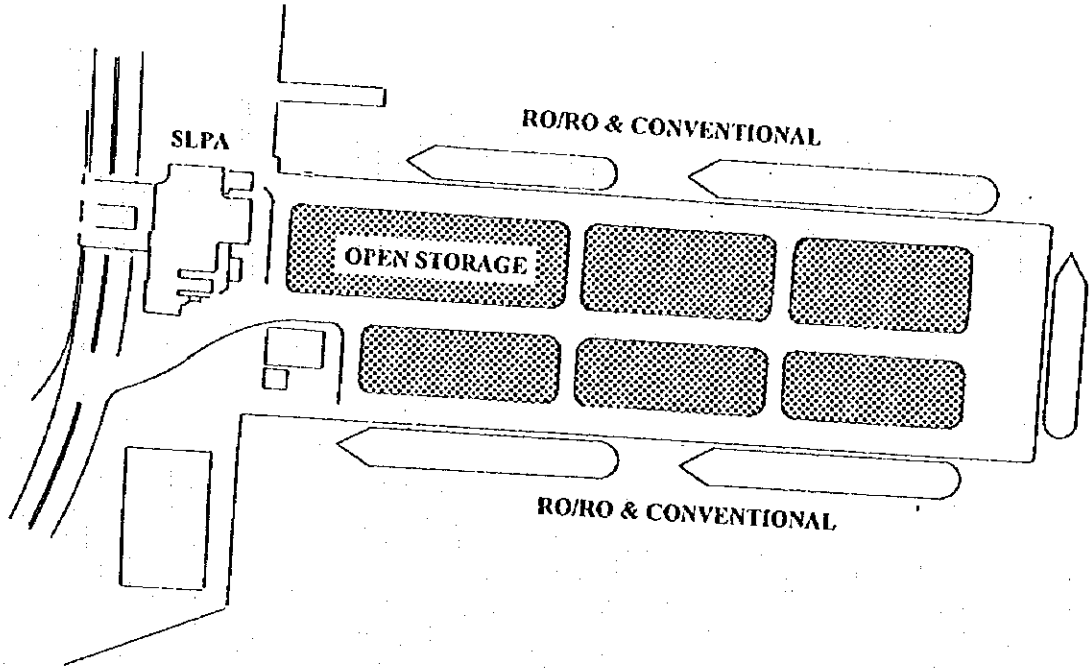
Rehabilitation Works	Quantity	Est.Cost
Demolition of Warehouses	4	Total Cost: US$ 16.8 million
Paving	53,000 m2	
Rubber Fenders and Cap Concrete	1,080 m	
Yard Lighting	53,000 m2	

FIGURE 5.2(1) SHORT-TERM DEVELOPMENT PLAN QEQ OUTER TERMINAL

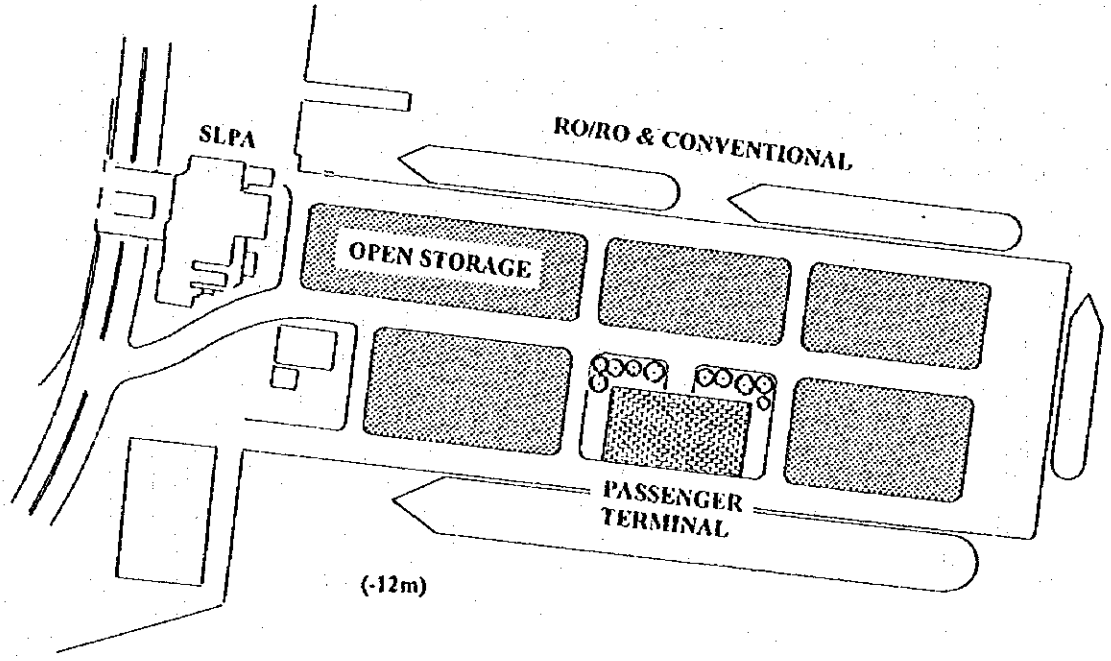


Note: Broken line indicates a redevelopment plan in the future. The short-term development plan recommends an additional berth on the inside of QEQ to minimize the possible interruption in terminal operations. After completion of QEQ No.6 Extension, it may be possible to redevelop QEQ No.3 and No.4 as a main berth if it is confirmed that redevelopment work will be finished while the Port has remaining cargo handling capacity.

FIGURE 5.2(2) Bandranaike Quay Short-Term Redevelopment Plan



Long-Term Redevelopment Plan



(3) Navigation safety measures

(Additional pilots and simulator training)

9. It is recommended that the number of pilots (currently 15) should be increased to 24 (in low growth case), 29 (medium growth) and 34 (high growth) to manage the forecasted increase in vessels. A training program for pilots with ship manoeuvring simulator would be necessary to cope with the great changes in calling vessels.

(Reinforcing tug fleet)

10. A proper number of capable tug boats are necessary to assist calling vessels forecasted in the future. It is also recommended that the aged ones of over 30 years be replaced in due course. Number of new tug boats required for future cargo throughput are assessed at about five (in low growth case), six (medium growth) and eight (high growth).

(Navigation aids/sailing regulations/ VTS)

11. New port development requires the installation of a certain number of navigation aids to conform to the international standards of IALA, the revision of the existing port traffic regulations to cope with the coming situation, and the introduction of Vessel Traffic Service (VTS) to control heavy ship traffic and secure uninterrupted port activities.

(4) Widening the West Entrance

12. The narrowest navigable width between NW and SW breakwaters is 125 meters for a vessel with a draft of 13 m or more. The width required would be more than six times of the supposed vessel's beam so that the W entrance is considered a substandard for larger vessels over 30 m beam and a draft of 10 m. Since the biggest Post Panamax vessel operated has a dimensions of 318 m L, 42 m B, and 14 m D, the width of the W entrance is less than three times of the ship's breadth.

13. Widening the W entrance is an urgent matter from viewpoint of navigational safety. As the widening is likely to deteriorate the calmness in the inner harbour, the demolition of end part of the SW and NW breakwaters should not be executed until adequate measures to prevent waves/swells invasion have been taken.

14. To solve the problematic situation, a possible measure is to develop the QEQ outside area in line with the short term plan as early as possible to accept the rapid increase of vessel traffic, extend the new SW breakwater and, upon ensuring inner port calmness, remove the extension arm of the SW and the south end of the NW breakwater.

Table 5.2(3) Navigable Width at the West Entrance

Depth	Width
-10 m	178 m
-11 m	171 m
-12 m	151 m
-13 m	137 m
-14 m	131 m
-15 m	125 m

(5) North Channel Dredging

15. The major problems related to the new channel alignment are the hard rock formation existing in close proximity off the N entrance, two submerged oil pipe/sewage pipe crossing the channel and some range of shoal off the port. Thus, the dimensions of the new channel should be limited to -12 m, curved from the entrance to 60° port side with 1,500 m radius.

16. The developed N channel (depth:-12m, width:300m) will be able to function as a normal passage for those vessels drawing under 10.5 m and it would be able to accommodate middle/small class vessels. Ship traffic through the N channel will be more than 3,000 per annum, which is equivalent to the existing traffic volume at the W channel.

(6) Road Development

17. The traffic on the inter-terminal road will increase considerably following the redevelopment of QEQ and the development of QEQ outer terminal. Some sections of the present inter-terminal road have four lanes, however, it shall be expanded to full four lane road with two side lanes throughout the road.

18. Assuming that only Gate No. 11 serves heavy lorry traffic, Gates No. 7, 11, 13 serve small lorries, and all gates available serve passenger cars and other port-related traffic except cargo transportation, future traffic is assessed as follows:

TABLE 5.2(4) Inter-terminal Road Traffic after QEQ Outer Development

(Traffic/Day)

Section on Inter-terminal Road	1996	After QEQ Dev.
QEQ South End	3,156	6,100
BQ Entrance	6,361	10,400
Dock Yard West End	4,510	9,600

19. Detailed road expansion plan shall be prepared as soon as possible and all buildings in the road plan area shall be replaced when they will have need for rehabilitation. Within a short-term development period, widening shall be carried out where buildings or rail road are demolished. The bridge over the canal has two lanes and can be a bottleneck so that a new bridge shall be planned to cope with traffic congestion anticipated.

(7) Expansion of JCT Cargo Handling Equipment

a) Expansion of JCT Container Crane and Yard Equipment
At JCT No.1-No.2 terminal, one more container crane and three RTG cranes are necessary to build up a six-container-crane main berth by 1998.

b) Installation of Container Crane at JCT-CBS for feeder vessel
At JCT southern cross berth (JCT-CBS), installation of a container crane for feeder vessel is on schedule. An additional container crane of the same type should be installed as soon as possible to create a two-container-crane feeder berth.

c) Enhancement of Empty Container Storage Capacity
Four 6-ton rail-mounted gantry cranes with eight-tier stacking height and eleven- raw width are planned to be installed for increasing storage capacity for empty containers. This installation should be completed at the latest in the year 1998. After the completion of these expansion plans, container handling capacity at JCT will reach up to 1,440,000 TEUs per year.

5.3 Urgent Development Plan

(1) QEQ Redevelopment and Outer Expansion

20. There is an urgent necessity for the early implementation of small projects to increase the capacity of cargo handling and ship accommodation. In connection with container transhipment, it is important to accommodate feeder ships without delay, so that the redevelopment of QEQ will be of great help to reduce ship waiting time.

21. Urgent plan for the QEQ redevelopment and outer expansion is shown in Figure 5.3.1. This plan is the first stage of the South Port Development consisting of QEQ No.6 Extension, rehabilitation of QEQ Nos.2-3 and land reclamation of 40 ha. Project cost of the urgent plan for QEQ redevelopment and partial expansion to the outside is estimated at about US$ 470 million.

(2) Redevelopment of Bandaranaike Quay

22. Utilization of Bandaranaike Quay will be another way to increase the container handling capacity. BQ will have a total terminal area of 5.4 ha with an open storage yard of 2.6 ha, which can be used as a container yard until QEQ has enough capacity. At the first stage of the redevelopment, the south side of the quay, No.1-2 Berths, can be modified to a Ro/Ro and feeder berth.

(3) North Channel Dredging

23. Increasing ship calls will bring a long ship waiting queue in the near future and ship traffic will become a bottleneck of port operations. Driven by an increase in ship traffic, the North Channel will be utilized as an exit from the port so as to introduce the separation of in/out ships. Dredging shall be carried out in the short term.

(4) Navigation Assistance

24. Increasing ship calls also bring further requirements for powerful tug boats and pilotage services. By the year 2000, two more tug boats will be necessary to cope with the anticipated cargo increase. Radar control of ship traffic is also indispensable for increasing the capacity and safety of ship traffic.

(5) JCT Container Handling Equipment

25. In order to meet the urgent demand, reinforcement of JCT is a practical way to improve the capacity of the port. Given that container throughput will increase to 1.9 million TEUs around the year 2000, an additional quay crane should be installed at JCT No.1-2 terminal and JCT Cross Berth. It is also recommended to add transfer cranes and trailer chassis in connection with the quay cranes.

(6) North Pier Development

26. The development plan of the North Pier has been already finalized and is in the process of implementation. Development work consists of the improvement of existing quay structure (380 m), land reclamation (3.5 ha), two units of multi purpose cranes for the handling of fertilizer and container and is scheduled to be completed before the end of March 1999.

(7) Ancillary Facilities

(Truck Pool)

27. Truck pool in the port area or nearby the port access road will help clear the inter-terminal road. Rail yard behind JCT or SLPA property along the port access road can be utilized as a truck pool.

(Inland Container Depot)

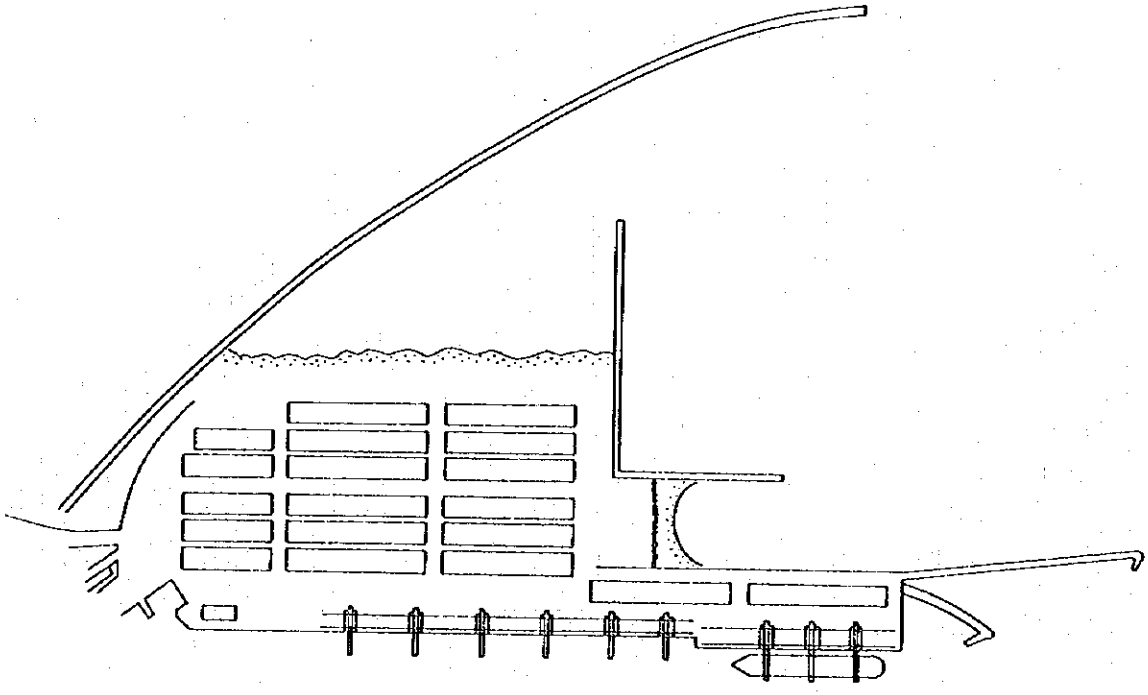
28. Efforts should be made to encourage private sectors to build ICDs and to reduce container dwelling time in the port. SLPA should also operate ICDs around the port so as to increase the capacity of container yard.

(Yard Operations and Communications)

29. A computer system to control cargo flow will play a key role in cargo handling productivity. Computer system should be updated periodically to cope with increasing cargo.

Communications with shipping lines and agents are also upgraded to EDI, by which port users will be encouraged to bring more transhipment.

FIGURE 5.3 URGENT DEVELOPMENT PLAN QEQ OUTER TERMINAL



5.4 Structural Design

30. Subsequent to the preliminary structural design of the proposed port facilities prepared pursuant to the procedure described in Section 4.4 hereof, the respective structural cross sections were developed for the purpose of the basic design of the facilities planned under the Short Term Development Plan, on the basis of analysis of design factors including those pertaining to the detailed design stage.

31. First, the following physical conditions, one of the key design factors, were established on the basis of existing data and the results of field surveys and investigations.

(1) Design Wave Heights

Design Wave Parameters for the Seawall and Breakwater for the South Port Development

Type of Structure	Return period of wave (Yr)	Water depth alongside (m)	$H_{1/3}$ (m)	H_{max} (m)	Period (sec)
Breakwater (Type A)	50	-15	5.2	9.4	10.0
Seawall (Types A&B)	15	0 ~ -12	3.7	6.1	8.7
Seawall (Type C)	15	-12 ~ -13	4.0	7.2	8.7

Design Wave Parameters for Breakwaters and Seawall for the under North Port Development

Type of Structure	Return period of wave (Yr)	Water depth alongside (m)	$H_{1/3}$ (m)	H_{max} (m)	Period (sec)
South Breakwater	50	-15	5.2	9.4	10.0
North Breakwater	50	-13.5	2.8	5.0	7.0
Seawall	50	-13.5	2.8	5.0	7.0

(2) Soil Conditions

32. The proposed sites of the seawall, breakwater and quaywall under the South Container Terminal Project consist of sandy soil and cohesive soil showing an N-value of 10 at depths ranging from -10 m to -15 m and attaining an N-value of 25 at a depth of around -22 m. Since these soils are underlain directly by the bedrock they would be capable of supporting key structures, if they are dredged and replaced in small quantities with suitable material. The proposed structure sites under the North Container Terminal Project consist of the same types of soil which, however, are encountered at a depth some meters less than at the structure sites under the South Container Terminal Project.

(3) Port Structure Planned under Short Term Development Project

33. The cross section of the concrete caisson type structures -- selected as optimum as referred to in Section 4.4 -- was determined on the basis of indepth studies of such design factors as external forces, sliding, overturn and bearing capacity of foundation subsoils. For the steel sheet pipe pile type quay structure for QEQ No.6 Berth, the design of this -14 m quaywall structure was developed pursuant to the standard procedure beginning with the establishment of design conditions and proceeding to calculations of earth pressure, residual water pressure, and other external forces, determination of penetration depth of steel sheet piles, study of circular failure and finally the determination of the sheet pile cross section.

(4) Submarine Oil Pipeline and Sewer Pipes

34. The existing submarine oil pipeline must be relocated if the North Port Development is to be implemented. For this reason, the sequence, method and time requirement for the relocation were studied in depth. As for the sewer pipes, if they are to be relocated, they should be buried well below the planned seabed level, except for the part of the pipes crossing the area to be reclaimed.

5.5 Construction Planning

(1) Summary of Works

The project consists of the following works

1)	Seawall, revetment and breakwater construction	3,810	m
2)	Container quaywall construction (-14 m and -16 m alongside providing 3 berths)	1,220	m
3)	Container yard preparation	71	ha
4)	Reclamation	8,900,000	m^3
5)	Dredging	6,000,000	m^3
6)	Caisson fabrication and installation (1,700 - 3,000 ton apiece)	203	units
7)	Riprap work	1,600,000	m^3
8)	Concrete blocks (2, 6, 12 and 22 tons)	58,000	units
9)	Building works, telecommunications installations and water supply works		
10)	Procurement and installation of container handling equipment		

35. It should be noted that the construction works of the project are characterized by (1) short construction time (9 years) considering the magnitude of the works (2) difficulty in obtaining adequate spaces for a work yard in the port area, and (3) considerable difficulty expected in carrying out offshore construction activities during six months of the year due to monsoons.

(2) Construction Base

36. According to wave observation records from the area adjacent to the Port of Colombo under the influence of the southwest monsoons, waves higher than 1 m are observed continuously during the six-month period from May to October. During the same period, the predominant wave period is 8 sec or more, which renders offshore construction activities difficult.

37. For this reason, in the initial stage of the construction period, the 6-month period referred to above would have to be devoted to the storage of quarry-run material and the

fabrication/temporary storage of concrete blocks and caissons. A work yard of adequate size can hardly be secured in Colombo Port where various port activities are carried on briskly in limited spaces. In this respect, the Study Team suggested providing a work yard of about 6 ha and a construction base with 3 ha of closed calm waters through reclamation in the area off the northern shore of the port.

5.6 Cost Estimates

(1) Preconditions for Estimation

38. The cost estimates were prepared by applying the basic prices and rates in Colombo for various types of construction plant, equipment, materials, fuels and labour which were obtained through the Study Team survey conducted in late 1995. However, adjustments were made to the cost estimates based on the prices and units in Colombo on the basis of market prices prevailing in Southeast Asian countries for comparable construction equipment and materials. The cost estimates were prepared on a quantification basis taking into due consideration the operational characteristics and restraints of construction works at the project site.

1) The following exchange rates are applied in working out the cost estimates which are made up of foreign and local currency components.

US$1,00 = Rs. 53.36 = ¥104.4 (as of January 1996)

2) All prices and rates for construction equipment and materials were those prevailing in January 1996.

3) No allowance was made for the import duties applicable to imported construction equipment and materials.

5) No allowance was made for various taxes to be levied on construction works.

6) No price escalation was included in the cost estimates for construction works, cargo handling equipment procurement, engineering services and contingency.

(2) Project Cost for Short Term Development Plan

39. Table 5.6 (1) summarizes the project cost for the Short Term Development Plan targeted for the year 2005. The total project cost for the Short term Development Plan amounts to US$940 million, of which US$750 million represents the foreign currency component. Of the total project cost, US$840 million would go for the South Port Development with the breakdown into the foreign currency portion amounting to US$660 million and the local currency portion amounting to US$180 million.

TABLE 5.6(1) Summary of Project Cost

SHORT TERM DEVELOPMENT PLAN 2005

Thousand US$

No.	Description	Construction Cost			Remarks
		Foreign	Local	Total	
I	**South Port Development**				
I-1	Civil Work	360,491	143,764	504,255	
I-2	Building, Electric and Water Supply	44,935	8,655	53,590	
I-3	Cargo Handling Equipment	176,280	0	176,280	
I-4	Engineering Service	31,553	8,383	39,936	
I-5	Physical Contingency	49,357	15,242	64,599	
I-6	Sub Total	662,616	176,044	838,660	
II	**Renovation of Bandaranaike Quay**				
II-1	Construction Cost	10,378	3,628	14,006	
II-2	Engineering Service	1,038	363	1,401	
II-3	Physical Contingency	1,038	363	1,401	
II-4	Total	12,454	4,354	16,808	
III	**Navigation Assistance**				
III-1	Construction Cost	28,600	0	28,600	
III-2	Engineering Service	1,702	300	2,002	
III-3	Physical Contingency	2,860	0	2,860	
III-4	Total	33,162	300	33,462	
IV	**Widening Main Channel**				
IV-1	Construction Cost	19,147	3,648	22,795	
IV-2	Engineering Service	1,340	256	1,596	
IV-3	Physical Contingency	1,915	365	2,280	
IV-4	Total	22,402	4,269	26,671	
V	**Road Development**				
V-1	Fort Road	11,697	3,687	15,384	
V-2	Engineering Service	1,170	368	1,538	
V-3	Physical Contingency	1,170	368	1,538	
V-4	Total	14,037	4,423	18,460	
VI	**North Channel Dredging**				
VI-1	Construction Cost	4,485	520	5,005	
VI-2	Engineering Service	449	52	501	
VI-3	Physical Contingency	449	52	501	
VI-4	Total	5,383	624	6,007	
VII	**Grand Total**	750,054	190,014	940,068	

(3) Project Cost for North Port Development

40. With respect to the Short Term Development Plan 2005, the project costs for two alternatives envisaging the North Port Development were also worked out. Table 5.6(2) summarizes the construction cost estimates for three alternatives under the Short Term Development Plan.

TABLE 5.6(2) Cost Comparison of Project Alternatives for Short Term Plan 2005

Thousand US

No.	Various Works Involved	Short Term Development Plan		
		Base Plan	Alternative 1	Alternative 2
1	Port Expansion - Civil Work	578,675	653,166	629,597
2	Port Expansion - Building Works and Electric Works	58,706	66,263	63,872
3	Port Expansion - Container Handling Equipment	201,278	227,189	218,990
4	Renovation of Bandaranaike Quay	16,808	16,808	16,808
5	Navigation Assistance	33,462	33,462	33,462
6	Widening Main Channel	26,671	26,671	26,671
7	Road Development	18,460	22,421	2,241
8	Relocation of Submarine Pipeline	-	85,053	85,053
9	North Channel Dredging	6,007	-	-
10	Grand Total	940,067	1,131,033	1,076,694

(4) Project Cost for Urgent Development

41. Costs for the projects selected from the Short-term Development Plan are summarized in Table 5.6(3). Investment in the urgent development plan of the QEQ Outer Terminal is estimated at about US$470 million and the renovation of Bandaranaike Quay is about US$17 million.

TABLE 5.6(3) Summary of Project Cost

URGENT DEVELOPMENT PLAN 2000

Thousand US$

No.	Description	Amount	Remarks
I	**South Port Development**		
I-1	Civil Work	291,377	01 Main Berth, 53 ha Container Yard, etc.
I-2	Building, Electric and Water Supply	39,535	CFS, Gate, Office, Reefer, Generator, Light
I-3	Cargo Handling Equipment	75,667	07 Container Crane, 21 Transfer Crane, etc.
I-4	Engineering Service	22,173	
I-5	Physical Contingency	36,875	
I-6	Total	465,627	See detail in TABLE 4.3.5.2
II	**Renovation of Bandaranaike Quay**		
II-1	Construction Cost	14,006	06 ha Open Yard, Lighting, etc
II-2	Engineering Service	1,401	
II-3	Physical Contingency	1,401	
II-4	Total	16,808	See details in Figure A 3.3.2.1
III	**Navigation Assistance**		
III-1	Construction Cost	9,400	Communications, Tug Boat, Navigation aids
III-2	Contingency	940	
III-3	Engineering	658	
III-4	Total	10,998	See details in Figure A 3.3.2.2
IV	**North Channel Dredging**		
IV-1	Construction Cost	5,005	Dredging -12.0 m
IV-2	Contingency	501	
IV-3	Engineering	501	
IV-4	Total	6,007	See details in Figure A 3.3.2.3
V	**Grand Total**	499,440	

5.7 Economic Analysis

(1) Prerequisites of Analysis

42. All benefits and costs in the economic analysis are evaluated using economic prices based on the border price concept. Feasibility of the project is assessed by the Economic Internal Rate of Return (EIRR) in a cost benefit analysis.

43. The prerequisites of economic analysis are as follows:

1) Project life of the short-term development is assumed to be 30 years after the completion and the construction will take 9 years, so that economic analysis is implemented for 39 years from 1997 to 2035.

2) The foreign exchange rate adopted for this analysis is US$1.00= 53.36 Rs. and US$1.00=104.4 Yen, the same rate as used in the cost estimation.

3) "With"case: three cases of container demand forecast in target year 2005 consist of 3.5 million TEUs (High Growth Case), 2.9 million TEUs (Medium Growth Case) and 2.3 million TEUs (Low Growth Case).

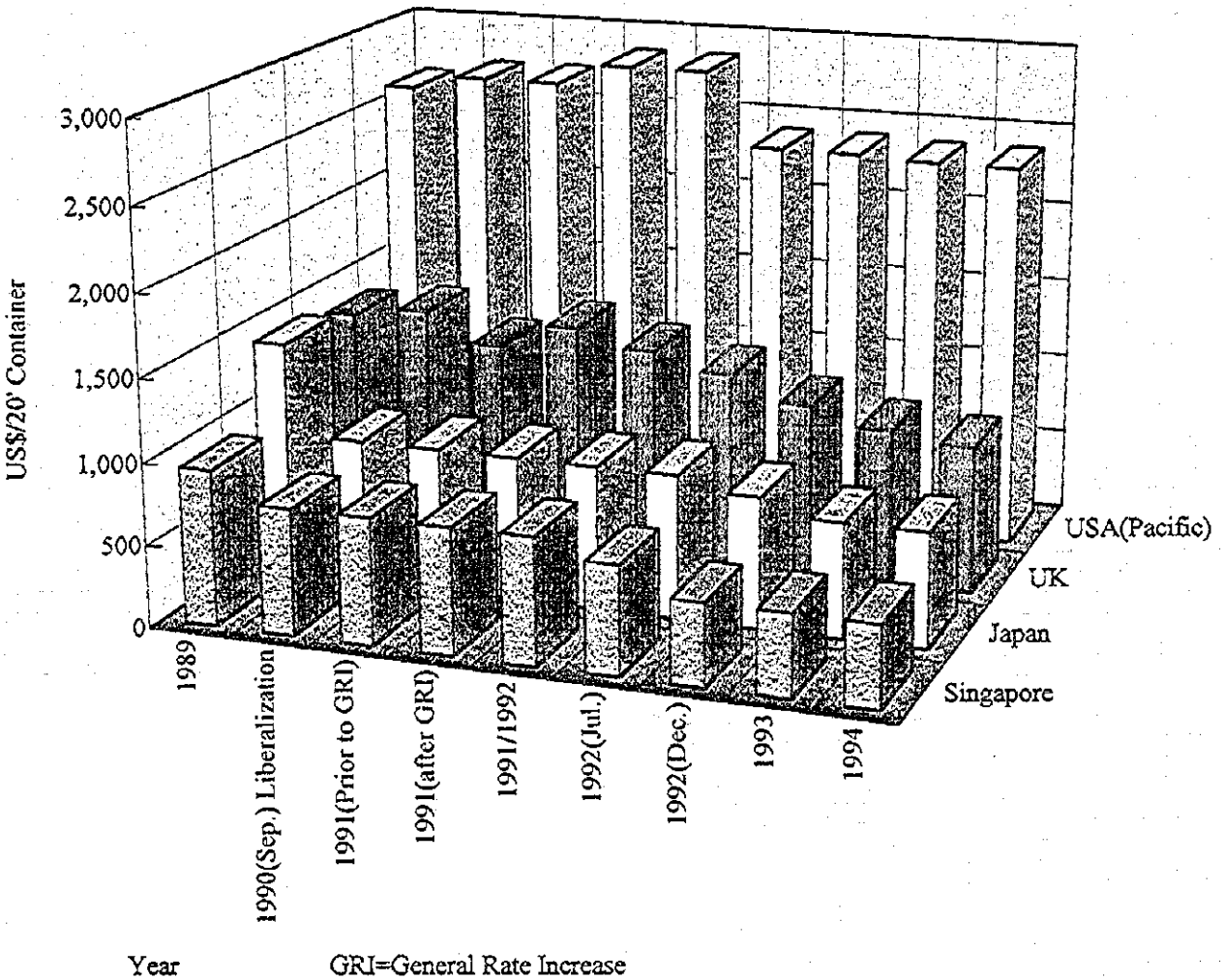
4) "Without"case: Existing port capacities are estimated at 1.9 million TEUs including ongoing construction at the Port of Colombo.

(2) Benefit of the Project

44. Owing to the new port development, Sri Lankan economy can enjoy:
1) Foreign currency earnings from transhipment cargo handling;
2) Savings of the transportation costs of imports and exports;
3) Agents commissions;
4) Ground rent of port premises;
5) Savings in waiting time of calling ships and cargoes;
6) Decrease in the possibility of accidents; and
7) Increase in employment opportunities.

45. Owing to the fact that the Port of Colombo becomes a hub port, calling vessels have increased considerably during last five years and container freight from/to Colombo has decreased to the contrary (see Figure 5.7). Container freight from/to Colombo is about two-third of that of neighbouring ports such as Cochin, Madras and Bombay. Since the lower freight of import and export containers is brought by frequent calls of mother vessels, the development of new port is not only propitious to regional maritime transport but also important for the Sri Lankan economy.

FIGURE 5.7 Trends of Export Freight Rate(Tea)



46. Within the above mentioned benefits to be brought about by the short-term development, items listed in 1), 2), 3) and 4) are calculated in monetary terms by cost-benefit analysis.

(3) Costs of the Projects

47. Project costs are listed in Table 5.6(1) and Table 5.6(2) of the previous section. In addition, maintenance costs and renewal costs are incorporated in the financial analysis. .

(4) Evaluation of the Projects

48. EIRR of the master plan is calculated as 11.5%-20.5%. It is generally accepted that infrastructure or social service projects are economically viable if the EIRR exceeds 10%. Therefore, this short-term development plan development project is deemed to be viable from the viewpoint of the national economy. Even after a sensitivity analysis, EIRR remains at a satisfactory level.

TABLE 5.7 EIRR of the Short-term Development Plan

Case	EIRR	Sensitivity
High Growth Case	20.5%	18.5%
Medium Growth Case	18.7%	17.0%
Low Growth Case	11.5%	10.5%

Note/ In the sensitivity analysis, costs increase by 10% and benefits decrease by 10%.

5.8 Financial Analysis

49. The purpose of the financial analysis is to appraise the financial feasibility of the proposed port development scheme. The analysis focuses on the financial viability of the project itself from the view point of SLPA and the influence by implementation of the project on the financial soundness of the port management body (the SLPA).

50. The viability of the project is analyzed using the Discount Cash Flow Method and appraised by the FIRR (financial internal rate of return). The influence on the financial soundness of the port management body (SLPA) is appraised based on projected financial statements regarding the project (Income Statements, Cash Flow Statements and Balance Sheets).

51. Prerequisites are shown in TABLE 5. 8 (1).

TABLE 5.8(1) The Prerequisites of Financial Analysis

(1) The details of scenarios

			Scenario 1 (Calculated in Low Growth & Medium Growth case)	Scenario 2 (Calculated in only Medium Growth case)	Scenario 3 (Calculated in only Medium Growth case)
1 Development & Operation System	1-1 System		QEQ 6-8: developed & operated by SLPA QEQ 9-11: developed & operated by private sectors	The same as the present system (QEQ 6-11: developed & operated by SLPA)	QEQ 6-8: land lease system QEQ 9-11: developed & operated by private sectors
	1-2 Construction	QEQ No 6,7,8	SLPA	ditto to the left	Breakwater - reclamation: SLPA Others: Private sectors
		QEQ No 9,10,11	Breakwater, Dredging: SLPA Others: Private sectors	SLPA	Breakwater, Dredging: SLPA Others: Private sectors
	1-3 Management & Operation Body	QEQ No 6,7,8	SLPA	ditto to the left	Private sectors (Land: SLPA)
		QEQ No 9,10,11	Private sectors	SLPA	Private sectors
2 Revenues & Costs	2-1 Revenues Gained by SLPA		a. Marine service charges (Port dues, Pilotage, Towage, Berthing etc.) b. Cargo handling charges c. Tally charges d. Royalty for QEQ 9-11 (In Low Growth Case, only cargo handling tariff will be increased by 20% in 2006 and 2011.In Medium Growth Case, the same as the present tariff)	a. Marine service charges (Port dues, Pilotage, Towage, Berthing etc.) b. Cargo handling charges c. Tally charges (All tariffs are the same as the present levels.)	a. Marine service charges (Port dues, Pilotage, Towage, Berthing etc.) b. Cargo handling charges c. Tally charges d. Royalty for QEQ 9-11 e. Land lease charge for QEQ 8-10 (All tariffs are the same as the present levels.)
	2-2 Costs Paid by SLPA	Initial Investment	All development costs for Short-Term Plan 2005	All development costs for Short-Term Plan 2005, and construction costs for QEQ No9,10,11	Civil work costs for South Port Development (Short-Term Plan, except paving work)
		Personnel Costs	Calculated based on personnel arrangement plans (In Low Growth Case, unit costs will be increased by 20% in 2011, in Medium Growth case, increased by 30%.)	Calculated based on personnel arrangement plans (Unit costs will be increased by 30% in 2006 and 2011)	None
		Other Costs	a. Maintenance & repair costs b. Administration costs c. Depreciation costs d. Re-investment costs e. Taxes	ditto to the left	a. Depreciation costs b. Re-investment costs c. Taxes

(2) Funds raising

	Foreign funds	Domestic funds	Other funds
Kinds of Loans	Long-term loans from foreign countries	Long-term loans from domestic banking institutions	Short-term loans from domestic banking institutions
Range Covered by Loans	85% of construction costs	15% of construction costs	Raised only in the case of cash shortage outbreak
Loan Period	30 years (including a grace period of 10 years)	10 years (including a grace period of 3 years)	1 year (with no grace period)
Interest Rate	2.3 % per annum	10.0 % per annum	16.0 % per annum(Scenario1-M.G.Case,Scenario2) 4.6% per annum(Scenario1-L.G.Case) Interest-free(Scenario3)
Repayment	Fixed amount repayment of principal	Fixed amount repayment of principal	Fixed amount repayment of principal

(3) Others

Cargo Handling Volume	Estimated based on the demand forecast
Project Life	30 years after construction
Base Year	1996

52. Sensitivity analysis is conducted to examine the impact of unexpected future changes. The following three cases are envisioned:

Case 1: The income decreases by 3.4% (The rate of income decreasing is determined considering difference between Micro and Macro forecast in demand forecast).

Case 2: The project cost increases by 6.2% (The rate of cost increasing is determined considering movement of foreign exchange rate for the last five years).

Case 3: The income decreases by 3.4% and the project cost increases by 6.2%

53. The results of FIRR calculation are shown in TABLE 5.8(2).

TABLE 5.8(2) The Results of FIRR Calculation

	Scenario 1		Scenario 2	Scenario 3
	Low Growth Case	Medium Growth Case	Medium Growth Case	Medium Growth Case
Original Case	4.8%	5.3%	7.1%	4.2%
Sensitivity Analysis				
Case 1	4.4%	4.8%	6.6%	3.8%
Case 2	4.1%	4.4%	6.3%	3.9%
Case 3	3.7%	3.8%	5.7%	3.5%

54. Weighted average interest rate of the funds is 3.5% in this study. In all cases of Scenario 1, 2 and 3, and including above three cases of sensitivity analysis, FIRR exceeds this rate. Therefore, this project is deemed to be financially feasible.

55. In all cases of Scenario 1, 2 and 3, the indicators which shows "Profitability", "Loan Repayment Capacity" and "Operational Efficiency" of the port management body (SLPA) are all on appropriate levels. Therefore, it can be judged that the port management body (SLPA) has financial soundness in this project.

56. In Scenario 1 - Low Growth Case, revision of cargo handling tariff and control of payroll increase are essential conditions. Therefore, the SLPA must improve the efficiency of port activities, and utilize the development by private sectors described in Scenario 1 or 3, through which SLPA can reduce the amount of its loan and can alleviate the risk of huge investment. SLPA should consider public benefit and methods/conditions when inviting the private sector to participate in port development.

<Reference Data - the financial analysis from a point of view of a private company which implements BOT>

57. To analyze viability of the projects in Scenario 1 and 3 more concretely, it is important to consider whether the project yield enough profit to a private company which implements BOT. For reference, viability of the project and financial soundness from a point of view of a

private company which implements BOT are analyzed as follows. The methodology of analysis is the same as the one aforementioned in chapter 8.1 in Final Report.

58. The main prerequisites and the result of FIRR calculation of analysis are shown in TABLE 5.8 (2).Other prerequisites which are not included in TABLE 5.8 (2) are the same as the ones in Scenario 1 mentioned in TABLE 5.8 (1).

59. Weighted average interest rate of the funds is 8.5% in this case. Because FIRR exceeds this rate, this project is deemed to be financially feasible. The indicators which show "Profitability", "Loan Repayment Capacity" and "Operational Efficiency" of the private company which implements BOT are all on appropriate levels. Therefore, it can be judged that the private company which implements BOT has financial soundness in this project.

60. Though FIRR and the financial indicators show feasible levels, they are not yet profitable enough for private companies to maintain their commercial activities. Sri Lankan private sectors should help private companies which implement BOT to raise funds at a low interest rate through a guarantee for debt or direct funds supply.

TABLE 5.8(3) The Main Prerequisites and the Result of FIRR Calculation

(1) Prerequisites - Revenues & Costs

1 Revenues Gained by the Private Company		a. Cargo handling charges (All tariffs are the same as the present levels.)
2 Costs Paid by the Private Company	Initial Investment	Construction costs for QEQ No.9.10.11 (except for breakwater)
	Personnel Costs	Calculated based on personnel arrangement plans (Considering salary levels of foreign private companies, unit costs of executive grade are calculated as ten times as high as the ones of SLPA.)
	Other Costs	a. Maintenance & repair costs b. Administration costs c. Depreciation costs d. Re-investment costs e. Taxes f. Royalty

(2) Prerequisites - Fund raising

	Foreign funds	Other funds
Kinds of Loans	Long-term loans from foreign banking institutions	Short-term loans from foreign banking institutions
Range Covered by Loans	100% of construction costs	Raised only in the case of cash shortage outbreak
Loan Period	20 years (including a grace period of 3 years)	1 year (with no grace period)
Interest Rate	8.5 % per annum	10.0 % per annum
Repayment	Fixed amount repayment of principal	Fixed amount repayment of principal

(3) Result of FIRR calculation

Original Case	11.1%

5.9 Preliminary Environmental Impact Assessment

61. National Environmental Act (NEA) was legislated in 1980 and following the legislation the Central Environmental Agency (CEA) was established in 1981. NEA was once amended in 1988 and recently the Environmental Impact Assessment (EIA) Regulations were gazetted in 1993. National Environmental Action Plan, 1995-1998 was released in June 1994 in collaboration with the World Bank.

62. Marine Pollution Prevention Act was legislated in 1981, one year after NEA. In accordance with the provision of the Act, Marine Pollution Prevention Authority (MPPA) was established in 1988. The Government of Sri Lanka has not ratified the convention entitled Prevention of Pollution of the Sea from Ships 1973 and the Protocol of 1978 (MARPOL).

63. Regarding other international conventions on oil pollution, Sri Lanka is a party to the 1969 Convention on Civil Liability for Oil Pollution Damage (CLC) and the 1971 Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage.

Any discharge or escape of oil or other pollutant into Sri Lankan waters from any ship, an offshore installation, a pipeline and any place on land is subject to the provision of the M.P.P. Act. Dumping oil or other pollutants into Sri Lankan waters is also banned by the provision of the Act.

64. Environmental factors to be considered in relation to the development of the new port of Colombo are categorized into nine groups: (a) water quality; (b) coastal hydrology; (c) bottom contamination; (d) marine and coastal ecology; (e) air quality; (f) noise and vibration; (g) waste management; (h) visual quality; and (i) socio-cultural impacts. As a result of screening, following factors are selected for a detailed study.

- Changes in current patterns which may be caused by dredging and construction of breakwaters/seawalls;
- Disposal of dredged material;
- Changes in water quality of the inside and outside of harbour;
- Coastal hydrology on the south and north coast of the new port;
- Traffic load on access roads; and
- Air pollution which may be caused by future port traffic.

65. Field surveys covered waves, currents, water pollution, shoreline configuration, sediment contamination, port-related road traffic and air pollution, terrestrial flora and fauna, and local residents and cultural assets.

66. Current observation showed that the predominant direction of the currents are from south to north and the speed is 30 cm/s at a maximum and mostly less than 10 cm/s. As a result of simulation on the new port development, changes in current velocity are limited to the area adjacent to the new port and no significant change is seen in the offshore area. Current speed is reduced slightly along the north coast of Kelani River.

67. Water quality survey showed that the background level of the salinity is about 1.8 %, COD 4-5 mg/l, SS 1.5-2.0 mg/l, and DO 6-7 mg/l. Pollution is observed in the inner harbour and in the Mutwal Fishery harbour to some extent. As a result of computer simulation, no significant deterioration is predicted in the project area. Simulation also showed that the dispersion of suspended solids being generated by construction will be in a tolerable range, under 2 mg/l near construction work site.

68. The coast between Colombo and Negombo has been eroded by the lack of sediment supply from south and sand mining in the Kelani River. Changes in wave action were checked by a computer simulation. No change in wave action is seen on the shoreline of Galle Face coast and a decrease in wave height is predicted to some extent in the limited area of the north of Crow Island reclamation. It will bring sand accumulation in the limited area in front of the mouth of Kelani River so that two groins are planned to keep the mouth clear from siltation and sand accumulation.

69. Air pollution is not so serious in Colombo. Though field survey showed that suspended particulate matter exceeds the permissible limit at some major cross sections in SW monsoon season and sulfur dioxide level exceeds the permissible limit temporarily at some major cross sections, pollution level is generally low at this stage. Port related emissions of SOx and NOx are deemed low compared with total emissions in Colombo. Careful routing of port related lorry traffic is recommend to mitigate air pollution such as requiring heavy lorries to use Gate No.11 or new Crow Island Access Road and small lorries to use Gate Nos.7,11,13.

70. Consideration is given to disposal of dredged material. Disposal site is designated in the sea about 4 km offshore from the north coast of Kelani Ganga and 6 km north west of the port. Since the volume of landfill is larger than the dredging, most of the dredged material can be filled in land reclamation, dumping is therefore deemed not to cause serious adverse effects.

71. Biological survey showed that mangroves are poorly represented at the Kalani river mouth and are not found anywhere else in the study area. Marine plants survey found that the algal (seaweed) growth was very poor in the offshore sea about 9-10 m deep. Coral reefs are composed of sandstone and coralline mineral and covered with a thick layer of sediment. As a result the coral cover on the reef is less than 1 %. It was found that the quantity of the marine organisms was relatively low in the study area.

72. The area behind the coast of Crow Island has a population density of 168 per hectare and is mainly used for private houses. About 400 shanties are identified in the area and all of them are illegal settlemenst. Colonial architectures are located in the area including temples and churches, some of them are historically important buildings. Since the master plan is to develop firstly the South Port and secondly the North Port on land reclamation, relocation of these assets is not required. A buffer zone behind the Crow Island reclamation will be able to separate the new port from residential area.

Chapter 6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Policy Alternatives for the New Port

(1) Basic Concept of Public Port

1. The Port of Colombo has been developed and operated as a pubic port by the Sri Lanka Port Authority, which is a government organization. The port has provided the required facilities and services which are vital for the seaborne cargo flow of the nation. In the last decade in particular, the port has made a large contribution to national economic development by providing international container transhipment function as a major hub port in South-Western Asia. Now, the presence of the port is essential in creating an efficient world port network and in promoting the global shipping economy as well.

2. In this sense, the port should continue to be considered as a so called public port. In general, public ports should be considered as economic infrastructure, or social capital, or as a national asset which is vital in promoting the national economy and upgrading the total welfare of citizens. Under this concept, ports should be owned by the public sector (national or regional government), and basic policy of port development and management and provision of basic facilities should be controlled by the government. For countries like Sri Lanka in particular, where the national economy is greatly dependent on foreign trade or international container transshipment operation, it is very important for the government to have competence over the particular functions of the ports and to establish a national port policy based on the public port concept.

3. The above concept may seem to ignore the positive effects of free competition among private entities for port development/operation business, but it does not necessarily preclude introduction of the free market system when required. Actually, many western countries have succeeded in utilizing financial, human or technical resources of the private sector for effective port development and operation projects. It should be noted however, that the very nature of a port, as a basic infrastructure, does neither allow nor accept full privatization of its core function.

4. Under the above public port concept, it is very important to understand that the port facilities and its services are just for providing private business entities with well cultivated fields in which they can promote their economic activities freely under a liberalized competitive market. The government as owner of the port should take full responsibility in securing effective provision of such a field ready for open public use.

(2) Basic Policy Alternatives for New Port Development

5. Since the New Colombo Port Development has several unique factors, basic policy of the port development should carefully be considered as described here below;

(Potential Demand of Cargo Flow and Target Level of Port Capacity)

6. The major component of target cargo demand will most likely be international container transshipment traffic of which future demand is highly sensitive to future capacity of international hub port service network and actual service level to be provided by the New Colombo Port project. It should clearly be understood, therefore, that a certain level of uncertainty may creep into cargo traffic forecasts, and that there must be a certain gap between forecasted potential cargo traffic demand and actual future cargo traffic to be served by the project port facilities.

7. Under the situation, it is not proper to consider that maximum potential demand of cargo traffic should always be fully accommodated within the capacity of the port facilities/services to be developed under the project. In other words, the scale of port development needs to be decided not simply by the forecasted cargo demand but on the basis of low risk and high net return consideration.

(Evaluation Policy for Selection of Alternative Plans)

8. Since the port area sheltered by the existing breakwaters cannot provide adequate space for port expansion, the new port development needs to be considered at the site outside of the breakwaters, which entails high construction cost. On the other hand, substantial economic benefits can be expected from the project because of its wide-ranging contribution to various economic aspects of the nation. Financial viability of the project may therefore be poor compared with its economic viability, which means that the project alternative needs to be selected at the sacrifice of better financial position of the project to some extent.

(Financing Policy Alternatives)

9. How to mobilize the considerably large amount of required funds for the project is one of the most critical issues for successful development of the port. There may be several ways to procure funds for the project. Mobilization of construction funds from private sector through privatization of core function of the port is one possible alternative. This selection, however,is not always appropriate from the public port development concept point of view.

10. If the purpose of privatization is to improve efficiency of port operation through competition, this selection may be allowed generally for any type of port development including a port of highly public function. However, if the government wants (mainly because of heavy shortage of original funds) to get instant money for the project by simply selling a vital part of the port site and its function to private sector, such a policy should not be applied. Considering the aspect pointed out in the above paragraph, it may be better for the government to use its own funds for the project (at least for the initial stage of the project) including utilization of possible soft foreign loan or combination of both public and private financing sources.

(Consideration of External or Contradictory Effects of the Project)

11. Addressing possible external or contradictory effects accompanied by the New Port Development is equally vital for securing total economic return and smooth implementation of the project. Improvement in port operation efficiency and labor problems, large scale of functional requirement of the port and conservation of better environment, substantial amount of investment

and severe shortage of available pubic funds, requirements for safe operation and maximum utilization of the port facilities, maximization of total return and cost/benefit ratio of the project, are the typical sets of conflicting factors characterizing such a project.

12. In many cases, such conflicting factors tend to be ignored mainly due to the difficulty of analysis as these external effects are often intangible or uncertain. However, planning and selection of the most preferable alternative of a project full of contradictory requirements needs to be considered carefully to keep reasonable balance between such sensitive factors. In such a case, project evaluation should not be made simply based on the indices such as FIRR, EIRR or other quantitative analyses on the engineering factors. It should be noted, in this sense, that the avaiable ways of theoretical analyses are not almighty.

(3) Port Development Planning Policy

13. While there may be many key policy requirements of development planning for public infrastructure, the following three points are the most basic (though easily forgotten) requirements:

(Clear Identification of Planning Purpose)

14. For the master plan of the New Colombo Port Development, the planning purposes can be summarized as follows:

1) to be a guideline for long-term investment and operational improvement scheme of the port.
2) to be a base for short-term/urgent development plan of which contents are required to be consistent with total development scheme.
3) to provide port users, investors, and other business entities concerned with future prospect of business environment and thus to guide the business behavior of private sector in proper direction consistent with the port development.
4) to promote harmonized development of other infrastructures necessary to realize the proposed port development scheme.
5) to be a component of national port plan so that the New Colombo Port Development can appropriately be coordinated with the overall concept of national port development.
6) to be a base for consideration of various financing agencies in their investment or financial assistance plan.

(Appropriate Timing of Initial Planning and Periodical Review)

15. Appropriate selection of timing of planning and decision is extremely important for the Port of Colombo in particular, because of its vital role in serving the rapidly increasing container transhipment traffic. The initial planning for expansion of container handling capacity of the port was completed quite timely in 1981 and second planning works for further expansion of container facilities was done also well in time, which was followed by timely construction of the terminals to catch up with the sharply increasing cargo traffic.

16. However, the third development planning works (namely this Study) was started only in 1995 due to various procedural reasons and lack of understanding of the parties concerned on the importance of early commencement of the Study. It is quite regrettable for the port that due to late commencement of the Study, SLPA could have only limited lead time for realizing timely expansion of container handling capacity, which may jeopardize the port's advantage in attracting potential transshipment container traffic. Considering the above situation, more importance should be attached to the timing of planning.

17. In this connection, necessity of periodical review of the existing port plans should also be stressed. As already pointed out, container cargo traffic demand in this region is and will be increasing rapidly, and total container handling capacity and its distribution in the region are expanding and changing year by year according to aggressive policies of the countries concerned in attracting cargo to their own ports. Under the situation, it is very important to understand that the original plan might lead the development policy of the port in an undesirable direction. In this sense, constant review of the plans is essential to meet any contingency in the surrounding situation. For the Port of Colombo, the recommended plan should be carefully reviewed and adjusted at least every two years after its completion.

(Authorization of the Recommended Plan)

18. How to utilize the recommended development plan of the port is another important point for effective implementation of the project. There are many cases observed in developing countries where the project development as recommended in the studies fails to be successfully realized. The major reasons (apart from apparent failure in planning) for this type of failure can be summarized as follows:

1) Lack of practicability, applicability or flexibility in the proposed schemes
2) Basic change in the government's policy for the target port development
3) Shortage of funds for the development
4) Failure in developing other port related infrastructure and facilities
5) Lack of proper control of the government on the private sector activities concerned

19. In order to avoid the above mentioned cases, the plan should officially be authorized through proper procedure by the laws, regulations or any other form applicable to the country concerned. This is quite effective in particular in securing public expenditure on a long-term time basis for the project itself as well as for other public works necessary for the project. The plan also needs to be open to the public so that any business activities concerned could be guided properly along the line of concept of the plan.

6.2 Conclusions

(Findings on the present port)

20. Owing to the economic boom in the Indian Subcontinent, cargo throughput at the port of Colombo has rapidly increased since 1990 and reached one million TEUs in 1995. However, the port of Singapore is attracting more transhipment containers from the Indian Subcontinent and

the port of Colombo is therefore required to develop a competitive transhipment terminal with enough capacity, deeper berths, efficient productivity and quality services.

(Bottlenecks)

21. Sheltered basin of the port of Colombo is very narrow to accommodate post Panamax vessels as the port was originally developed at the end of the 19th century to provide an anchorage for lighterage and the breakwaters have remained unchanged for a century. Consequently, many bottlenecks are identified to develop a modern container port such as 1) curved fairway and very narrow entrance; 2) short stopping distance; 3) little under keel clearance in the approaching channel and basin; 4) shallow North Channel; 5) wave disturbance to smaller vessels; 6) poor equipment for ship traffic control; 7) slender container yard (QEQ); and so forth. Operational problems are also recognized such as 8) extra cost for inter-terminal transportation between JCT and QCT; 9) less priority to feeder vessels; 10) berthing arrangements for mother vessels; 11) hidden cost besides the tariff; 12) productivity of cargo handling; 13) customs clearance procedure; 14) capacity of inland container depots.

(Natural Conditions)

22. Wave observation performed at a northern offshore point with a depth of minus 15 m has shown that the predominant wave direction is SW and some waves are from NNW-NW with a maximum height of 1.5 meters. Maximum wave height for the structural design is determined at H=5.7 m, T=10 sec, with a 50 year return period through statistical processing of previous wave observation records. The predominant wave direction through the year was SW and 46% of waves exceeds 1.0 m in height. Offshore currents observation has revealed that the current velocity in this area is very low and littoral currents flow mainly from south to north except the shore near fishery harbour where the littoral currents flow toward S or SW. Soil boring survey, carried out at five offshore points and six onshore points, revealed hard bed rock in the north area of PVQ.

(Environmental conditions)

23. Off the northern shore of the port of Colombo, water is most transparent with some pollutant from the sewerage outfall and the land surface. In the inner harbour, water is considerably polluted due to discharges into the port. Near the fishery harbour, water is least transparent with pollutant from sewerage outfall. Kelani river water contains some inorganic and organic SS without saline intrusion. Water samples from nearby wells were clean with minimal pollutant. Variety of sediments were observed from coarse sand in Kelani river to silty clay in the outer harbour.

24. Air quality is rather deteriorated in the north of the port but better in the south. Marine plants or macro seaweeds grow poorly in species and sizes. Besides benthic fauna, coral fish are identified around the reefs. Coastal vegetation is mostly confined to Kelani river without human activity. Mangrove vegetation only grows in some patches along the river mouth and Hamilton canal. Many species of birds and seabirds including migrants are recorded in uncultivated land homesteads. In Colombo North, there are many factories, government and private organizations

as well as a large population. The study area is rich in historical and cultural assets dating back to the colonial period.

(Role of the Port of Galle)

25. The port of Galle can be a supplement to the port of Colombo serving vessels with cargo from/to the Southern Province. At the first stage, the port of Galle should cater to bulk and breakbulk carriers. It will be necessary to accommodate pleasure boats and fishing vessels. As far as transhipment services are concerned, efforts should be placed on the development of Colombo so as to enable the port to enjoy economies of scale.

(Demand Forecast)

26. A considerable increase in the container traffic, both in the transhipment and in the country's imports/exports, is envisaged owing to the economic boom in the Indian Subcontinent and the economic growth of Sri Lanka. (2.3-3.6 million TEUs in the year 2005, 3.8-6.7 million TEUs in 2015). Cargo growth rate is estimated at about 12.7% in the high case and 8.5% in the low case for the period of short-term development and at about 4.7%-6.5% for the period of 2005-2015.

Year		2005			2015		
Cargo Type		High	Med.	Low	High	Med.	Low
Transhipment Containers		2,616	2,145	1,684	4,641	3,835	2,670
Domestic Containers		929	767	660	2,096	1,444	1,110
Total	('000 TEU)	3,545	2,912	2,344	6,737	5,279	3,780
Conventional Cargo	('000 ton)	7,458	6,669	6,013	9,926	8,268	6,978
Coastal Trade	('000 ton)	376	277	179	376	277	179

(Capacity of the Present Port)

27. The annual container handling capacity of the JCT, QCT and NP terminals amounts to approximately 1,500,000 TEUs as of the end of 1995 when JCT No. 4 terminal was completed. The annual capacity in the year 2000 is estimated to reach about 1,900,000 TEUs subject to the rehabilitation and redevelopment of QCT and NP and to the procurement of additional cargo handling equipment at JCT.

(Requirements for the new port)

28. To meet the requirements for a competitive hub port, the port needs to accommodate post Panamax vessels of 6,000 TEU class and to assure safe manoeuvring at the entrance. Reliable operations are essential for further development.

(Master Plan for 2015)

29. Master Plan for 2015 has two development scenarios. In the low/medium growth case, South Port Development will be able to cover the demand anticipated in 2015 but in the high growth case, North Port Development will be necessary in addition to the South Port Development. North Port has two optional plans, Crow Island Offshore Development and PVQ North Development, which will be reviewed following a series of wave and current observations.

Facilities	High Growth Case		Low/Medium Growth Case
	PVQ North Development	Crow Island Offshore Dev.	
Terminal Area	236 ha	340 ha	120 ha
Additional Berths	Main CT: 10 Feeder: 7	Main CT: 11 Feeder: 5	Main CT: 6 Feeder: 3
Handling Capacity	7.7 mil. TEUs	7.7 mil. TEUs	4.9 mil. TEUs
Breakwater/Seawall	6,350 m	7,010 m	3,610 m
Dredging	12.5 mil. m^3	13.3 mil. m^3	5.3 mil. m^3

(Short-term Development Plan)

30. The proposed projects for the short-term development and details of the QEQ Outer Terminal Development are as follow:

1) QEQ Outer Terminal as a part of South Port Development;
   Breakwater/Seawall: 3,130 m,
   Berths: Main 3, Feeder 3
   Terminal Area: 73 ha
   Capacity: 2.0 million TEUs
   Estimated Cost: US$840 million
2) Redevelopment of Bandaranaike Quay (US$17 million);
3) Widening the West Entrance (US$27 million);
4) North Channel dredging (US$6 million);
5) Inter-terminal road expansion (US$18 million);
6) Navigation Aids (US$33 million); and
7) Renovation of JCT Cargo Handling Equipment (under E/S).

QEQ Outer Terminal

Facilities	Quantity
Breakwater/Seawall	3,130 m
Berths	Main: 3 (6)[1]; Feeder: 3 (3)[1]
Terminal Area	73 ha (120.4 ha)[1]
Capacity	2.0 (3.5)[1] million TEUs

Note: ( )[1] indicates the final stage of the development.

(Stage Plan)

31. The development of the South Port enables the expansion of QEQ container terminal to the outside as well as the construction of deeper berths behind the new South-west Breakwater. North Port can be economically developed after the offshore area of Crow Island is sheltered from rough waves by the South Port. The development of the North Port will be flexible in accordance with the demand for cargo throughput. Priority was given to the South Port Development from the viewpoint of construction cost and period. By the year 2005, three full-size container berths will be completed in the QEQ Outer Terminal and the capacity of QEQ Outer Terminal will be increased to 2 million TEUs.

(Urgent Development Plan)

32. In order to cope with the demand in the near future, some rehabilitation projects are selected for urgent implementation. Urgent plan comprises 1) QEQ No.6 extension; 2) rehabilitation of QEQ Nos.2-3; 3) reinforcement of JCT container handling equipment; 4) redevelopment of North Pier; 5) redevelopment of Bandaranaike Quay; 6) dredging North Channel; 7) encouraging installation of Inland container depots; and 8) upgrading tug boats and other port service facilities.

(Structural Design)

33. Economic and rapid construction of breakwater plays a key role in the outer port development. After comparing possible structural types of breakwater, it was concluded that caisson structure will be the best for breakwater and seawall in the deep water from the viewpoint of stability and construction period.

(Construction Procedure)

34. Construction works start with the new South-West seawall and the extension of QEQ No.6 berth. Shortly after the commencement of construction, back yard of QEQ can be expanded and be utilized as a container yard. After the completion of QEQ No.6 extension and the rehabilitation of QEQ Nos.2-3 with outer container yard (five years after commencement of construction), cargo handling capacity of QEQ will reach 0.9 million TEUs.

35. Development of the new S-W seawall and breakwater makes the approach channel calm, which allows easy manoeuvring to the present port. After the completion of the new S-W seawall,

the present S-W Extension Arm can be removed and the West Entrance can be widened accordingly.

(Cost Estimates)

36. Project cost of Master Plan 2015 is estimated at about US$ 1.1-1.4 billion in case of the South Port Development. Estimated cost of the North Port Development is about US$ 1.1-1.4 billion in case of Crow Island Offshore Development and at about US$ 1.0-1.2 billion in case of PVQ North Development including all other projects and relocation of oil pipeline and sewer outfall.

37. Project cost of the short-term development plan is estimated at about US$ 940 million for a period of 10 years, of which estimated cost for the urgent plan is about US$ 500 million. Estimated cost of major components is as follows:

Project	Estimated Cost (US$)
South Port Development	840 million
Civil Works	(500)
Equipment	(180)
Buildings & Others	(160)
Bandaranaike Quay Rehabilitation	17
Widening Main channel	27
North Channel Dredging	6
Inter-terminal Road Expansion	18
Navigation Aids	33
Total	940

(Economic Analysis)

38. EIRR of the short-term development plan is assessed at 20.5% in the high growth case, 18.7% in the medium growth case and 11.5% in the low growth case. The short-term development plan has sufficient economic viability. After conducting a sensitivity analysis, the EIRRs are still in a feasible range as shown below.

Development Case	EIRR	Sensitivity*
High Growth Case	20.5%	18.5%
Medium Growth Case	18.7%	17.0%
Low Growth Case	11.5%	10.5%

**Sensitivity: Benefits-10%, Costs+10%*

39. Container handling business brings the port benefits of more than US$ 13 million per 100,000 TEUs. Benefits incurred by transhipment business spread across a wide area of commercial activities including not only the port and shipping agents but also truck operators, ship chandlers and other downstream companies. Construction work also brings considerable economic benefit to the country.

(Development Scenarios)

40. The following scenarios are considered for the development of the new port:

Scenario 1) All breakwaters/seawalls will be developed by SLPA and land reclamation/terminal facilities of the Berths Nos.6,7,8 be developed by SLPA while land reclamation/terminal facilities of the Berths Nos.9,10,11 be developed by private sectors;

Scenario 2) All breakwaters/seawalls will be developed by SLPA and land reclamation/terminal facilities of the Berths Nos.6-11 be developed by SLPA;

Scenario 3) All breakwaters/seawalls will be developed by SLPA and land reclamation for the Berths Nos.6,7,8 be carried out by SLPA while terminal facilities of the Berths Nos.6-11 be developed by private sectors.

In case that private sectors develop terminal facilities, the operations of their terminal(s) shall be carried out by the developer. In case that the SLPA develops terminal facilities, the operations shall be carried out by the SLPA or by private sectors given an SLPA's mandate.

(Financial Analysis)

41. Owing to the large initial investment in the civil works, the proposed short-term development plan is infeasible if cargo handling productivity is not improved and construction cost exceeds the estimates. FIRR is calculated based on three scenarios, all of which are based on the stage plan that QEQ short-term development (Berth Nos.6,7,8 and breakwaters) will be completed in 2005 and cargo throughput will increase as projected in the medium growth case (290 million TEUs in 2005).

42. FIRR is assessed at 4.8%-5.3% in the first scenario according to the cargo growth case, and at 7.2% in the second scenario. FIRR in the third scenario is estimated at 4.2% based on the assumption that the rent of terminal is determined to cover the construction cost of infrastructure.

	Scenario 1		Scenario 2	Scenario 3
Cargo Growth	Medium case	Low Case	Medium Case	Medium case
FIRR	5.3%	4.8%	7.2%	4.2%
Sensitivity	3.8%	3.7%	5.8%	3.5%

Note/ Scenarios: See the above paragraph "Development Scenarios"

(EIA)

43. Field surveys covered waves, currents, water pollution, shoreline configuration, sediment contamination, port-related road traffic and air pollution, terrestrial flora and fauna, and local residents and cultural assets. Biological survey showed that the project area is rather poor in terms of the biological abundance as it has already been urbanized.

44. Initial environmental examination is adopted to study changes in current patterns, disposal of dredged material, impacts on water quality, coastal hydrology, traffic load on access roads, and air pollution. To assess the impact of the port development, tidal currents and the dispersion of water pollution are identified by means of computer simulation. Adverse effects on air pollution and shoreline configuration are also studied. As a result no significant adverse effect is shown in the preliminary EIA.

(Overall Evaluation of the Project)

45. Economic benefits borne by the port have greatly contributed to the Sri Lankan economy in terms of foreign currency earnings, job opportunities, trade promotion and industrial development. However, the development of a new port requires a large capital investment in breakwaters and reclamation work in the deep sea area, so that financial feasibility is very critical in connection with construction cost and port revenues. EIRR is estimated at 11.5% and 18.7% in the low and medium growth cases respectively, but FIRR is at 4.8% and 5.3% in the same cases. In this regard, Master Plan for 2015 is economically a very important project to Sri Lanka but difficulties are envisaged in the financial management of the project.

46. Since the project needs large investment and is not so profitable for the private sector, it will only be feasible in case that the public sector develops all port facilities or in case that the public sector develops the port infrastructure and invites the private sector to invest in and to operate port superstructures, subject to the payment of royalty to SLPA for the use of port infrastructure. Soft loans or other financial assistance to the private sector can encourage their participation. In both cases, cargo handling productivity plays a key role in the feasibility of the project.

6.3 Recommendations

(Basic Concept of Public Port)

47. Port is a basic infrastructure for a nation's imports and exports so that the public sector should administer the port from the viewpoint of people's welfare. However, commercial activities related to the port are basically supported by private sectors in the field of terminal operations, stevedoring, harbour services and other ancillary services. Participation of the private sectors in these fields needs to be encouraged under the administration of SLPA.

(Participation of Private Sectors)

48. In view of privatization of a part of SLPA functions, following schemes can be applied to the new terminals. These alternatives should be selected appropriately according to the financial situation of the project and the prospect of terminal operations.

Scheme 1: SLPA develops all port infrastructures and superstructures, and requests the private sector to operate a terminal.

Scheme 2: SLPA provides only basic port infrastructures and invites the private sector to build superstructures and to operate its own terminal.

Scheme 3: SLPA prepares only the breakwater and basin, and invite the private sector to build and operate a terminal.

(Port Development Policy)

49. There should be a legal scheme in which SLPA proposes a master plan for the development of the port of Colombo and seeks authorization from the Government. It would be helpful to coordinate all related development projects such as the road development project or oil pipeline project. It would also be useful to encourage private sector's participation in port development. SLPA should be given a mandate to consent to the development plan proposed by the private sector in accordance with the authorized master plan. Periodical review of the master plan is important to cope with changes in shipping environment and the demands for the port.

(Necessities for a Competitive Hub)

50. Factors required for a successful hub port are 1) Strategic Location; 2) Excellent Infrastructure; 3) Reliable Operations; 4) Skilled and Disciplined Work Force; 5) Good Banking and Financial Services; 6) Efficient Telecommunications; and 7) Stable Government. Though the port of Colombo is located in a strategic position, the port fails to meet most of the other requirements. Efforts should be made to satisfy all of the requirements.

(New Port Development)

51. Development of the outside of the present breakwaters is a possible means to increase the capacity of the Port to the required level, however, difficulties are anticipated in the high cost and the lengthy period of breakwater construction. It is essential to the development that the construction period and cost be reduced to the minimum level through a careful engineering study on the structural design.

(QEQ Redevelopment)

52. To meet the urgent demand for main/feeder berths and additional container yard in QEQ area, it will be helpful to develop the inner side of QEQ. However, QEQ expansion to the inner harbour should be minimized from the viewpoint of ship maneuvering in the harbour, inter alia berthing at the Bandaranaike Quay and QEQ Nos.1-2 Berths and turning of lengthy Panamax vessels in the restricted basin between JCT and QEQ.

(Widening the West Entrance)

53. The navigable width of the present entrance channel is 125 meters for a Panamax vessel with a draft of 13 meters, which is far below the internationally accepted standard, i.e. more than 5-6 times of the breadth of the maximum ship entering the port, namely 160-200 meters in case of a Panamax. The present entrance should therefore be widened as soon as possible.

(Ship Traffic Separation)

54. As a result of the proposed development, future ship traffic will increase by 1.7-2.6 times in 2005. Daily in/out traffic will reach 31-46 moves so that separation between incoming and outgoing vessels becomes necessary. Short-term Development Plan includes a project to dredge North Channel to minus 12 meters. Installation of Vessel Traffic System (VTS) is recommended to control the approaching and outgoing vessels.

(Wave Observation)

55. With a view to economical design of port structures, a considerable series of wave data is essential so that the wave observation at the offshore point of Crow Island should be continued for more than five years, preferably ten years.

(Project Implementation)

56. On-site work period for the construction of outer seawall and breakwater is limited to the NE monsoon season so that it will take more than eight years to complete the first berth on the outside of the present breakwaters. With a view to filling the gap between demand and capacity foreseen, the development of the new terminal shall be started as soon as possible.

(Construction Cost/Period)

57. In order to build the new port within a limited budget and time frame, the supply of quarry will play a key role in saving the cost and time for construction, as it is an indispensable material for the construction of breakwater and seawall. It is also important to undertake an in-depth study on the design of breakwater and quaywall from the viewpoint of economical construction following the result of wave observation.

(Improving Cargo Handling Productivity)

58. To improve container handling productivity, it is recommended that 1) container handling facilities be augmented; 2) crane operator's skill be enhanced by training at an advanced terminal; and 3) container terminal planning/operation system be established so that the simulation of and preparation for terminal operations (ship and yard) can be completed before ship arrival.

59. It is also important to introduce a proper incentive system (preferably linked to work productivity) to speed up cargo operations. Introduction of private operators into terminal operations will also encourage efficient cargo handling. Urgent improvements should be made in berth assignment to feeder vessels, in priority berthing to regular mother vessels, in reducing inter-terminal container transportation.

(Harbour Services)

60. It is recommended to take certain countermeasures to prevent possible sea accidents and to promote efficiency of port activities in a heavily congested situation, namely, introducing a VTS, updating the traffic regulations, reinforcing the tug fleet, and retraining pilots. The stuff training is particularly important for the prosperous port of Colombo.

(Port Management and Operations)

61. To cope with changes in the demand for the port, SLPA should be given the power to operate the port in its own capacity, particularly in terms of investment, procurement, decision of labour wages, and other financial management with the responsibility for the balance.

(Financial Assistance)

62. Bearing in mind that the project is economically propitious to the country but financially not so profitable, public sector should play an important role in developing the port infrastructure and efforts should be placed to encourage the participation of private sectors in terminal development and operations by preparing soft loans or through other financial assistance.

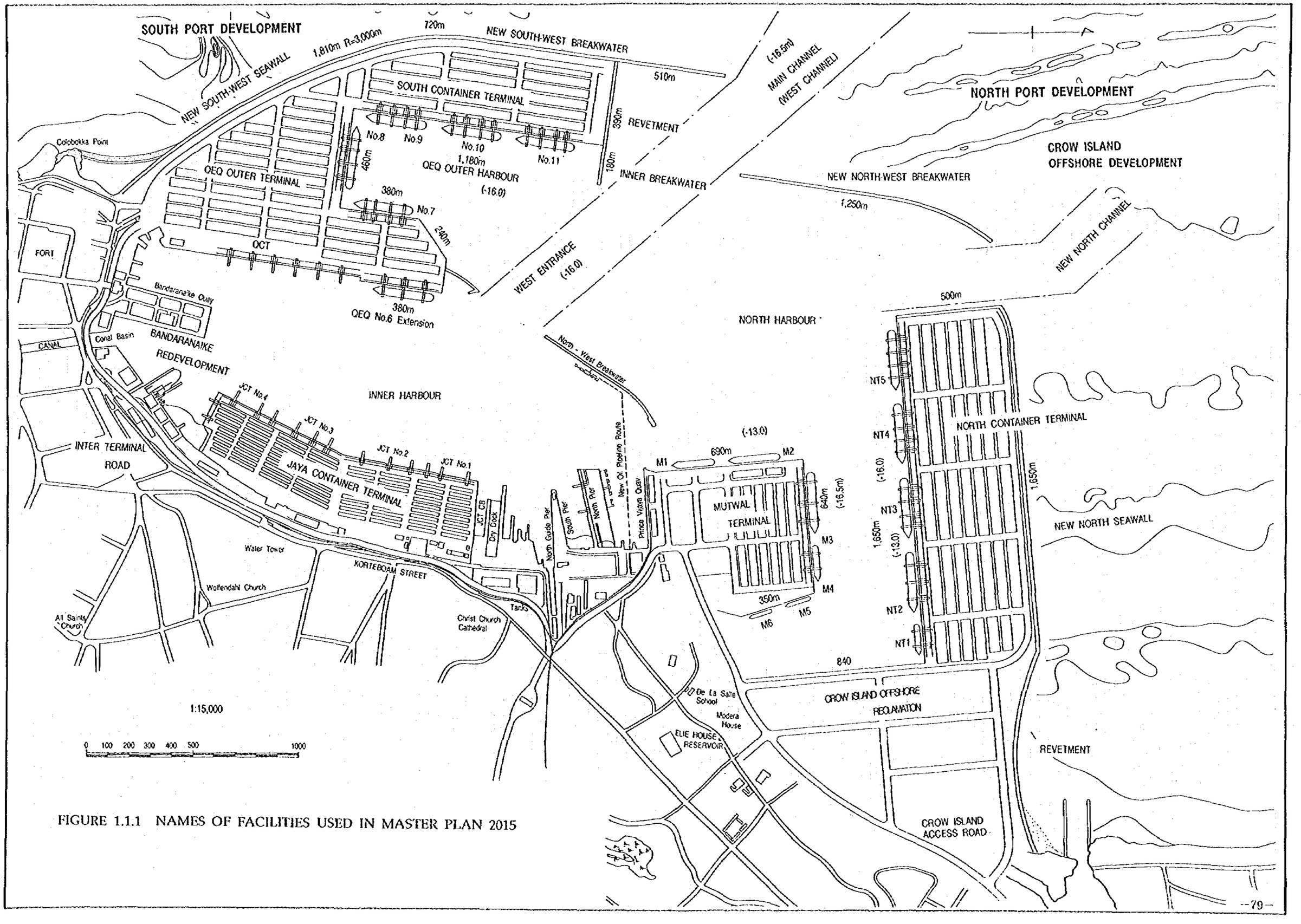


FIGURE 1.1.1 NAMES OF FACILITIES USED IN MASTER PLAN 2015

JICA