Chapter 5 Short-Term Improvement Plan of the Port of Aqaba

5.1 Basic Concept for the Short-Term Improvement Plan

The Short-Term Improvement Plan is to be formulated within the framework of the Master Plan and it is prepared as a first phase plan with a target year of 2000. Taking into account the target year, its basic concept is thought as follows:

a) To solve current problems caused by the existing facilities

b) To cope with demand forecast, that is, cargoes expected most likely to increase in the near future

c) To aim at long-range prosperity of the port of Aqaba in a strategic sense, that is to say, as a transit port

d) To make best use of the existing facilities and equipment through necessary improvement and rehabilitation

e) To introduce modernized computerization and advanced administrative measures together with training system

f) To step forward to steady and scheduled implementation for completion of the project proposed in the Master Plan

g) To re-examine designs of facilities and project implementation program through the results of site investigation and so on

h) To minimize the undesirable influence to port activities as much as possible during project implementation

5.2 Site Investigation

5.2.1 Natural Conditions Survey

During the second field survey period from June to August, 1995 the following natural conditions survey was conducted in Main, Container and Industrial Port Area.

- Topographic Survey ---------- 1.6 km^2 (Container & Industrial)
- Bathymetric Survey ---------- 42 km (Total Survey Run)
- Current Observation ---------- 6 points (Three Ports Area)
- Offshore Boring Works ------- 4 points (Container & Industrial)
- Onshore Boring Works ------- 2 points (Container Port)
- Soil Laboratory Test ---------- Sum

The result of survey for three ports area.

(1) Main Port Area

a) The sea depth in front of existing berths are deep and -50m contour line is about 200m distance from berth face line.

b) Current velocity is relatively small and maximum velocity 0.15 m/s was observed.

(2) Container Port Area

a) Backside of existing container yard is rocky low mountain area.
The sea depth in front of existing berths are deep enough for post panamax container ship.
b) Offshore soil condition is coral sand with some shells and onshore soil condition is granitic sand with some fine gravels.
c) The maximum current velocity is 0.11 m/s.

(3) Industrial Port Area

a) The shape of coast line from beach to existing road is 8 percent gradient sand beach.
b) The offshore contourline is similar shape of coast line and -50m contourline is about 250m distance from beach.
c) Offshore soil condition is branched coral in upper horizon and hard grained beach sand in the second horizon.
d) The maximum current velocity is 0.12 m/s.

5.2.2 Environmental Conditions

(1) Seawater

The seawater is extremely clear along the coast of the Gulf of Aqaba. Especially, the water contains dissolved oxygen at the maximum level for its temperature and coliform found in the water seems at its minimum level.

Construction of any port facilities should be of such a type that will cause no pollution to the sea. The tourism and leisure activities are also to be strictly controlled by the relevant authorities.

(2) Seabed Materials

The seabed consists mainly of fine and very fine fractions and does not contain harmful substances to the environment, such as organic substances and heavy metals. In addition, elution of heavy metals and phosphate from the seabed sediments are very low. Therefore, the underwater excavation will cause no significant impacts to the environment if it is carefully confined to the required minimum.

(3) Coral

Generally speaking, the corals are well developed along the coast of the Gulf of Aqaba. However, many of them are dead at the existing berths, mainly due to the sediments from phosphate and other bulk cargoes.

At the southern part of the existing container berth, well-developed and living corals are confirmed through the coral survey. While on the northern part, there are no such corals. Therefore, it is recommendable that extension of the exiting berth be made southward only

where living corals are not significant. The future extension of the container berth should be made northwards.

(4) TSP and P_2O_5

All the survey stations show the daily TSP level was in the range of 65 $\mu g/m^3$ to 207 $\mu g/m^3$ which are lower than the acceptable limit of 260 $\mu g/m^3$ of USEPA Standards, except 473 $\mu g/m^3$ recorded when the wind direction changed.

All the survey stations shows that the daily P_2O_5 level was in the range of 0 - 10 $\mu g/m^3$ which are lower than the acceptable limit of 50 $\mu g/m^3$ of USSR-YUG Standards.

However, it may require a longer-term observation to conclude how significantly the low daily P_2O_5 level is attributed to the installation of the choke feeders.

As is observed, P_2O_5 is far dissipating leeward to the phosphate berths down to the southern coast where a tourism zone is planned by ARA. In planning a much longer-term development of the coast of the Gulf of Aqaba, proper location of the phosphate berths should be taken into consideration.

5.3 Demand Forecast for the Short-Term Improvement Plan

Demand forecast up to the target year 2000 (Short-Term Improvement Plan) is estimated based on Case 5.

Table 5.3.1 Cargo Volume up to year 2000 (Unit:,000tons)

Cargo	Year	Total	Export	Import
Total	1993	12,003	6,390	5,613
	1998	18,587	11,431	7,156
	2000	22,016	13,834	8,182
Local Bulk	1993	8,313	6,130	2,183
	1998	14,139	10,586	3,553
	2000	17,081	12,850	4,231
Local BreakBulk	1993	1,740	160	1,580
	1998	1,875	365	1,510
	2000	2,027	437	1,590
Container (Local & Transit)	1993	690	100	590
	1998	1,269	224	1,045
	2000	1,517	267	1,250
Transit (Bulk & BreakBulk)	1993	1,260	0	1,260
	1998	1,304	256	1,048
	2000	1,391	280	1,211

(Note: Cargo volume in 1993 is modified from statistics)

5.4 Required Port Facilities and Equipment up to 2000

This study is executed under the following fundamental conception.

a) The capacity of berths / facilities and cargo handling productivity are examined based on the best use and improvement of existing berths / facilities and the improvement of current handling productivity.

b) Cargo working days per year is to be 351 days

c) Cargo working hours per day is, in principle, to be 18 hours for general cargo and 24 hours for specialized cargo.

d) Berth occupancy does not exceed 70 percent in all cases.

5.4.1 Required Number of Berths

The following table is calculated by the method as described in the previous Chapter and shows forecast cargo volume, cargo handling productivity, vessel berthing time and required number of berth and so on in 2000.

(1) Main Port

Table 5.4.1 Required Number of Berth in the Main Port (2000)

Item	Phosphate	Break Bulk	Grain	Vegetable
Forecast Cargo Volume (x1,000T)	5,700	2,748	1,550	320
Average Cargo Volume / Vessel (T)	50,000	3,000	40,000	15,000
Cargo Handling Productivity (T/Day)	53,760	2,500	9,677	6,451
Number of Days Necessary other than Cargo Handling / Day	0.15	0.10	0.20	0.15
Total Berthing Days /Vessel	1.08	1.30	4.33	2.48
Total Berthing Days /Year	123	1,191	168	53
Required Number of Berth	0.50	4.85	0.68	0.21

(2) Container Port

Table 5.4.2 Required Number of Berth in the Container Port (2000)

Item	Container	Cement	Rice
Forecast Cargo Volume (x1,000 T)	1,517	700	520
Average Cargo Volume/Vessel (T)	4,080	20,000	18,000
Cargo Handling Productivity (T/day)	7,500	5,376	6,720
Number of Days Necessary Other Than Cargo Handling /Vessel	0.15	0.20	0.20
Total Berthing Days/Vessel	0.69	3.92	2.88
Total Berthing Days/Year	258	137	83
Required Number of Berth	1.05	0.56	0.34

(3) Industrial Port

Table 5.4.3 Required Number of Berth in the Industrial Port (JFI W/E) (2000)

Item	Potash/DAP/NPK/ Salt/MgO	Sulfur	Liquid Ammonia	Phosphoric Acid
Forecast Cargo Volume (x1,000 T)	5,300	1,000	310	1,000
Average Cargo Volume/Vessel (T)	20,000	20,000	20,000	20,000
Cargo Handling Productivity (T/Day)	20,160	6,720	9,140	7,526
Number of Days Necessary Other Than Cargo Handling Days/Vessel	0.10	0.15	0.15	0.15
Total Berthing Days/Vessel	1.09	3.13	2.34	2.81
Total Berthing Days/Year	289	156	36	140
Required Number of Berth	1.18	0.64	0.15	0.57

Table 5.4.4 Required Number of Berth in Industrial Port (Oil Jetty/JFI-1)(2000)

Item	Fuel/Crude Oil	Mineral Oil	Livestock
Forecast Cargo Volume (x1,000 T)	720	550	81
Average Cargo Volume/Vessel (T/Day)	25,000	20,000	200
Cargo Handling Productivity (T/Day)	20,000	6,048	860
Number of Days Necessary Other Than Cargo Handling/Vessel	0.15	0.15	0.15
Total Berthing Days/Day	1.40	3.46	0.38
Total Berthing Days/Year	40	95	155
Required Number of Berth	0.16	0.39	0.63

5.4.2 Port Facilities and Cargo Handling Equipment

(1) Phosphate Berth B

The capacity of existing berth, storage facility and equipment is sufficient in the year 2000, assuming handling productivity could be improved and cargo dwelling time in the storage facility would be controlled within 14 days.

(2) New Grain Berth

Large sized grain vessels like Panamax with full load are currently calling and such vessels will become dominant in the near future. On the other hand, No.1 berth is shallow. Therefore New Grain Berth should be constructed and exclusively used for grain operation. Consequently, the capacity of the new berth, existing storage facility and existing handling equipment is sufficient in 2000, assuming handling productivity could be improved and cargo dwelling time is controlled within 19 days.

- New Grain Berth ; 280 m length and 14 m depth for 50,000 DWT

(3) Break Bulk Cargo (General Cargo) Berths

Forecast cargo volume is the nearly same as at present and size of calling vessels will also not change. Therefore the capacity of storage area and present equipment is sufficient in 2000. Required number of berths is five as shown in the Table 5.4.1 and the size of the berths is as described in the next Chapter.

(4) New Oil Berth (Phosphate Berth A)

Because Phosphate Berth A will have been 35 years since the berth was built, some rehabilitation will be necessary. The capacity of the berth, handling equipment and storage facilities in 2000 is quite sufficient for this cargo, assuming cargo dwelling time controlled within 16 days.

(5) New Container Berth

Transitional facilities and the quantity of equipment in the container terminal by 2000 en route to the Master Plan, 2010 entail the following.

- Berth extension of by 60 m to south for 2 Panamax type vessel of 35,000 DWT
- Establishment of office and maintenance shop in the planned place
- One additional gantry crane (Panama type)
- 5 transfer cranes

(6) Al-Mushtarak Berth (for Cement)

The capacity of the existing berth, storage domes and handling equipment is sufficient for loading cement in 2000, assuming cargo dwelling time could be controlled within 15 days.

(7) Mo'ta Floating Berth (for Rice)

The capacity of the existing berth, storage tanks and handling equipment is sufficient for unloading rice in bulk in 2000, assuming cargo dwelling time could be controlled within 19 days.

(8) Industrial Berths (JFI West and East)

More than 8 kinds of cargoes might be handled at these berths in 2000. Cargo volume in 2000 is forecasted nearly 3 times of that in 1994. It is definitely indispensable to improve port facilities as well as cargo handling productivity.

- To construct one additional berth

Consequently, three berths (two existing and one to be added) could handle the forecast cargo volume in 2000. But the operation of Fuel / Crude oil should be transferred to Oil Jetty by 2000.

(9) Oil Jetty

Mineral Oil and Fuel / Crude Oil shall be handled at this jetty in 2000.
The capacity of the berth and facility for these cargoes are quite sufficient in 2000.

(10) New JFI-1 Berth (for livestock)

This berth will be suitable for handling livestock because of its remote location from the town. Due to small berth (80 m in length and 7 m in depth), large sized vessels cannot berth. Currently large vessels of livestock are assigned to other berths. Number of the large vessels is expected to greatly increase in the future because livestock cargo volume in 2000 is forecasted as 3.7 times greater than that in 1994. As a result, the following improvement of this berth is required.

- To enlarge berth length to 200 m and depth to 11 meters
- To build temporary stock yard equipped with sewage disposal behind the berth

5.5 Proposed Short-Term Improvement Plan

(1) New Grain Berth

The berth is proposed to be 280 m in length and 14 m in depth so as to accommodate Panamax type vessel of 50,000 DWT. There are two alternatives in regard to the location of the berth (See Figure 5.5.1 and 5.5.2).

Table 5.5.1 Comparison of Two Alternatives for New Grain Berth Location

Alternative	Construction Work	Construction Cost	Overall Layout	Phosphate Dust Contamination
1 (Near Berth No.1)	Grain operation is suspended at Berth No.1	6 million JD	Located at extreme south end of General cargo berths	Contamination problem due to near Phosphate Berth B
2 (Near Berth No.3)	Grain operation can be continued at Berth No.1	2 million JD	General cargo berths divided into two	No contamination due to 700 meter distance from Phosphate Berth B

The main reason for such a difference in cost is the great work required to ensure that Berth No.1 is only 11 m in depth and the face line of the berth is inclined by two degrees. Alternative 2 is finally proposed for adoption.

(2) New Break Bulk Cargo (General Cargo) Berths

As New Grain Berth is proposed to be located near existing Berth No.3, the New Break Bulk Cargo Berths shall be rearranged, taking into account existing berth length and depth (See Figure 5.5.2).

From south to north

a) 170 m length and 10 m depth for 10,000 DWT ; two berths
b) 280 m length and 14 m depth for 50,000 DWT ; one berth (New Grain Berth)
c) 240 m length and 12 m depth for 30,000 DWT ; one berth
d) 170 m length and 10 m depth for 10,000 DWT ; one berth
e) 150 m length and 8 m depth for less than 10,000 DWT ; one berth

(3) Container Terminal

Transitional layout based on the Master Plan is proposed taking account of forecast cargo volume in 2000 (See Figure 5.5.3).

a) To extend the berth by 60 m to south
b) To complete yard pavement to the southern half of the final planned yard

c) To found new office and maintenance shop
d) To make sure of container transferring road between new yard and the eastern half of existing Yard 2 and Yard 3 as a temporary stacking yard

(4) New JFI-1 Berth

All livestock shall be handled at this berth in 2000 because the location in the Industrial Port is remote from the town and the improvement of existing JFI-1 is practical due to considerable space for temporary stock yard behind the berth (See Figure 5.5.4).

- Proposed berth length to be 200 m and depth to be 11 m

(5) JFI North Berth

The construction of JFI North Berth shell be required by 2,000 in addition to existing JFI West and East Berths to cope with the greatly increased cargo volume (See Figure 5.5.4).

- Proposed berth length to be 230m and depth to be 15m

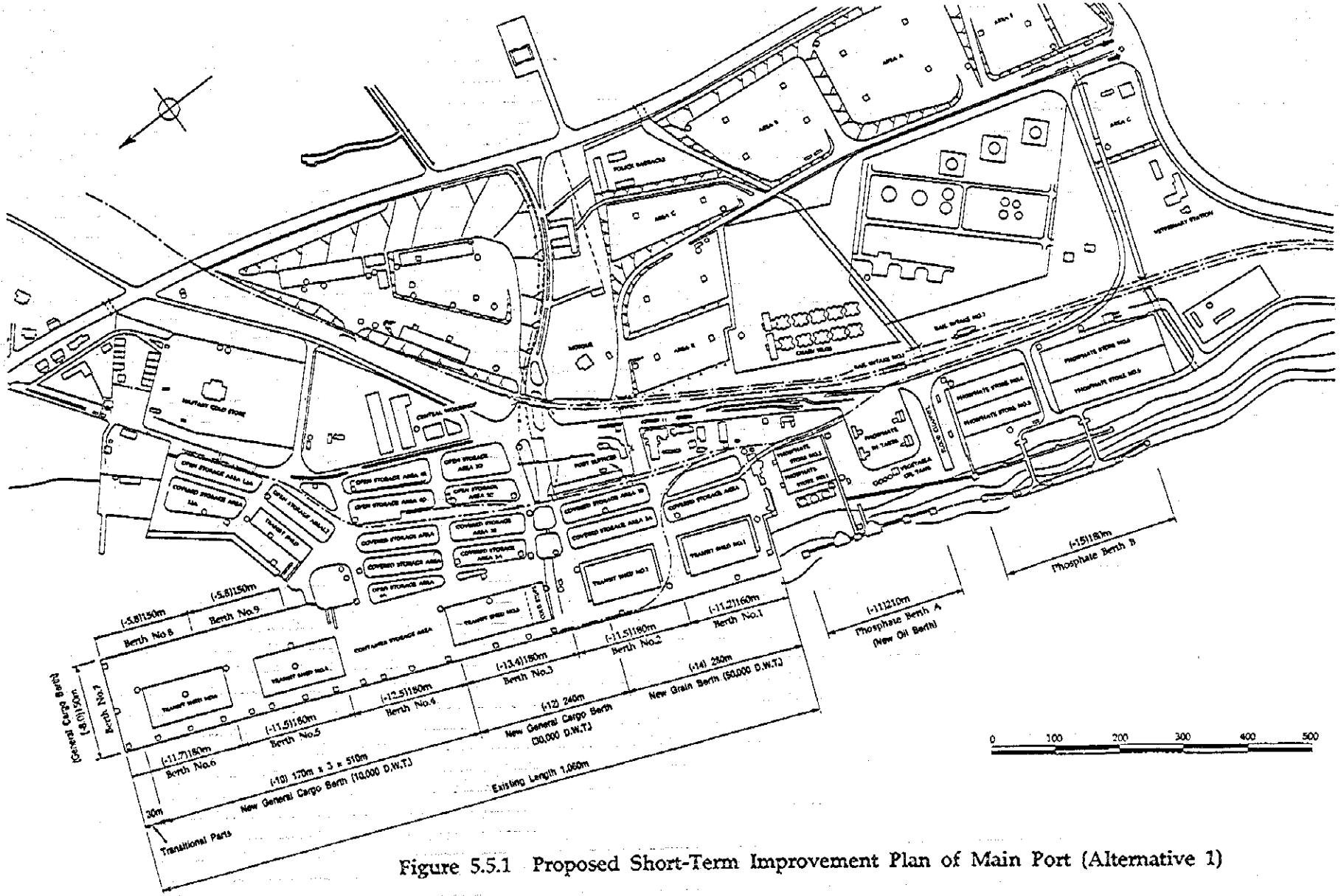

Figure 5.5.1 Proposed Short-Term Improvement Plan of Main Port (Alternative 1)

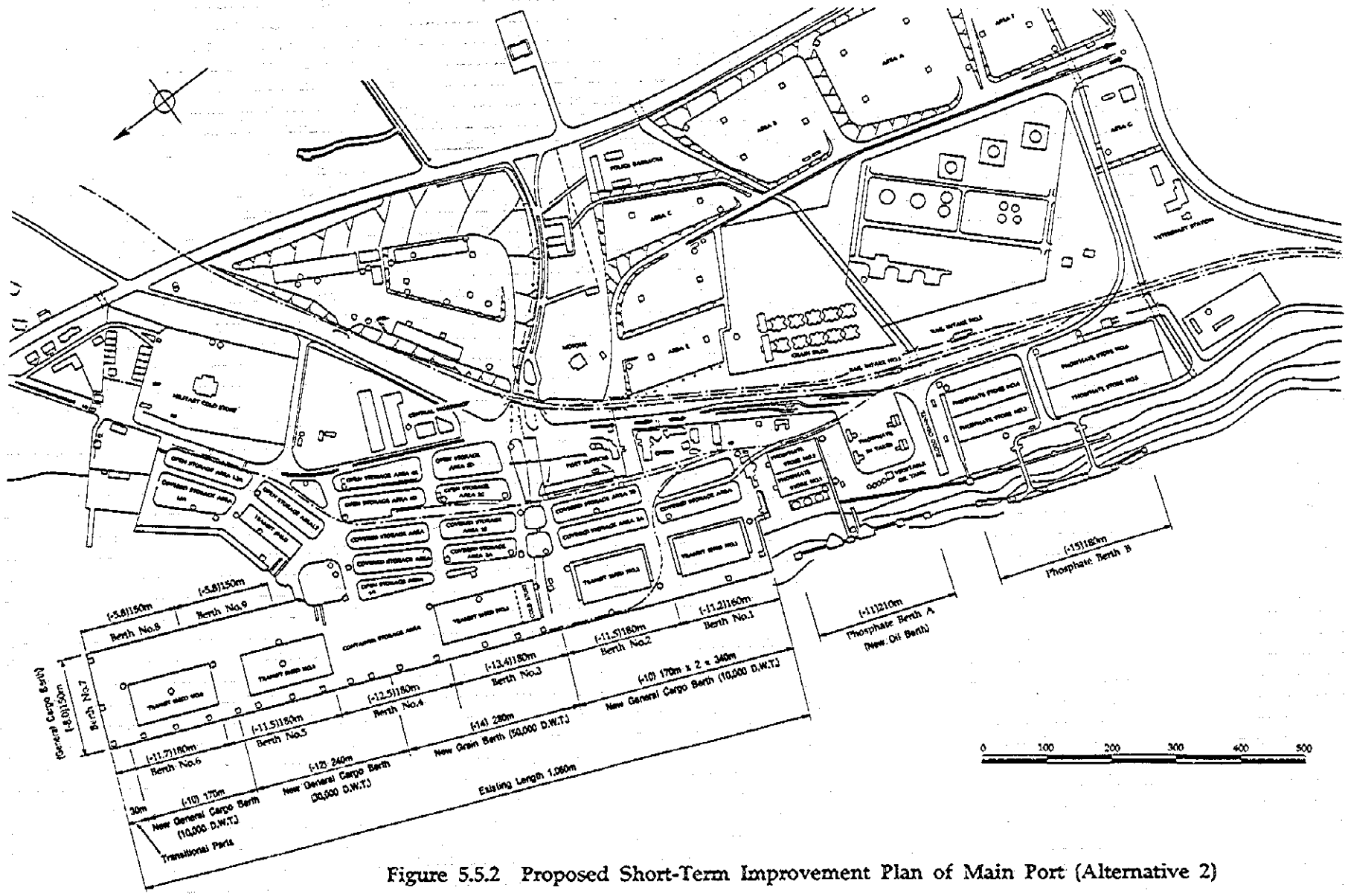

Figure 5.5.2 Proposed Short-Term Improvement Plan of Main Port (Alternative 2)

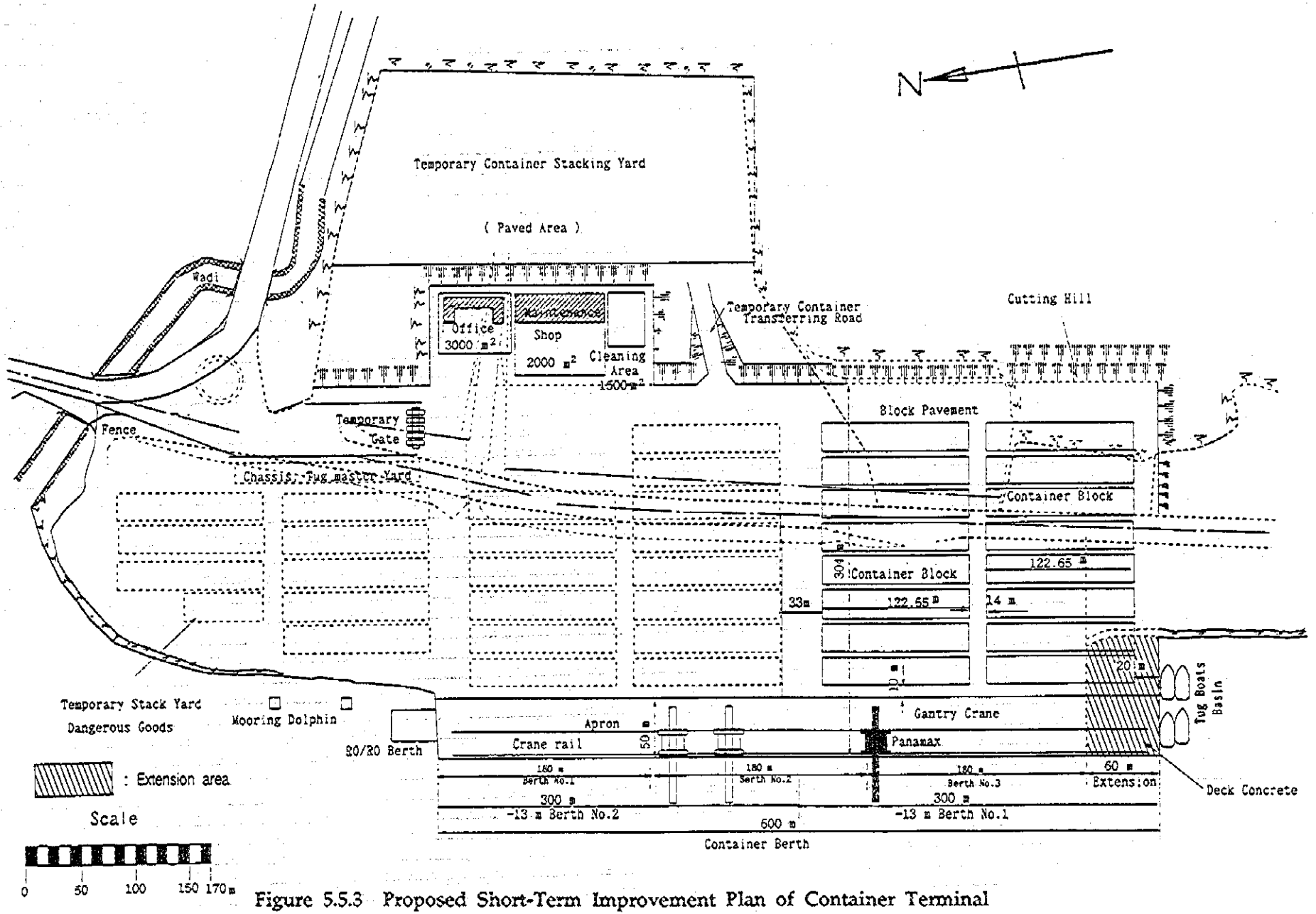

Figure 5.5.3 Proposed Short-Term Improvement Plan of Container Terminal

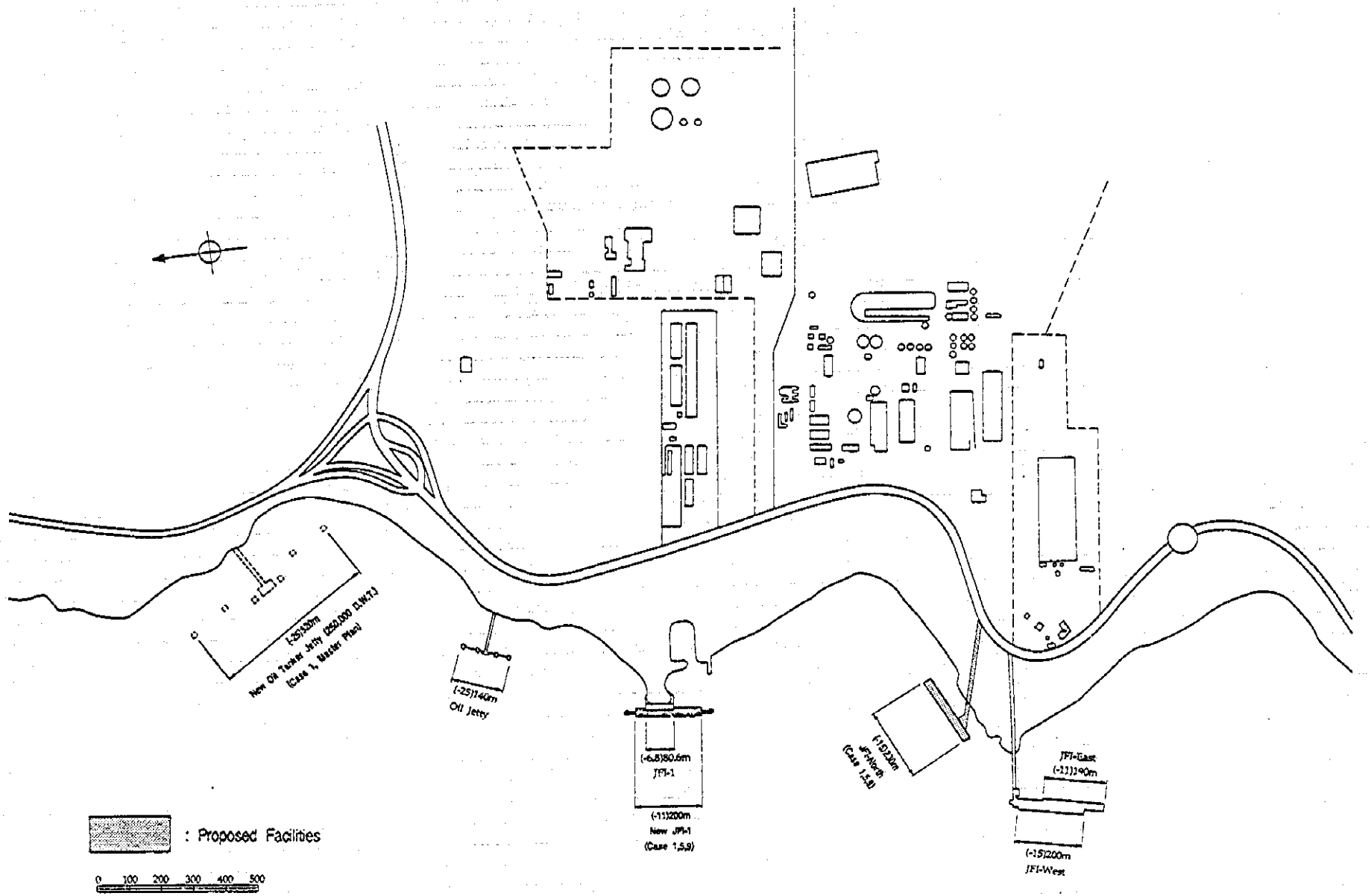

Figure 5.5.4 Proposed Short-Term Improvement Plan

5.6 Information System for the Short-Term Improvement Plan

5.6.1 Computer System for the Target Year

(1) Pre-study for Computerization

Each Department seems to have some independent ideas for their computerization to perform their works. To make a total computer network of PC in future, it is necessary to establish the project team for computerization prior the year 2000. The project team will be comprised of the representatives of each department including computer specialists, who will formulate policy for computerization.

The project team analyzes the routine work of each department, and collect all documents which are circulated among the departments. The most important item is to choose the data which is required by each department, and to design the data, system and equipment. To make a total computer network, the project team should work under the Director General directly.

(2) File Design

After choosing necessary data, file design will be planned. Items of data, record including the order of data, length of data and way to access to data are designed.

(3) System Design

For introduction of a computer system, the study about the system design should be concluded prior to decision of computer model. The basic procedure of the system design is as follows;

- Determination of requirements
- Design
- Evaluation

(4) Container Terminal

Possible computer systems of PC are listed up in the master plan. In the short-term improvement plan, the container terminal should be given the first priority for computerization. The total volume of container handling will increase up to around 200,000 TEUs per year with two berths at the target year. Port of Aqaba will need a computer assistance in 2000.

(5) Main Port

Break-bulk cargoes, such as bags, cartons, boxes and steel products, are handled at Main Port. These break-bulk cargoes are discharged by the stevedoring section, and transferred and shifted to the warehouses or sheds. To improve cargo handling productivity of break bulk, a determination of storage location and for control and delivery of cargo would be effectiveon computer system.

At present, to store break-bulk cargoes in suitable and proper warehouses or sheds, an alphabetical index system is adopted at Main Port by manual. The alphabetical index is prepared by shipping agents based on the cargo manifest according to loaded ports B/L No. in the alphabetical order. The alphabetical index is submitted to PC from shipping agent prior to vessel arrival, and Operation department will decide the storage location referring to the index and space availability without aid of computer.

1) Alphabetical Index

Procedure of the alphabetical index by computer is as follows;
Input the data of cargo manifest.

- Name of vessel, Arrival data, Shipping agent, Customs clearing company, Shipper, Consignee
- B/L No., Loaded port, Commodity, Type and number of package, Weight

The name of consignees will be sorted and arranged in the alphabetical order, and the storage location and address will be decided in a proper suitable space by computer.

2) Cargo Delivery

Receipt & Delivery section control and manage cargo receipt and delivery. Procedure of alphabetical index by computer is as follow;

The name of consignees will be input by keyboard, and the storage address and locations will be seeked for reference. The section informs a truck driver of the data, and transfers to a shed master.

5.6.2 Container Terminal

(1) Process of Introduction

1) Pre-study

In the same way, the pre-study is necessary to the container terminal. The project team check and analyze the procedures, documents and functions of each section of the container terminal. Generally, 200~250 byte are required per one container for recording the data.

2) Document

The container terminal dose not get all shipping documents from shipping agent for operating their terminal. Shipping documents, such as the container cargo manifest, stowage plan, bay plan, container loading/discharging list are required by all means for input these data prior to vessel arrival.

3) System Design

At present, PC has the main computer, three printers and ten keyboards and displays. From the view point of effective use of these existing computer, printers and displays, it seems the most effective and practical use for PC to introduce these equipment in their container terminal up to the year 2000.

Existing computer can be used sufficiently for control the container terminal, but additional equipment and parts should be added according to the increase of containers with minimum requirement. The computer should be remained to install in a current computer room until replacement of a new terminal building.

(3) Operation

1) Organization

To introduce a computer system into existing container terminal, sections and offices should be precise about their jobs and charges, and will be provided with keyboards and displays for data processing.

a) Terminal Gate : No.1, No.3 and Yarmouk
b) Office : No.8 waiting area office, No.1 yard office, No.2 yard office, No.3 yard office
c) Document section
d) Operation section

2) Operation

For introducing the computerization into the existing container terminal, the basic concept of the operation are as follows;

a) Current procedure for document flow will be maintained as much as possible.
b) Arrangement of the offices will be maintained as they are.
c) Data will be input into computer at the office where the documents are handled and dealt with.
d) The computer system will not be directly connected to any outside organizations.
e) Terminal staff should be trained to operate their computers, and to be familiar with a general flow of documents and container.

Table 5.6.1 Arrangement of Peripheral

	Main Computer	Keyboard & Display	Printer
Computer room (Main Port)	HP-9000 1 Unit	1 Unit	1 Unit
No.8 Waiting area		2	2
No.1 Gate (Weighbridge)		1	0
No.1 yard office		2	2
No.2 yard office		2	2
No.3 yard office		2	2
No.3 Gate (Weighbridge)		1	0
Main terminal office (Document section)		3	2
Main terminal office (Operation section)		3	2
		17	13

(4) New Container Terminal in Future

1) New Container Terminal

The container terminal will be developed to one flat storage yard, equipped with transfer crane and four gantry crane by 2010. Terminal building, maintenance shop will be arranged to an efficient layout. At the renovated new container terminal, a new computer is to be installed as a part of network of PC.

2) Terminal Gate

When container trailer-chassis comes to the gate with "gate in slip" or "delivery order", a gate staff input the container number on keyboard, the document data will be read by scanner with bar code. EIR (OUT/IN) will be exchanged between driver and gate staff.

3) Terminal Building

A main office building will be constructed in the container terminal as its control center. The operation, document and computer section have their offices in the building. All offices inside the building will be wired for LAN system.

4) Document and Operation Section

The document section is only one gateway for receiving/delivery all the shipping documents which will be stored and transferred by floppy disk. These data will be input into computer.

The operation section operates a yard control system and ship's loading/discharging system. Container storage address and loading position will be decided by computer, and yard plan and ship's loading/discharging plan will be also drawn by computer.

5.6.3 Training of Computer Operation

(1) Main Computer

One computer engineer is studying the port operation and documentation flow. For computerization of PC, however, only one engineer is not enough. More computer engineers and programmers should be employed as the staff of the computer section.

(2) Personal Computer

The introduction of personal computers is most important and basic as the first step for the computerization of PC. In the network system, personal computers have been more important. To know how to use personal computer is one of the most important requirements for operating the future network.

(3) Instructor of Personal Computer

An instructor is engaged in training of personal computer. PC should educate more instructors of personal computers by self-education or by dispatching them to a technical school.

(4) Trainee of Personal Computer

The staff of each section should be able to use personal computers which will be a part of the system. From this point of view, trainees of the personal computer course should be chosen from all the concerned department, and they should take the training course prior to the completion of the introduction of computer network.

(5) Training Course of Personal Computer

PC has a training course of personal computer of which a term is two weeks. To introduce computer system into their routine works, more advanced courses and frequent sessions are needed. On the training course, the training program should be mainly aimed at practical use of an application software instead of technical and theoretical matters.

Recently, there are many kinds of application software on the market such as word processors and spreadsheets. It would be very useful for the trainees to introduce these application software into their training course.

The basic items of the personal computer training course are as follows;

a) General information of hardware and software
b) Operating System (O/S)
c) Personal Computer and Peripherals
d) Application Software

5.7 Preliminary Design

(1) Main Port

An exclusive grain berth is planned at the existing general cargo berth No.3 and a part of No.4 hat is the location alternative 2.

The grain berth is designed as 280 m in length and 14 meters below Char Datum in depth to accommodate 50,000 DWT grain carrier. The design depth of the basin is set as -14.50 m considering tolerance of dredging works.

Dimension of crane gauge and the distance from quay face-line is set as same as the existing situation. Since current grain unloader cranes at berth No. 1 are moved to new grain berth.

The deck under the rear crane rail is reinforced by constructing pile heads and longitudinal beams.

A belt conveyor line is erected behind crane lane of new grain berth and extended to connect to the existing conveyor line at extremity of general cargo berth No. 1.

(2) Container Port

At container yard, southern 2 blocks of container yard are improved in the Short-Term Improvement Plan. Therefore the extension of container wharf is included in the Short-Term Plan. Retaining wall behind quay and revetment for container yard are designed as the structure of steel sheet piles wall. A type of interlocking concrete block pavement is designed as the pavement of yard considering operation of transfer cranes, 4 steps stack of container box and furthermore easiness of the maintenance. Cutting slopes at hill are shaped with 1:1.5 gradient and planned berm of 5m, width every 10 m height. New port office building is designed as 2nd floors in reference with the existing administration building at container terminal.

(3) Industrial Port

A live-stock import berth utilizing the existing timber jetty is improved in the Short-Term Improvement Plan. Berth length is designed as 200 m long. The face-line of the berth is planned at 15 m seaward parallel to the existing timber berth. Design depth is set as 11.0 m below Chart Datum. An open type pier with steel pipe piles foundation is applied in design.

Since maximum ship size to accommodate the berth is planned as 20,000 Gross Tonnage, live-stock carrier overall length of 200 m, the berth of 200 m long is not enough in length.

To accommodate such size of ships, two mooring dolphins are planned at both extremities.

A fertilizer berth is planned at the north ward of the existing JFI-East and West berths.

The face-line of the berth is set on -15.0m contour to avoid dredging works. Angle tower with operation room is planned at the southern edge of the berth for future extension.

The width of berth is set on 18.0m considering quay crane gauge and width of traffic way for trucks. Berth length is planned by 230m and an open type pier with steel pipe piles foundation is applied to design structure.

5.8 Project Implementation Program

In implementing the facilities construction and equipment procurement and installation of the short-term development, the following are generally presumed:

Except JFI-North Berth

a) The financial sources are finalized before the middle of 1996 and selection of a consulting firm is to commence in July, 1996.
b) The detailed design is to commence in the middle of October, 1997.
c) Contractor(s) for civil works and supplier(s) for equipment procurement are to be selected through international competitive bidding according to guidelines of respective financial sources.
d) The procurement of the equipment and the construction of civil works are to be completed before they are required according to the cargo demand forecast.
e) Contract packages are to be as follows:
   i) Waterborne works (berth) construction
   ii) On-land civil works (cut and fill, pavement, buildings, utilities)
   iii) Procurement of a container quay-side gantry crane (panamax)
   iv) Procurement of transfer cranes
f) Construction of facilities, procurement of equipment, training of employees, etc., identified under Urgent Improvement Plan and Improvement Measures of Environment are excluded from the planning.
g) Repair works of damaged/deteriorated facilities are excluded from the planning.

JFI-North Berth

a) The berth is to be operated at the beggining of 1999.
b) The selection of the contractor of civil works is made based on the basic design only through international competitve bidding.

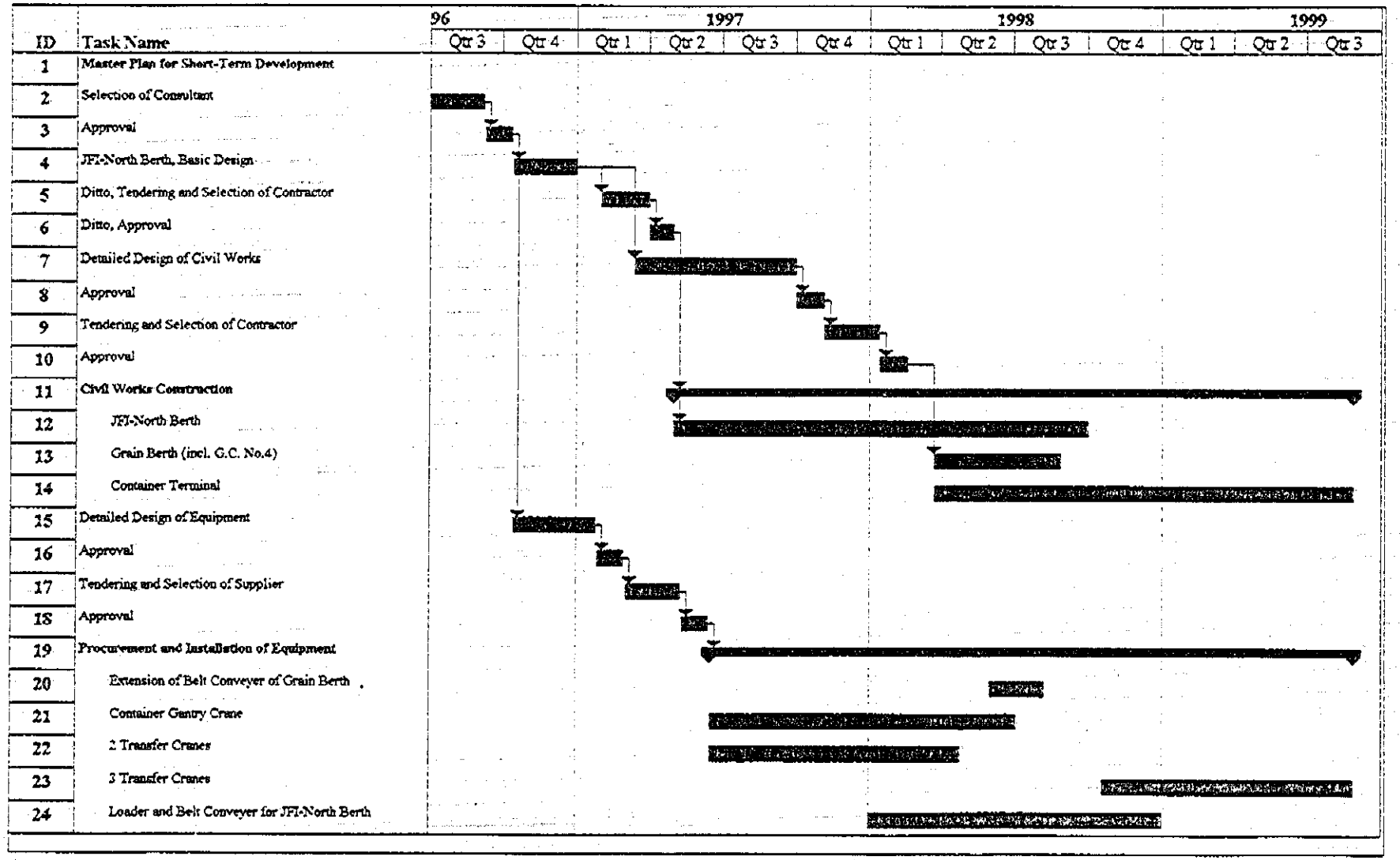

Figure 5.8.1 Implementation Program of the Short-Term Improvement Plan

5.9 Cost Estimation

The cost for the facilities construction and equipment procurement and installation of the short-term development are estimated as:

1) Quantities of the main civil works are based on the preliminary designs of typical cross sections. Therefore, they are rather approximate.
2) Unit rates of the on-land works generally follow those which were collected during the site surveys. Unit rates of the waterborne works, such as concrete beams and slabs of the jetties, are obtained multiplying those of the on-land concrete works with certain factors.
3) Unit rates which cannot be obtained using the collected data were obtained from the actual prices from similar projects or experiences.
4) Unit prices of the equipment were quoted by a potential supplier. Therefore, they are higher than would-be actual prices through a competitive bidding.
5) An exchanges rate in which 1 J.D. equals to 130 Japanese Yen and 1.45 US is dopted.

Table 5.9.1 Cost Estimate of the Short-Term Improvement Plan

Item No.	Description of Work	Amounts Total(J.D.)	Currency	
			F/C(J.D.)	L/C(J.D.)
1	**Main Port**			
1.1	Grain Berth (-14m, 280m)			
1.1.1	Civil Works Deepening of Birth, Rubber Fenders, Bollards, Reinforcement Concrete Deck, Crane Rails, Foundation of Conveyers, Cable Duct, etc.	679,000	632,000	47,000
1.1.2	Procurement and Installation of Equipment 450 m Extension of Belt Conveyer, Relocation of Unloaders, etc.	1,230,000	1,101,000	129,000
	Grain Berth Total	1,909,000	1,733,000	176,000
1.2	General Cargo Berth No. 4 Deepening to - 12 m	15,000	14,000	1,000
	Main Port Total	**1,924,000**	**1,747,000**	**177,000**
2	**Container Port**			
2.1	Container Terminal			
2.1.1	Civil Works			
2.1.1.1	Berth Extension	2,816,000	2,465,000	351,000
2.1.1.2	Yard Development	3,672,000	2,516,000	1,156,000
2.1.1.3	Buildings	505,000	253,000	252,000
	Sub-Total of Civil Works of Container Terminal	6,993,000	5,234,000	1,760,000

2.1.2	Procurement and Installation of Equipment			
2.1.2.1	Container Quay-Side Crane (Panamax)	5,540,000	5,263,000	277,000
2.1.2.2	Container Transfer Crane (RTG, 4 tire-stacking)	7,200,000	7,200,000	0
	Sub-Total of Procurement and Installation of Equipment	12,740,000	12,463,000	277,000
	Container Port Total	**19,733,000**	**17,697,000**	**2,036,000**
3	**Industrial Port**			
3.1	JFI-1 Berth			
	Civil Works	5,221,400	4,639,000	582,400
3.2	JFI-North Berth			
3.2.1	Civil Works	5,521,640	4,989,476	532,164
3.2.2	Procurement and Installation of Equipment			
3.2.2.1	Loader of Fertilizer Products	3,480,000	3,375,000	105,000
3.2.2.2	Belt Conveyor Line	1,008,000	948,000	60,000
3.2.2.3	Operation & Angle Tower	240,000	168,000	72,000
	Sub-Total of Procurement and Installation of Equipment	4,728,000	4,491,000	237,000
	Industrial Port Total	**15,471,040**	**14,119,476**	**1,351,564**
	Direct Cost Total	**37,128,040**	**33,563,476**	**3,564,564**
	Consulting Services (8% of Civil Works)	1,474,403	737,204	737,204
	Ditto (3% of Cargo Handling Equipment)	560,940	448,752	112,188
	Administration Cost for PC(2 % of Direct Cost)	742,560	0	742,560
	Physical Contingency(10 % of Civil Works)	1,843,004	1,455,973	387,031
	Ditto(5% of Cargo Handling Equipment)	934,900	906,853	28,047
	Ditto(5% of Consulting Services)	101,767	62,078	39,689
	Ditto(5% of Administration Cost of PC)	37,128	0	37,128
	Physical Contingency Total	2,916,799	2,424,904	491,895
	Cost Total	**42,822,742**	**37,174,336** (86.8 %)	**5,648,406** (13.2 %)
	Tax (18% of Total)	7,708,093	0	7,708,093
	Project Cost Total	**50,530,835**	**37,174,336** (73.6 %)	**13,356,499** (26.4 %)

5.10 Management and Operation System for the Short-Term Improvement Plan

5.10.1 Introduction of New Sections

(1) Port Planning Section

In order to provide means for orderly development, PC should introduce Port Planning Section which is in charge of preparing port development policy and plan. PC should appeal to Ministry of Transport to fix this policy and plan as a national policy.

(2) Port Management and Operation Strategy Section

PC should introduce Port Management and Operation Strategy Section which is in charge of preparing the strategies for financial (including tariff), port promotion and personnel affairs in order to ensure the financial resource and capable human resources and activate the organization for promoting the Short-Term Improvement Plan.

5.10.2 Financial System

PC should make Ministry of Finance and other related organs recognize the necessity of not only the project but also continuous budget and internal finance resource (contribution cutbacks).

Port tariff should be revised so that it can be easily understood by port users.

5.10.3 Establishment of Effective Maintenance System

It is recommended to prepare a list of facilities together with possible damage. Monitoring the present usage and damage inspection should be conducted periodically.

5.10.4 Training System

(1) Establishment of the Information Center (Effective use of the existing library)

It is recommended that the existing library of Training Center will function as the Information Center. To widen instructor's and staff's knowledge, the following is required;

a) To gather the data which are acquired by the dispatched staffs
b) To prepare updated technical texts, port related journals, brochures of foreign ports and training institutions, etc.

(2) Widening Instructor's Knowledge

It is required for instructors to have an overall knowledge of port in order to promote better understanding on the part of trainees and they can teach several related training courses systematically.

The following measures are recommended;

a) To send several staffs to foreign ports for a long term
b) To get the latest information from the dispatched staffs
c) Personnel changes of dispatched staff and instructor

(3) Practical Training

As mentioned in the Master Plan, investment for practical training institution with port facilities and the latest equipment is very costly.

It is recommended for PC to send several operators to the training institutions in the foreign countries in order to heighten skills of operators.

Regarding the land handling machines (mobile crane, forklift, etc.) it is possible to execute controlled practical training if suitable space is arranged.

(4) For the Projects of the Short-term Improvement Plan

1) For operation of the new container terminal

It is necessary to rear container terminal operation staffs and transfer crane operators. It is recommended to send several staffs and operators to foreign ports in order to acquire the latest management and operation or cargo handling experience.

2) For executing the projects

PC should rear capable technical staffs such as port planning, design, construction and maintenance work for the proper enforcement of the project.

a) Training for port planning

Not many staffs are required for port planning so the following training should be introduced;

- Send selected staffs to domestic or foreign technical school or related organ
- Invite experts for a long term (Experts should be assigned to port planning section study to assist in on-the-job training)

b) Training for design, construction and maintenance work

PC has many port facilities and equipment. Many staffs for civil, mechanical or electrical work are required considering the scale of port.
Following training should be considered;

- Invite part-time instructors from domestic technical school or experts in a long term from foreign countries as instructors of Training Center.

3) For effective cargo handling and office work

a) Training for heightening self-awareness

It is very important to raise the morale of employees which leads to efficiency of cargo handling and office work.
PC should provide following training periodically for heightening self-awareness of all staffs.

- Port related laws and regulations, Functions of each Department

- Personnel administration system (Promotion system, Pay system)
- Port facilities and equipment (Structure, Function)
- Port activities (Cargo flow, Cargo volume, Cargo handling system)
- Future plan and target, Problems to be solved

b) Training on personal computer

Practical training on personal computer using application software such as word processor, spread sheet, drawing processor should be strengthened.

5.11 Economic Analysis

(1) Outline

The purpose of the economic analysis is to appraise the economic feasibility of short term plan components of the ports of Aqaba from the viewpoint of the national economy of Jordan. The Short Term Plan consists of 4 projects at 3 ports in Aqaba, namely Grain Berth at main port, Container Terminal at container port, JFI North Jetty at industrial port and JFI-1 Berth at industrial port.

Benefit gained from the implementation of projects are savings in vessel waiting cost, savings in time cost of cargo and savings in land transportation cost.

EIRRs of former 3 projects greatly exceed 10%, which is the opportunity cost of capital in Jordan. In case of JFI-1 berth project, EIRR just barely exceeds 10%.

(2) Benefit

As for benefits from the projects, three kinds of economic benefits are estimated through the so-called "With" and "Without" comparison. The type of vessel and type and volume of cargo are the same in both cases.

a) Savings in vessel waiting cost
Existing berth will be operated in "Without" case and waiting of vessels will be introduced through severe congestion.

b) Savings in time cost of cargoes
Cargo owner gets the capital gain as early return of invested capital from shortened waiting time and shortened handling time.

c) Savings in land transportation cost
In case of JFI-1 berth project, savings in land transportation are estimated for large scale of vessel.

(3) Cost

The items that should be considered as costs of the projects are:construction cost, maintenance cost and renewal cost. Labor cost is assumed same in "With" and "Without" cases.

Table 5.11.1 Cost and Benefit by Project

Project	Cost	Benefit
Main Port Grain Berth	*Deepening of Berth *Extension of Conveyer *Maintenance	*Savings in Vessel Waiting cost *Savings in Time Cost
Container Port Container Berth	*Extension of Berth *Improve. of Equipment *Maintenance	*Savings in Vessel Waiting cost *Savings in Time Cost
Industrial Port JFI North Berth	*Construction of Berth *Install. of Facility *Maintenance	*Savings in Vessel Waiting cost *Savings in Time Cost
Industrial Port JFI-1 Berth	*Deepening of Berth *Extension of Berth *Maintenance	*Savings in Vessel Waiting cost *Savings in Time Cost *Savings in Land Transportation Cost

(4) Economic Internal Rate of Return

Economic evaluation of a project is carried out by calculating EIRR. Minimum value of EIRR is 11% reported in Table 5.11.2. EIRRs of former 3 projects greatly exceed 10%, which is employed as the opportunity cost of capital in many developing countories. In case of JFI-1 berth project, however, EIRR just barely exceeds 10%.

Table 5.11.2 Economic Internal Rate Return

Project	Cost (Million JDs)	Benefit (Million JDs)	EIRR (%)
Main Port Grain Berth	5.1	39.6	26
Container Port Container Berth	52.3	133.5	19
Industrial Port JFI North Berth	23.9	122.4	25
Industrial Port JFI-1 Berth	7.7	43.5	11
Total Short Term Plan	89.0	338.9	20

5.12 Financial Analysis

5.12.1 Purpose and Methodology of the Financial Analysis

(1) Purpose of the Financial Analysis

The purpose of the financial analysis is to appraise the financial feasibility of the port facility development plan.

The project in this study is defined as construction in the Short-Term Improvement Plan.

(2) Methodology of the Financial Analysis

The viability of the project is analyzed using the Discount Cash Flow Method and appraised by the FIRR (Financial Internal Rate of Return). The revenues and expenditures in this analysis are defined as the difference between the "With" the project and the "Without" the project case in order to analyze the viability of the project of the Short-Term Improvement Plan itself.

The influence on the financial soundness of the port management body is appraised based on projected financial statements (Profit and Loss Statement, Cash Flow Statement and Balance Sheet) using the revenues and expenditures in With Case.

5.12.2 Prerequisites of the Financial Analysis

(1) Cargo Handling Capacity in With Case and Without Case

Compared with Without Case, the following facilities are improved in cargo handling productivity in the Short-Term Improvement Plan (With Case).

a) Grain Berth
Improvement of cargo handling efficiency due to the expansion of berth length and depth

b) Container Berth
Increase in cargo handling capacity due to the establishment of additional gantry crane and improvement of cargo handling efficiency due to the reformation of the container yard and cargo handling system

c) JFI-East, West
Increase in cargo handling capacity due to the establishment of additional cargo handling equipment

d) JFI-1
Improvement of cargo handling efficiency due to the expansion of berth length and depth

When cargo handling volume in each berth will reach maximum handling capacity of berth (berth occupancy rate : 70%) or capacity of cargo handling equipment, its volume is defined as the maximum cargo handling volume.

(2) Fund raising

Seventy-five percent of initial investment costs is assumed to be raised by foreign fund. The remain initial investment costs (25%) and all of renewal investment costs are assumed to be raised by the internal resources of port management body (PC).

The following conditions apply to the above foreign fund.

[Foreign Fund]
Loan period : 30 years
Grace period : 10 years
Interest rate : 2.7 %
(Note) These conditions are quoted from those of the OECF in 1995 (Japan)

(3) Others

Project life : 34 years, including 4 years of detailed design and construction of port facilities
Base year : 1994

5.12.3 Revenue and Expenditure

(1) Revenue

The revenues from the port activities are calculated by the present port charges and the cargo handling volume or the number of calling vessels which are estimated based on the demand forecast.

The viability of the project (FIRR) is analyzed using the difference of revenues between both cases.

The influence on the financial soundness of the port management body is analyzed using revenues of With Case.

(2) Expenditure

1) Initial investment costs
The initial investment costs of the project are estimated in Section 5.9.

2) Renewal investment costs
The facilities and equipment will be renewed based on their service lives. The funds for renewal investment costs will be financed by internal resources of PC.

Two expenditures mentioned above are equal to the difference of expenditures between the With Case and Without Case(=0). Therefore, the viability of the project and the influence on the financial soundness is analyzed using these expenditures.

3) Operating expense

a) Personnel cost
The annual personnel costs are set to the amount in 1994 (13 million JD).

b) Administration Cost
Generally administration cost is required to be 60 % of personnel costs.

Therefore present administration cost (3 million JD) should be raised to 60 % of present personnel costs except casual labor's wage (9.8 million JD x 0.6 = 6 million JD) until 2000.
The rise in above administration cost should be appropriated for employee training or improving communication within the organization.

Two expenditures mentioned above are same situation in the With Case and Without Case. Therefore, the difference of expenditures between the With Case and Without Case is zero. In the analysis of the viability of the project these expenditures are zero and the influence on the financial soundness is analyzed using these expenditures.

c) Maintenance and repair

The annual maintenance and repair costs for port facilities are calculated as follows;

Infrastructure : 1% of the original construction cost
Cargo handling equipment : 4% of the original procurement cost

The viability of the project is analyzed using the maintenance and repair cost for the planning facilities which means the difference between the With Case and Without Case. The viability of the project is analyzed using the maintenance and repair cost in the With Case (existing and planned facilities).
Maintenance and repair cost for existing facilities is calculated based on the investment costs until 1994.

4) Depreciation costs

The annual depreciation costs of port facilities and equipment are calculated by the straight line method based on their service lives.
Residual values after all depreciations are estimated as zero. At the end of the project life, fixed assets are assumed to be sold at their residual values.
Depreciation cost is exempted from calculation of the analysis of the viability of the project. In the analysis of the influence on the financial soundness depreciation cost is calculated on the existing and planned facilities, the same as for the maintenance and repair cost.

5.12.4 Appraisal by the Results of Financial Analysis

(1) Appraisal by the Financial Viability of the Project (FIRR)

The results of the FIRR calculation including sensitivity analysis are shown in Table 5.12.1. Sensitivity analysis is conducted to examine the impact of unexpected future changes. Unexpected future changes could be as follows;

1) Decrease of the revenue
Decrease of the estimated cargo volume
Decrease of the tariff level

2) Increase of the project cost
Increase of the facilities construction cost by soil condition
Sudden rise in building materials prices

Weighted average interest rate of the funds, which is the floor limit, is 2.025 % in this study. FIRR exceeds this rate, even in Case C of the sensitivity analysis, therefore this project can be judged to be financially feasible. (See Table 5.12.1)

Table 5.12.1 Results of the FIRR Calculation

Original Case	8.0 %	
Sensitivity Analysis A	6.6 %	Revenue decreases by 10%
Sensitivity Analysis B	6.8 %	Project cost increase by 10%
Sensitivity Analysis C	5.4 %	Revenue decreases by 10%, Project cost increases by 10%

(2) Appraisal by Financial Soundness of the Port Management Body

The financial indicators based on the projected financial statement, profitability, loan repayment capacity and operational efficiency show excellent levels. Therefore, the port management body will be financially sound.

Chapter 6 Environmental Impact Assessment

The purpose of using the environmental impact assessment(EIA) is to incorporate into development a planning tool which identifies a plan for environmental protection and enhancement on a project-by-project basis. The EIA procedure may be divided into two complementary tasks: the initial environmental examination(IEE) and the environmental impact assessment(EIA). In most countries, the port development project is required to prepare EIA reports because of its significant environmental impacts.

The IEE was basically designed as a means of reviewing the environmental integrity of projects to determine whether EIA-level studies must be performed. In this sense the IEE is used for project screening to determine which projects require a full-scale EIA. The IEE has several other uses for ensuring project-oriented environmental management as well as to minimize effort, expense, and delay in carrying out such planning. The IEE assesses the potential environmental effects of a proposed project, is done within a very limited budget, and is based on information at hand or readily available. If the IEE results indicate that a full-scale EIA is not required, then any necessary environmental protection measures or a monitoring programme would be prescribed, thus completing the EIA for this project.

Based on the results of the IEE using a checklist, the impacts caused by dredging, stirring of bottom soil and soil dumping into water and air pollution(dust) caused by cargo loading activities and utilization of storage facilities seemed to have small negative impacts. Other potential impacts were evaluated to have no adverse effect.

Therefore, the activities which would affect the environment and need further inspection were considered to examine the environmental impact further. These activities are dredging, stirring of bottom soil and soil dumping into water which induce dispersion of turbid water, reduction of aquatic lives and devaluation of tourism resources. Regarding cargo loading activities and utilization of storage facilities, they are expected to cause dust dispersion accompanied with phosphate handling.

6.1 Noise and Vibration of Construction Machines

Although a piling boat, two cranes and several work vehicles will cause noise and vibration during construction of JFI-North Berth, there would be no noticeable effect, because there are no residential areas in the vicinity of the work site.

6.2 Dispersion of Turbid Water due to Dredging and Reclamation

Simulation of turbid water dispersion was made based on the simulated current pattern and the work plan. Activities considered to cause turbid water are reclamation of the berth in Container Port and dredging at the timber berth in Industrial Port. Concentration of suspended solid(SS) was employed for an indicator of the turbidity.

Based on the result of the numerical simulation, maximum concentration of SS due to reclamation at Container Port was predicted as 2.5 mg/l at the neighboring water area of the site. Considering the background SS value (2-5 mg/l), the estimated SS concentration in construction phase would be 4.5-7.5 mg/l. As for dredging at Industrial Port, predicted SS concentration at the site due to the work was 5 mg/l, then 7-10 mg/l would be expected for future SS concentration during dredging.

High concentration of SS is observed only at vicinity of the construction sites.

Therefore, the turbid water would be expected to appear only in small limited area.

6.3 Reduction of Aquatic Lives due to Dispersion of Turbid Water

Considering examples of the environmental water quality standards for SS and transparency in some countries, and background SS concentration in the Jordanian coastal water (2-4 mg/l), along with Japanese criteria for SS concentration regarding fisheries and aquaculture, target concentration of SS to protect aquatic lives in Gulf of Aqaba was set as project-originated SS load of 2 mg/l or less. Comparing the simulated SS value with the target concentration of SS(2 mg/l), the impact of turbid water dispersion on aquatic lives will be negligible.

6.4 Devaluation of Tourism Resources

As target concentration of SS for conservation of corals, project-originated load of 1 mg/l or less was set based on the background SS concentration in Gulf of Aqaba and an example of water quality standard for conservation of corals. Result of numerical simulation showed that the SS concentration in future was expected to stay in the permissible concentration level to protect the coral reef, and the turbid water would not reach to the coral reserve area.

6.5 Air Pollution

Prediction of the dust dispersion of phosphate in the surrounding area of the Main Port was carried out using a numerical simulation.

In this task, the following issues were estimated.

a) Dust deposition for a short period (1 h).
b) Dust deposition in April which likely has the most adverse impact on the land. (The frequency of south-southwest wind is the highest in April.)
c) Annual dust deposition

Based on the estimated volume of phosphate handled in future (totally 5.7 million t/yr), the emission volume was estimated.

The result of the investigation showed that the maximum amount of deposition was estimated to be 21.6, 5.3, 2.9 g/m^2 in hourly value under condition of wind velocity of 1, 3, 5 m/s, respectively.

Maximum monthly dust deposition on land was observed to exceed 50 g/m^2 /month. This value stands comparison with those of dust abundant regions in the world. Viewed horizontally, distribution of this high value is limited to the port area, thus the dust would not affect local residents but only port workers.

For the annual value, maximum dust dispersion on the sea site was predicted to be 2.13 $kg/m^2/yr$ while that on the ground site was estimated to be 0.42 $kg/m^2/yr$. The handling of phosphate would not affect the surrounding area.

6.6 Conclusion

Result of assessment for environmental impacts revealed the negative effect due to dust dispersion. A countermeasures to cope with dispersion phosphate dust was recommended.

Recommendations were also made on the strengthening of legislative and administrative system for integration of the environmental issues to the planning of development projects including the development of EIA system, implementation of environmental monitoring and special care for the border-transgressing pollution in the international sea area.

Chapter 7 Evaluation of the Feasibility of the Project

According to the feasibility study, the proposed Short-Term Improvement Plan is, as a whole, judged to be viable from economic, financial and environmental viewpoints.

a) EIRR for the total project is 20 %. This means that EIRR of the proposed project fairly exceeds 10 %, which is employed as the opportunity cost of capital in many developing countries.

b) The result of EIRR calculation shows the priority among project components, that is to say, the priority in terms of economic sense, is, in due order, enlargement of grain berth, improvement of cargo handling system at the Industrial Port, development of new container terminal and improvement of JFI.1 Berth.

c) FIRR is 8.0 %. This exceeds 2 %, which is estimated as the weighted average interest rate for expected foreign aids in Jordan.

d) In calculation of FIRR, current tariff rate is adopted. The Ports Corporation has been actually making a profit from port activities and contributing to the national budget revenue. Such a situation is not assumed in the cash flow analysis.

e) Environmental Impact Analysis shows that the proposed project will not cause serious problems for the environment.

f) Dust dispersion of phosphate, however, should be reduced in due course through scheduled countermeasures.

JICA