社会開発調査部報告書

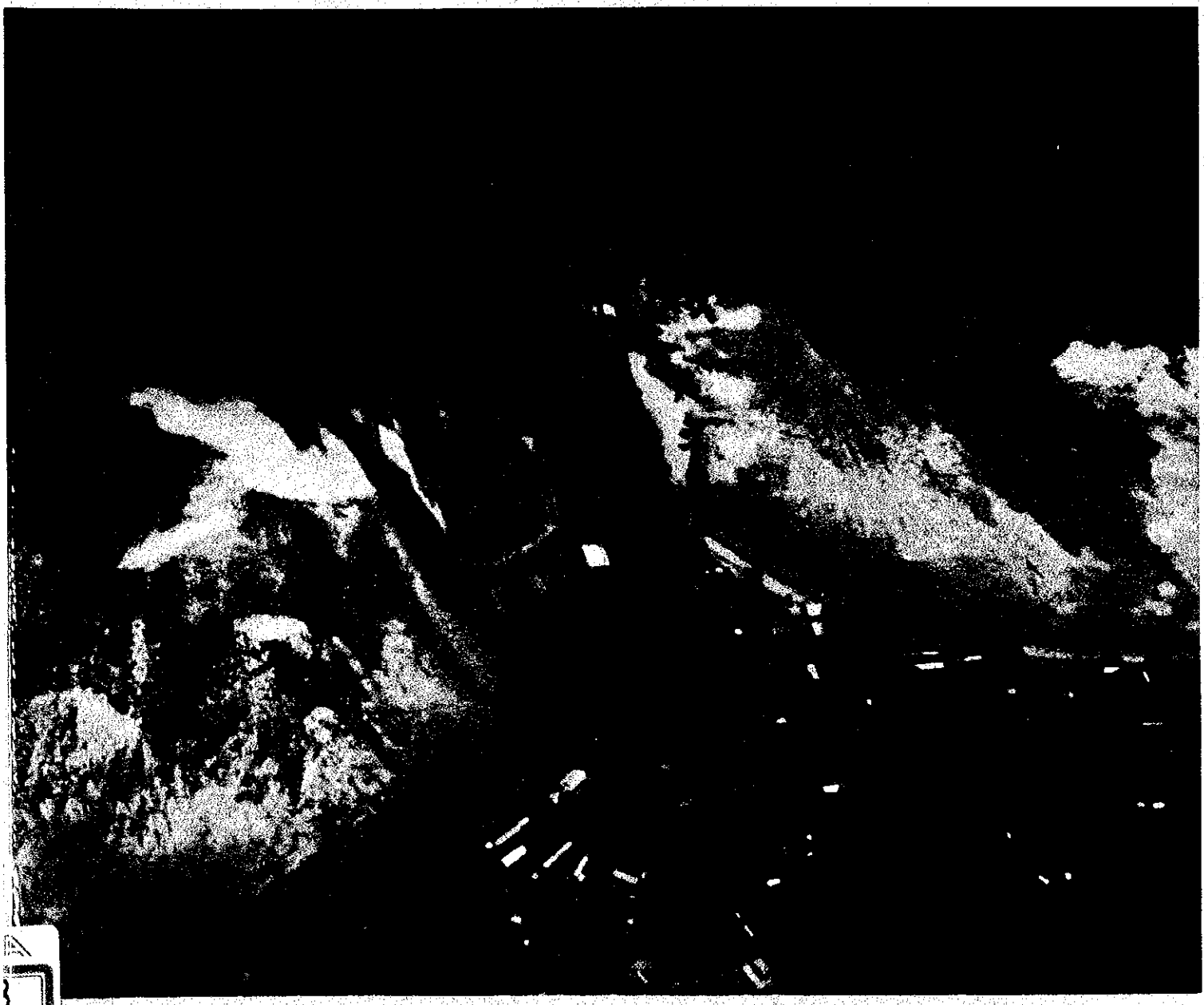
No. 52

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF TRANSPORT, COMMUNICATIONS AND TOURISM
THE REPUBLIC OF KIRIBATI

FINAL REPORT

THE STUDY ON PORTS DEVELOPMENT IN KIRIBATI

(SUMMARY)



MARCH 1995

NIPPON TETRAPOD CO., LTD. (NTC)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF TRANSPORT, COMMUNICATIONS AND TOURISM
THE REPUBLIC OF KIRIBATI

FINAL REPORT

THE STUDY ON PORTS DEVELOPMENT IN KIRIBATI

(SUMMARY)

MARCH 1995

CURRENCY EXCHANGE RATE

1 Australian Dollar = 0.757 US Dollar = 75.33 Japanese Yen

(As of July, 1994)

PREFACE

In response to a request from the Government of Republic of Kiribati, the Government of Japan decided to conduct a feasibility study on Ports Development in Kiribati and entrusted the study to the Japan International Cooperation Agency (JICA).

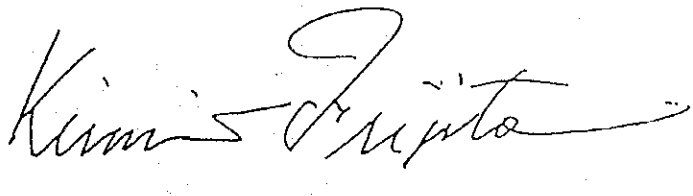
JICA sent a study team to Kiribati three times between March 1994 and January 1995. The study team was headed by Mr. Hisanori Kato of the Nippon Tetrapod Co., Ltd. (NTC).

The team held discussions with the officials concerned of the Government of Kiribati and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Republic of Kiribati for their close cooperation extended to the team.

March, 1995



Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

March, 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Mr. Fujita

It is my great pleasure to submit herewith the Report for the Study on Ports Development in Kiribati.

The study team which consists of the Nippon Tetrapod Co., Ltd. (NTC), headed by myself, conducted a survey in Kiribati from March 1994 to January 1995 as per the contract with the Japan International Cooperation Agency.

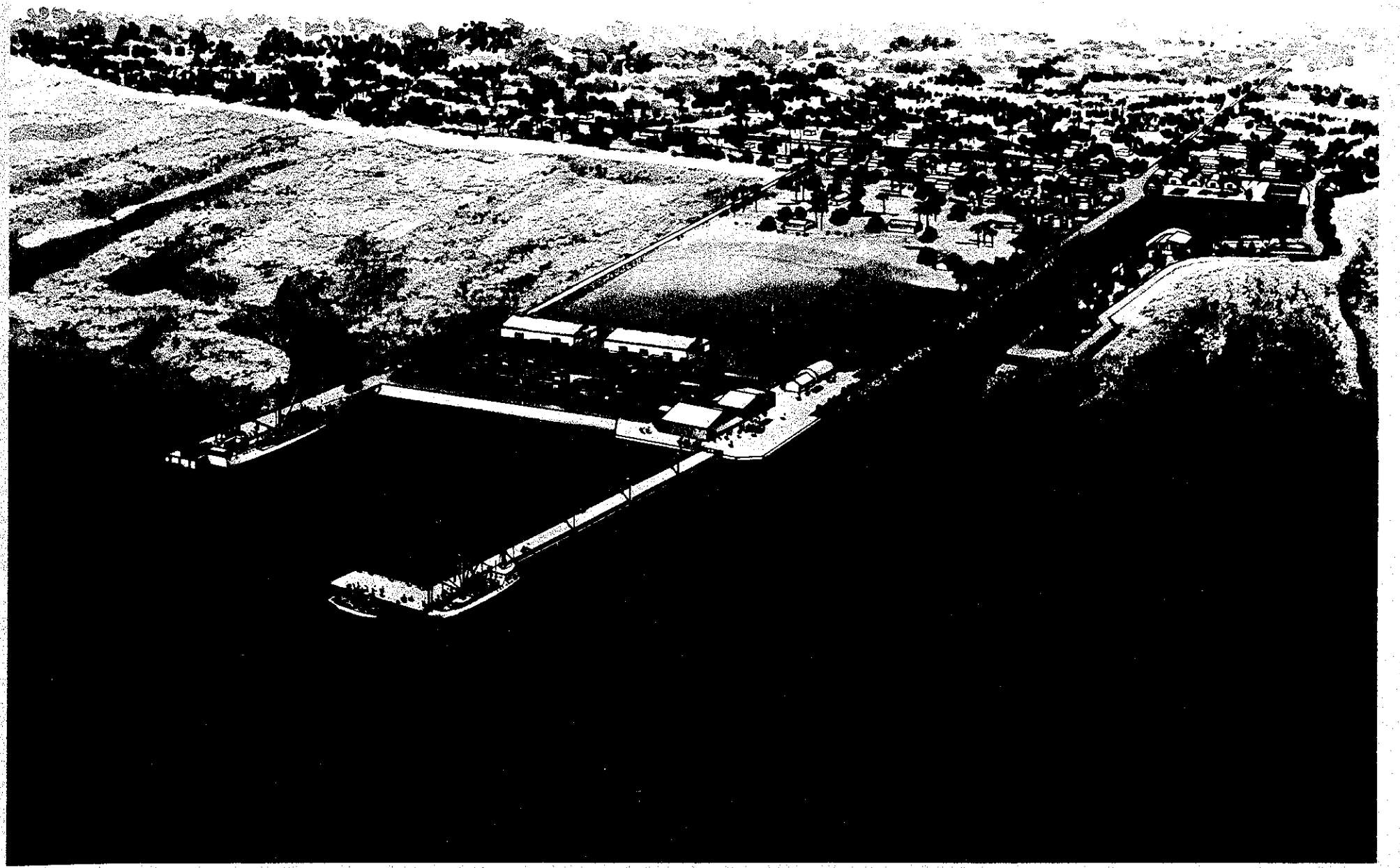
The findings of this survey were fully discussed with the officials of the Ministry of Transport, Communications and Tourism and other authorities concerned to formulate the Conceptual Port Development Plan for the period up to the year 2005 and to formulate and examine the feasibility of the Improvement Plan for the period up to the year 2000, and were then compiled into this report.

On behalf of the study team, I would like to express my deepest appreciation to the Government of Kiribati and other authorities concerned for their brilliant cooperation and assistance and for the heartfelt hospitality which they extended to the study team during our stay in Kiribati.

I am also greatly indebted to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Transport and the Embassy of Japan in Fiji for giving us valuable suggestions and assistance during the preparation of this report.

Respectfully,

Hisanori Kato
Leader of the Study Team for
the Study on Ports Development
in Kiribati



Conceptual Port Development Plan of Betio Port

Conceptual Port Development Plan of London Wharf

ABBREVIATIONS

A$	:	Australian Dollar
BHL	:	Bali Hai Line
BSL	:	Betio Shipyard Limited
BTC	:	Betio Town Council
CCS	:	Chief Container Service
CDL	:	Chart Datum Line
CFC	:	Factor for Consumption
CFL	:	Conversion Factor for Labour
CIF	:	Cost, Insurance and Freight
DL	:	Datum Line
DP 6	:	Kiribati Sixth National Development Plan 1987 – 1991
DP 7	:	Kiribati Seventh National Development Plan 1992 – 1995
DWT	:	Dead Weight Tonnage
EEZ	:	Exclusive Economic Zone
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
FIRR	:	Financial Internal Rate of Return
FOB	:	Free on Board
GDP	:	Gross Domestic Product
GOK	:	Government of Kiribati
GRT	:	Gross Registered Tonnage
IEE	:	Initial Environmental Examination
JICA	:	Japan International Cooperation Agency
KCCS	:	Kiribati Cooperative Copra Society
KCWS	:	Kiribati Cooperative Wholesale Society
KOIL	:	Kiribati Oil Limited
KPA	:	Kiribati Ports Authority
KSSL	:	Kiribati Shipping Services Limited
LOA	:	Length Over All
LPG	:	Line and Phoenix Group
MCIE	:	Ministry of Commerce, Industry and Employment
MENRD:		Ministry of Environment and Natural Resources Development
MFAIT	:	Ministry of Foreign Affairs and International Trade
MFEP	:	Ministry Finance and Economic Planning
MHARD:		Ministry of Home Affairs and Rural Development

MHWS	:	Mean High Water Level Spring
MLPD	:	Ministry of Line and Phoenix Development
MLWS	:	Mean Low Water Level Spring
MTC	:	Marine Training Center
MTCT	:	Ministry of Transport, Communications and Tourism
MWE	:	Ministry of Works and Energy
MSL	:	Mean Sea Level
NRT	:	Net Registered Tonnage
NPO	:	National Planning Office, MFEP
PFL	:	Pacific Forum Line
PWD	:	Public Works Division, MWE
PVU	:	Plant and Vehicle Unit
RERF	:	Revenue Equalization Reserve Fund
SCF	:	Standard Conversion Factor
SCK	:	Shipping Corporation of Kiribati
SS	:	Suspended Sediments
SWL	:	Safe Work Load
TEU	:	Twenty-feet Equivalent Unit
TML	:	Te Mautari Limited
UK	:	United Kingdom

CONTENTS

Page

List of Tables

List of Figures

ABSTRACT

ABSTRACT

1. Background and Objectives

The Republic of Kiribati consists of 33 islands scattering over 4,500 km east-west and 1,800 km north-south of wide expanse of the Central Pacific Ocean and has a present population of about 80,000. Tarawa atoll, where Betio Port is located, is isolated at a long distance of about 4,500 km from a major trade partner, Australia, about 4,300 km from New Zealand and 5,200 km from Japan. All most all the islands of the country consists of coral atoll with poor soil for agricultural activities and hence depends on import for most of foods and living necessaries. Major export commodities are copra and fish however, trade balance has shown a heavy deficit since exhaustion of phosphate in 1979. Due to these peculiar geographical and social conditions, sea transport constitutes lifeline supporting its economic activities while, port facilities are indispensable infrastructure connecting sea and land transport for foreign and domestic cargoes. However, the major port of the country, Betio, the important port of Line Islands Group, London Wharf in Christmas Island and all the other outerisland ports suffer serious deterioration of port function due to long absence of improvement investment to port facilities.

Betio Port is a sole gate for foreign trade and a center of domestic sea transport. However, no significant improvement work has been done to the port since the development works of port facilities for small boats had been implemented about 30 years ago. In consequence, Betio Port confronts problems of inefficient and unsafe port operation due to deterioration of the facilities which are insufficient in capacity. Current situation of the deteriorated port is that the port could not maintain required port functions without urgent rehabilitation and improvement. Betio Port is not well provided for worldwide trend of containerization and is, among ports regularly called by container ships, now a sole port depending tug and barge instead of direct wharf handling in the Pacific region.

Full containers are handled only with a fixed tower crane in the container yard and they are stacked 5 high within the reach of the crane. Average handling time of containers stacked at random five high is about double that of containers normally handled in other international ports. Extremely small area for stacking containers makes handling efficiency worse. Since large container ships can not berth alongside in the port, containers are transferred from vessels to shore or vice-versa by using barges. This handling system further lowers cargo handing efficiency.

In Betio and the other outer-island ports, maintenance dredging operation has not been

done resulting in difficult and inefficient entry and berthing operation.

To cope with the above problems and constraints and encourage nation's economic development through the port development, the present study, responding to the request from the Kiribati Government, aims at:

1) Formulating a conceptual plan for Ports Development in Kiribati in the year 2005, and

2) Conducting a feasibility study on an improvement plan of Betio Port with the target year of 2000.

2. Outline of Plans

The conceptual plan for Ports Development targeting the year 2005 is proposed on the basis of development policies as "efficient port management with improving port facilities and establishing port authority, and as sea transport development with upgrade of efficiency and safety in sea transport sector" as stated in the DP7. The improvement plan of Betio Port in transition to the conceptual plan aims at practicability or feasibility with improving cargo handling efficiency. It is expected to be achieved by direct unloading/loading of cargoes alongside a wharf, by minimization of lighterage handling, and by efficient use of the existing port facilities with reducing project costs.

The scope of the improvement plan of Betio Port such as the land reclamation area and the wharf is almost the same as that proposed in the conceptual development plan, since the difference of volumes of cargo to be handled in the port is small between the two stages.

The outline of the plans with project costs are shown in the following tables. The first table shows the conceptual plan and improvement plan for Betio Port, and the second one shows the conceptual plan for London Wharf.

Project Scope and Cost for Betio Port

Plan	Conceptul Dvpt. Plan		Improvement Plan	
Target Year	2005		2000	
Cargo Volume	109,000ton		86,000ton	
Facilities	Quantity	Amount(mill. A$)	Quantity	Amount(mill. A$)
1. Dredging	138,648m3	4,503	138,648m3	4,503
2. Aids to Navigation	1 L.S.	351	1 L.S.	351
3. -6.0m Wharf	80m	5,230	80m	5,230
4. -3.0m Wharf Rehabilitation	130m	407	130m	407
5. Slope Protection	775m	2,921	775m	2,921
6. Land/Road Area and Yard Pavement	33,600m2	8,708	29,000m2	1,718
7. Road Pavement	955m	2,013	0	0
8. Shed	2,300m2	8,223	800m2	2,341
9. Passenger Terminal	650m2	687	560m2	670
10. Cargo Handling Equipment	1 L.S.	3,776	1 L.S.	2,348
11. Maintenance Dredging Equipment	1 L.S.	1,411	1 L.S.	1,411
12. Engineering Services	1 L.S.	3,088	1 L.S.	1,654
13. Physical Contingency	1 L.S.	1,641	1 L.S.	1,641
Project Cost	42,959 mill. A$		25,195 mill. A$	
	3,240 mill. Japanese Yen		1,900 mill. Japanese Yen	

Note: Currency Exchange Rate is 1 A$=75.33 Japanese Yen (as of July, 1994)

Project Scope and Cost for London Wharf

Facilities	Quantity	Amount(Mill. A$)
1. Dredging	16,100m3	700
2. Aids to Navigation	1 L.S.	300
3. -2.0m Wharf	50m	3,000
4. Seawall	75m	1,500
5. Container Yard Pavement	3,000m2	1,000
6. Slipway	10m	500
7. Cargo Handling Equipment	1 L.S.	4,600
8. Engineering Services	1 L.S.	700
9. Physical Contingency	1 L.S.	2,000
Project Cost	14,300 mill. A$	
	1,080 mill. Japanese Yen	

Note: Currency Exchange Rate is 1 A$=75.33 Japanese Yen
(as of July, 1994)

3. Evaluation

3.1 Economic and Financial Analysis

evaluating the improvement plan of Betio Port from economical and financial Internal rate of return with cost-benefit analysis is calculated for viewpoints. As a result, an EIRR is calculated as 2.74 % and an FIRR is 1.67 %. It shows implementation of the project is deemed to be feasible. In implementation of the project, financial affairs for KPA will be sound in viewpoints of profitability, cash flow and financial conditions with examining its financial statements. Port services for ships, cargoes and sheds will be improved, since 90 % of calling vessels will berth alongside after completion of all the facilities in the scope of the project. Under these circumstances, new port tariff is proposed with reflecting the improved services.

3.2 Environmental Impacts Assessment

Turbidity or SS dispersion induced with dredging works is considered to be a serious impact in implementation of the project and countermeasures like installation of a silt curtain and chemical treatment will be effective to minimize the impact to the environment. Other impacts examined will not be serious to the environment.

3.3 Implementation Plan

The proposed development plan for the Betio Port will be implemented with four phases and the each phase requires the following investment and implementation schedule.

Phase	Main Facilities	Investment (Million A$)	Implementation Schedule
Improvement Plan			
First Phase	Dredging, Yard, Wharf(40meters)	12.31	1995 to 1996 (two years)
Second Phase	Wharf (40 meters), Shed, Cargo Handling Equipment	12.88	1996 to 1997 (two years)
Conceptual Development Plan			
First Phase	Yard/Road Pavement	8.32	2000 to 2002 (three years)
Second Phase	Yard Expansion, Shed Cargo Handling Equipment	9.44	2003 to 2004 (two years)
Total		42.95	1995 to 2004 (10 years)

4. Recommendation

Through overall evaluation on the study results, the followings are recommended:-

(1) Urgent implementation of the improvement plan of Betio Port.

(2) Establishment of Kiribati Port Authority in the earliest possible opportunity, recruitment of expatriate key staff and training of local staff.

(3) New tariff system toward financial soundness of KPA.

(4) Establishment of management system and a usage plan of the rubbish disposal area with environmental consideration.

(5) Establishment of overall system for efficient maintenance dredging with monitoring of water depth change, acquisition of dredging technology, etc.

(6) Establishment of a monitoring system for sea environment to minimize environmental impacts.

CHAPTER 1

OUTLINE OF THE REPUBLIC OF KIRIBATI

1. OUTLINE OF THE REPUBLIC OF KIRIBATI

1.1 General

The Republic of Kiribati consists of 33 Islands in three archipelagic groups of the Gilbert, Phoenix and Line Islands, which are scattered over five million square kilometres of the Central Pacific Ocean. The nation's Exclusive Economic Zone (EEZ) covers more than three million square kilometres of water. The total land area of all the islands, however, is mere 810 square kilometres.

The population of Kiribati is about 72,000 and is increasing at 2.3 per cent per year. Some 93 per cent of the people are located in the Gilbert Islands and the main population concentration (40 percent) is on the Island.

Most islands in Kiribati comprise atolls and the environment is physically and economically restricted. The predominantly rural society depends mainly on subsistence agriculture and fishing. Kiribati is vulnerable to fluctuating world prices in copra and apart from efforts to develop the rich fish resources in the three million square kilometres of EEZ, development plan strategies focus on self reliance.

1.2 Geography and Climate

1.2.1 Geographical Conditions

The three archipelagic Islands are very widely dispersed in the central Pacific. The capital island of Tarawa in the Gilbert Islands keeps distance of 3,250 kilometres from Christmas Island and distance from Banaba Island in the west to Christmas Island in the east is 3,870 kilometres. The furthest distance between the islands from north to south is over 2,000 kilometres.

Tarawa is a typical atoll formed by a narrow strip of reef surrounding a central lagoon of varying depth with islands created by the erosion and subsequent deposition of fragments of coral reef and algae on the coral reef platform.

The total land area of Kiribati is 810.54 square kilometres of which Christmas Island with a land area of 388.39 square kilometres makes up about half. The total land area of the Gilbert

Islands (including Banaba) is 285.52 square kilometres, the Line and Phoenix Islands together comprising 525.02 square kilometres.

With the exception of Banaba, islands in Kiribati rarely rise more than three metres above mean sea level. As all islands are coral islands, soils are mainly shallow and alkaline, lack significant nutrients and minerals and have little water retaining ability.

1.2.2 Climactical Conditions

All the islands is in the tropical oceanic climate to be characterizing by little temperature variation and high humidity . Wind speeds are generally moderate with occasional strong winds during December and January. The easterly trade winds predominate from April to September, while westerly winds are encountered during the period of October to March.

1.3 Socioeconomic Situations

Under circumstances of stagnant economy, the government of Kiribati established the Seventh National Development Plan with expecting some promising features of economic growth in the areas like fisheries, small industries and tourism.

1.3.1 Population

The de facto population of Kiribati increased to 72,335 in the 1990 Population Census. Gilbert Islands absorbed 93 % of total population, 50.8 % of which is in Tarawa and Abaiang. An annual growth rate is 2.3 % over the period from May 1985 to November 1990. This increase has been absorbed mainly in South Tarawa. Northern Line Islands show remarkable population increase of 11.5% in five years since 1985 due to the Government resettlement plan.

1.3.2 Gross Domestic Production

After independence in 1979, Kiribati experienced a sharp fall of economic activities in 1980. Due to continuous successive national development plans toward economic and financial stability, a real GDP has shown modest positive increase of about 1 % since 1980. The external account position have been improved to off-set a large trade deficit.

1.3.3 Trade

Exports are limited to only two commodities of copra and fish accounting for about 10 – 15 % of GDP. While, imports accounted for about 80 % of GDP. During ten year period from 1980, imports increased at annual growth rate of 6.5 %, while exports rose at an annual rate of 3.6 %. Thus, the trade deficit widened from A$15.7 million to A$30.8 million in the same period.

1.4 Transport Sector

1.4.1 Sea Transport

Wide dispersion of islands over vast expanse of ocean is a bottleneck for Kiribati to develop basic infrastructure of administration, communication and transportation as well. Lack of adequate port facilities in turn limits sound growth of country's economy.

(1) International Sea Transport

Three shipping lines serve sea transport to Kiribati but frequency of the services is low.

Betio Port is a main port in Kiribati handling international cargos and is characterized by an imbalanced cargo volume between 50,000 ton of import and 12,000 ton of export. Containerization ratio of import cargos reaches about 80 % in recent years.

(2) Domestic Sea Transport

KSSL mainly contributes transport of domestic cargo volume of 14,000 ton and private ship operators share a domestic cargo volume of about 40 % in carrying copra and general cargos.

1.4.2 Air Transport

Twice-a-week services by Air Nauru and Air Marshall plays an role of transporting international passengers of about 8,000 in 1991 at a base of the Bonriki international airport. Air Tungaru serves domestic air passengers and recorded 27,000 passengers in 1991.

About 360 t of foreign cargoes was handled by air in 1991 and the air cargo volume shares only less than 1 % of the international cargoes.

1.4.3 Land Transport

Road transportation is required to be relatively low compared with sea and air transportation. In South Tarawa, paved road from Betio Port is tar sealed strong and wide enough to carry heavy container traffic.

330 vehicles of cars, trucks, buses, etc. are now registered in South Tarawa.

CHAPTER 2

PRESENT SITUATION OF BETIO AND OTHER PORTS

2. PRESENT SITUATION OF BETIO AND OTHER PORTS

2.1 Natural Conditions

2.1.1 Betio Port

(1) Topography

Betio Port is located north of Betio Islet at the south-west corner of Tarawa Atoll, facing the lagoon side. The two breakwaters surround main port facilities such as an access channel, a boat basin, a steel sheet pile wharf, some sheds and so on. An average depth of inner basin and access channel is 2 metres.

(2) Meteorology

Meteorological data in Tarawa during 1981 to 1992 characterizes tropical oceanic climate. Temperatures vary between 25 and 32oC with mean annual temperature of 28.4oC.

Mean annual relative humidity is 80.9 % and the difference between the wet season, November to April, and the dry season, May to October, is small. The mean annual rainfall is 2,221.3 mm and the monthly variation is small. Yearly fluctuation of rainfall is much greater than the variation. The winds data from 1991 to 1993 show that easterly winds are predominant.

(3) Sea Conditions

1) Tide and Tidal Current

The tidal range at Betio Port is 1.78 metres at a spring tide and 0.6 metre at a neap tide with appearance of a typical pattern of a semi-diurnal tide. The chart datum line is set to be 0.4 metre below the present bench mark, as a result of the study.

Around the mouth of the present port, the highest speed of tidal current is 30 cm and the mean highest speed is 18 cm/sec.

2) Waves

According to the hindcast of waves, the frequency of occurrence of lagoon waves less than 0.5 metre in height is estimated to be about 90 %. Applying ocean wave hindcast, waves around Betio Port are estimated to be 1.5 metres in height and 12 seconds in period.

(4) Soil Conditions

As soil investigation at the site was not conducted, only existing soil information was applied to this study. The existing data show that most surface layer comprises coral sand and coral fragments of about 10 metres thickness with N blows in the range of 0 to 29, and that layers deeper than 5 metres from the sea bottom is relatively dense, and some boreholes encounter a hard coral rock having N blows of over 50.

(5) Littoral Drift

1) Seabed material and suspended sediment

Medium diametres of seabed material in the inner port and the offshore vary from 0.017 to 1.200 mm to be fine and those on reef flats and near the reef edge are coarse with the median diametre (D50) ranging from 0.130 to 1.200 mm. Concentration of suspended sediments is about 10 mg/litter.

2) Outline of Littoral Drift along the South Coast of Tarawa

Volume of littoral drift inside lagoon is estimated to be 53,200 m3 for the past 49 years and to be 1,100 m3 annually. The estimate shows littoral drift is very few along Betio islet.

3) Sedimentation at Betio Port

Average volume of deposition of suspended sediment is estimated to be about 1,400 m3/yr in the Port. Volume of littoral drift around Betio islet is very few.

2.1.2 London Wharf

(1) Topography

The island of Christmas is the largest coral atoll in the country, and the land area is 388.39 square kilometres, accounting for about the half of the total land area of the country.

London Wharf is located at the north-west of the island and faces the lagoon side. This wharf's constraint is shoaling in the channel, which shallows the sea depth up to only one metre depth almost in the channel.

(2) Meteorology

Rainfall averages 1,034 mm annually, but it is very fluctuant as sustained records of 3,728 mm (in 1987) and only 243 mm (in 1985).
Temperatures vary between 24 and 30 degree C, and humidity averages 70 per cent. There is a predominant easterly winds, averaging 4.4 m/sec annually. A frequency of occurrence of easterly wind velocity less than 8 m/sec is 98 per cent.

(3) Sea Conditions

In the offshore of Christmas Island, twenty feet waves were visually recorded in an average of five or six times a season. Considering the above topographic features, the front sea area of the wharf is expected to be very calm throughout the year. The west coast of the Island is affected by long-period waves and occasional rough seas.

(4) Littoral Drift

As medium diameters varying from 0.140 to 2.100 mm, seabed materials in front sea of the wharf are very coarse. Sand Deposition has occurred in front of Wharf and present channels to the wharf are likely shallowed due to sedimentation .

2.2 Port Facilities

2.2.1 Existing Port Facilities of Betio Port

The outline of the existing facilities at Betio Port is shown in Figure 2-2-1 and principal facilities with cargo handling equipment are listed in Table 2-2-1.

(1) East and West Mole

The basin and approach channel of the port is made up by the two breakwaters of East Mole and West Mole having a length of 610 m and 305 m respectively.

(2) Approach Channel and Basin

The original channel was 60'(18.3 m) wide and dredged to 10'(3.05m) below Chart Datum. Since construction of the harbour, the water area in the harbour has been silted. The inner basin was originally dredged to 13'(3.96m) and is shallowed to 1 - 3 m deep due to siltation.

(3) Wharf

The wharf for landing container cargoes is located in the inmost harbour and serves mooring facilities for barges and small crafts. 92 m of the total wharf length is usable and water depth of the quaywall is now shallowed to 1-2 m due to siltation. The structure of the quaywall is of steel sheet piles with a concrete anchor wall.

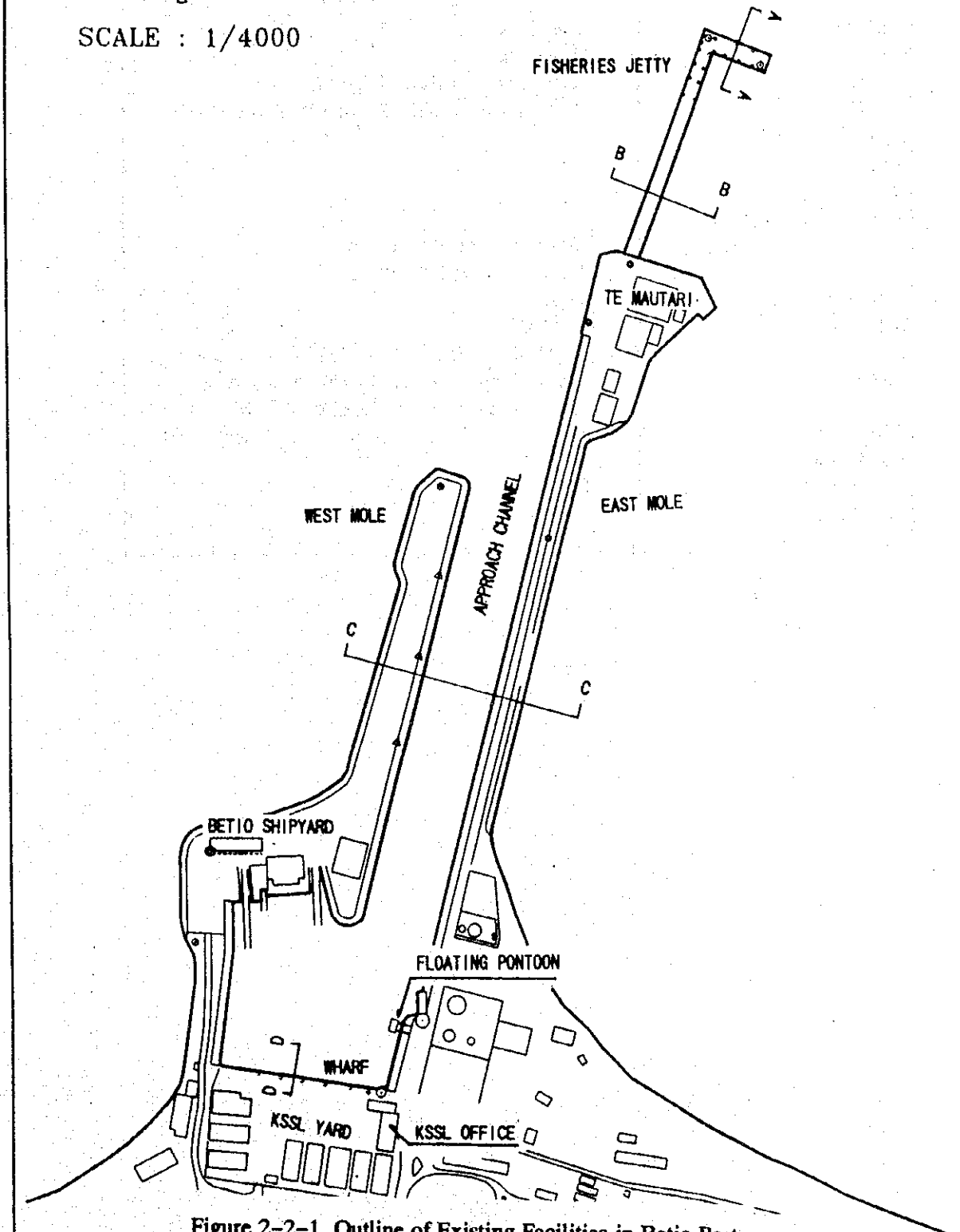


Figure 2-2-1 Outline of Existing Facilities in Betio Port

Table 2-2-1 Port Facilities in Betio Port

Facilities	Number	Remarks
East Mole	1	610m long
West Mole	1	305m long
Fisheries Jetty	1	220m long in total, 4 berths
Wharf	1	130m in total, abt 92m in net wharf length
Betio Light	1	
Buoy	7	
Beacon	7	
Bikeman Is. Beaconage	1	
KSSL Office Building	1	534m2 in total floor area
KSSL Shed	7	351m2 × 5, 330m2, 165m2
KCWS Shed	1	351m2
Container Yard	1	3,200m2
Tugboat	3	210HP × 2 boats, (2 × 127HP) × 1 boat
Barge	4	18m × 6.5m × 1.5m, 18.35m × 6.65m × 1.5m 18m × 6.8m × 1.5m, 18.35m × 6.8m × 1.5m
Mobile Crane	1	15t (one sunk in Sept. '94)
Fixed Crane	1	32.5t
Crane Truck	1	3t
Fork Lift	3	2.5t
Chassis Trailer	14	

(4) Fisheries Jetty

The new jetty was constructed in 1986/87 with UK assistance for promotion of fishery industry. The four berths practically accommodate not only fishing vessels but general cargo vessels. They also serve passenger embarkment/disembarkment and bunkering of the KSSL vessels. The jetty can not allow container handling.

(5) Open Storage Area, Warehouses and KSSL Office

Due to insufficient cargo handling equipment and storage area, full containers are stacked up to 6 high and empty containers are stacked to 3 or 4 high with using a mobile crane. A net open storage of the yard is limited to about 1000 m2. The yard is usually congested by vehicles taking delivery of container cargos.

Three sheds are used for storing copra, three sheds for break bulk cargoes and a shed for cement. KCWS owns a grain shed in the yard also. These warehouse are in a poor state of disrepair.

The KSSL office is in a fairly large size building.

(6) Navigation Aids

In general almost buoys and lights are deteriorated. Due to poor conditions of light beacons, navigation for ships coming into the port is impossible during night time.

(7) Cargo Handling Equipment and Floating Equipment

The fixed crane in the container yard plays a sole role to handle full containers to be landed from barges. There is no other equipment for handling full containers in the yard. Insufficient numbers of container handling equipment and small container yard are bottlenecks for improving efficiency of cargo handling.

2.2.2 Deterioration of Facilities at Betio Harbour

(1) Steel Sheet Piled Wharf

The steel sheet piles of the wharf has been badly corroded in a splash zone with many holes from where backfill soil is escaping. Wooden fenders originally installed in the

frontage have all lost, allowing further damages by ship's collision.

To access an economical remaining life of the wharf, thickness of steel sheet piles was measured with an ultrasonic thickness-meter. As a result, 10.7 mm of original thickness of the sheet piles are considerably reduced to about 5 mm around the Chart Datum Level.

(2) East and West Mole

The slope protection with bagged concrete are damaged and filling sand of the moles are exposed.

An urgent repair to the moles are required to prevent further damage and eventual collapse

2.3 Port Activities at Betio Port

2.3.1 Sea transport Sector

Cargoes imported to Kiribati are carried by three shipping lines, CCS, PFL and BHL and their shares are approximately 60%, 30% and 10% respectively. Out of three lines, KSSL has taken over sea transport services connecting Kiribati, Fiji, New Zealand previously done by MV Forum Micronesia by committing MV Arktis Trader.

Domestic cargoes in Kiribati are transported by three sectors, namely KSSL, private ship operators and informal sector.

Feeder services from Kiribati to Funafuti commenced in 1993 by Matangare.

2.3.2 Ships' Call

Table 2-3-1 shows ships' call at the Betio Port by ship's type for the period of 1989 to 1993. It shows that a average number of vessels calling at the harbour is 60 times a year.

Table 2-3-1 Number of Foreign Ships's Call

Year	Container Carrier	General Cargo Ship	Tanker	Copra Carrier	Fishing Boat	Others	Total
1989	25	23	9	3	2	1	63
1990	33	10	7	2	5	2	59
1991	31	7	10	2	1	1	52
1992	30	6	14	4	9	2	65
1993	29	15	11	5	9	23	92

Table 2-3-2 shows call of ships rendering regular services as Papuan Chief, Pacific Islander, Matangare, etc.

Matangare, medium size of ship calling, recorded its arrival draft in the range between 4.5 m and 3.6 m. Maximum draft was 8.4 metres for Moraybank and Ivybank, copra carriers. Vessels not larger than Matangare shared 60 % of total number of calling ships at the Betio Harbour.

Table 2-3-2 Number of Principal Cargo Vessels (1993)

Ship's Name	Nos. of Call	Maximum Arrival Draft	Type of Service
Papuan Chief	11	7.5 M	Regular service from Australia
Pacific Islander	6	7.4 M	Regular service from Japan
Forum Micronesia	3	4.0 M	Regular service stopped
Matangare	10	4.5 M	Regular service for/from Suva & Funafuti
Moraybank	2	8.4 M	Copra carrier
Ivybank	2	8.4 M	Copra carrier
Momi	2	3.0 M	Domestic irregular service
Mataburo	2	4.0 M	Domestic irregular service
Moanaraoi	1	3.9 M	Domestic irregular service

2.3.3 Cargo Handled

(1) Foreign Cargo

Table 2-3-3 shows steady increase with significant fluctuation. Total tonnage increased from 38,300 ton in 1983 to 61,950 ton in 1993 at an annual growth rate of about 5 %.

Table 2-3-3 Export/Import Cargo Statistics (1983-1993), Betio Port

Year	Import						Export			
	CONT'	TEU	B.BULK	TOTAL	B.FUEL	IM. TOTAL	COPRA	G.CARGO	EX. TOTAL	G.TOTAL
1983	11,561.5	625	11,656.2	23,217.7	6,999.4	30,217.1	5,854.9	2,232.5	8,087.4	38,304.5
1984	13,485.7	687	8,924.7	22,410.4	6,572.8	28,983.2	10,189.0	1,522.4	11,741.4	40,724.6
1985	15,083.9	784	5,019.8	20,103.7	5,091.2	25,194.9	8,516.5	563.7	9,080.2	34,275.1
1986	14,511.4	733	17,562.0	32,073.4	5,295.2	37,368.6	3,490.2	682.3	4,172.5	41,541.1
1987	18,880.5	982	10,095.8	28,976.3	6,311.4	35,307.7	3,898.0	807.6	4,705.6	40,013.3
1988	18,845.4	932	8,299.1	26,784.5	7,125.9	33,910.4	8,778.0	764.8	9,542.8	43,453.2
1989	22,638.7	1,243	7,000.0	29,638.7	6,605.1	36,243.8	8,622.0	1,390.8	10,012.8	46,256.6
1990	29,044.6	1,547	7,417.1	36,461.7	7,569.2	44,030.9	3,664.0	1,283.7	4,947.7	48,978.6
1981	26,196.6	1,373	4,636.0	30,832.6	8,910.2	39,742.8	5,308.0	1,043.5	6,351.5	46,094.3
1982	25,380.9	1,294	6,949.4	32,330.3	9,463.8	41,794.1	9,907.0	823.1	10,730.1	52,524.2
1993	31,079.9	1,549	9,704.3	40,784.2	9,125.2	49,909.4	8,587.0	3,454.1	12,041.1	61,950.5

1) Export Cargo

Remarkable feature of export cargo is overwhelming share of copra and its fluctuation. Production of copra is controlled by rainfall and export of copra highly fluctuated from 3,490 ton in 1886 and 10,189 ton in 1984.

2) Import Cargo

Major import cargos are containerized foodstuff and other daily requirement and bulk fuel imported from Fiji. Containerized cargos have been increasing with comparatively small fluctuation, reaching 80 % of containerization rate.

Bulk fuel does not show significant yearly fluctuation falling in order of 5,000 to 9,000 ton.

3) Transship cargoes

From mid 1993, KSSL commenced transship service to Tuvalu and the volume of cargo is 3,000 – 4,000 t.

(2) Domestic Cargo/Passenger

1) Domestic Cargo

In 1993, domestic cargos totaled at about 14,500 ton with outward general cargo accounting for 63 %, inward general cargo for 8 % and inward copra for 29 % as shown in Table 2–3–4.

Table 2–3–4 Domestic Cargo Statistics (1983–1993)

Year	OUTGOING	INCOMING	COPRA	TOTAL
1983	4,543.3	444.3	3,038.6	8,026.2
1984	5,892.6	867.0	5,536.9	12,296.5
1985	5,942.9	1,044.6	4,334.1	11,321.6
1986	5,722.9	1,109.7	2,758.6	9,591.2
1987	6,427.4	827.4	2,806.1	10,060.9
1988	8,908.3	942.3	8,717.8	18,568.4
1989	7,380.4	1,246.7	6,648.4	15,275.5
1990	7,134.5	1,267.7	3,249.1	11,651.3
1991	9,498.1	1,661.3	4,085.7	15,245.1
1992	11,624.9	2,038.2	5,049.2	18,712.3
1993	9,081.5	1,153.7	4,032.7	14,267.9

2) Domestic Passenger

In 1993, KSSL ships carried about 10,800 persons. Numbers of incoming and outgoing passengers are almost the same and interisland passenger account for about 10 % of total. In 1991 and 1992, passenger traffic exceeded the past trend due to immigrants transport to Line Islands.

Table 2-3-5 Passengers Statistics (1983-1993), Betio Port

YEAR	OUTGOING	INTER IS.	INCOMING	TOTAL
1983	2,362	663	1,856	4,881
1984	2,603	687	2,319	5,609
1985	2,314	1,241	2,863	6,418
1986	3,505	687	2,900	7,092
1987	4,375	498	3,910	8,783
1988	4,486	496	4,038	9,020
1989	4,356	1,227	4,150	9,733
1990	4,589	576	4,078	9,243
1991	7,887	950	5,530	14,367
1992	8,093	1,051	5,032	14,176
1993	4,696	863	5,199	10,758
AVERAGE	4,479	813	3,807	9,098

2.3.4 Cargo Handling Operation

(1) Container and General

Betio is currently a lighterage port, and cargo is transferred from vessel to shore or vice-versa by using lighters. Larger international vessels anchor offshore and inter-island vessels of the Kiribati Shipping Services Ltd. anchor near to the port. Containers of foreign vessels are handled in the same manner, which is cumbersome, slow and costly with double handling.

The study team inspected container stacking in the yard and it is estimated that there are about 230 TEUs of which 160 are laden and the balance of 70 are empties.

(2) Cycle Time of Ship to Shore Operations

1) Container cargo handling

Inspection by the Study Team revealed an entire flow of cargo handling. Required time for each handling is as follows:-

* Towing time(one way): 12 min.
* Handling a container to/from barges: 4-5 min./pce.
* Handling with on-shore fixed crane: 8 min.

2) Copra handling

Cycle time of one lifting operation is 3-5 min. depending on efficiency of ship's gear giving handling rate of 9-15 ton/hr.

3) General cargo handling

Serious congestion occurs in the open yard for open storage, and about 10-12 tons per gross gang hour is productivity of general cargo.

(3) Ships' Turnround Time

International vessels take 2-3 days to unload (FCLs) and load Empties.

(4) Working Hours

The working hours for the various staff are as follows:-

1) Overseas-vessel-operations staff: (Mon.-Sun.) 11 hours x 2 shifts
2) Domestic-ship-operations staff:(Mon.-Fri.) 7 1/4 hours
3) Office staff: (Mon.-Fri.) 7 1/4 hours

(5) Maintenance and Repairs (KSSL)

An Engineer is responsible for maintaining all port equipment with 3 technicians and a workshop which is not properly equipped. Major repairs have to be sent to an out-side private workshop or carried out by the PVU workshop.

2.3.5 Problems and Constraints

The existing container yard is occupied by customs and KSSL offices and seven cargo sheds. Open yard area is fully packed up with container and non-container cargo storage area and passage which is too small to permit smooth and efficient yard operation. Total area including office, shed and storage yard is 80 m x 130 m = 10,400 m2 and an effective area for stacking container and passage is only 40 m x 80 m = 3,200 m2. There are 50 slots stacked 5 high within the reach of the fixed crane installed at the centre and 28 slots stacked 4 high by a mobile crane on both sides of the fixed crane. This insufficient area of container yard seriously hampers efficient yard operation and will be given a thorough consideration in planning the Conceptual Development of Betio Port in the following chapter.

2.4 Ports in Other Outer Islands

2.4.1 London Wharf

(1) Port Facilities

1) Wharf

The wharf of 112 m long was constructed during the WWII with the wharf depth of 26'(7.92 m). Even during the war, the wharf was shallowed by littoral drift and the seabed elevation is now from 0 to -5 metres below Chart Datum. The quaywall structure is of sheet piles and is completely rusted with holes at around Chart Datum at each pile. The southern corner of the wharf was undermined and filling material behind the quaywall was sunk.

Total port area is about 6,700 m2 and a mobile crane from a private firm is used for handling cargoes when a ship comes in.

2) Shed

There are several warehouses to store general cargoes and copra outside the port area.

(2) Port Activities

1) Ships' Call

Table 2-4-1 shows number of ships calling at London Wharf. Number of vessels calling almost remains constant and number of cargo vessels remains under 35.

Table 2-4-1 Number of Ships' calling at Christmas

	Cargo Ships	Fishing Boats	Yachts etc.	Total
1989	20	18	21	59
1990	37	50	31	118
1991	31	45	35	111
1992	18	24	20	62
1993	34	42	35	111

2) Cargo Handled

i) Cargo Volume

Table 2-4-2 shows increase of total inward cargo does not significantly appear and total volume of cargo into Christmas Island remains about 2000s FT. Outward cargo volume is relatively small, being less than 1000 ton.

Table 2-4-2 Number of Principal Cargo Vessels (1993)

	INCOMING CARGO (TON)				OUTGOING CARGO (TON)			
YEAR	TEU	C. CARGO	B. CARGO	TOTAL	C. CARGO	COPRA	G. CARGO	TOTAL
1989	3.0	128.0	769.3	897.3	N.A.	576.1	78.5	654.6
1990	21.0	321.3	1,515.7	1,837.0	16.32	447.6	283.1	747.0
1991	31.0	534.0	1,254.1	1,788.1	119.86	1646.6	235.3	2,001.8
1992	N.A.	N.A.	1,625.2	1,625.2	N.A.	600.9	162.3	763.2
1993	63.0	1,125.8	963.9	2,089.7	125.24	375.2	28.7	529.1
TOTAL				8,237.3				4,641.7
AVERAGE				1,647.5				928.3

ii) Passenger

Passengers' statistics for Line and Phoenix Group and annual passengers in Christmas almost recorded abt 400s except 1991 and 1992. Significant increase of passengers are not recognized.

2.4.2 Other Ports

(1) Butaritari

1) Outline of the Island

The island of Butaritari is situated at approximately 150 kilometres north of Tarawa, whose area is only 13 square kilometres. Population in 1992 is given as 3,774, being the third largest in the country. Rainfall is very large averaging 3,221 mm annually. Temperature vary between 25 and 31 degree C, and there is a predominant easterly wind. The tidal range is relatively large with the mean high water spring being 1.68 metres.

2) Port Facilities

A jetty named Kings Wharf is the main port facility which is located inside of the lagoon, being free from ocean wave action, and connected to the main island with a causeway. Due to collapse of the wharf slope protection, settlement of the ground was caused. The front sea area is only one metre deep because of the long term siltation. The situation terminated usage of the facility.

3) Cargo Handling

Only landing crafts can approach to the wharf to transport cargoes from the cargo vessels. Cargoes on the land are handled by manpower. Total volume of cargo recorded 914 FT in 1993.

(2) Abemama

1) Outline of the Island

The island of Abemama is situated at the centre of the Gilbert Islands, 150 kilometres south-east of Tarawa. The land area is approximately 27 square kilometres. Population in 1990 is given as 3,218, being the fifth largest in the country. The main product is copra. Rainfall averages 1,559 mm annually, but it is very variable registering 3,026 mm (in 1958) and only 314 mm (in 1955).

2) Port Facilities

The breakwater constructed with steel drum with sand filling protects water basin and channel of about 1 metre deep, and the channel and basin was shallowed to 0.5 m deep after breakage of the top part of the breakwater.

There are two copra sheds with area of 120 m2 and 180 m2 respectively.

3) Cargo Handling

Cargoes are transported from a ship anchored offshore by a landing craft. Shortage of equipment and shallow water are bottlenecks for efficient handling. Total cargo volume in 1993 was 1,220 FT.

(3) Beru

1) Outline of the Island

The island of Beru is situated 250 more km south-east of Abemama and the land area is only 18 km3. Rainfall averages 1,309 mm annually, and temperatures vary between 25 and 32 degree C. There is a predominant easterly wind with moderate speed. The island is a long and slender shaped coral atoll and runs from the north-east to south-west with a total length of approximately 15 km.

2) Port Facilities

The main port facing the lagoon side is located at the north and the facilities directly face an entrance of the channel. Deposition of sand and pieces of coral in the basin are caused because of its layout. Tidal current is fast around the channel and water area of the southern side of the seawall.

There are two old sheds for copra and foodstuff which are insufficient for storing cargoes.

3) Cargo Handling

System of cargo handling in the island is same as the other outer islands stated above. Total handled cargoes at this port is 1031 ton in 1993.

CHAPTER 3

CONCEPTUAL PORTS DEVELOPMENT PLAN

3. CONCEPTUAL PORTS DEVELOPMENT PLAN

3.1 Basic Concept of Port Development

3.1.1 Role and Function of Port

Sea transportation is critical means for economic activities and transport facilities are essential for international/domestic trades and social interaction of people. The following objectives set up in DP7 in developing the sea transport sector are considered to be a basic development policy.

- To improve the safety, efficiency and seaworthiness of shipping operation and services for trade and transport needs.
- To upgrade the shipping and cargo handling services and facilities to ensure a reliable and least cost beneficent inter-island shipping services.
- To provide training (in-country and overseas) for I-Kiribati shipping personnel to upgrade their skills in shipping services.
- To adopt institutional measures to improve the fiscal management to enable the Government owned shipping company to become self-financing.

3.1.2 Improvement and Rehabilitation of Facilities

Betio Port, as described in the previous chapter, needs both improvement and rehabilitation to the port facilities as listed below:-

(1) Improvement of Port Facilities

1) Expansion of Container Yard
2) Minimization of Barge Operation
3) Reinforcement of Cargo Handling Equipment
4) Upgrading and improvement of Navigation Aids
5) Provision of Office for KPA

(2) Rehabilitation of Port Facilities

1) Corroded Steel Pile of Wharf to be rehabilitated
2) Damaged East and West Moles to be repaired

3) Unpaved Container Yard with covering trenches for drain and pipelines
4) Deteriorated Sheds to be repaired
5) Silted Channel and Basin to be dredged for small vessels

3.1.3 Improvement of Port Operation

(1) Container Operations

Stacking containers in the yard should be made as low as possible for good selectivity and more efficient service to port users. Empty containers can be block-stacked in another area. The inventory of TEUs in the stacks must be strictly monitored.

(2) Copra Handling

Large steel box of about 3 m^3 can be used to handle copra for efficient copra operation. Stacking height of copra bags in the present sheds should be low by availing other floor area for copra storage.

(3) Passenger Transport

Present transportation of passengers by barge is to be replaced by safe and efficient system.

3.2 Demand Forecast

3.2.1 Future Economic Framework

(1) Population

The Study Team has reviewed the study results on population forecast of "Inter Island Transport Study Kiribati" to be reasonable to follow and further population frame-work is summarized below:

Table 3-2-1 Population Forecast, Kiribati

Year	S. Tarawa	O. Gilbert	L/P Groups	Total	Remarks
1994	28,150	44,859	5,549	78,947	Population
2000	34,566	48,473	8,922	91,961	growth rate:
2005	43,956	50,000	10,094	104,050	2.5 %

(2) GDP

According to DP7, the primary sectors of agriculture and fisheries are projected to grow at a higher rate than the average growth rate of 5.0 %. While, the largest sector of public services of government offices is given a low rate of 4.0 %.

3.2.2 Port Cargo Forecast

(1) Export Cargo

1) Copra

Coconut production is a mainstays of the economy for both people's diet and cash income. Export volume of copra fluctuates significantly due to erratic rainfall. By analyzing the past trend of copra export, a modest annual growth rate of 1.2 % has been calculated to be adopted for copra export in the present study. The volume of export copra is forecast to increase only by about 7,050 t in 1995 to 7,950 t in 2005.

2) Fish

The annual growth rate of fisheries export is set at 2.6 % following the national development plan. Fish export is forecast to rise at an annual rate of 2.6 % to

about 1,000 t in 2000 and 1,180 t in 2005.

3) Seaweed

Seaweed is exported in container dried and compressed for higher stowage factor. The growth rate is set at more modest value of 9 % which coincides with a production plan of Atoll Seaweed Company. The export of seaweed is expected to increase to 2,000 t in 2000 according to the production plan of the company and 3,000 t in 2005.

4) General Cargo

The general cargoes including handicrafts, re-exports,etc. are forecast to rise from 750 t in 1993 to 980 t in 2000 and 1,200 t in 2005.

5) Transship cargoes

The volume of transship cargoes destined to Tuvalu is forecast to grow at an annual rate of 4.5 % according to UNDP Report "SEA/AIR TRANSPORT STUDY"1991. The present study assumes that the transship cargoes to Tuvalu grow from 3770 t in 1995 to 4700 t in 2000 and 5860 t in 2005 at 4.5 % per annum. All the transship cargoes are carried in container.

(2) Import Cargo

1) Container Cargo

The past trend of dry cargo imports handled through Betio Port has been analyzed to give 5 % for the growth rate of dry import cargoes. In the present study, through consideration of recent trend of containerization and "The Inter-island Transport Study Kiribati", the containerization rate is set at 85 % in 1995 increasing to a saturation rate of 90 % in 2000.

The container cargoes are forecast to increase from the present level of about 30,000 t to about 47,000 t in 2000 and about 61,000 t in 2005. In terms of TEU, containers are expected to increase from 1,600 in 1993 to 2,500 in 2000 and 3,200 in 2005.

2) Break Bulk Cargo

Uncontainerized cargoes out of dry import cargoes in the above calculation gives the volume of break bulk cargoes. The volume of break bulk cargoes is forecast to remain in order of 5,000 to 6,000 t throughout the project period.

3) Bulk Fuel

Fuel oil is imported in bulk from Fiji by tanker and past trend of imported volume of fuel shows a steady increase at an annual growth rate of 4.9 %. The volume of bulk import bulk fuel is forecast to increase from the present level of about 10,000 t to 13,000 t in 2000 and 16,000 t in 2005.

4) Transship cargoes

The same volume of transship cargoes is imported for transship service to Tuvalu as forecast in the previous section.

(3) Results of Cargo Forecast

Results of cargo forecast are shown in Table 3-2-2.

Table 3-2-2 Export/Import Cargo Forecast, 1995 - 2005

Freight Ton

Year	Export Total	Import Total	Grand Total
1995	13,854	54,491	68,345
1996	14,282	57,269	71,551
1997	14,732	60,188	74,920
1998	15,203	63,256	78,459
1999	15,700	66,482	82,182
2000	16,220	69,871	86,091
2001	16,770	73,434	90,204
2002	17,349	77,179	94,528
2003	17,957	81,115	99,072
2004	18,600	85,252	103,852
2005	19,278	89,599	108,877

3.3 Required Port Facilities and Equipment

3.3.1 Design Ship

Container cargo transport is rendered by three shipping lines. The container ship of CCS, Papuan Chief is 130 m in LOA drawing arrival draft of 7.5 m, Pacific Islander of BHL is 144.93 m with arrival draft of about 7.5 m while Matangare of KSSL is 68.00 m with arrival draft of 4.5 m. Papuan Chief is replaced by Baltimar Boreas with draft of 4.9 m and KSSL charters a Arktis Trader with draft of 5.0 m.

Based on the agreement between the Governments of Kiribati and JICA Preparatory Study Team, the present study has selected Matangare as a design ship so as to receive vessels plying between Betio and outer islands. But wharf depth is set to accommodate B. Boreas from CCS. A future wharf for the vessel will accommodate about 62 % of calling ships and about 80 % of total import cargoes will be handled.

3.3.2 Dimension of Wharf

(1) Berth Length

To accommodate Matangare, a berth requires length of LOA plus allowance of about 20 % of LOA as indicated on the "Technical Standard for Port and Harbour Facilities in Japan". The required berth length is 80 m.

(2) Depth

Design wharf depth is for B. Boreas class vessel is determined to be 6.0 metres, considering all allowance like waves, tide difference from Chart Datum, etc.

3.3.3 Container Yard, Shed and Equipment

(1) Container Yard

Annual number of containers in year 2005 will be 3522 TEUs and they will be transported by the same liners, assuming that the current vessels calling the port will continue to come in the year 2005. Number of TEUs in the yard including empty containers is estimated to be 561.

Average tiers of containers in the yard for year 2005 is planned to be 2.5 and necessary ground slots is calculated at 207. Required area of container yard is calculated as about 20,400 m2.

(2) Shed

Dwelling period of containers in the yard will be shortened as the container storage fee will increase in proposed port tariff system for containers.

Considering the above and storing conditions, the required floor area of a shed is calculated to be 1,100 m^2.

(3) Equipment

Considering conditions and number of the present equipment owned by KSSL, the following items are proposed for improving efficiency of cargo handling in the container yard.

Table 3-3-1 Proposed Cargo Handling Equipment

Name	Capacity	Nos.
Mobile Crane	80 t	1
Forklift	25 t	2
Forklift	5 t	4
Truck Tractor & Trailer	20 t	1

3.3.4 Other Facilities

(1) Passenger Terminal

To accommodate 506 passengers in 2005, a Passenger terminal with a floor area of 650 m^2 will be provided.

(2) Office for Kiribati Port Authority

A number of staffs of Kiribati Port Authority is proposed and a office building will be

required for the new staffs. An required area for the organization is estimated to be 350 m^2 to accommodate the new staffs of the Port Authority.

3.3.5 Usage of the Existing Facilities

The existing facilities, with repair work to the wharf and dredging in the channel and basin, shall be efficiently utilized supplementing the proposed new facilities as follows;

(1) Ships using the Existing Port

Ships which utilize the existing port include those of private ship operators, informal sector, fishing boats, tugs and barges, landing crafts, ships to be repaired in the ship-yard, leisure boats, etc. About 40% of domestic cargoes are handled by private ships other than KSSL.

(2) Container Yard

The existing container yard shall be used as open storage and parking area.

(3) Sheds

The existing sheds shall be used for storing cargoes of Supply Division and KCWS, long staying cargoes and waiting area of passengers.

3.4 Conceptual Development Plan

As described in the previous chapter, due to serious obsolescence and insufficiency of the existing port facilities, Betio Port has already reached to saturation in handling capacity and safety of port operation is not secured. Inefficient port operation gives rise to increase of transportation cost and eventually hampers sound growth of the country's economy. The existing port facilities could not meet an increasing traffic demand of container cargos without drastic improvement and rehabilitation. The existing port facilities can be improved by such measures as i) reinforcement of cargo handling equipment ii) reinforcement of tugs and barges iii) expansion of the existing wharf iv) expansion of the existing container yard v) construction of a new wharf and vi) construction of a new container yard. Thorough consideration to the local conditions of Betio Port has led the conclusion that expansion of the existing facilities is difficult and construction of a new wharf and a new container yard is necessary. A construction site near coast in a reef flat area involves large and expensive dredging work and an offshore site near reef edge is advantageous allowing efficient utilization of the existing Moles.

3.4.1 Possible Sites for Development

Land area necessary for future port development is not available on land near the existing Betio Port and reclamation work is necessary to create the land area required in the port development project.

Sites for future port development will be determined as either east or west of the existing Moles or in between, considering the land use plan authorized by the Betio Town.

3.4.2 Proposed Port Layout

Following the result of consideration on site selection, three alternative plans can be proposed as shown in Figure 3-4-1. They are compared in various aspects as detailed in Table 3-4-1.

Alternative 1 has a disadvantage of interference of a yard traffic with a traffic of Te Mautari Limited and Fisheries Jetty while Alternative 2 is likely to affect precious ecology of coral located in west of the proposed construction site.

Overall evaluation of all the aspects and their importance on the Plans leads to selection of Alternative Plan 3 and the proposed layout plan is shown in Figure 3-4-2.

Table 3-4-1 Comparison of Alternative Conceptual Port Development Plans

	Plan 1	Plan 2	Plan 3
Construction Cost	○	△	△
Existing Channel	△	○	○
Wharf/Yard Traffic	×	○	△
Land Use	○	△	○
Environment	△	×	○

3.4.3 Examination on Siltation

Computor simulation has been carried out to assess siltation in the channel and basin planned in three alternative plans. The results show that siltation rate is very low at about 1,000 m^3 for all alternative plans.

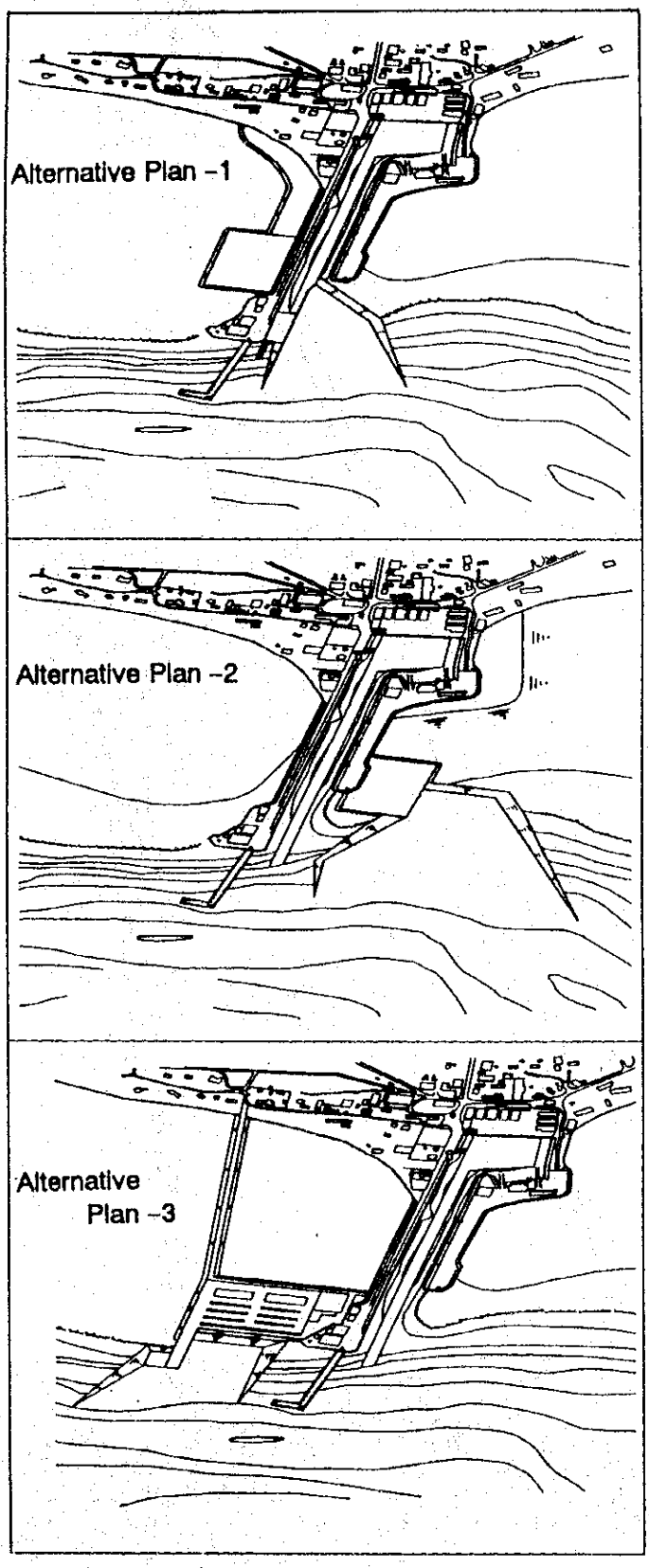


Figure 3-4-1 Alternative Conceptual Port Development Plans

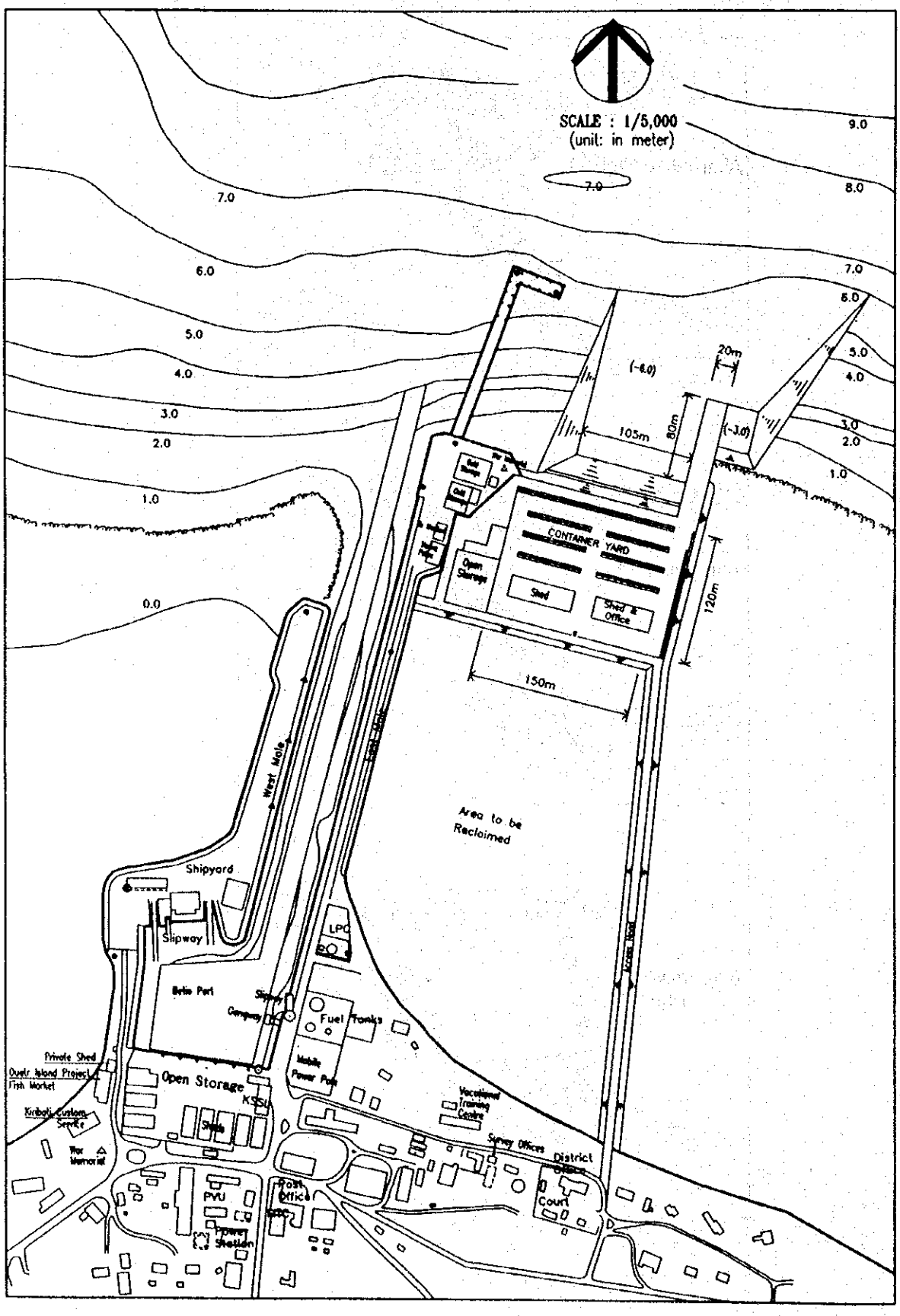


Figure 3-4-2 Proposed General Layout Plan

3.5 Structural Design

3.5.1 Design Premises

To make a plan appropriate and to minimize its cost, imported material and equipment will be minimized and dredged spoil be placed near the site with consideration of environment aspects. The facilities will be designed as to the premises from local conditions.

3.5.2 Design Conditions

(1) Dimensions of Wharf

- Overall length : 80 m
- Depth : 6.0 m below Chart Datum
- Crown Height : + 4.00 m

(2) External Force

* Surcharge : 3.0 tf/m^2
* Approach velocity of a berthing ship : 20 cm/sec
* Design seismic coefficient (k_h) : 0.05

(3) Natural Conditions

1) Sea conditions
   * Tidal Level : M.H.W.S + 1.80 m, M.L.W.S + 0.10 m, C.D.L. - 0.40 m
2) Wind Speed : 30 m/sec

(4) Soil Conditions

All the facilities will be designed, based on the boring logs from the survey for the construction of Fisheries Jetty as below:

* Bulk density : 1.7 tf/m^3 (in air)
* Angle of internal friction : 30 °
* N value : 15 (average)

3.5.3 Proposed Port Facilities

(1) Mooring Facility

1) Wharf

Examining the wharf structure with consideration of the site conditions and the proposed plan, steel sheet piled quaywall will be recommended for the new wharf in Betio Harbour.

The wharf structure is shown in Figure 3-5-1.

2) Return wall

As the wharf stated above, the return wall will be constructed with steel sheet piles with anchor sheet piles.

(2) Seawall

The seawall will be low-cost structure of concrete board with fabric-sheet forms as applying to the slope protection of the Causeway between Betio and Bairiki.

(3) Buildings

1) Shed and Administration Office

The structure of the building will be of steel frames with anti corrosion paint. The administration office for KPA will be located inside of the shed building.

2) Passenger Terminal

The terminal will be built as " Maneaba" type to create open space with fresh air.

(4) Apron and Container Yard Pavement

In the plan reinforced concrete pavement will be required for the apron and container yard.

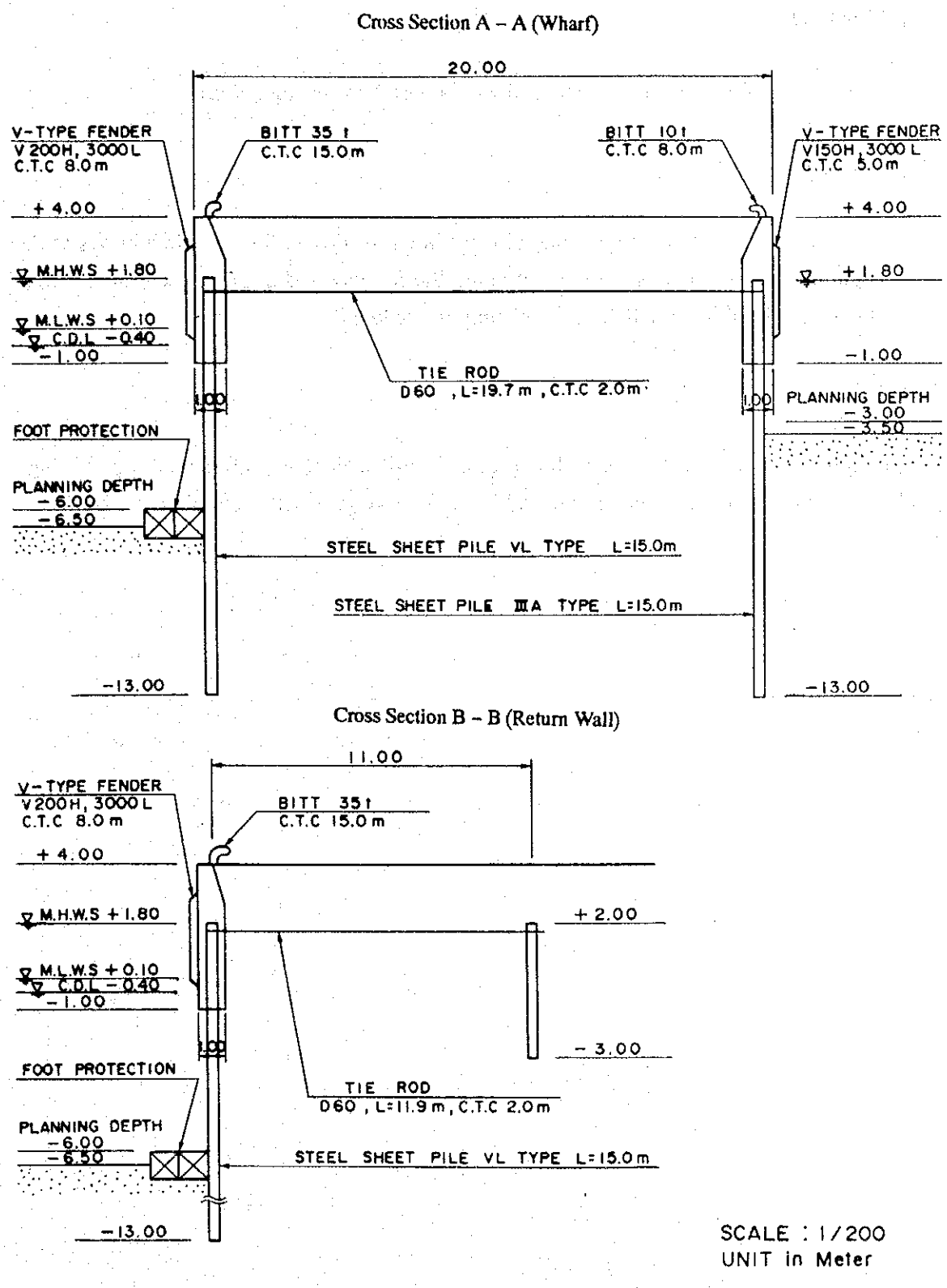


Figure 3-5-1 Typical Cross Section of Wharf and Return Wall

(5) Lighting

Lighting system in the container yard will be installed for night work.

(6) Navigation Aids

New arrangement of navigational aids is shown in Figure 3-5-2. New buoys with light and radar-reflector will be set along the fairway and a light beacon indicating the harbour will be installed in the vicinity of the wharf.

3.5.3 Rehabilitation of the Existing Wharf

To improve stability of the quaywall and protect further damage, the face of the existing quaywall will be covered with concrete and rubber fender system will be applied on the front surface.

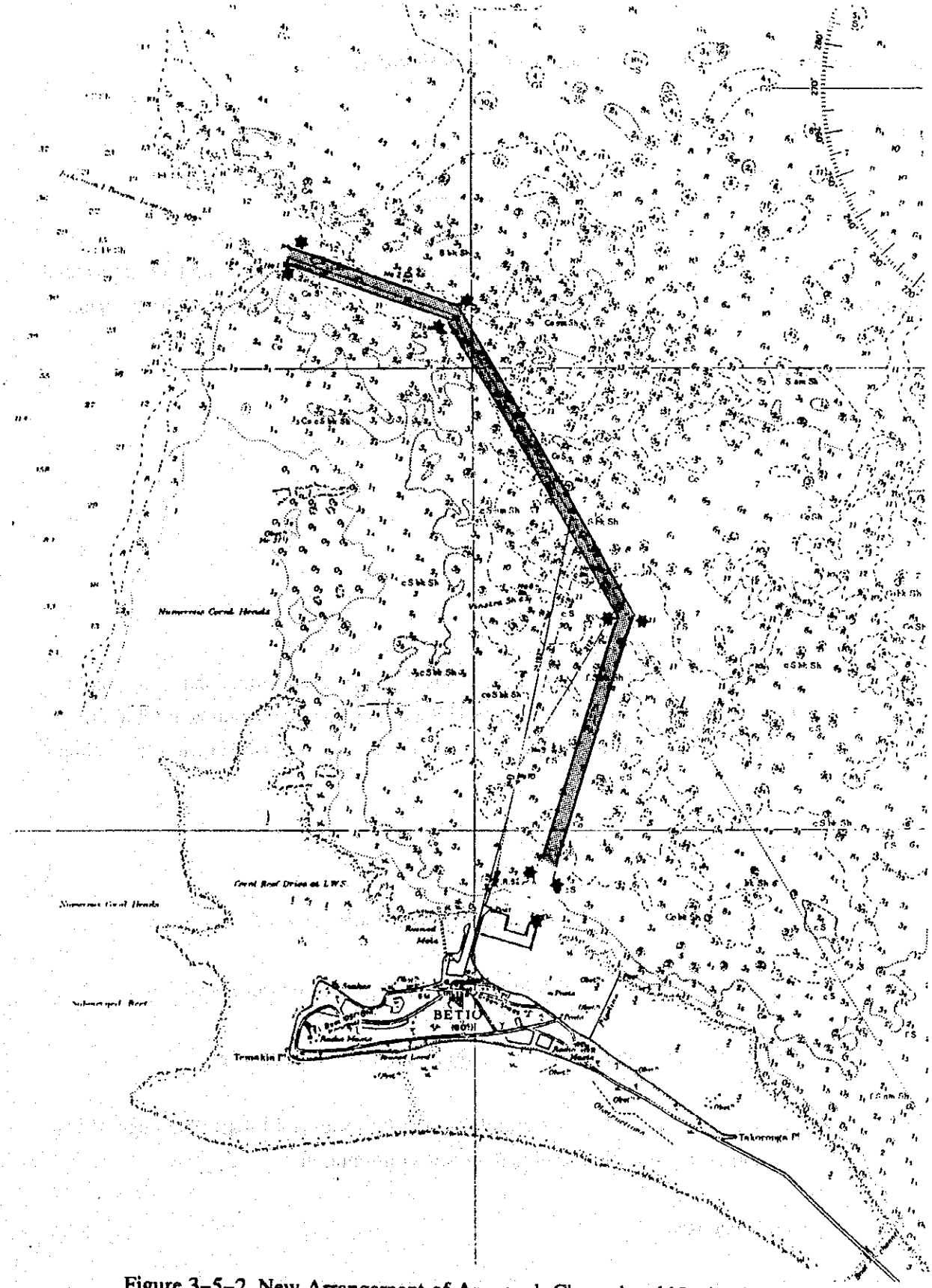


Figure 3-5-2 New Arrangement of Approach Channel and Navigation Aids

3.6 Construction Plan and Preliminary Cost Estimation

3.6.1 Construction Schedule

Construction schedules of Betio Port is presented in Table 3-6-1.

Marine construction equipment will be procured from Japan, considering their prices and availability of those in the adjacent countries. Steel material will be also procured from Japan.

3.6.2 Cost Estimation

The construction costs of Betio Port are estimated as follows:

(1) Estimate Conditions

1) Estimation Limit

(a) The construction costs of Alternative 3 are estimated.
(b) Taxes locally imposed on materials and labours are included in the estimation.
(c) Customs duties imposed on import goods are excluded from the estimation.
(d) Land rents, compensations and insurance costs are excluded from the estimation.

2) Domestic and Foreign Portion

In general, the costs of the foreign portion include:

(a) Articles and goods which have never been produced domestically,

(b) Articles and goods which are seldom produced domestically,

(c) And articles and goods which cannot be procured locally because of low domestic production or high domestic consumption

3) Exchange Rate

1 AUS.$ = 0.757 US$ = 75.33 Yen (31st July 1994)

Table 3-6-1 Construction Schedule

Facility	Unit	Quantity	Construction Year									
			1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Dredging	m^3	138,648										
2. Aids to Navigation	LS	1										
3. -6.0m Wharf	m	80										
4. Rehabilitation of -3.0m Wharf	m	130										
5. Slope Protection	m	775										
6. Land/Road Area and Yard Pavement	m^2	33,600										
7. Road Pavement	m	955										
8. Shed	m^2	2,300										
9. Passenger Terminal	m^2	650										
10. Cargo Handling Equipment	LS	1										
11. Maintenance Dredging Equipment	LS	1										

4) Physical Contingency

Contingency rates are as follows:

(a) 0% : Imported cargo handling equipment and other machineries and construction costs of shed and concrete pavement

(b) 5% : Construction cost of slope protection

(c) 10% :Construction costs of steel sheet pile wharf and electric facilities

(d) 20% :Dredging cost

(2) Estimation Result

The summary of the construction cost of Betio Port is presented in Table 3-6-2.

Table 3-6-2 Summary of Construction Cost

Facility	Unit	Quantity	Construction Cost ('000 AUS$)		
			Total	Foreign Portion	Local Portion
1. Dredging	m3	138,648	4,503	3,680	823
2. Aids to Navigation	LS	1	351	309	42
3. -8.0m Wharf	m	80	5,230	3,490	1,740
4. Rehabilitation of -3.0m Wharf	m	130	407	287	120
5. Slope Protection	m	775	2,921	1,450	1,471
6. Land/Road Area and Yard Pavement	m2	33,600	8,708	3,504	5,204
7. Road Pavement	m	955	2,013	667	1,346
8. Shed	m2	2,300	8,223	5,756	2,467
9. Passenger Terminal	m2	650	687	480	207
Sub-total (1 to 9)			33,043	19,623	13,420
10. Cargo Handling Equipment	LS	1	3,776	3,776	0
11. Maintenance Dredging Equipment	LS	1	1,411	1,411	0
Sub-total (10 to 11)			5,187	5,187	0
12. Engineering Services	LS	1	3,088	2,007	1,081
13. Physical Contingency	LS	1	1,641	1,207	434
Grand Total			42,959	28,024	14,935

3.7 Port Development in Christmas Islands

3.7.1 Development Plan

Seventh National Development Plan has emphasized development of outer islands with expectation of contribution to restriction of population growth in Tarawa as well as growth of country's economy. The resettlement plan will remove differences of living standard and quality of life between urban and rural areas in the country by providing improved social infrastructures and services to the immigrants.

(1) Resettlement Plan

Settlement Programme of shifting more than 6,000 persons from highly populated Gilbert Islands to Northern Line Islands for the period from 1989 to 1993 has been initiated. It is aimed to settle an optimum number of applicants to Fanning and Washington Islands. The programme has not been fully implemented due to delay of providing adequate infrastructure and support.

(2) Port Development Plan in Christmas

1) Possible Sites for Development

Two options have been proposed on the port development of London Wharf. First one is to construct a new jetty facing the western ocean near the oil depot, and second option is to rehabilitate and improve the present facility.

2) Proposed Port Layout

Three alternatives are proposed following the above two options. Comparison is made in various aspects and shown in Table 3-7-1.

Alternative 1

- 6m jetty on west coast near the oil depot.

Alternative 2

Reconstruction of the existing wharf to -5m wharf with -5.5m channel

Alternative 3

Reconstruction of the existing wharf to −2m wharf with new tugs and barges.

As a result of evaluation of alternatives, alternative plan 3 shown in Figure 3−7−1 is selected as an appropriate one.

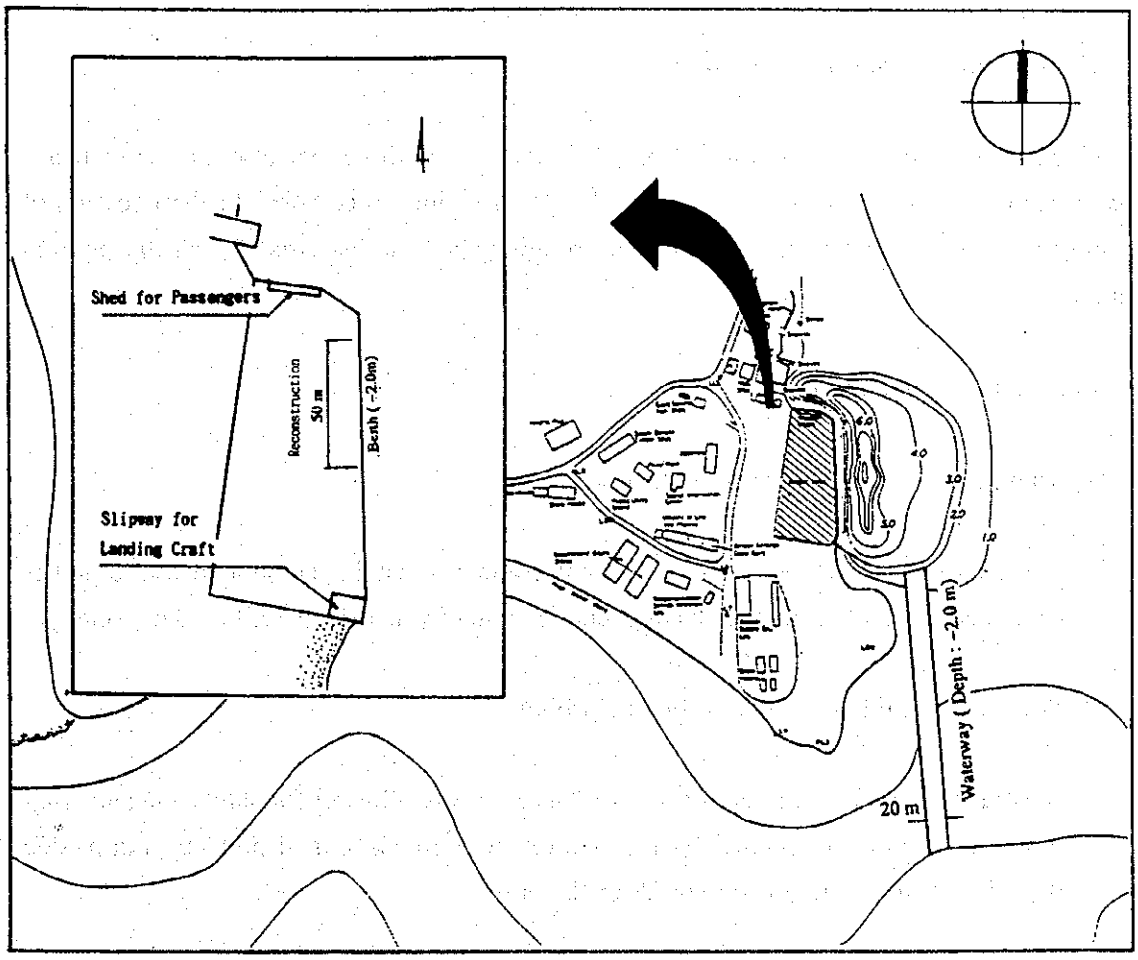


Figure 3-7-1 Conceptual Plan of London Wharf, Alternative Plan 3

Table 3-7-1 Comparison of Alternative Conceptual Port Development Plans

	Plan 1	Plan 2	Plan 3
Construction Cost	×	×	○
Construction Work	×	△	○
Rate of Workable Days	×	○	○
Siltation	○	×	△
Environment	△	○	○

3.8 Maintenance Dredging Operation

There are constraints on littoral drift at all the ports in Kiribati, because no maintenance was made due to unavailable of dredgers and shortage of maintenance cost. In the occasion of establishing the development plan, maintenance dredging shall be discussed for all the ports in this country.

3.8.1 Maintenance Drudging in Betio Port

(1) Volume of accumulated sand in the port

As discussed in sub-section 3-4-3, total volume of sand accumulated in the port is estimated as 1000 m^3 and an average change rate of water depth will be 3 or 4 cm /yr.

(2) Proposed Dredging Method in Betio Harbour

In spite of a small sand deposition as above, it is not allowed for safety maneuvering not to maintain the channel basin. Therefore, an economical and minimum-size dredging system below is proposed for the port.

* A crawler crane (25 t) mounted on a flat barge

Dredging will be conducted when any obstacles or shallow places are found on the seabed but it is recommended that dredging be carried out every 10 years normally with irregular dredging.

3.8.2 Dredging Method in Outer Islands

The above system will be towed by Matangare to the outer islands for maintenance dredging when required. Dredging will be most helpful for efficient pot operation in the outer islands in the course of provision of a dredger.

Dredging equipment will be operated by KPA and it is recommended that MLPD will finance KPA for dredging in outer islands when required. Monitoring of sedimentation in the channels or basins will be indispensable to determine timing to conduct dredging.