

**BASIC DESIGN STUDY REPORT  
ON  
THE WENO HARBOR EXTENSION PROJECT  
IN  
CHUUK STATE  
THE FEDERATED STATES OF MICRONESIA**

**NOVEMBER 1993**

**NIPPON TETRAPOD CO., LTD.**

GRS
CR (2)
93-181



JICA LIBRARY



1116851151

国際協力事業団

26930

**JAPAN INTERNATIONAL COOPERATION AGENCY**  
**THE FEDERATED STATES OF MICRONESIA**

**BASIC DESIGN STUDY REPORT**  
**ON**  
**THE WENO HARBOR EXTENSION PROJECT**  
**IN**  
**CHUUK STATE**  
**THE FEDERATED STATES OF MICRONESIA**

**NOVEMBER 1993**

**NIPPON TETRAPOD CO., LTD.**



## PREFACE

In response to a request from the Government of the Federated States of Micronesia (FSM), the Government of Japan decided to conduct a basic design study on the Weno Harbor Extension Project in Chuuk State and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to FSM a study team headed by Mr. Masaki Shiomi, Chief of Design Standard Section, the Port and Harbor Research Institute, Ministry of Transport and constituted by members of Nippon Tetrapod Co., Ltd., from March 30 to May 9, 1993.

The team held discussions with the officials concerned of the Government of FSM, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to FSM in order to discuss a draft report, and as this result, the present report was finalized.

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 the Federated States of Micronesia for their close cooperation extended to the teams.

November, 1993



Kensuke Yanagiya  
President

Japan International Cooperation Agency





November, 1993

Mr. Kensuke Yanagiya  
President  
Japan International Cooperation Agency  
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Weno Harbor Extension Project in Chuuk State, the Federated States of Micronesia.

This study was conducted by Nippon Tetrapod Co., Ltd., under a contract to JICA, from March 19 to November 2, 1993. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of FSM and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Transport. We would also like to express our gratitude to the officials concerned of the Department of External Affairs of the FSM Government, the Department of Transportation and the Department of Planning and Statistics of the Chuuk State Government, the Consulate-General of Japan in Agaña for their cooperation and assistance throughout our field survey.

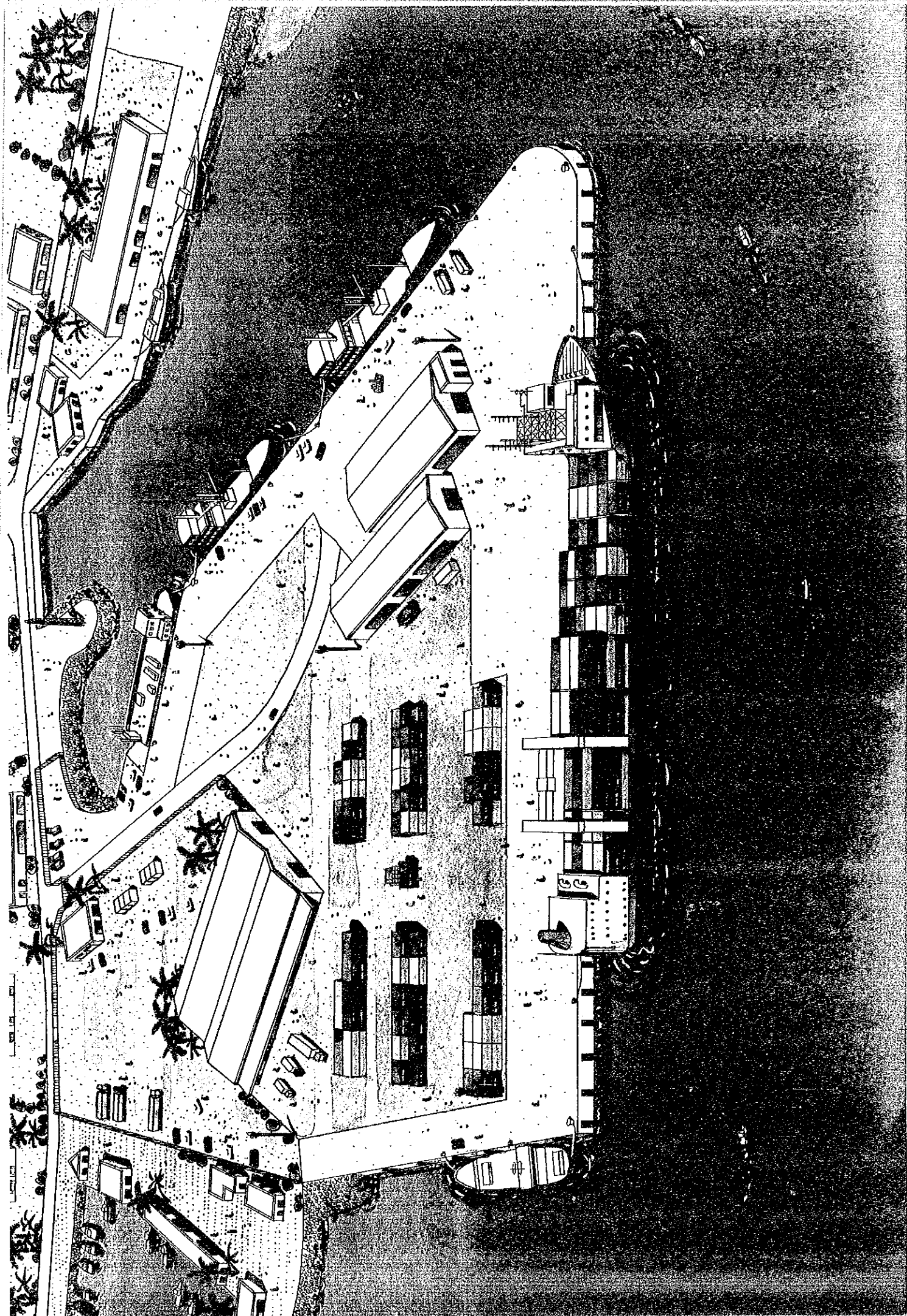
Finally, I hope that this report will contribute to further promotion of the project.

Very truly yours,

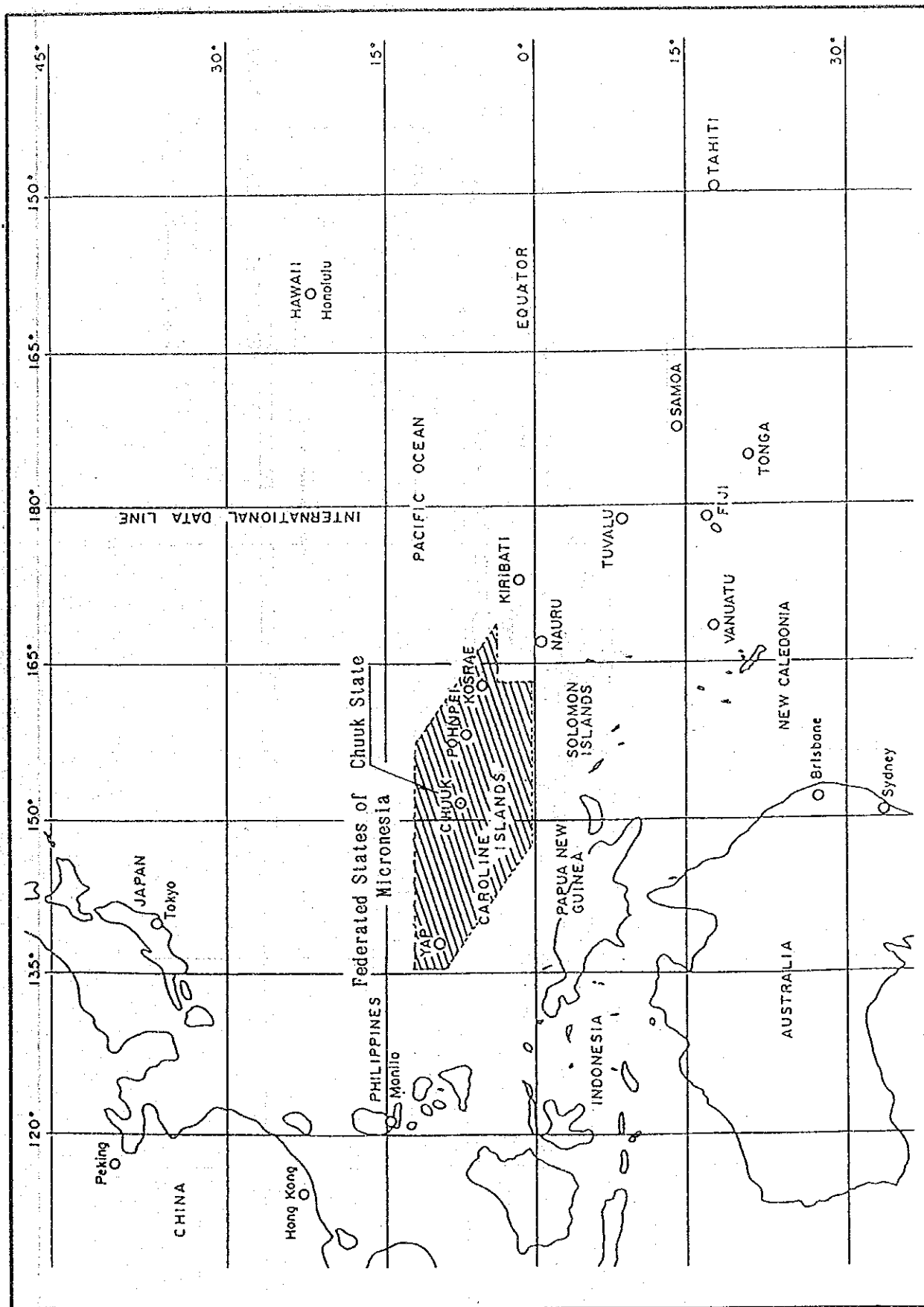


Ken Ishiguro  
Project Manager,  
Basic Design Study Team on  
The Weno Harbor Extension Project  
in Chuuk State  
Nippon Tetrapod Co., Ltd.

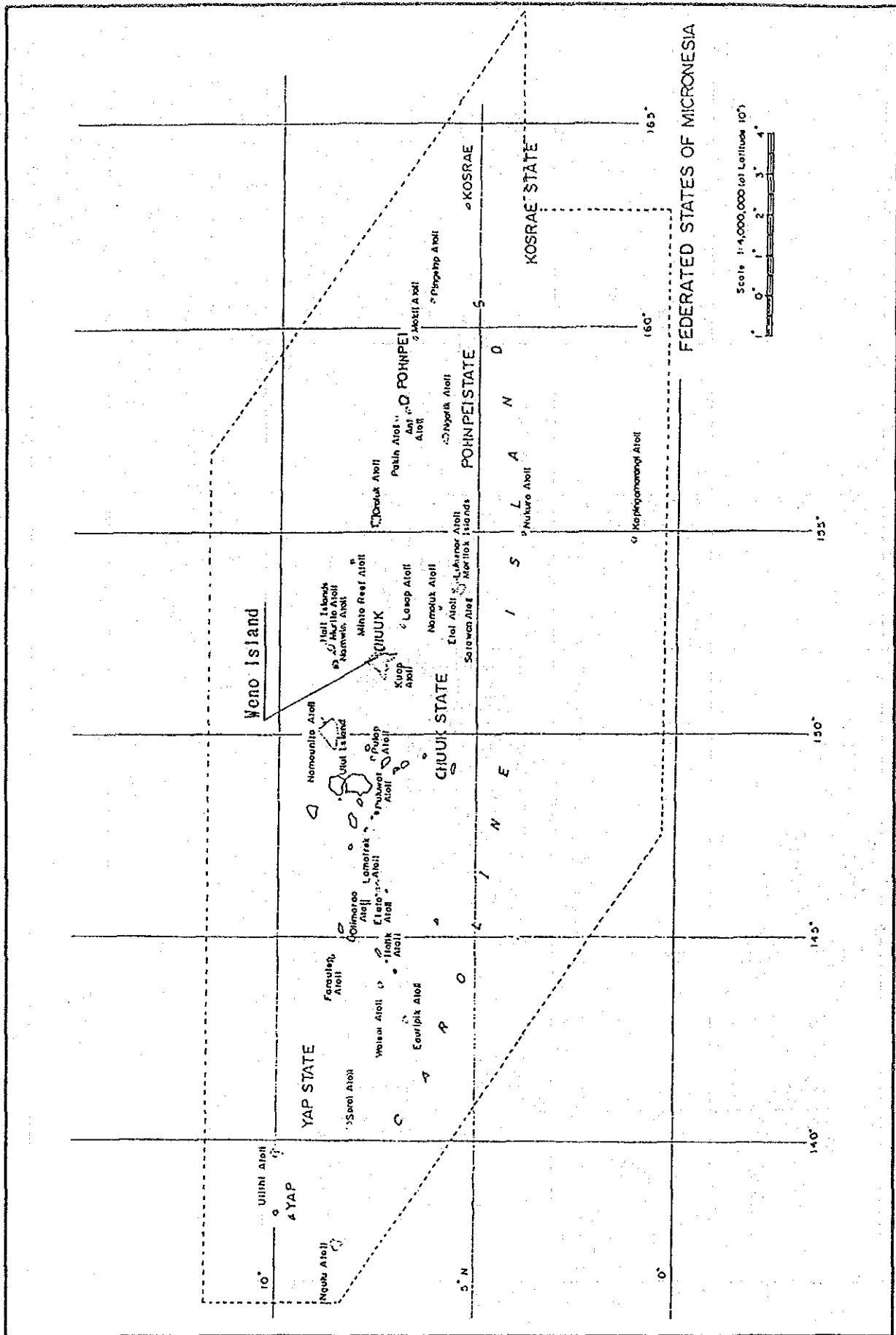




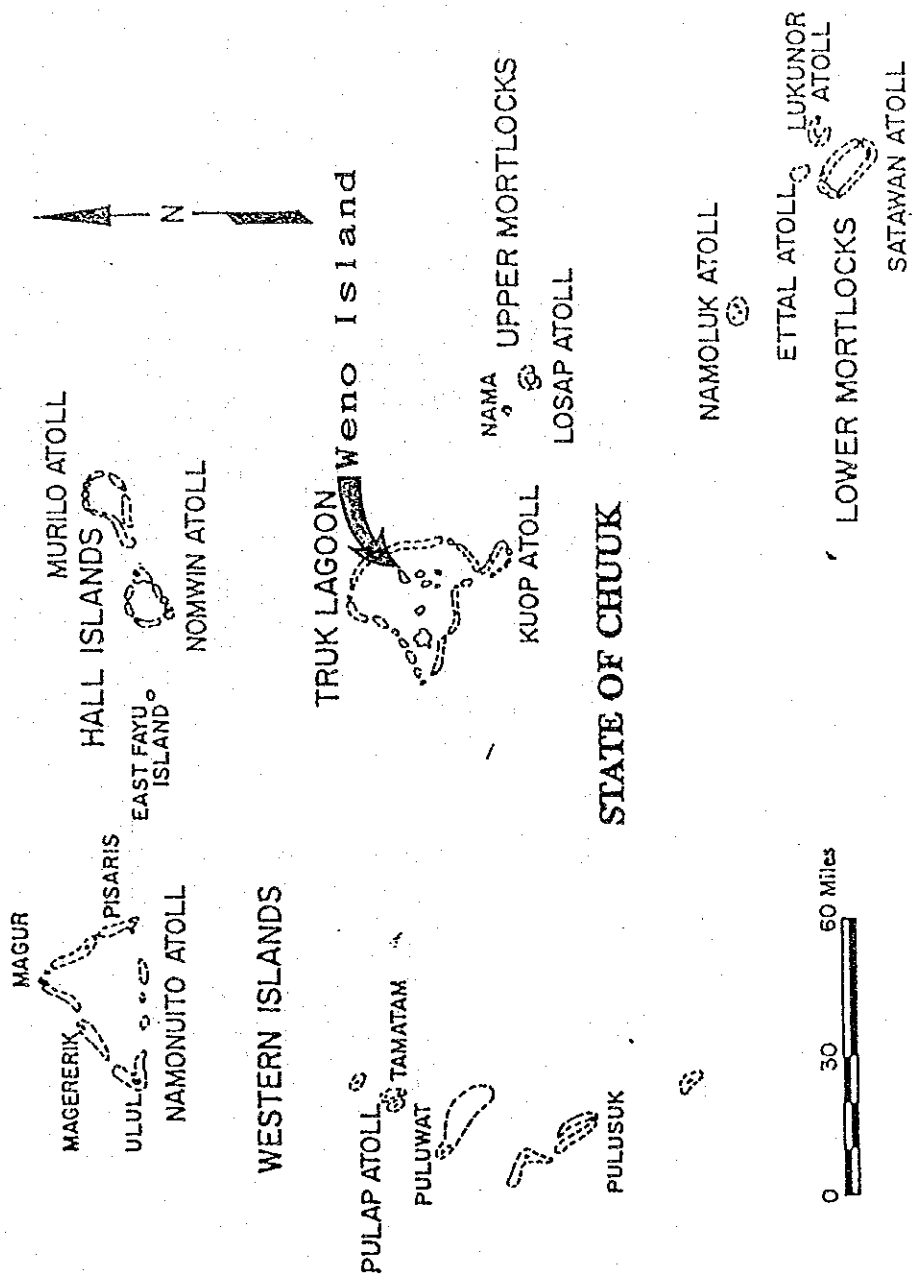




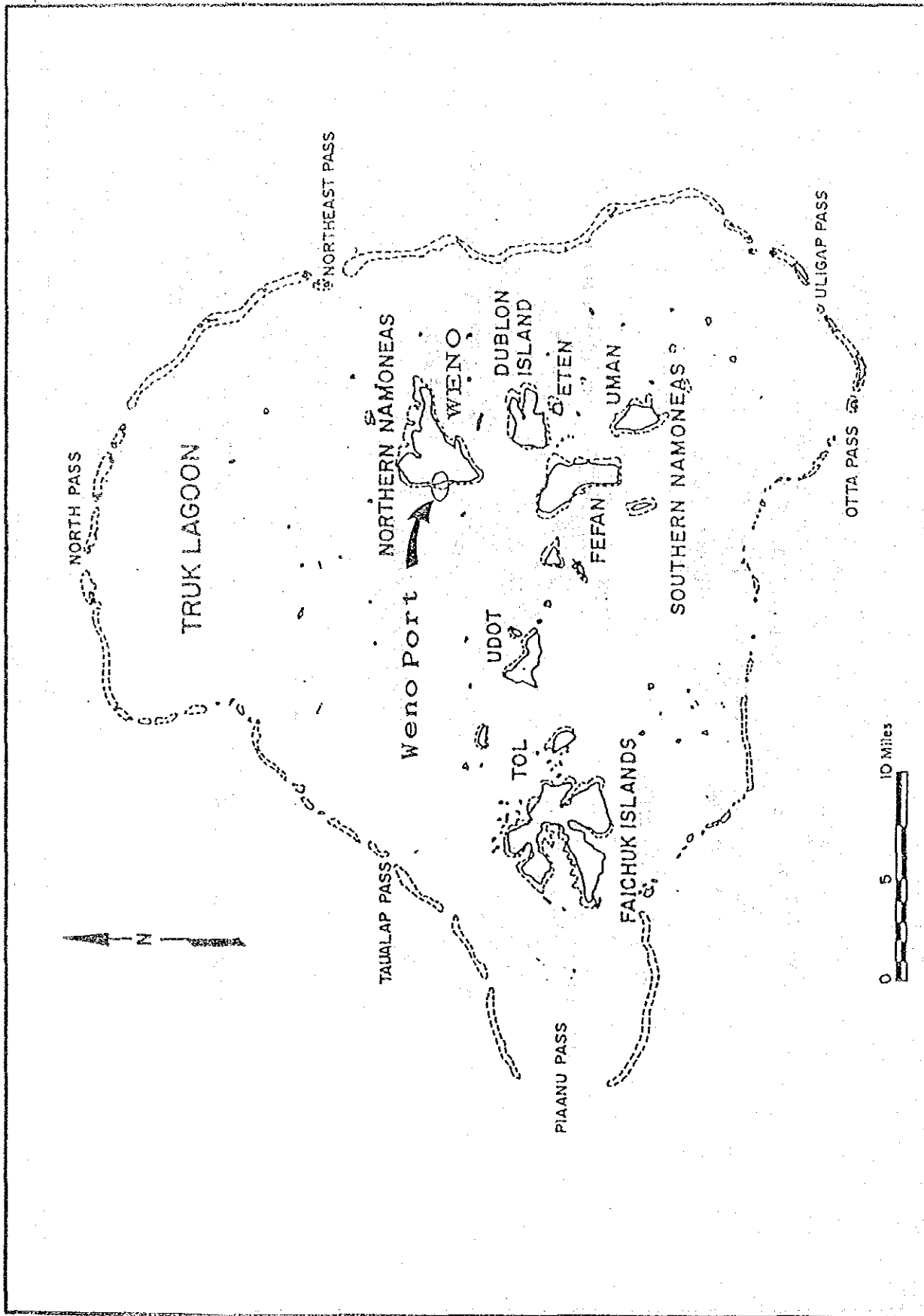
Location Map of the FSM



Location of Weno Island (1)

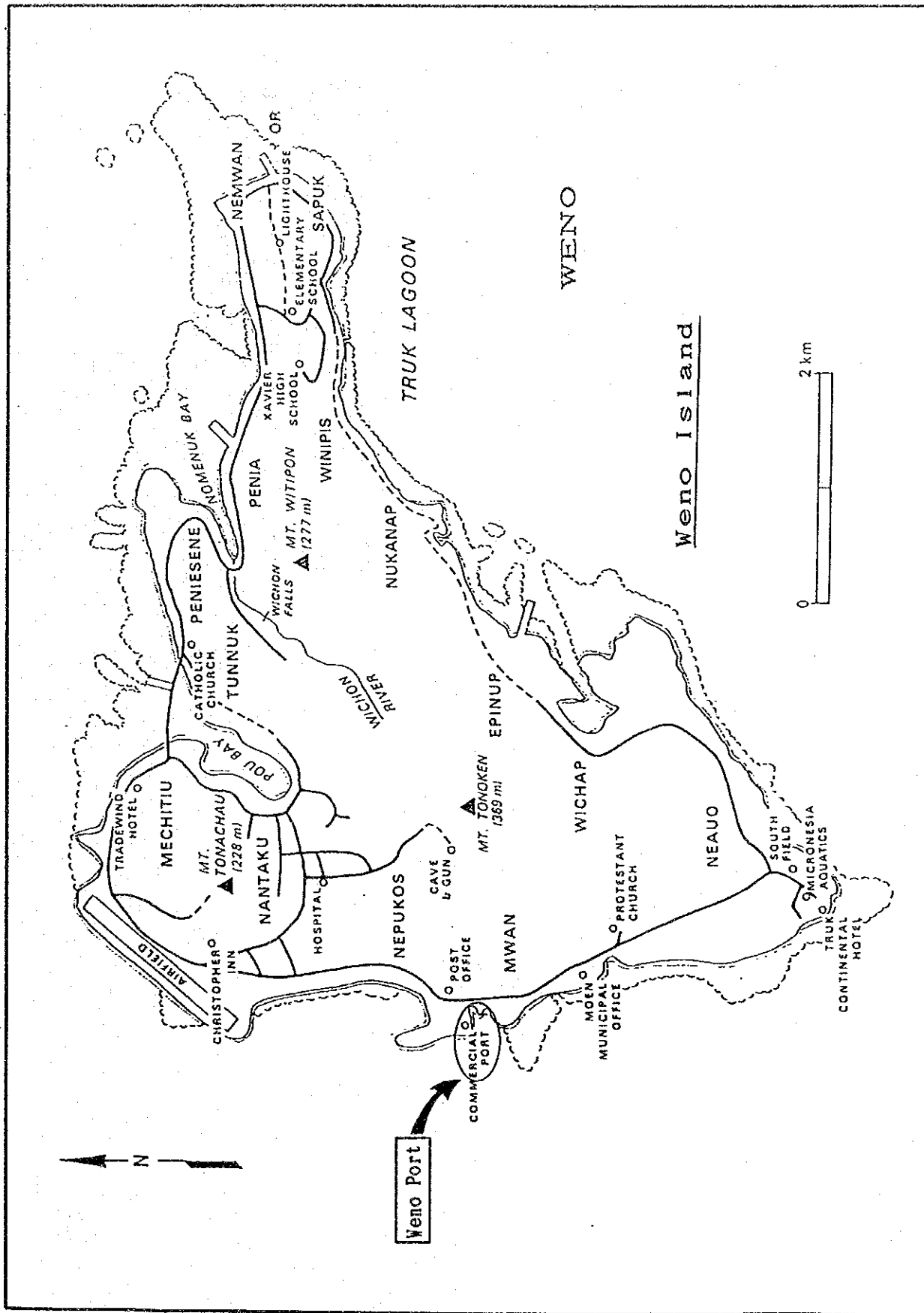


Location of Weno Island (2)



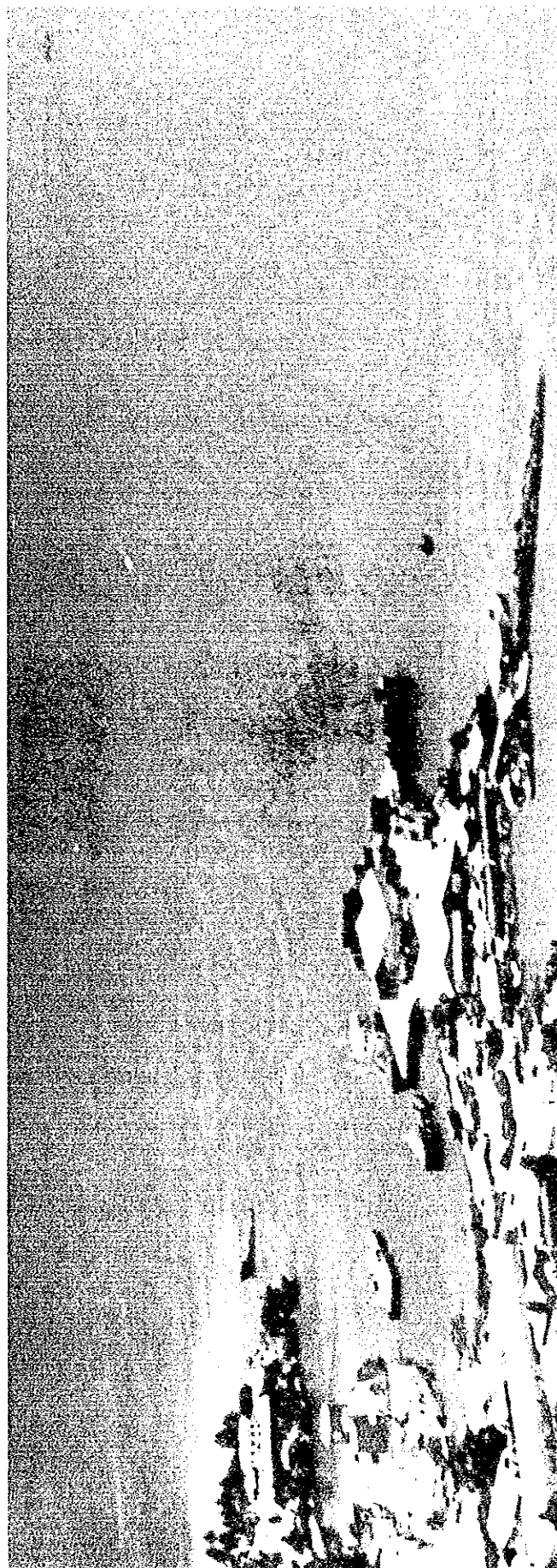
Location of Weno Port (1)





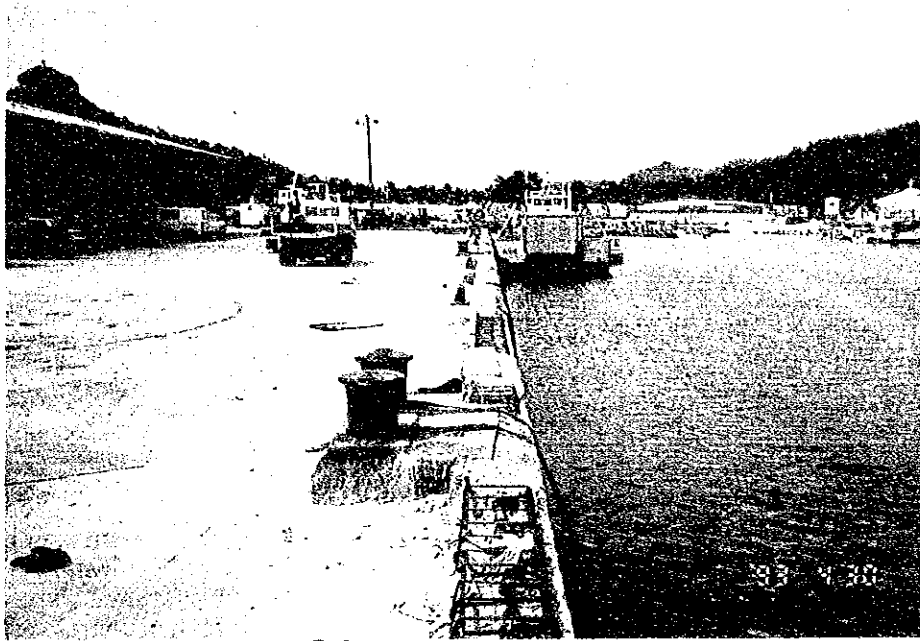
Location of Weno Port (2)



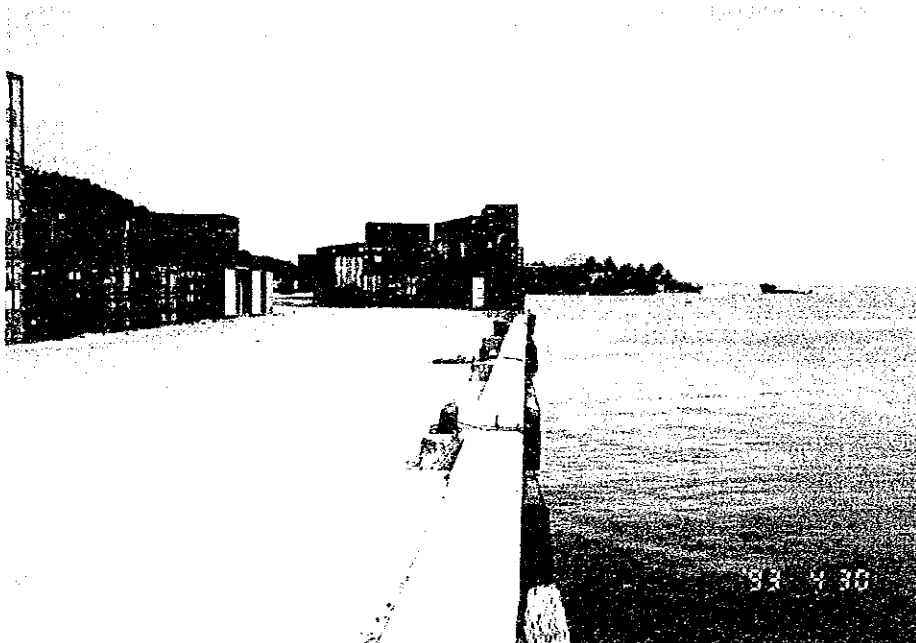


Bird eyes View of Weno Port





Existing Dock-A



Existing Dock-B





International Trade Vessel at Dock-A



Domestic Service Boat at Dock-A

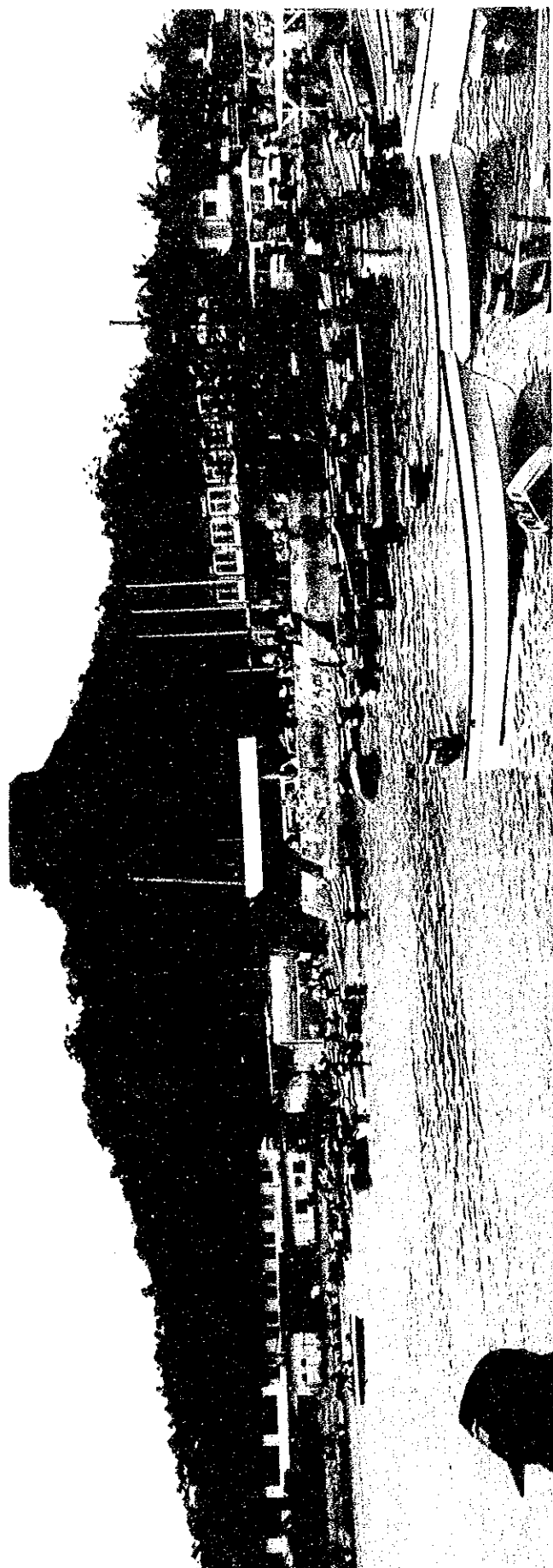






Project Site for Expansion of Dock-B



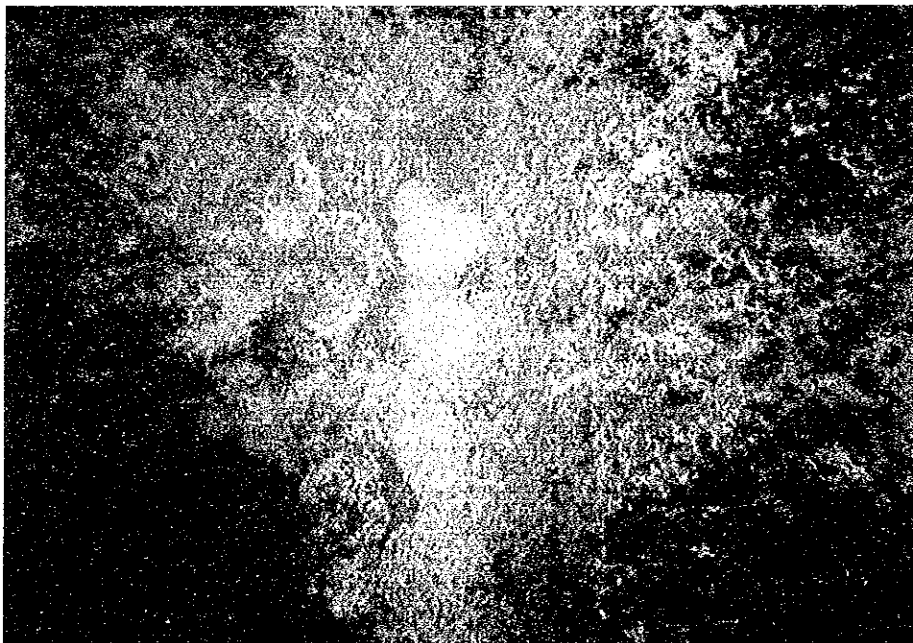


North Inner Basin





(Damage of Wales)



(Hole of Tierod)

Underwater Survey Photos of Existing Dock-A (Sheet Piles)



## SUMMARY





## SUMMARY

The Federated States of Micronesia (FSM) is an oceanic island country located in central western Pacific area, and consists of some 600 islands divided into four states by island groups of Pohnpei, Chuuk, Yap and Kosrae. The total land area of this country is 700 km<sup>2</sup> only, scattering over more than 3,700 times wider vast sea area of 2,600,000 km<sup>2</sup>, forming the EEZ (Exclusive Economic Zone) and being dwelt by approximately 100,000 of population in total.

State of Chuuk is situated at eastern center of FSM, consists of 7 island groups of totally 290 islands. The population of Chuuk State is about 50,000 which is about 50% of FSM population, on the total 130 km<sup>2</sup> of island area.

As FSM consists of several number of major group islands and a great number of outer islands in four states, marine transport plays most important role in traffics between islands and in transportation of import and export goods to and from FSM. Therefore, the National Development Plan of FSM assigned high priority in development of marine transport and its supporting infrastructures such as ports and harbors to stabilize supply of import goods for daily life use and to enhance export of domestic products from local industry. With the termination of trusteeship administration, the government of FSM established long term development plan to achieve self-reliance of national economy, and this year of 1993 fits in the second progressive year in the Second National Development Plan.

Marine transport in FSM consists of international trade routes linking FSM to main ports in Asian countries (mainly Japan), west coast of U.S.A. and the Oceanian countries, as well as domestic service routes for inter-state and intra-state shipping.

Weno Port is the main port of Chuuk State situated in west coast of Weno Island. Weno Port is the real lifeline port for 50,000 Chuuk State people including outer islands residents, and is assessed at the base of economic activity of Chuuk State.

In 1993, the State Government of Chuuk has revised the State Master Plan set forth in 1987. Correspondingly, Chuuk State established the Sea Port Master Plan with stage up development scheme.

Port activity in Weno Port can be classified into two major categories of general commercial port function and fishery base port function, and both functions are interminglingly operated in the same berth at present due to insufficiency of port facility. For separation of those major functions at each separated area, new fishery base port complex is now under construction in southern port area. After completion of the new fishery port complex, site of the Weno Harbor Extension Project will be the reserved area for commercial port function only.

The commercial port function of Weno Port consists of the following three types of marine transportation mode:

- (1) International marine transport linking Chuuk to other countries in Pacific area
- (2) Domestic marine transport for intra-state and inter-state traffic and shipping
- (3) Commuter marine traffic linking Weno Island to other islands in the Truck Lagoon

International trade vessels make some 50 calls to Weno Port yearly and domestic service boats make about 100 voyages every year, while some 300 commuter boats run daily to and from Weno Port. Because of insufficiency of berthing facility at present in Weno Port, commercial port area is congested by those traffic on sea causing operational inefficiency and even occasional accidents.

The main facility of the commercial port consists of .97 m long Dock-A constructed in 1962 and 91 m long Dock-B constructed in 1983. Since all those facilities were designed and built before containerization of cargo handling, the berth length are as short as only one half of present standard berth length, and the cargo handling yard area is extremely narrow being about 3,500m<sup>2</sup> only.

Still more, Dock-A has been already very badly deteriorated due to severe corrosion developed in 30 years time, and Dock-B is buried by sand deposition.

Though three intra-state service boats are operated by Chuuk State stationed in Weno Port, they are not provided with mother port berths, being compelled to moor in offshore basin usually. For fleets of commuter small boats with out-board engine, which are the daily traffic means of lagoon island residents, no mooring facility is furnished in boat basin area.

Normal operation of the port is now suffering from certain hindrances due to above factors, and to restore order and safety and efficiency, the governments of Chuuk and FSM have established plan to rehabilitate and expand port facilities for berth mooring and cargo handling, and to improve the commuter boats terminal.

Based on these background, the Government of FSM sent to the Government of Japan a request in regard to grant assistance for rehabilitation and expansion of facilities for berthing and cargo handling, and improvement of the commuter boats terminal in Weno Port in Chuuk State.

Upon the request, the Government of Japan decided to conduct a basic design study, and JICA organized a basic design team and dispatched the mission to FSM to conduct field survey from March to May, 1993. The Study Team held a series of discussion with concerned officials of the FSM Government and the Chuuk State Government, and made a series of survey and study. By analysis and examination of data and information and materials, the study team carried out basic design study and prepared a draft report. The draft report was presented in FSM in September, 1993.

The Basic Design has been worked out with examination of the request of the Government of FSM, and with consideration of the results of the discussion with concerned officials of the Government of FSM and the Government of Chuuk State, to be appropriate for the objective of grant assistance. The project plan is divided into two phases, considering requirements of reasonable periods for execution. The contents of project items covered by this project are as described below:

With regard to impacts on environments by the project, Preliminary Initial Assessment Study was conducted by Chuuk State official concerned and field survey study was also conducted by the study team. As the result of the studies, significant effects are not foreseen in implementation period and in operational stage of this project.

### Contents of the Project

#### (1) Dock-A Reformation

1) Rehabilitation of Dock-A	-9 m deep	93 m long
2) Extension of Dock-A	-9 m deep	60 m long
3) Small Dock along East Return Wall with Ramp	-4.5 m deep	50 m long
4) Dredging of Mooring Basin	-9 m deep	approx. 32,000 m <sup>3</sup>

#### (2) Dock-B Extension

1) Extension of Dock-B	-9 m deep	92 m long
2) Dock-C Replacement along North Return Wall	-5 m deep	50 m long
3) Dredging of Mooring and Turning Basin	-9 m deep	approx. 73,000 m <sup>3</sup>

#### (3) Container Facility

1) Yard Area Improvement	approx. 8,800 m <sup>2</sup> (new area 5,700 m <sup>2</sup> )
2) Revetment	60 m
3) Ancillary facility	
Drainage	210 m
Flood lighting	5 nos.
Reefer power	2 nos.
Fence and gate	Fence 20 m and gate 1 no.

#### (4) Navigation Aids

1) Repair of Markers	6 lighted markers
2) Markers on Boundary of Turning Basin for Dock-B	2 lighted markers
3) Light Beacon for approach to Dock	1 lighted aid

## Project Phases

### Phase 1

- 1) Extension of Dock-B
- 2) Small Dock on North Return wall
- 3) Dredging of Mooring and Turning Basin-B
- 4) Revetment of Container Yard
- 5) Improvement of Navigation Aids

### Phase 2

- 1) Rehabilitation of Dock-A
- 2) Extension of Dock-A
- 3) Small Dock on East Return Wall with Ramp
- 4) Dredging of Mooring Basin-A
- 5) Improvement of Container Yard
- 6) Ancillary facilities of Container Yard

Project implementation in Phase 1 requires 4 months for Detail Design Works and 12 months for Construction Works, and in Phase 2 also 4 months for Detail Design Works and 12 months for Construction Works.

The executing agency of the project in FSM are Department of Planning and Statistics and Department of Transportation of Chuuk State, and Department of Transportation is responsible for administration and maintenance of finished project facilities. Both departments have sufficient experiences and expert staff for execution of the project, and also provided with financial and managerial capability for administration and maintenance of the facilities by the project.

Followings are effects and benefits envisaged from implementation of the Weno Harbor Extension Project:

- (1) By rehabilitation of the existing Dock-A, dangerous condition in this dock will be remedied and safe operation of vessel and cargo can be restored.
- (2) By container yards improvement works, total yard area will be expanded up to 9,200 m<sup>2</sup> wide, which contributes for efficiency raise and for safety improvement to a great extent.

- (3) Extension of Dock-B provides full scale complete berth for international shipping vessel (10,000 DWT class) in a close vicinity of the expanded container yard, and better maneuverability of ship and higher efficiency of cargo handling will be brought about as well as improvement of safety condition. Extension of Dock-B, will expedite realization of call of a larger size cargo vessel in near future, which in turn results in cost saving of marine transportation.
- (4) Extension of Dock-A provides mother port berths for intra-state shipping boats of Chuuk State, improving service condition of domestic shipping for outer islands and between other states. Extended Dock-A can offer alternate berthing accommodation for international cargo boat in an occasion of adverse sea condition at Dock-B in westerly wind season, securing stable supply of import goods to Chuuk State.
- (5) Navigation aids improvements enhance safety of navigation and secure marine traffic operation even at night, enabling quick dispatch and preventing accident.

As mentioned above, the project is envisaged to bring about multiple effects and benefits to a significant degree, and a great extent of contribution will be made for the peoples' life and the national economy of FSM, being integrated into the efforts of the National Development Plan of FSM for strengthening basic structure of the national economy and to achieve self-supporting economy. Therefore, in conclusion, implementation of this project under grant assistance system of the Japanese Government can be fully justified and evaluated highly beneficial.

## CONTENTS

### PREFACE

### LETTER OF TRANSMITTAL

### PERSPECTIVE

### LOCATION MAPS

### PHOTOS OF WENO PORT

### SUMMARY

page

#### CHAPTER 1 INTRODUCTION

1.1	Background of the Request .....	1
1.2	Dispatch of the Study Team .....	2
1.3	Study Items .....	2

#### CHAPTER 2 BACKGROUND OF THE PROJECT

2.1	Profiles of the FSM and State of Chuuk .....	4
2.1.1	Geography .....	4
2.1.2	Social and Economical Status .....	5
2.2	General Outline of National Development Plan .....	12
2.2.1	National Development Plan of FSM .....	12
2.2.2	The Development Plan of the State of Chuuk .....	14
2.3	Outline of Marine Transport and Ports in FSM .....	15
2.3.1	Outline of Marine Transport .....	15
2.3.2	Outline of Main Ports in FSM .....	16

#### CHAPTER 3 OUTLINE OF WENO HARBOR

3.1	Natural Conditions .....	19
3.1.1	Climatic Conditions .....	19
3.1.2	Hydrographic Conditions .....	25
3.1.3	Land and Sea Bottom Topography .....	28
3.1.4	Foundation Soil Conditions .....	30
3.1.5	Geology .....	31
3.1.6	Earthquake .....	31

	page
3.2 Outline of Weno Harbor .....	31
3.2.1 Development Plan for Weno Port .....	31
3.2.2 Current Status of Weno Port .....	34
3.2.3 Port Facilities of Weno Port at Present .....	44
3.3 Contents of the Request .....	55
 <b>CHAPTER 4 CONTENTS OF THE PROJECT</b>	
4.1 Objectives of the Project .....	59
4.2 Examination of the Request .....	59
4.2.1 Appropriateness of the Project .....	59
4.2.2 Operation and Administration Plan .....	60
4.2.3 Associated Projects and Aid Programs .....	60
4.2.4 Projection of Marine Transport in Weno Port .....	61
4.2.5 Examination of Contents of the Request .....	63
4.2.6 Strategy of Project Planning .....	70
4.3 Proposal of Project Plan .....	70
4.3.1 Proposal Plan .....	70
4.3.2 Layout of Proposal Plan .....	82
4.3.3 Outline of the Proposed Project Plan .....	83
4.3.4 Operation and Maintenance Plan .....	86
4.4 Technical Cooperation .....	88
 <b>CHAPTER 5 ENVIRONMENTAL CONSIDERATION</b>	
5.1 Background of Environmental Control .....	89
5.2 Environmental Survey by the Study Team .....	90
5.2.1 Sea Current Survey .....	90
5.2.2 Water Quality Survey .....	97
5.2.3 Marine Sediment Quality Survey .....	99
5.2.4 Marine Biological Survey .....	101
5.2.5 Survey for Explosive Objects .....	106
5.3 Environmental Consideration .....	106
5.3.1 Environmental Impact Factors .....	106
5.3.2 Preliminary Environmental Assessment by the Study Team .....	107
5.4 Measures for Environmental Protection .....	109



**CHAPTER 6 BASIC DESIGN**

6.1	Policy for Basic Design .....	110
6.2	Basic Design of Project Facilities .....	111
6.2.1	Work Items of the Project .....	111
6.2.2	Selection of the Type of Quaywall Construction .....	112
6.2.3	Dock-A Reformation Works .....	116
6.2.4	Dock-B Extension Works .....	120
6.2.5	Container Yard Works .....	124
6.2.6	Navigation Aids Works .....	127
6.3	Design Drawings .....	129
6.4	Implementation Plan .....	142
6.4.1	Implementation Policies .....	142
6.4.2	Construction Conditions and Implementation Plan .....	145
6.4.3	Supervision by the Consultant .....	146
6.4.4	Procurement and Logistic Policy .....	148
6.4.5	Environmental Monitoring Plan and Safety Control ...	149
6.4.6	Implementation Schedule .....	149

**CHAPTER 7 PROJECT EVALUATION AND CONCLUSION**

7.1	Project Evaluation .....	152
7.2	Conclusion .....	159

**APPENDICES**

## List of Figures

## List of Tables

1. Basic Design Study Team Members and Site Study Schedule
2. Minutes of Discussions
3. List of Interviewees
4. Statistical and Technical Data

## LIST OF FIGURES

Figure No.	Title	Page
Fig. 2-1	Organization of the National Government Executive Branch .....	8
Fig. 2-2	Organization of the Chuuk State Government Executive Branch...	9
Fig. 3-1(1)	Wind Rose, 1980-1992 .....	22
Fig. 3-1(2)	Wind Rose by Month, 1980-1992.....	23
Fig. 3-1(3)	Wind Rose by Month, 1980-1992.....	24
Fig. 3-2	Tide Level Chart.....	25
Fig. 3-3	Topographic Map of Project Site.....	29
Fig. 3-4	Outline of the Sea Port Master Plan.....	33
Fig. 3-5	Present Plan of Weno Port.....	36
Fig. 3-6	Standard Cross Section of Existing Dock-A.....	47
Fig. 3-7	Flow of Cargo Handling Operation.....	49
Fig. 3-8	Entrance Channel to Weno Port.....	50
Fig. 3-9	Organization Chart of Department of Transportation.....	54
Fig. 3-10(1)	Contents of the Request (1).....	57
Fig. 3-10(2)	Contents of the Request (2).....	58
Fig. 4-1	Chrological Graphs of Wave Height at Dock-B in 1992.....	78
Fig. 4-2	Container Yard Area before and after Expansion.....	81
Fig. 4-3	Layout Plan of the Project Items : (1).....	84
Fig. 4-4	Layout Plan of the Project Items : (2).....	85
Fig. 5-1	Location of Current Observation.....	92
Fig. 5-2	Maximum Current Speed and Direction.....	93
Fig. 5-3	Spot Observation.....	95
Fig. 5-4	Location of Water Quality Survey.....	98
Fig. 5-5	Location of Marine Sediment Quality.....	100
Fig. 5-6	Location of Marine Organization Survey.....	102

## LIST OF TABLES

Table No.	Title	Page
Table 2-1	Population of Micronesia, 1990.....	5
Table 2-2	National Production Indices, 1983-1989 .....	6
Table 2-3	Combined State and National Government Budget, 1990.....	10
Table 2-4	Exports and Imports of FSM .....	11
Table 2-5	Exports and Imports of Chuuk State .....	11
Table 3-1	Frequencies of Wind Occurrence by Direction and Speed, 1980-1992.....	21
Table 3-2	Frequencies of Wave Occurrence by Direction and Height, 1989-1992.....	27
Table 3-3	Vessels of Major Regular Lines.....	35
Table 3-4	Cargo Handled as International Cargoes (Import).....	39
Table 3-5	Cargo Handled as International Cargoes (Export).....	39
Table 3-6	Number of Containers Landed.....	40
Table 3-7	Import of Petroleum Products and Fuel Oil.....	40
Table 3-8	Number of Calls of International Vessels.....	40
Table 3-9	Vessels of Domestic Shipping.....	42
Table 3-10	Cargo and Passengers Transported by Domestic Vessels.....	42
Table 3-11	Outline of Port Facilities.....	44
Table 3-12	Cargo Handling Equipment.....	48
Table 3-13	Port Dues (International Vessels).....	53
Table 3-14	Annual Budget of Department of Transportation.....	53
Table 4-1	Projection of Incoming Marine Cargo, 2003.....	61
Table 4-2	Number of Containers in 2003.....	64
Table 4-3	Area Requirement for Container Yard.....	66
Table 4-4	Rate of Operationable Days for Mooring.....	77
Table 4-5	Ratio of Provision of Container Yard after Expansion.....	80
Table 4-6	Outline of the Project Items.....	83
Table 5-1	Results of Current Meter Survey.....	91
Table 5-2	Results of Float Trackings.....	96
Table 6-1	Selection of Type of Quaywall Structure .....	114
Table 6-2	Selection of Type of Steel Sheetpile Wall.....	115
Table 6-3	Project Implementation Time Frame .....	151

Figure No.	Title	Page
Fig. 6-1	Layout Plan of Extension of Docks.....	130
Fig. 6-2	Typical Cross-section of Rehabilitation of Dock-A.....	131
Fig. 6-3	Typical Cross-section of Extension of Dock-A.....	132
Fig. 6-4	Typical Cross-section of Small Dock along East Return Wall....	133
Fig. 6-5	Typical Cross-section of Ramp .....	134
Fig. 6-6	Typical Cross-section of Extension of Dock-B.....	135
Fig. 6-7	Typical Cross-section of Small Dock along North Return Wall...	136
Fig. 6-8	Typical Cross-section of Revetment of Container Yard.....	137
	(Steel Sheetpile Type)	
Fig. 6-9	Typical Cross-section of Revetment of Container Yard.....	138
	(Rubble Mound Type)	
Fig. 6-10	Plan of Dredging Area and Navigation Aids.....	139
Fig. 6-11	Plan of Navigation Aids (Entrance Channel).....	140
Fig. 6-12	Typical Design of Navigation Aids.....	141
Fig. 6-13	Organization Chart of Project Implementation.....	143

# CHAPTER 1

## INTRODUCTION



## CHAPTER 1: INTRODUCTION

### 1.1 Background of the Request

The Federated States of Micronesia (FSM) consists of about 600 islands scattered for the distance of 4,500 km from east to west at 0° to 14° N latitude in western Pacific ocean, and its inter-island transportation of people and daily commodities and export/import of goods to a large extent depend on marine transport. Therefore promotion of marine transport is essential for economic self-reliance of the country in terms of stable commodity prices and in expansion of export. Thus improvement of port facilities as basic infrastructures is considered a policy of primary importance.

Weno Port is the principal port of the Chuuk State located on western coast of Weno Island, one of the major islands in Truck Lagoon, which is one of the largest lagoon in the world (225 km in perimeter and 64 km in the largest diameter). Weno Port serves for about 50,000 people living on these islands as the life line and the base for State's economic activities.

The commercial port of Weno consists of Dock-A (depth: -9 m, length: 97 m) built in 1962 and Dock-B (depth: -9 m, length: 91 m) built in 1983. The container yard area is as small as about 3,500 m<sup>2</sup>, and the facilities are obsolete as they were built with an intention for the use of conventional type vessels and cargo handling system before container cargo system started. The dock is too short that it is only one half length of the standard length and the cargo handling area is also quite small. Corrosion and aging that has progressed during 20 to 30 years after they were built, and accumulated sand deposits in front of Dock-B for many years have created another problem. Mooring facilities are inadequate for small commuter boats (equipped with outboard engine), which are common means of traffic among the Lagoon island resident, hindering normal port activities within Weno Port causing congestion.

In order to improve such situation and to enhance the capacity of Weno Port, which is believed to be a great contribution for economic development of Chuuk State, the Government of the Federated States of Micronesia requested

the Government of Japan for a grant aid for extension of Weno Port including repair and extension of the docks, expansion of container yard and improvement of the commuter boats terminal.

## **1.2 Dispatch of the Study Team**

In response to the request by the Government of FSM, the Government of Japan decided to conduct a basic design study of the project and the Japan International Cooperation Agency (JICA) sent a study team headed by Mr. Masaki Shiomi, Chief of Design Standard Section, the Port and Harbor Research Institute, Ministry of Transport of Japan, to FSM for a period of 41 days from March 30 to May 9, 1993 to conduct a field study. In the course of the study, the study team collected data and information necessary, and discussed with concerned officials of the Chuuk State Government and with officials of the Government of FSM. Minutes of Discussions were signed on April 20, 1993. The further study was made in Japan and draft report of the study was prepared and presented to the Government of FSM from 4th to 16th of September, 1993. The basic scheme of the project has been confirmed and agreed.

## **1.3 Study Items**

Objectives of the basic design study are to work out the basic design for the expansion project requested by the Government of FSM, through detailed study on the background, scope and effect of the project. The study team conducted the following studies to formulate an appropriate project plan.

- (1) Confirmation of background and contents of the requested project
- (2) Confirmation of project priorities
- (3) Inspection of project sites
- (4) Confirmation of present conditions of the port
- (5) Survey of natural conditions (topography, sounding, etc.)
- (6) Survey on environmental conditions
- (7) Study on operation and maintenance of the port
- (8) Study on administration and organization of the port
- (9) Study on availability of local construction material and equipment
- (10) Scope of works to be born by the Government of FSM



This report presents the results of project study on the project components, facility layout, structural design, management system and overall project suitability basing on the above study.

The list of the Study Team members, study schedule, list of main interviewees and the Minutes of Discussions are attached in the Appendices of this report.



## **CHAPTER 2**

### **BACKGROUND OF THE PROJECT**



## CHAPTER 2: BACKGROUND OF THE PROJECT

### 2.1 Profiles of the Federated States of Micronesia and State of Chuuk

#### 2.1.1 Geography

##### (1) The Federated States of Micronesia

The Federated States of Micronesia is a typical insular country consisting of four states of Pohnpei, Chuuk, Yap and Kosrae, and consists of about 600 islands scattered in western Pacific at 0° - 14° N Latitude and 135° - 166° E Longitude.

The total land area of the country is about 700 km<sup>2</sup> and its Exclusive Economic Zone extends over an area of 2,600,000 km<sup>2</sup>. The principal islands and outer smaller islands are separated by distance and time, and the transportation for people as well as for goods and transmission of information are restricted in terms of speed and frequency.

As many of the islands are of the volcanic origin or atoll origin and have less sedimentary layers, the land is lean and agriculturally fertile only for growing palms and taros. However surrounded by abundant marine resources, development of marine industry are being promoted. The country's capital is established in Palikir, Pohnpei State.

##### (2) State of Chuuk

The State of Chuuk consists of seven island groups totally about 290 in number. Territory of the state covers 3° -13° N and 147° -155° E, at about 5,000 km southwest of Honolulu, at about 3,400 km southeast of Tokyo, at about 1,000 km southeast of Guam and at about 4,700 km north of Sidney.

Truck Lagoon ( 225 km in perimeter, 64 km in the largest diameter, 2,129 km<sup>2</sup> in lagoon area) situated at center of the State, surrounded by outer island groups of Mortlocks Islands, Hall Islands, and Western Islands etc. Total land area of the State is 130 km<sup>2</sup>, and the state capital is located in Weno City, Weno Island.

## 2.1.2 Social and Economical Status

### (1) Population

Table 2-1 shows the population of the Federated States of Micronesia estimated in 1990; however, the census were not conducted in the same year for each state. The total population of FSM is about 100,000 and about a half of them live in Chuuk State. Population increase in recent years is 2.8% for the whole country while that of Chuuk is 2.59 %.

Fertility ratio of FSM was over 3 % in the past 40 years, and it still maintain high ratio even in recent years. However, there are also reports that number of emigrants to Guam, etc. have been increasing at high rate since 1986.

In Chuuk, about 80% of state population are counted in Truck Lagoon area and some 30% reside in Weno Island. Population under the age of 15 accounts for about 49% in this state in 1990, and the working age population aged 15 and over accounts for about 25,000. The unemployment ratio is 13.5 %.

Table 2-1 Population of Micronesia (1990)

	Chuuk	Kosrae	Pohnpei	Yap	FSM
1990	48,853	7,435	33,346	10,886	100,520
Percentage	48.7	7.4	33.1	10.8	100.0
Growth Rate 1973-1985/89	2.59	3.88	3.31	2.05	2.80

Source: Second National Development Plan, FSM

## (2) Economic Status

The economy of FSM is characterized by the dual structure of money and market economy and self-subsistence economy. The former system functions among merchants, government employees and workers living in urban area of principal islands of the four states, and the latter system functions among villagers living in rural area and outer islands. The population under the self-subsistence economy in FSM is estimated to be about 50 % excluding pupils and students.

Of the workers in FSM, 47 % are engaged in agriculture and fishery, and 24 % are government employees and 29 % are employed by private companies. The high ratio of government employee is a characteristic feature in FSM. However the government employment mainly depends on decreasing financial aids from the United States, and unemployment of rapidly increasing young population is the issue to be resolved by enhancement of private industry.

Table 2-2 shows economic indices of the FSM. Gross domestic production (GDP) for 1989 was US\$ 144.8 million and gross national production (GNP) was US\$ 157.4 million. The breakdown of GDP (based on expenditures) for 1989 is shown in Appendix Table A-2-1. The Table shows that household consumer spending and government consumer spending are about US\$ 80 million each, indicating high dependence on the government expenditure in the money economy.

Table 2-2 National Production Indices (1983-1989)

(US\$ Million, Current Prices)

	1983	1988	1989
GDP at market prices	106.5	141.1	144.8
Gross national product	111.0	145.0	157.4

Source : Second National development Plan, FSM

Except for agriculture (copra cultivation) and fishery and tourism, none of the four states currently has any industry or mineral resources of any size. Recently developed abundant fishery sources of tuna and bonito in vicinity waters area yields more than 150,000 ton catch per year, being expected to be the nation's most important natural resource.

Figs. 2-1 and 2-2 show organizations of the National and Chuuk State Government, and Table 2-3 shows the 1990 fiscal year budgets of the National Government and each State Government. The 1985 - 1990 budgets for FSM and the 1988 - 1991 budgets for the Chuuk State Government are shown in Appendix Tables A-2-2 and A-2-3.

Table 2-3 shows that the entire revenue for FSM is US\$ 162 million, 73% of which being provided by foreign aids (particularly contributions from the United States) and only 8.5% coming from tax income. The income from fishing license fees is about US\$ 13 million constituting about 8%. Without aids from outside, the balance of the national budget is complete red figure by about US\$ 84 million deficit. The same applies for the budget of the Chuuk State Government.

The U.S. monetary aids are to be offered for 15 years under the Compact Fund Agreement concluded in 1986, accounting for about 90 % of the bilateral aids for FSM. Most of aids are grant aids of financial assistance type to nurture industries for self-supporting economy and to establish economic base to withstand decrease of economic aids every 5 years.

Remittance of earned money from emigrants to home family in FSM are said being a significant contribution for economy of FSM, but no detail are available.



Fig. 2-1 Organization of the National Government Executive Branch

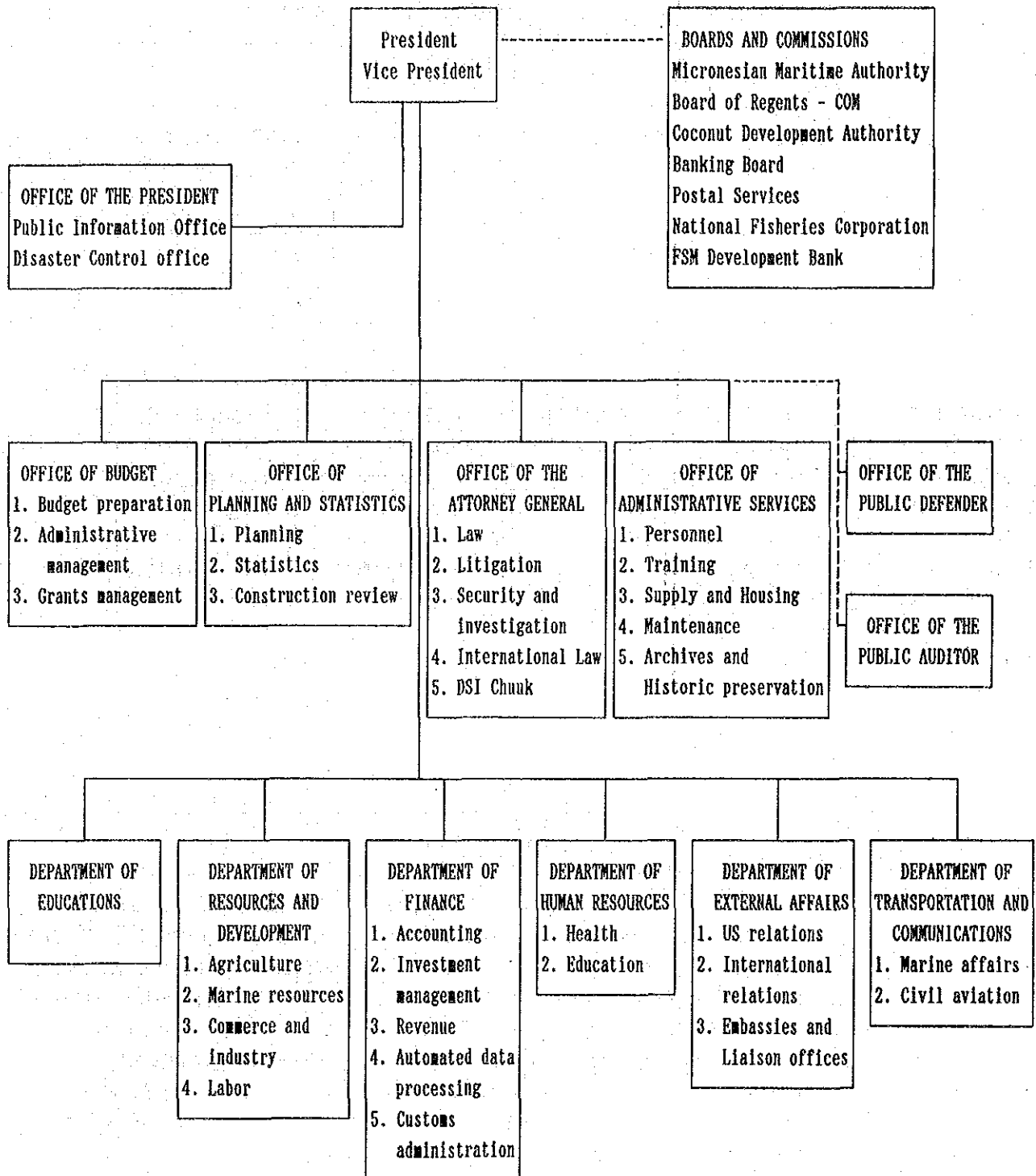


Fig. 2-2 Organization of the Chuuk State Executive Government Branch

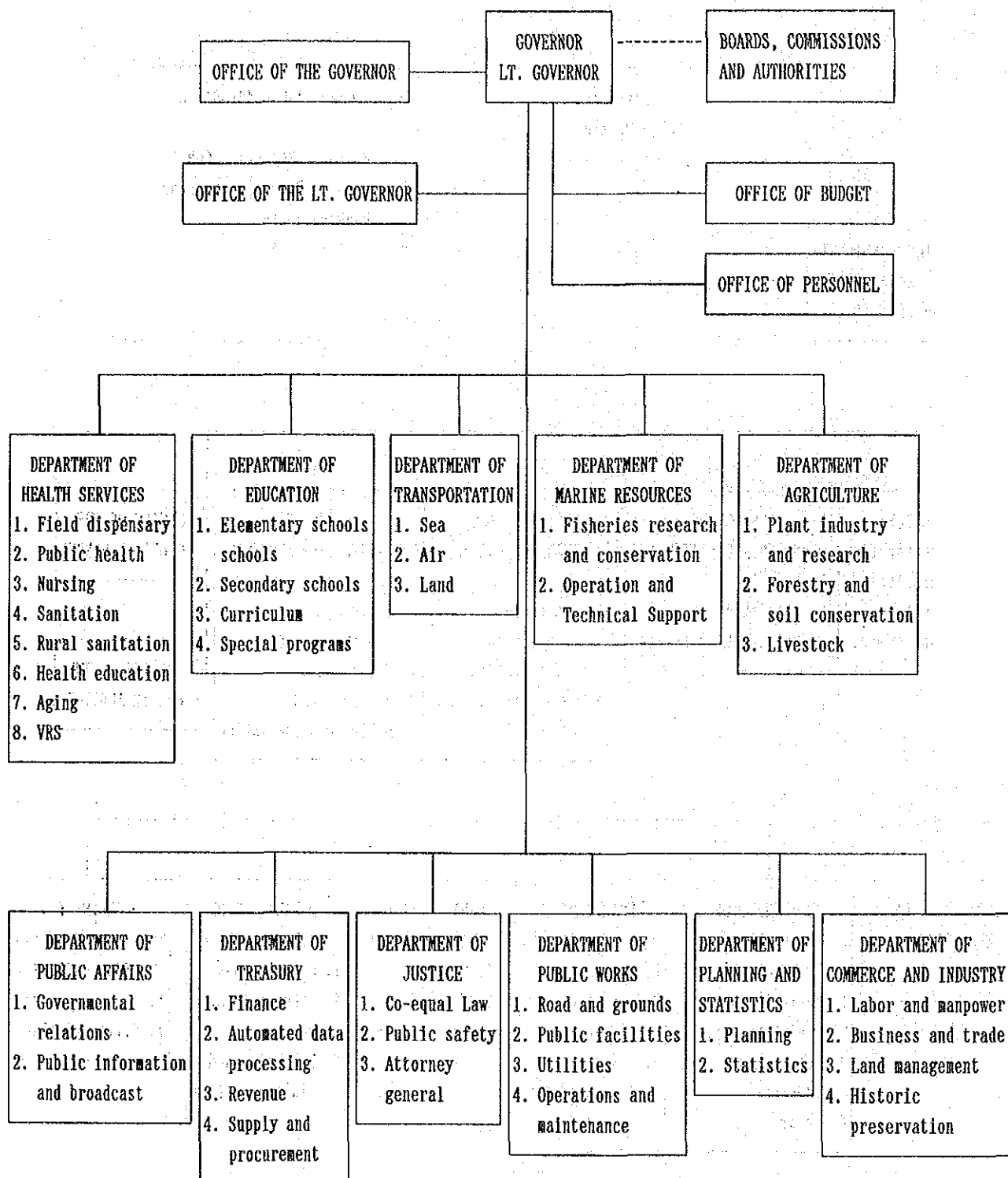


Table 2-3 Combined State and National Government Budget 1990

(US\$ Thousand)

	National	Chuuk	Kosrae	Pohnpei	Yap	Total	%
REVENUE AND GRANT							
Tax revenue	5,162	2,813	641	3,108	2,045	13,769	8.5
Nontax revenue	7,343	2,770	928	3,159	2,857	17,057	10.5
External grants	23,929	39,034	12,810	25,060	17,667	118,500	73.2
Fishing rights fees	12,660					12,660	7.8
TOTAL REVENUES	49,094	44,617	14,379	31,327	22,569	161,986	100.0
EXPENDITURES							
General fund	18,190	22,569	5,612	14,353	8,168	68,892	53.9
Special revenue funds	5,140	9,655	4,244	7,298	4,318	30,655	24.0
Capital projects funds	2,026	7,255	3,954	7,589	5,509	26,303	20.6
Expendable trust funds	1,755	-	122	19	34	1,930	1.5
TOTAL EXPENDITURES	27,111	39,449	13,932	29,259	18,029	127,780	100.0
OVERALL BALANCE INCLUDING GRANTS	21,983	5,168	448	2,068	4,542	34,209	
EXCLUDING GRANTS	-1,946	-33,866	-12,362	-22,992	-13,125	-84,291	

Source: Second National Development Plan, FSM

## (3) Trade

Tables 2-4 and 2-5 show the trade and balances for FSM and the State of Chuuk. The export and import volume breakdown by items and the trade balances by countries are shown in Appendix Tables A-2-4 to A-2-6.

These tables show the excess of imports by large margins; in 1991 the import is approximately three times more than the export for the whole country and about 10 times more for Chuuk. Major export items are marine products and copra and principal import items are food-stuff, followed by construction materials, machinery, automobiles, and petroleum products. The breakdown of exports by trade partners reveals Japan at the top of the list with about 90 % of share mainly by marine products, and for imports from the mainland U.S. and Guam occupy about 70 %, followed by Japan at about 20 %.

The extreme imbalance between exports and imports which results in foreign vessels returning empty is one of the factors for pushing up the freight costs. The National Government is promoting export by increasing export products, diversifying export items by introducing new products, developing new markets, and increasing export items of high added values.

Table 2-4 Exports and Imports of FSM

(US\$)

Type	Year	1987	1988	1989	1990	1991
Exports		7,962,575	13,167,571	17,428,004	21,705,138	29,467,119
Imports		41,889,621	67,701,424	72,724,789	83,880,020	88,630,630
Balance of Trade		-33,927,046	-54,533,853	-55,296,785	-62,174,882	-59,163,511

Source: FSM, Trade Bulletin, November, 1992.

Table 2-5 Exports and Imports of Chuuk State

(US\$)

Type	Year	1987	1988	1989	1990	1991
Exports		1,336,020	1,582,352	2,428,310	2,370,009	3,546,968
Imports		15,404,596	26,912,214	26,275,684	32,278,179	34,458,201
Balance of Trade		-14,068,574	-25,329,862	-23,847,374	-29,908,170	-30,911,233

Source: FSM, Trade Bulletin, November, 1992.

## **2.2 General Outline of National Development Plan**

### **2.2.1 National Development Plan of FSM**

FSM has established long term development plans for achievement of self-reliance of economy after termination of trusteeship. The plan is divided into three terms, one term covering for five years.

#### **(1) The First National Development Plan (1987 - 1991)**

Period of transition and reconstruction: efforts were exerted to complete the transition from Trusteeship status to full self-government and to promote the development of the private sector and to reconstruct the economy.

#### **(2) The Second National Development Plan (1992 - 1996)**

Period of sustained economic growth : The country will enter the stage of recovery from development investments.

#### **(3) The Third National Development Plan (1997 - 2001)**

Period of achievement of economic self-reliance : The country will become free from dependence on foreign aids.

In 1993, the FSM is currently entering the second year of the Second National Development Plan. As the background for this plan, economic development is progressing slowly despite termination of the First National Development Plan, levels of out-migration are high, funding under the Compact of Free Association is reduced and most US Federal programs such as health program and Training Partnership Act, etc. are decreasing to the FSM.

The Second National Development Plan highlights the following eight objectives.

- 1) Economic Development : Involving additional employment and income-earning opportunities in the private sector;

- 2) Human Resource Development : Improving the education system and training opportunities;
- 3) National Unity : Unity between the National Government and the State Government
- 4) Efficiency in Government : Improving efficiency in government activities
- 5) Cultural Development : Promoting traditional and cultural values and skills
- 6) Equity : Ensuring distribution of development opportunities
- 7) Quality of life : Elimination of poverty
- 8) Youth : Provision of education, training, and recruitment programs for rapidly increasing younger generation groups

As the country consists of four states of group islands and outer islands, sea and air ports play vital roles as the bases for exchange and transport of commodities and human resources between foreign countries and among islands. Improving these facilities is thus given the top priority in the development plan.

The development plan for improving the infrastructure for industry includes the following.

- a) Expansion of existing commercial port facilities in the four states

Existing docks and land facilities shall be improved to facilitate berthing and cargo handling of large ocean-going container ships. Also container yard shall be secured to serve as the base for containers.

- b) Improving the fishery related facilities

By improving facilities for fishery on land, marine products can be shipped out by the combined air/sea transport, thus promoting fishing industry as an export industry.

The policy plan for the Port and Harbor Division includes the following.

- a) Establishing Port Authority to integrate the management of port operations and improve their efficiency
- b) Improving and expanding major ports in the four states
- c) Improving the management system for inter-island shipment services
- d) Improvement and maintenance for inter-island transportation vessels
- e) Training the personnel for safe and efficient transportation

Facilitation of operation and management of marine transport in FSM are essential as an insular nation, and improvement and expansion of ports are essential for its economy because of its import dependence nature.

#### 2.2.2 The Development Plan of the State of Chuuk

The State of Chuuk also has established its own development plan corresponding to the National Plan, and proposes to appropriate much of the development funds for improvement of infrastructures.

The following four items are given priorities in the State's Development Plan.

- (1) Improvement of efficiency and cost-effectiveness within the State Government and that of ability to maintain, operate and rehabilitate the infrastructure;
- (2) Encouragement and facilitation of local foreign investment in sectors of pelagic fisheries and tourism and labor intensive manufacturing;
- (3) Developing human resources and promoting greater participation of all sections of the community in the progress of change;
- (4) Improving the management of the environment and natural resources.

The Port and Harbor Division plans the following:

- 1) Improvement and expansion of Weno Port and development of the coastal area;
- 2) Improvement of navigation aids in and out of Truck Lagoon; and
- 3) Introduction of the ferry services among islands in Truck Lagoon.

## **2.3 Outline of Marine Transport and Ports in FSM**

### **2.3.1 Outline of Marine Transport**

As FSM depends largely on marine transport for transportation of men and goods, marine transport is an essential means for sustenance and economic activities of its people. FSM marine transport consists of routes for international lines connecting major ports of FSM states with ports of Asia (mainly Japan), the United States and Oceania and routes for domestic inter-island lines.

#### **(1) International Lines**

Ten shipping companies serve the ports in FSM regularly for international trade; Tiger Lines (UMDA), Saipan Shipping Company (Sai Ship), Pacific Common Carrier (P.C.C.), Palau Shipping Company (PAL Ship), Nauru Pacific Lines (N.P.L.), Philippine Micronesia and Oriental Navigation Company (PM&O), Nippon Yusen Kaisha (N.Y.K.), Tokyo Senpaku Kaisha (T.S.K.), and Kyowa Line.

Each liners call at the major ports of the states at the frequency of once a month on an average. As the import is in huge excess of exports, there is an extreme imbalance in the cargo volume, and the ships are quite often empty going back from Micronesia. The lines therefore take the space charter system, with the feeder service by containers from Guam to FSM accounting for the major portion. With the increase of cargo volume, containerization is rapidly progressing, and the demand for reefer containers is expected to increase with developments of the marine resource industry.



## (2) Domestic Cargo Lines

Government-owned five cargo-passenger vessels of 880 DWT class are in service for transportation of men and goods among the principal ports of the states and outer islands. These ships are used also for government services such as transporting sick patients or assistance for disaster occasion. Their role are very highly evaluated though present services are not on regular schedule. Regularization of services are at high demand.

### 2.3.2 Outline of Main Ports in FSM

In FSM, each state has each own international trade port as the main port for each state, functioning as a basic infrastructure to support livelihood of state inhabitants.

Main facilities of each port are outlined below.

#### (1) Kolonia Port in Pohnpei State

1) Approach channel:	Length of channel	3.2 km
	Width of channel	91.4 m
		(at narrowest part)
	Depth of channel	-22 to -44.8 m
2) Main wharf:	Length	292.6 m
	Depth	-9.1 m
	Type of construction	Concrete pile type
3) Warehouse:	Area	2,043 m <sup>2</sup>
4) Open storage yard:	Area	17,800 m <sup>2</sup>

#### (2) Weno Port in Chuuk State

1) Approach channel:	Length of channel	22.5 km
	Width of channel	240.0 m
	Depth of channel	-14.6 m

2) Main wharf:	Length	Dock-A	97.0 m
		Dock-B	91.0 m
	Depth		-9.1 m
	Type of construction	Steel sheetpile type	

3) Warehouse:                      Area                      1,443 m<sup>2</sup>

4) Open storage yard:              Area                      3,467 m<sup>2</sup>

### (3) Yap Port in Yap State

1) Approach channel:              Length of channel              2.4 km  
    Width of channel              100.0 m  
    (at narrowest part)  
    Depth of channel              -8.5 m

2) Main wharf:                      Length                      250.0 m  
    Depth                      -10.5 m  
    Type of construction      Steel sheetpile type

3) Warehouse:                      Area                      1,443 m<sup>2</sup>

4) Open storage yard:              Area                      26,100 m<sup>2</sup>

Financial cooperation under a grant aid program from the Government of Japan was made during 1990 and 1991 to improve the following facility works in the Yap Harbor.

- 1) Approach channel widening and deepening;
- 2) Turning basin;
- 3) Navigation aid system;
- 4) Main wharf and container yard extension.

Implementation of the Project made significant contribution for development of society and economy of the Yap State.

(4) Okat Port in Kosrae State

1) Approach channel:	Length of channel	0.8 km
	Width of channel	91.0 m
		(at narrowest part)
	Depth of channel	-22.0 m
2) Main wharf:	Length (Main dock )	167.6 m
	(Western dock)	121.9 m
	Depth	-9.0 m
	Type of construction	Concrete pile type

Each port is under administration of Port Division in each state government. Operation of cargo handling are undertaken by private sectors entrusted by the state government, owning their own equipments.



## CHAPTER 3

### OUTLINE OF WENO HARBOR



## CHAPTER 3: OUTLINE OF WENO HARBOR

### 3.1 Natural Conditions

#### 3.1.1 Climatic Conditions

The climate of the State of Chuuk is a typical tropical one characterized by warm temperature with less variation and high annual precipitation. Chuuk has two seasons, dry and wet. The dry season begins in the month of January and continues through March and the wet season starts in June and remains through until November.

Weather observation in Chuuk has been conducted since November, 1945 by the Chuuk Weather Station situated nearby the Chuuk International Airport. The observed data have been transferred to the National Climatic Data Center, US Department of Commerce, which compiles annual summary and monthly summary. A part of the latest annual summary of the year 1991 is shown in Appendix Tables A-3-1 to A-3-3. According to the information obtained from those climatic data, the Chuuk climate is summarized as follows:

##### (1) Temperature and Humidity

Average temperature for the past 30 years was 27.5°C with less than 1°C variation on the monthly average. Yet, temperature variation in a day is wide, as much as 7°C.

Relative humidity has been observed four times a day, and averages were 86% at 4 o'clock, 79% at 10 o'clock, 77% at 16 o'clock and 84% at 22 o'clock per year, which indicates tendency that the relative humidity in the nighttime is a little higher than in the daytime. The maximum variation of humidity through a year was something like 8%.

## (2) Weather and Precipitation

Average number of complete sunny days in daytime is 3 days per year, and partly cloudy days are 45 days. Partly cloudy with occasional shower days is 317 days. Most of days are generally momentarily rainy at early morning or late night and cloudy in the daytime with an occasional squall, but raining all day is not common.

Average annual precipitation for the past 30 years was 3,451 mm. Precipitation during dry season, January through March, is approximately 100 mm in monthly average, but during wet season, June through November, rainfall exceeded 300 mm per month.

No fog was ever recorded in Chuuk.

## (3) Winds

Annual average wind velocity for the past 26 years was 3.9 m/sec. Prevailing winds are the trade wind from northeast from November through June. These winds range from 3.2 to 5.1 m/sec in monthly average; about 20% higher velocities occur during dry season, January through March.

From July to October, winds shift to the southeast-southwest quadrant and diminish to about 3.1 to 3.6 m/sec. Table 3-1 and Fig. 3-1 show frequencies of wind occurrence by direction/speed and wind rose.

Between July and November, Weno island is occasionally influenced by tropical storms which are generated from moist southerly winds and tropical disturbances. It is reported in the Seaport Master Plan for Island of Weno that in November, 1991, Cyclone OWEN passed over Truk Lagoon to north and caused damage on some facilities in the Weno Port area, and the Chuuk Weather Station reports that the peak gust at that time was 26.4 m/sec. Among the past records observed at the Chuuk Weather Station, the fastest peak gust was 42 m/sec recorded at the time of Cyclone NINA, in November, 1987. Some five tropical storms raged at Chuuk during the past five years.



Table 3-1 Frequencies of Wind Occurrence by Direction and Speed  
(1980 - 1992)

WIND DIRECTION	U.K.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
WIND SPEED (m/s)																		
Calm	2044 5.9	0 0.0	1 0.0	2 0.0	3 0.0	4 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.0	2 0.0	3 0.0	4 0.0	1 0.0	0 0.0	0 0.0	2065 5.9
0.0 - 2.5	3 0.0	115 0.3	120 0.3	351 1.0	538 1.5	1106 3.2	768 2.2	541 1.6	239 0.7	211 0.6	72 0.2	83 0.2	96 0.3	127 0.4	89 0.3	74 0.2	64 0.2	4597 13.2
2.5 - 5.0	15 0.0	576 1.7	962 2.8	3733 10.7	3500 10.0	2863 8.2	981 2.8	662 1.9	290 0.8	653 1.9	353 1.0	493 1.4	492 1.4	684 2.0	321 0.9	306 0.9	243 0.7	17127 49.2
5.0 - 7.5	3 0.0	175 0.5	594 1.7	3619 10.4	1949 5.6	956 2.7	290 0.8	189 0.5	66 0.2	288 0.8	291 0.8	385 1.1	317 0.9	361 1.0	115 0.3	84 0.2	52 0.1	9734 28.0
7.5 - 10.0	0 0.0	17 0.0	81 0.2	365 1.1	128 0.4	51 0.1	24 0.1	14 0.0	4 0.0	48 0.1	92 0.3	139 0.4	72 0.2	71 0.2	15 0.0	9 0.0	14 0.0	1145 3.3
10.0 - 15.0	0 0.0	1 0.0	4 0.0	5 0.0	6 0.0	2 0.0	1 0.0	2 0.0	0 0.0	10 0.0	46 0.1	38 0.1	10 0.0	10 0.0	6 0.0	5 0.0	4 0.0	150 0.4
15.0 - 20.0	0 0.0	0 0.0	1 0.0	0 0.0	0 0.0	1 0.0	0 0.0	1 0.0	0 0.0	0 0.0	0 0.0	2 0.0	1 0.0	1 0.0	0 0.0	0 0.0	0 0.0	7 0.0
20.0 - 25.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
25.0 - 30.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.0
30.0 -	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
TOTAL	2065 5.9	884 2.5	1763 5.1	8076 23.2	6124 17.6	4983 14.3	2064 5.9	1409 4.0	600 1.7	1210 3.5	855 2.5	1142 3.3	991 2.8	1258 3.6	547 1.6	478 1.4	377 1.1	34826 100.0

Note : U.K. : Wind Direction Unknown Data

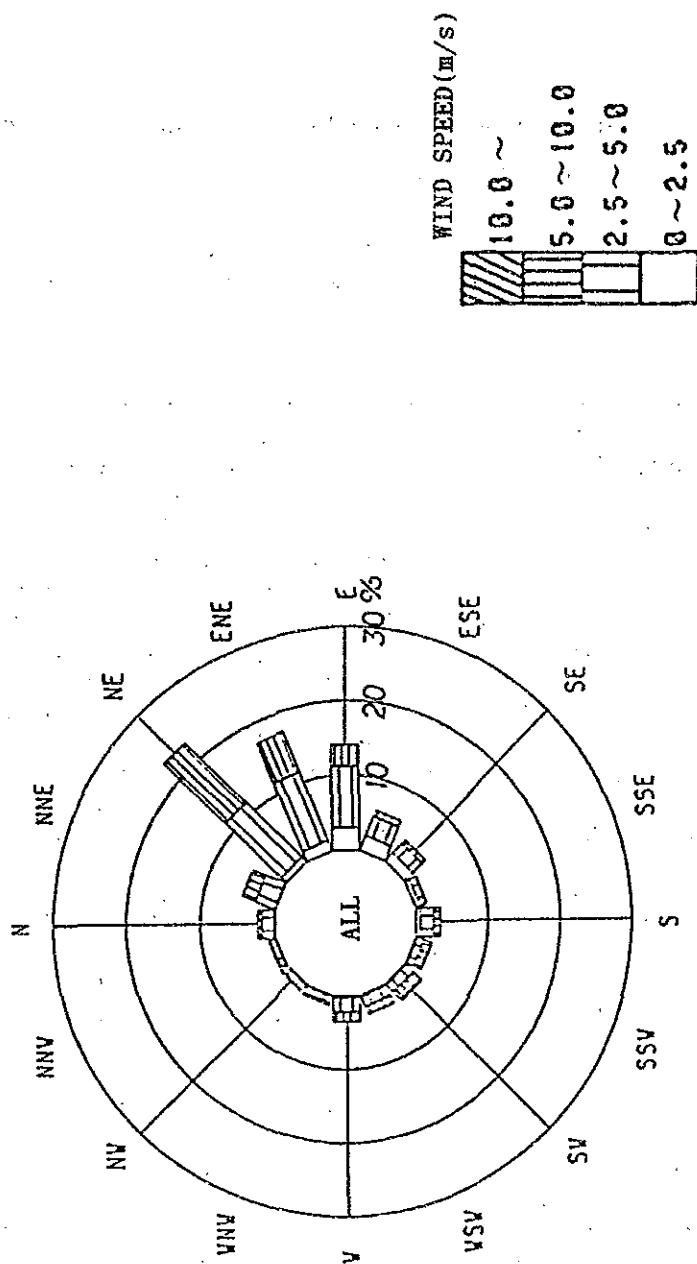


Fig. 3-1 (1) Wind Rose (1980 - 1992)

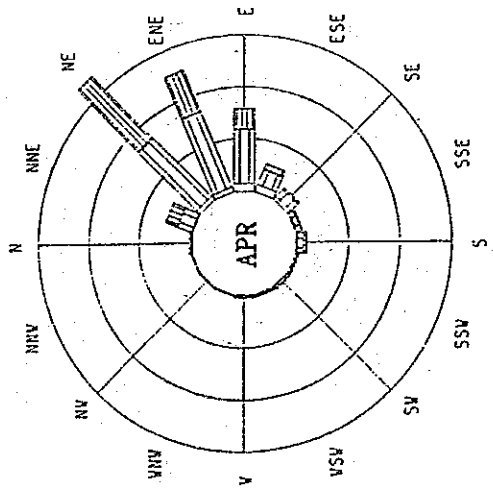
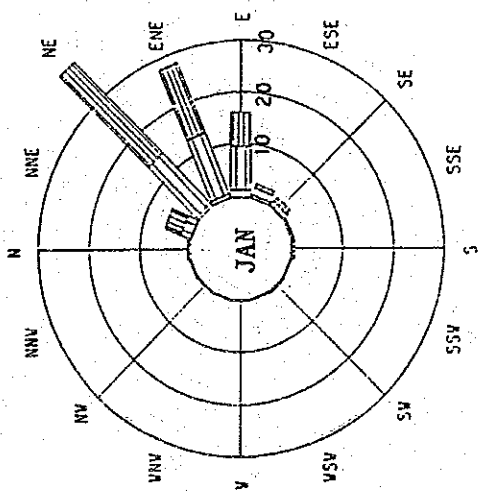
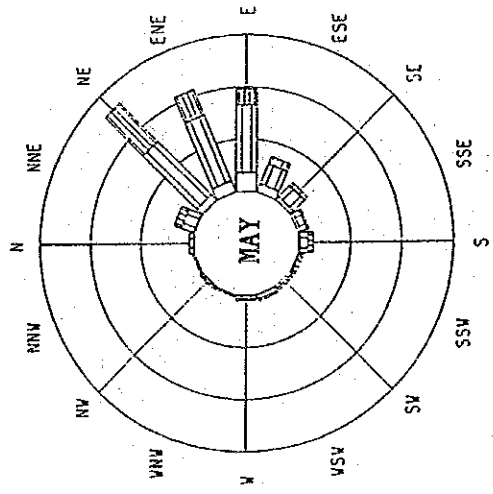
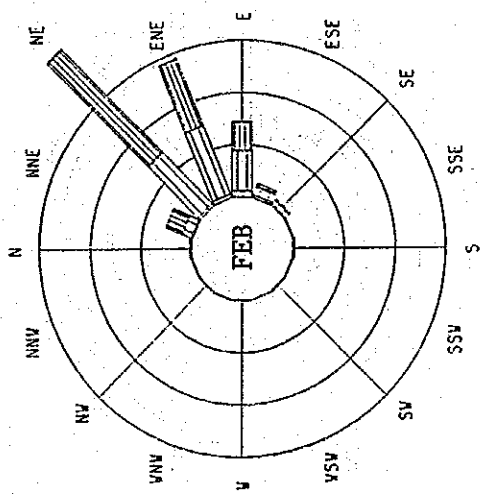
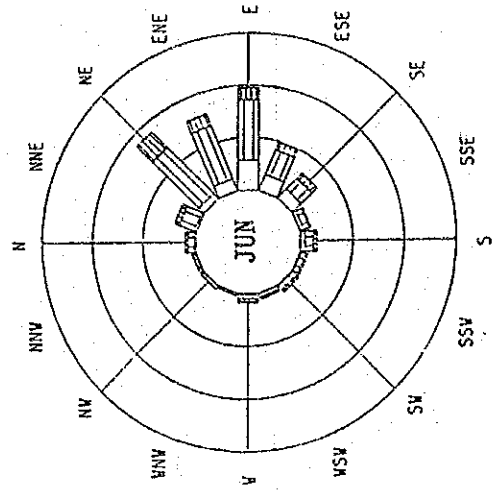
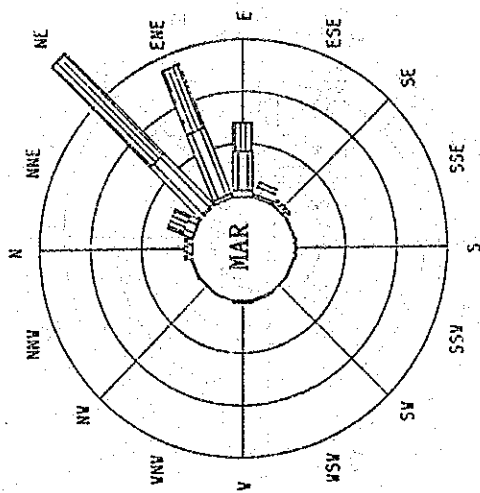
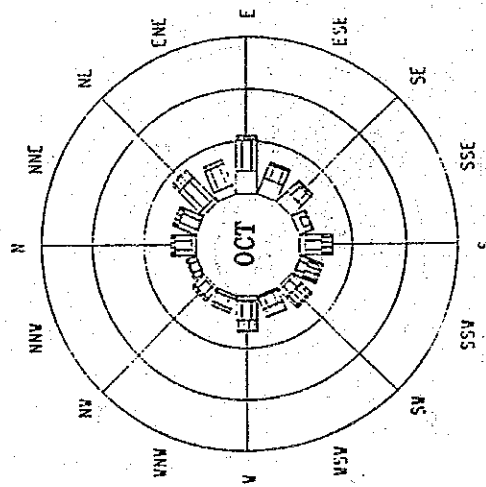
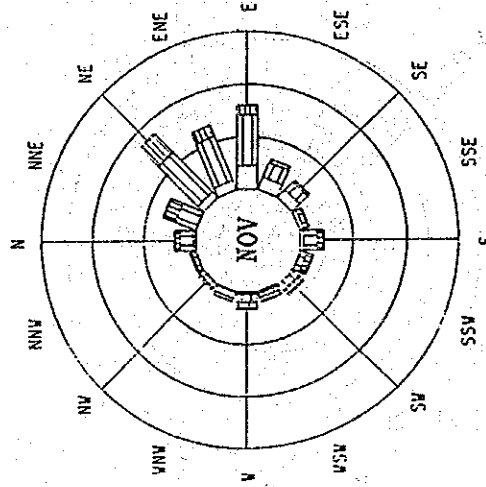
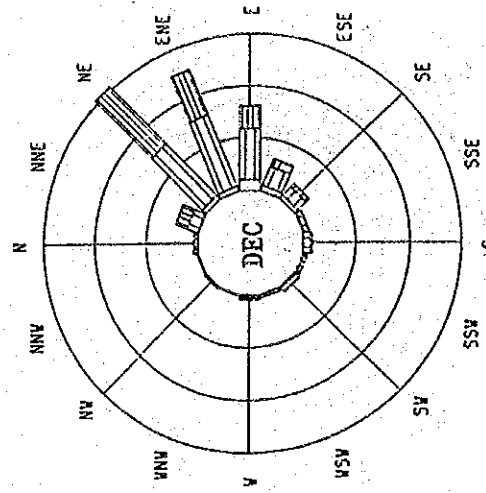
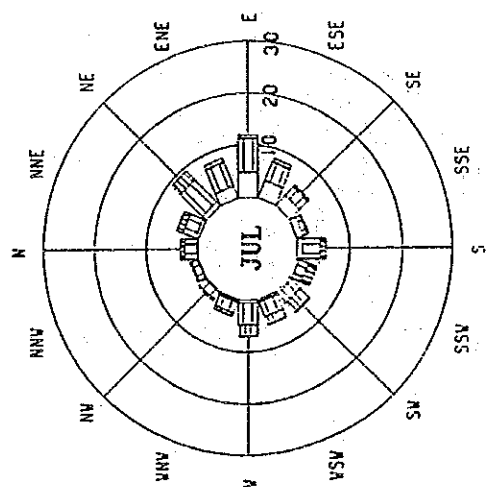
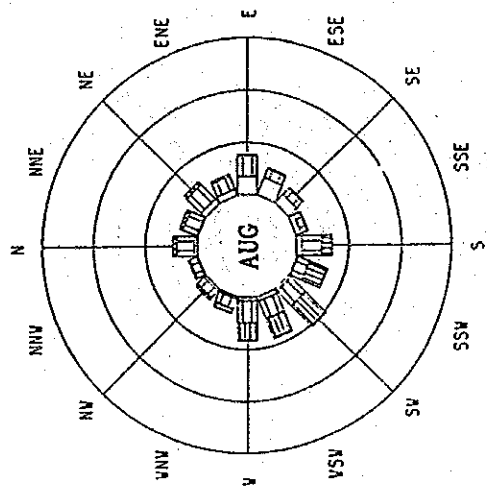
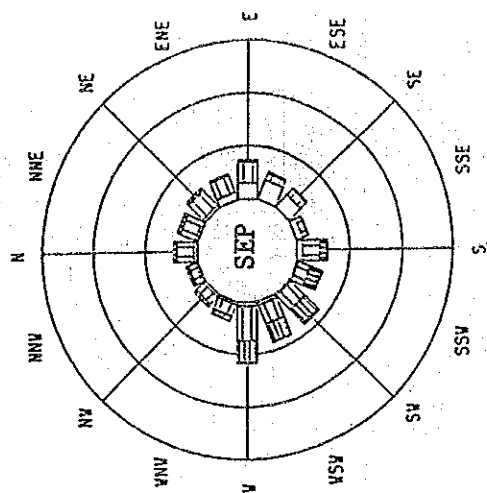


Fig. 3-1(2) Wind Rose by Month, 1980-1992



**Fig. 3-1(3) Wind Rose by Month, 1980-1992**

### 3.1.2 Hydrographic Conditions

#### (1) Tide

The study team made tide observation at Weno Harbor for 28 days from April 10 to May 8 using pressure type tide-meter. Tide data were taken at a location neighboring to Tide Gauge Station of Chuuk Weather Station placed at the east end of Dock-A. The results of observation and analysis are shown in Appendix 4(1).

The tide characteristics in this region show a specific pattern of diurnal type with some semi-diurnal variation.

Tide Level Chart is shown in Fig. 3-2.

Since the chart datum line of Weno Island has been set at 2 ft. (0.6096 m) below the mean sea level by Admiralty Chart, levels of all kind tide are given on the basis that chart datum line level is 0.00 m.

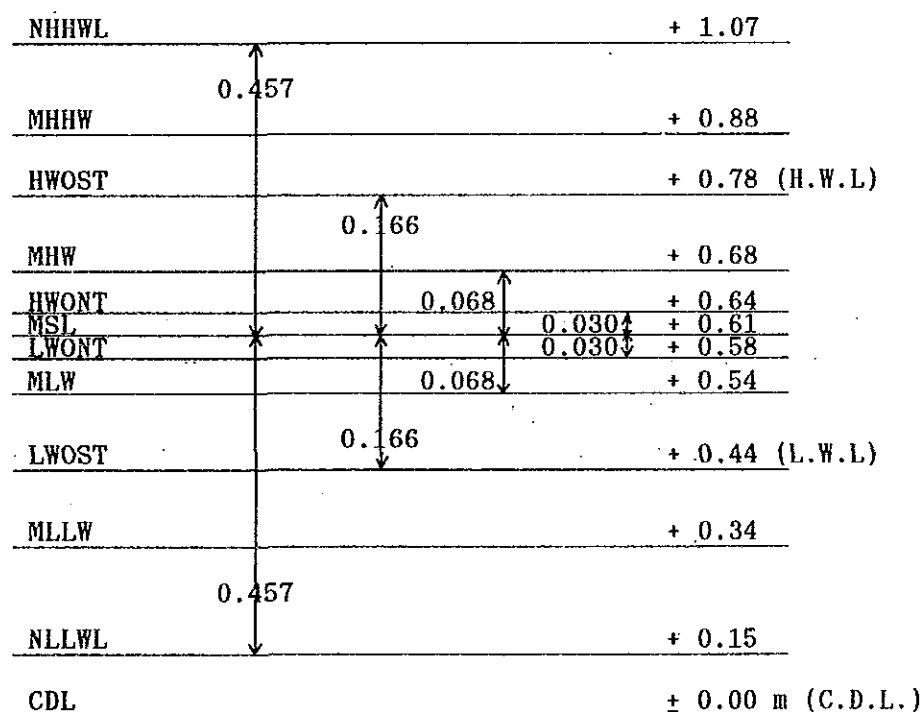


Fig. 3-2 Tide Level Chart

## (2) Wave

The barrier reefs that surround Truk Lagoon protect Weno and other lagoon islands from the direct approach of Pacific ocean waves. Consequently, the characteristics of waves reaching Weno Harbor are primarily surface wind wave and occasionally accompanied by tropical storms waves passing over the reef.

Since there is no wave observation record is available in Chuuk, the study team attempted estimation of waves to reach Weno Harbor on the basis of the records of surface wind and tropical storms and cyclones. The wave estimation can be divided into two types according to purposes of use as the followings:

- 1) For the purpose to estimate rate of operationable days of Dock-A and Dock-B in Weno Port per year.

A wave computation were performed on ordinary wind wave condition by surface wind.

- 2) For the purpose of design of revetment of Weno Port.

Wave computation were performed for the case of extraordinary wind wave condition by tropical storms or cyclones.

For the case of ordinary wind condition, S.M.B. method (method for wave calculation from wind velocity, fetch and duration of wind) was applied including the effect of duration and attenuation due to wind direction. Wind records for the period from 1989 to 1992 were used since missing data are relatively lesser. Wind directions from north-northeast to south-southeast were omitted since objective port, Weno harbor, open west and sheltered from easterly winds. From the above conditions, frequencies of wave occurrence by direction and height are obtained in Table 3-2. By this estimation study, frequency of deep water wave of 0.5 m and over height is found to be 7.3%, and that of 1.0m and over is found 0.8%. Detail of wave computation for the case of ordinary wind condition are given in Appendix 4(2).

Table 3-2 Frequencies of Wave Occurrence by Direction and Height  
(1989-1992)

WAVE DIRECTION	N	NNE-SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
WAVE HEIGHT(m)											
Calm	0 0.0	8661 74.1	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	8661 74.1
0.00 - 0.25	133 1.1	0 0.0	232 2.0	80 0.7	99 0.8	88 0.8	103 0.9	57 0.5	79 0.7	63 0.5	934 8.0
0.25 - 0.50	164 1.4	0 0.0	290 2.5	129 1.1	152 1.3	138 1.2	144 1.2	80 0.7	75 0.6	61 0.5	1233 10.5
0.50 - 0.75	31 0.3	0 0.0	45 0.4	47 0.4	116 1.0	112 1.0	106 0.9	41 0.4	26 0.2	24 0.2	548 4.7
0.75 - 1.00	11 0.1	0 0.0	8 0.1	22 0.2	51 0.4	43 0.4	51 0.4	15 0.1	9 0.1	6 0.1	216 1.8
1.00 - 1.25	0 0.0	0 0.0	2 0.0	18 0.2	22 0.2	14 0.1	3 0.0	2 0.0	1 0.0	6 0.1	68 0.6
1.25 - 1.50	0 0.0	0 0.0	0 0.0	3 0.0	4 0.0	5 0.0	2 0.0	1 0.0	2 0.0	0 0.0	17 0.1
1.50 - 2.00	0 0.0	0 0.0	0 0.0	0 0.0	6 0.1	1 0.0	1 0.0	0 0.0	0 0.0	1 0.0	9 0.1
2.00 - 2.50	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.0	1 0.0	0 0.0	0 0.0	0 0.0	2 0.0
2.50 -	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
TOTAL	339 2.9	8661 74.1	577 4.9	299 2.6	450 3.9	402 3.4	411 3.5	196 1.7	192 1.6	161 1.4	11688 100.0

For the case of extraordinary wind condition, wave height in case of Cyclone OWEN which attacked Weno Island in 1990 was estimated by computation, and as the results, deep water wave height was found to be 3.1 m and its period to be 6 second.

### (3) Currents

Observation of current in sea was made by the study team at the project site by means of recording current meter reading and floats. The detailed results are described in the Chapter 5, but the general characteristics are summarized below.

The current comprises two components of residual current and tidal current. The maximum observed current velocity was about 5 cm/sec at northern area of Dock-B and in front of Dock-A, and was 10.4 cm/sec at approximately 250 m offshore point. The most frequently observed current velocity ranges from 0 to 4 cm/sec and the average current velocity is about 3 cm/sec, which indicate extremely weak current.

The current pattern in the project site were toward in between east-southeast and southwest at flood tide, and toward northeast at ebb tide.

#### 3.1.3 Land and Seabottom Topography

Topographic survey in land area was carried out by the study team covering areas of the project site and its vicinity. The resulted map is shown in Fig. 3-3.

Bathymetric survey by sounding was performed by the study team covering areas of the project site and its offshore approximately 1 km away. The resulted bathymetric chart is as shown in Fig. 3-3. All sounding depths are given in chart datum depth as established in the preceding section, 3.1.2 (1).







Fig. 3-3 Topographic Map of Project Site



### 3.1.4 Foundation Soil Conditions

Foundation Soil survey were conducted by the study team by means of soil boring and laboratory tests. The total number of boring logs was 7 points (6 sea bottom borings, 1 land boring). The locations of boring logs and boring logs at each point are shown in Appendix Figs. A-3-7 and A-3-8. The characteristics of soil conditions are summarized as follows:

#### (1) Dock B and northern area

In this area 4 sea bottom borings were performed, at Boring No. 1 to 4. According to boring logs shown in Appendix Fig. A-3-8, it can be seen that gravelly sand and silty sand with coral fingers and shell fragments generally constitute foundation layer. N-value by Standard Penetration Test ranges from 3 to 15 depending on the soil density. Stiff layer of sandy silt underlies the said silty sand at boring No.4, but its N-value is relatively high; from 10 to 30. Hard coral boulders were found in place to place. No bedrock has been reached within these boring depths.

#### (2) Dock-A and eastern area

In this area 2 sea bottom borings were performed at Boring No. 5 to 6. Soil property therein are much the same as in the northern area for Dock-B as described above, though N-value are lower, ranging from 2 to 7, and relatively loose. A relatively thick layers of light grey-brown sandy silt layer lie in intermediate stratum ranging in generally soft to stiff consistency.

#### (3) North Inner Basin Area

In this area one land boring was performed, at Boring No.7. Soil property therein is much the same as in the northern area of Dock B, but N-value is a little lower ranging in 3 to 9, with relatively loose consistency.

### 3.1.5 Geology

Chuuk islands generally consists of high volcanic origin islands inside the Truk Lagoon, surrounded by lower coral atolls.

The higher volcanic origin islands in the Truk Lagoon are remnants of a former large shield volcano consisting of basalt, andesite, and basalt lava flown out interbedded with pyroclastic rocks and conglomerates. Volcanic basalt rock are the primary geologic characteristic of the higher islands in the Truk Lagoon. Younger sediments have gradually settled at around foot of island slopes forming low-lying coastal marshes and swamps. Also silty sand layer with coral fragments have been deposited along the shoreline of islands.

### 3.1.6 Earthquake

No observation data on earthquake is available for the island. However this area is known to be affected by earthquakes occurring in Marina Trench area. Earthquake intensity in this area are conjectured in Appendix 4(3).

## 3.2 Outline of Weno Harbor

### 3.2.1 Development Plan for Weno Port (Master Plan)

The State Government of Chuuk revised the Master Plan for Weno Port (prepared in 1987 by a consultant of Pohnpei) in 1993, to establish a long term development policy for Weno Port in expectation of grant aids. Chuuk State was presented this Master Plan to the Basic Design Study Team before starting the site survey.

The Master Plan is entitled the "SEAPORT MASTER PLAN FOR ISLAND OF WENO", and revision was completed in January 1993 by a consultant in California under the technical assistance of the United States Government.

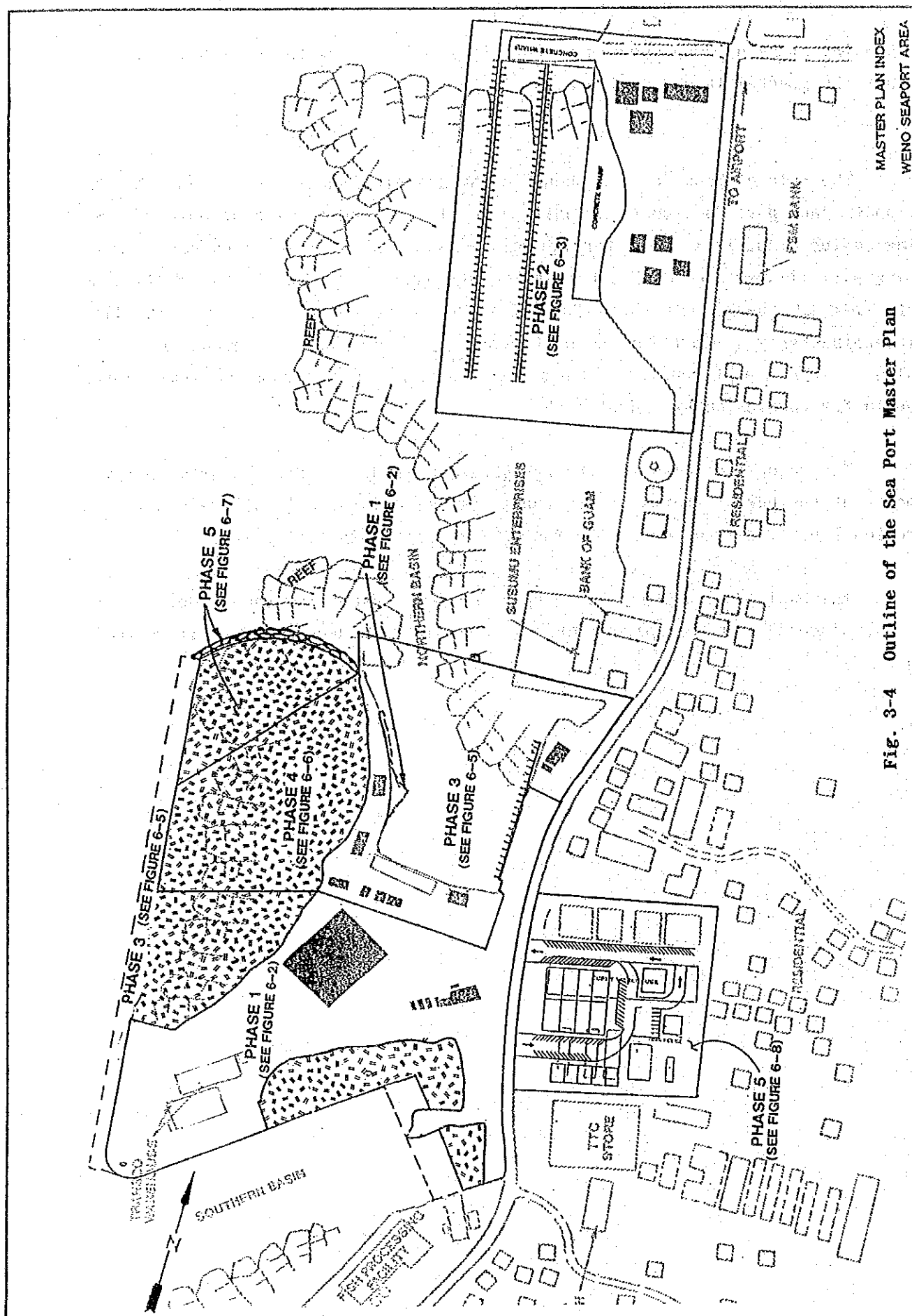
The new Seaport Master Plan is intended corresponding to establishment of "the renewed second term of the "National Development Plan of FSM" and "the State Development Plan of Chuuk", aiming to achieve common basic objectives of economic growth and economic self-reliance. The Seaport Master Plan envisages a 50 % economic growth in this state during the decade from 1993 to 2003,

proposing stage-up developments of port facilities to reach the goal. Fig. 3-4 shows the general layout of the plan.

The role of Weno Port in Chuuk in the Master Plan is to act as international trade port for importing daily necessities, and as fishing base exporting marine products to earn foreign currencies, and also as intra-state shipping port serving to regional traffic and transportation for outer islands of State of Chuuk. As these functions currently operated in same facility interminglingly, separation of port zone by functions is proposed in the plan. Fishery port complex is now under construction along the south inner basin for completion by end of 1993.

The requested items for the Basic Design Study are particularly improvements of the port in terms of its functions as an international trade port and regional port, designated in the Master Plan as the initial stage.

The Basic Design Study has been proceeded respecting the Seaport Master Plan, since it contains plenty of guidance plan and useful reference materials.



MASTER PLAN INDEX  
WENO SEAPORT AREA

Fig. 3-4 Outline of the Sea Port Master Plan

### 3.2.2 Current Status of Weno Port

Weno Port currently performs two major functions as a general commercial port and as a fishery base port. Because of limited berthing facilities, vessels for both purposes are sharing the use. To separate the functions and to provide specialized reserved area, a new fishery complex dock is now under construction by the National and the State Government.

In consideration of the separation policy of fishery function, this basic design study covers commercial port function only. Fig. 3-5 shows the plan of Weno Port.

Commercial port functions of Weno Port are further classified into the following three categories:

- 1) Functions of international trade port for import and export vessels
- 2) Functions of intra-state service port and inter-state service domestic port
- 3) Functions of mooring basin for commuter boats within Truk Lagoon

Those three functions are operated in same facility intermixingly in this port because of insufficiency of berthing facility. Some 300 commuter boats run every day, while international trade vessels make some 50 calls a year and domestic boat make some 100 calls yearly in this port, causing disorder and inefficiency and dangers. To solve the situation, it is necessary to expand port facility to improve respective port functions.

#### (1) International trade port function

Weno Port is a gate port for international trade for the State of Chuuk, and daily necessities such as foods, sundries and fuel oil are imported through this Port and distributed to outer islands from this port. The Port is thus the starting point of the trunk arteries for Chuuk.

Major international liners regularly calling at Weno Port are PM&O Line connecting the U.S. West Coast and South Asia via Micronesia,



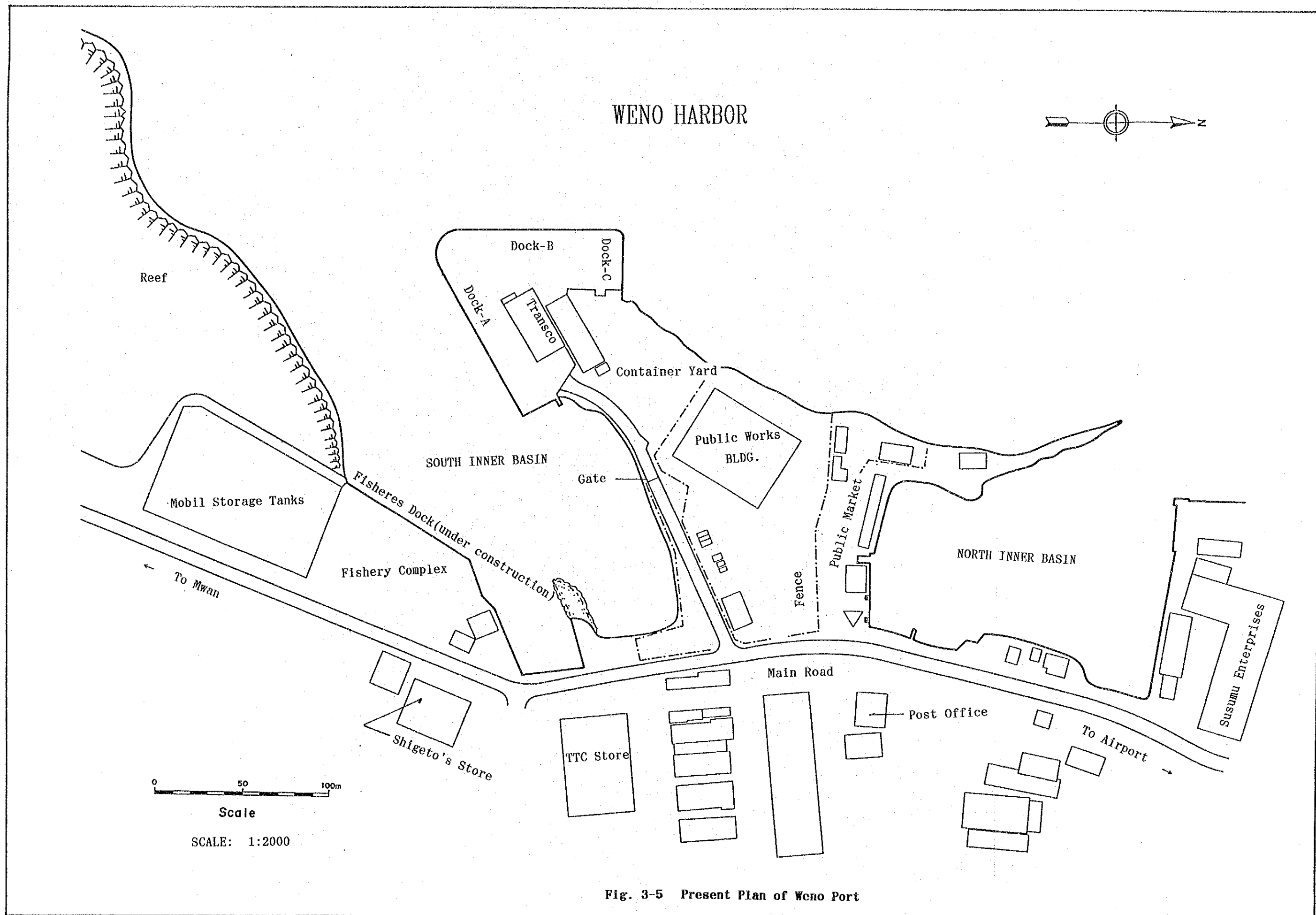
and Kyowa Line serving Japan, Micronesia and Far East. Other regular and non-regular lines from Australia, Singapore and Hawaii also calling the port. European and American passenger cruise boats are also known to call at the port on non-regular basis. Table 3-3 shows vessels of major regular lines.

Table 3-3 Vessels of Major Regular Lines

Shipping Line	Name of Ship	Number of Ship	Gross Tonnage (GT)	Length (m)	Width (m)	Draft (m)
PM&O Line	MICRONESIAN COMMERCE	3	5,731 (8,800DWT)	127.3	20.6	6.7
	MICRONESIAN INDEPENDENCE		5,537 (8,800DWT)	127.3	20.6	6.7
	MICRONESIAN PRIDE		6,783 (8,800DWT)	120.8	20.8	7.3
Kyowa Line	KYOWA ROSE	2	5,650 (6,300DWT)	99.4	18.8	7.5
	KYOWA VILOLET		7,337 (8,000DWT)	118.0	19.2	7.3
Mobil Oil	GOLDEN CRAIG	1	4,409 (6,700DWT)	107.8	18.0	6.9

Note:- DWT : Dead Weight Tonnage







PM&O Line connects Micronesia to west coast of the United States, Hawaii and Guam by three container ships (8,800 DWT). As all the ships are more than 10 year old, a plan to build larger ships is now under way. PM&O Line calls at this port at an interval of three weeks on an average, unloading 80 to 90 containers per call, and loading out about the same number of empty containers. They also bring reefer containers.

Kyowa Line serves Pusan, Kobe, Yokohama, Saipan, Guam and Micronesia by two semi container ships (about 8,000 DWT). As they are also more than 10 years old, there is a plan to replace the ships with new ones. Kyowa Line makes call at the port once a month on an average, unloading 70 to 80 containers and bulk cargo (including vehicles), and loading out about the same number of empty containers. They plan to launch a monthly feeder service between Guam and the States of Micronesia from July, 1993.

Tables 3-4 and 3-5 show the cargo handled as international cargoes (import/export) in 1988, 1991, 1992, and records of vessel calls and incoming cargo in 1991 are shown in Appendix A-3-11. The 1992 cargo volume consisted of about 50,000 tons of import and about 1,000 tons of export, showing an extreme excess of import. Of the import cargo, FCL (full container loaded) accounted for about 70 %, LCL (less than container loaded) for about 7 % and bulk cargo for about 23 %, indicating a high ratio of FCL. About 35 % of the export is copra.

FCL means containers charged with cargo shipped in the unit of one container and directly transported from the cargo owner to the receiver, whereas LCL means containers that are charged with cargoes of multiple owners which are less than one unit of container, requiring charging and discharging at CFS (container freight station).

Table 3-4 shows a radical increase of import for 1991 because of the emergency aids and import of reconstruction materials for recovering of damages inflicted by large cyclone OWEN in November, 1990.

Table 3-6 shows the number of containers landed. In 1992, about 1,700 containers of 20 ft equivalent were landed. Recently, the number of 40 ft containers is increasing.

Table 3-7 shows the import of petroleum products and fuel oil. Mobil Oil imports about 22,000 kilo liters (about 139,000 barrels) of gasoline, jet fuel, kerosene, and diesel oil per year through Weno Port at an interval of 30 days on an average from Singapore and other places. Because of rapid increases of automobiles and boats with outboard engine, the demand of fuel is rising. A tanker is used for their import.

Table 3-8 shows the number of calls of international vessels (including tanker), which is about 50 ships per year in recent years. Including non-regular liners and cruise ships, the main berth is in use at least once a week on an average by international vessel. A ship is moored for 24 to 48 hours on an average. Thus, Weno Port requires a berth specially reserved for use of international vessels. Berth occupancy rate is quite high for operationable days after deducting bad weather days and holidays, and the port will soon be in full operation in near future. As the ships call the port on their own schedule, two ships may enter the port at the same time, forcing one to wait offshore.

Table 3-4 Cargo Handled as International Cargoes (Import)

(Revenue Tons)

YEAR	CONTAINERIZED CARGO						BREAK BULK						ALL CARGO
	FCL	LCL				GEN	HAZ	STEEL	OTR	VEHI- CLES	SUBT.		
		GEN	REEF	HAZ	STEEL							SUBT.	
1988	26,784	3,558	375	233	390	4,554	21	2,291	1,831	2,552	8,907	40,245	
1991	37,894	4,679	435	112	115	5,341	89	1,863	8,368	1,334	13,699	56,934	
1992	35,333	3,017	326	105	103	3,551	125	1,512	3,828	3,206	11,351	50,235	

Source : TRANSCO

Note:- Revenue Ton : Revenue ton refers to a 2000 pound weight, 1000 kilogram weight, a forty cubic foot measurement, or a three cubic meter measurement. All charges are computed on whichever will produce the greatest revenue.

Table 3-5 Cargo Handled as International Cargoes (Export)

(Revenue tons)

YEAR	CONTAINERIZED CARGO						BREAK BULK				ALL CARGO
	FCL	LCL				GEN	COPR	VEHI- CLES	SUBT.		
		GEN	HAZ	STEEL	SUBT.						
1988			217				359	411	44	814	1,031
1991	256	57	1	28	86		20	456	11	487	829
1992	449	90		20	110		46	358	46	450	1,009

Source : TRANSCO