BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REACTIVATION OF
DAMAGED OLD DOCK AT MAJURO
IN
THE REPUBLIC OF THE MARSHALL ISLANDS

JULY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of the Marshall Islands, the Government of Japan has decided to conduct a Basic Design Study on the Project for Reactivation of Damaged Old Dock at Majuro, and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Marshall Islands a study team headed by Mr. Masao Kishino, Deputy Director, Disaster Prevention and Coastal Protection Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, from March 3 to March 26, 1988.

The team had discussions on the Project with the officials concerned of the Government of the Marshall Islands and conducted a field survey in the Project areas. After the team returned to Japan, further studies were made, a draft report was prepared and, for explanation and discussion of it, a mission headed by Mr. Kunihiro Shinoda, Technical Staff, Construction Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries was sent to the Marshall Islands from June 6 to June 13, 1988. As a result, the present report has been prepared.

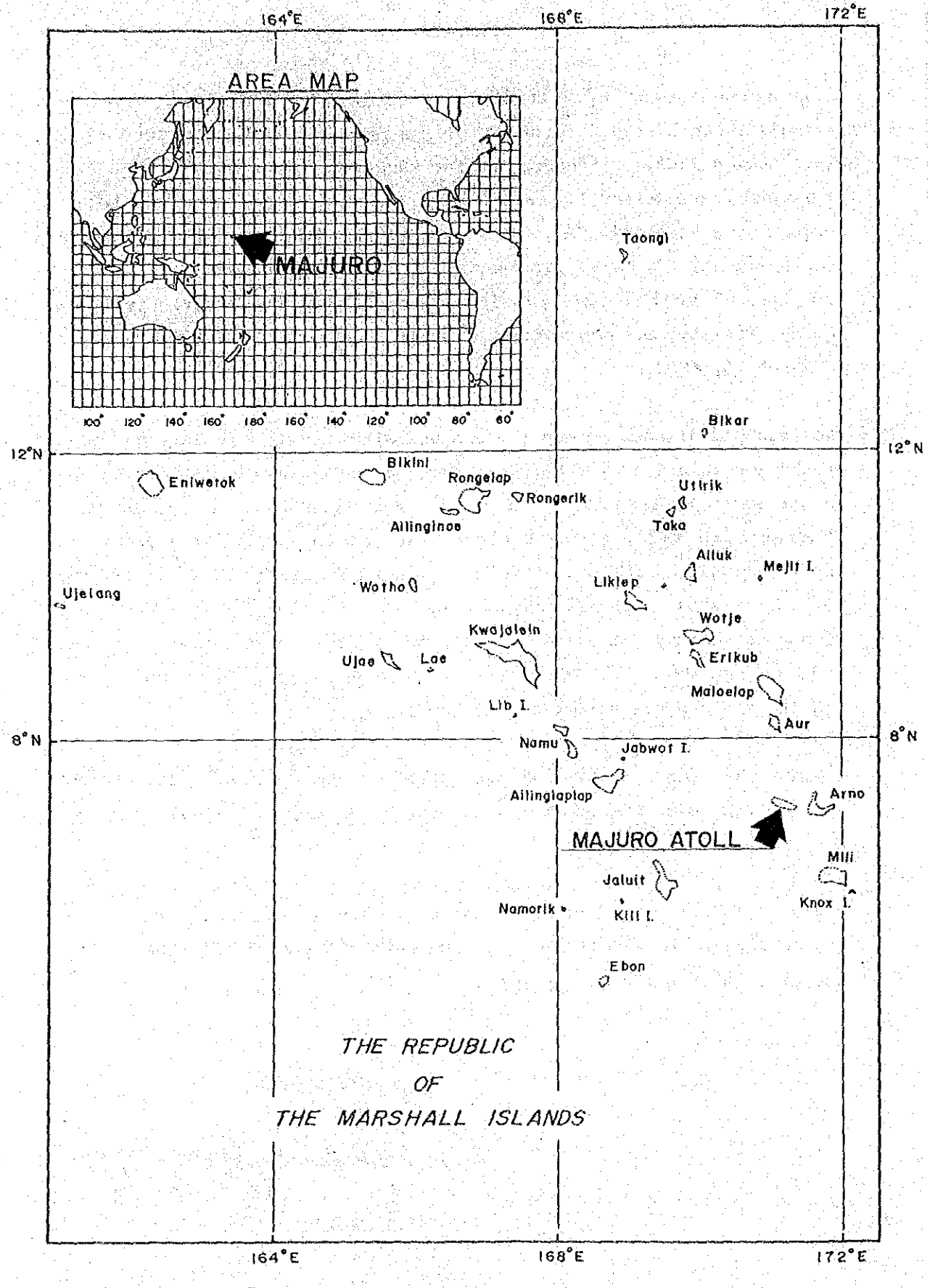
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

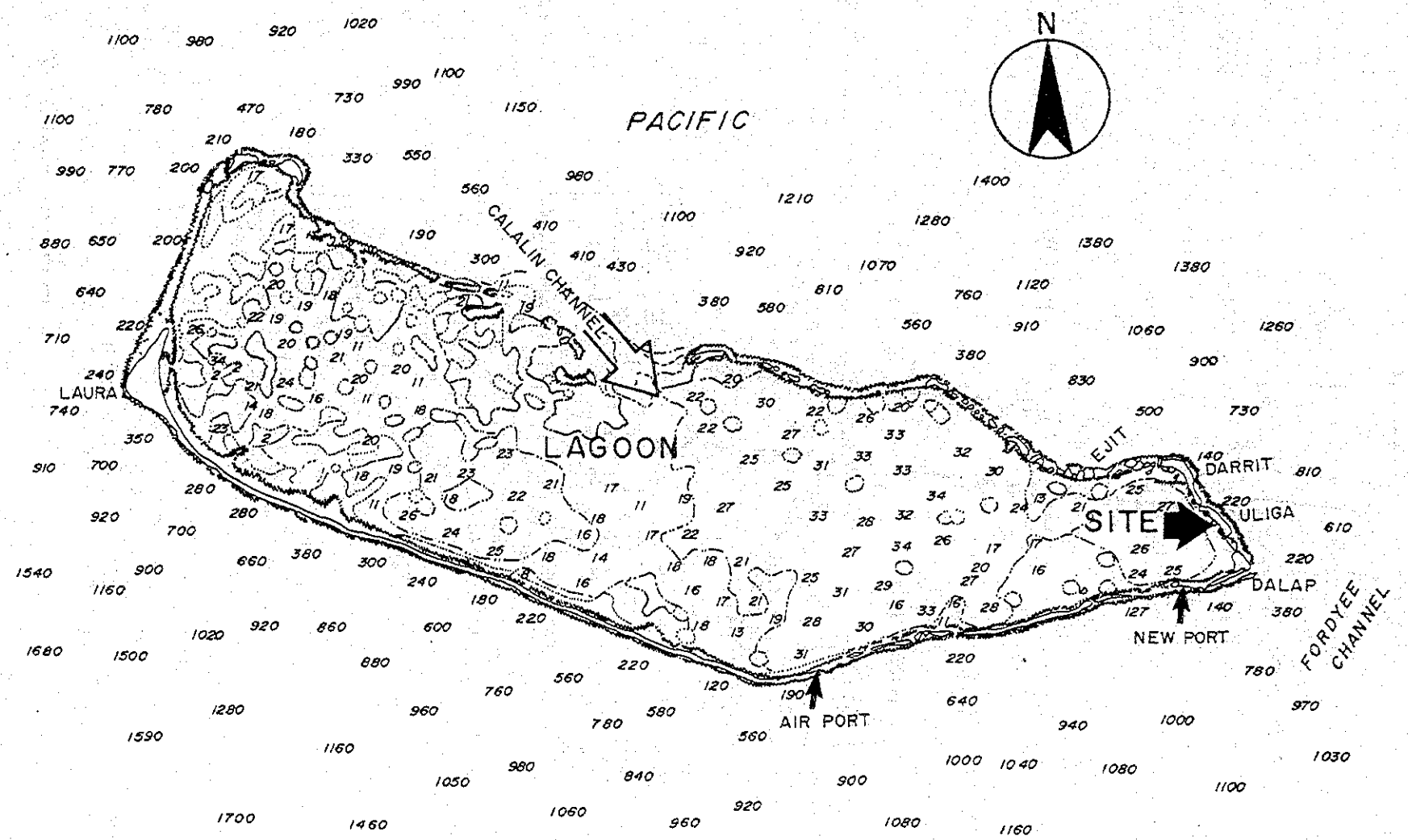
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Marshall Islands for their close cooperation extended to the team.

July, 1988

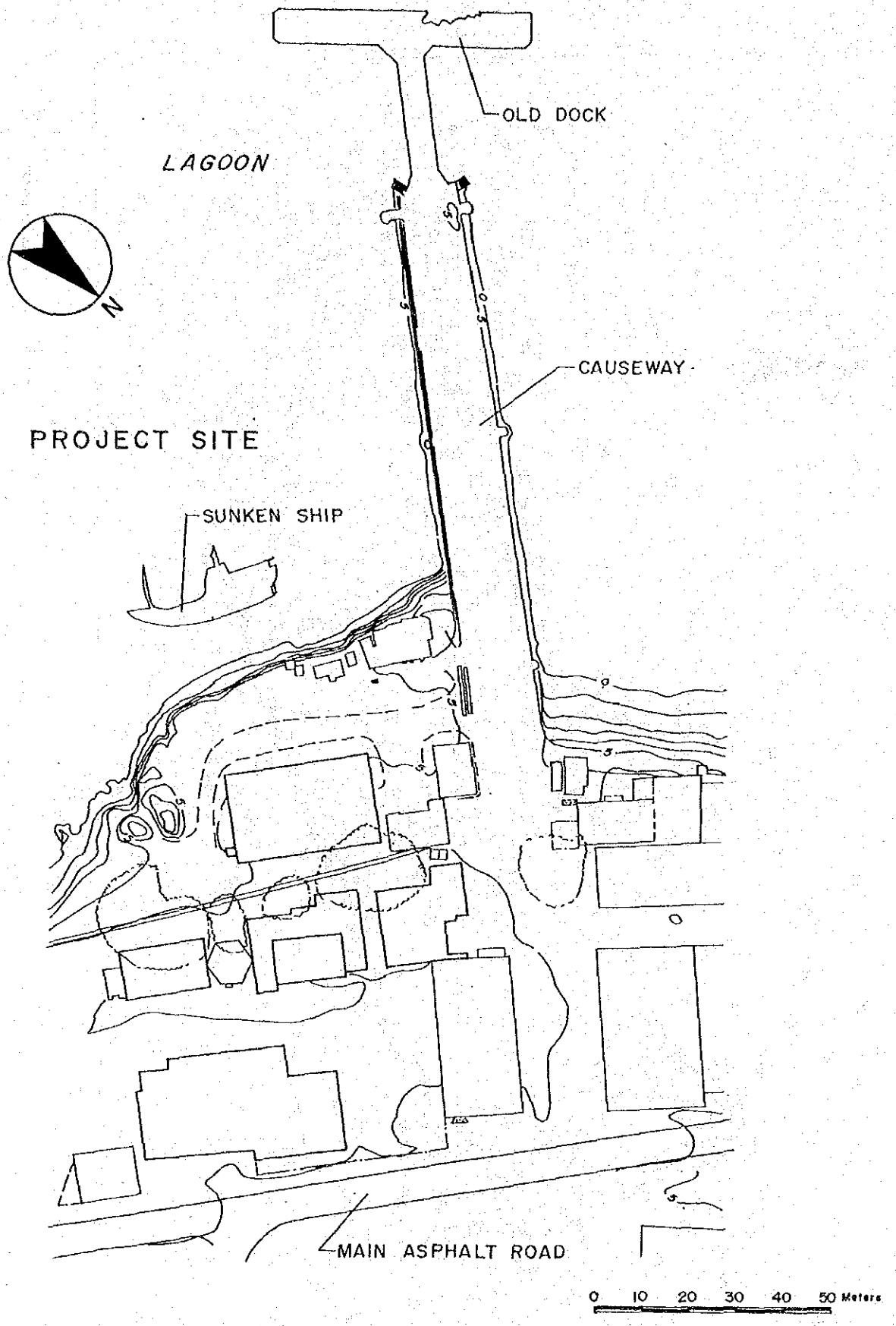
Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency


164°E
168°E
172°E
AREA MAP
MAJURO
100° 120° 140° 160° 180° 160° 140° 120° 100° 80° 60°
Taongi
Bikar
12°N
Bikini
Rongelap
Rongerik
Utirik
Ailinginae
Taka
Eniwetok
Ailuk
Mejit I.
Likiep
Ujelang
Wotho
Wotje
Kwajalein
Erikub
Ujae
Lae
Maloelap
Lib I.
Aur
8°N
Namu
Jabwot I.
Ailinglaplap
Arno
MAJURO ATOLL
Milli
Jaluit
Knox I.
Namorik
Kili I.
Ebon
THE REPUBLIC
OF
THE MARSHALL ISLANDS



MAJURO ATOLL


OLD DOCK
LAGOON
N
CAUSEWAY
PROJECT SITE
SUNKEN SHIP
MAIN ASPHALT ROAD
0 10 20 30 40 50 Meters

SUMMARY

The Republic of the Marshall Islands is composed of 34 islands scattered over an expanse of 1,900,000 km^2, but the total land area is only 181 km^2. At present, copra is the country's only export product, but high hopes are held for developing the rich marine resources around the islands as a new source of foreign currency. These resources, however, are presently being harvested mainly by foreign fishing vessels.

The Government of the Marshall Islands, in order to insure balanced development on the various islands, deems it vital to first establish a viable livelihood and develop industries on the outer islands. As a direct means of realizing this objective, it has been putting major effort into the improvement of internal marine transportation. At present, the 5 vessels comprising the inter-island fleet use Majuro Old Dock as their home port. These vessels are intimately related, as a means of transport, to copra and fisheries development on the outer islands. The skipjack and tuna fishing vessels operating within the waters of the Marshall Islands also utilize the Old Dock as their supply base, and, in addition, small fishing and cargo boats use this facility for loading and unloading operations. However, the Old Dock at Majuro is now about 40 years old and so quite obsolete. In addition, as a result of vessel rammings, the dock pilings are dangerously leaning. The Marshall Islands Government has, therefore, developed a repair plan for this dock (hereafter referred to as 'the Plan') within the body of the country's Rephased First Five Year Development Plan (1986/87 -1990/91) and has requested a grant-in-aid from the Government of Japan to permit realization of the Plan.

Based on this request, the Government of Japan, through the Japan International Cooperation Agency, dispatched a Basic Design Study Team to the Marshall Islands, led by Mr. Masao Kishino, Deputy Director, Disaster Prevention and Coastal Protection Division, Fishing Port Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries. This team visited the country from March 3 through 26, 1988 and conducted a field survey, including a boring survey, collected various materials, and reviewed the request with concerned officials of the Marshall Islands Government.

As a result of the survey, it was established that the damage to the Old Dock was indeed severe; that, if left in its present condition, the dock was in grave danger of collapsing, so that corrective measures were urgently required; that the dock was ideally located to serve as the base port for the inter-island vessels; and that it was also playing an important role in the refueling of foreign fishing vessels.

The purpose of the Plan, then, is to renovate the Old Dock and promote the development of the outer islands by insuring effective operations by the inter-island fleet. Based on the Basic Design Study, we reached the conclusion that this objective could best be attained by building the following new facilities:

1. Engineering Facilities

(1) Mooring Docks

1) Dock for use by inter-island vessels

Dock length:	120m
Plan depth:	M.L.W.L. -7.5m
Plan crown height	M.L.W.L. +3.0m

2) Dock for use by foreign fishing vessels

Dock Length:	40m
Plan depth:	M.L.W.L. -5.0m
Plan crown height:	M.L.W.L. +3.0m

3) Dock for small fishing and cargo boats

Dock length:	96m
Plan depth:	M.L.W.L. -2.0m
Plan crown height:	M.L.W.L. +3.0m

Floating dock for unloading purposes:

width x length:	3.0 x 15m
freeboard	0.6 - 0.8m

(2) Work Apron

Width: 15m, 24m (warehouse portion)

(3) Landing Ramp for Small Fishing Boats

Width x Length: 4.0 x 27m

Depth at forward block:

M.L.W.L. -1.0m

2. Shore Facilities:

(1) Warehouse: Steel-frame, single-storied;
floor area -- 140m^2

(2) Passenger waiting facility:
Reinforced concrete, single-storied;
floor area -- 110m^2

(3) Paving of access road:
width x length: 6.0 x 175m

3. Attached Facilities:

(1) Power facilities:
Outside lamps and lighting
Power facilities for delivery to vessels

(2) Water supply and drainage facilities:
Water supply for vessels
.Inter-island vessels
.Small fishing and cargo boats
Water supply for general use

(3) Refueling facilities
Pipe pit
Fueling facility for small fishing and cargo boats

The implementing agency for the Plan would be the Ministry of Transportation and Communications, which presently operates the inter-island shipping services. However, maintenance of the completed facilities would be the responsibility of the Ministry of Public Works. Since the dock would be built using the sheet piling method, the maintenance burden would be minimal. And, since this type of dock is extremely resistant to accidental shock, we do not foresee any maintenance problems.

Since the Plan is intended to maintain the inter-island fleet at top operating capability by providing it with a new dock facility, benefits from the project would be spread widely among the residents of the outer islands. The Plan, therefore, is very much in the public interest.

The annual budget for operating the inter-island fleet is approximately $1.2 million and so represents a major fiscal burden for the Government. Through implementation of the Plan, the loading and unloading of cargo and the movement of passengers would be made much more efficient, and this would, in turn, serve to reduce operating costs. In addition, with the assurance of regular schedules, the outer islands would derive enormous benefit from the project in terms of economic development, while a major improvement can also be anticipated in the efficiency of refueling operations for foreign fishing vessels.

Accordingly, it is the conclusion of the Basic Design Study Team that there is considerable justification for implementing the Plan on the basis of a grant-in-aid from the Government of Japan.

CONTENTS

CHAPTER 1 INTRODUCTION

The Government of the Republic of the Marshall Islands, with the coming into effect of the Compact of Free Association with the U.S. in October, 1986, drew its Rephased First Five Year Development Plan (1986/87 - 1990/91) in December, 1987. In this Five Year Plan, the Government places emphasis on achieving an independent economic system during the 15 years period of the Compact. The Republic is composed of many atolls and islands scattered over a wide expanse of the Pacific Ocean, and, in order to insure balanced development on the outer islands, the Marshall Islands Government has attached high priority in the Plan to improve the efficiency of inter-island transportation for people and cargoes. The Government has therefore drafted a plan to reactivate the Majuro Old Dock (hereafter referred to as 'the Plan'), which is obsolete and severely damaged as a result of repeated ramming of the vessels, and has requested a grant-in-aid from the Government of Japan to carry out this Plan.

The Government of Japan, in response to the request, decided to conduct a Basic Design Study and, under the auspices of the Japan International Cooperation Agency (JICA), dispatched a Basic Design Study Team to the Marshall Islands headed by Mr. Masao Kishino, Deputy Director, Disaster Prevention and Coastal Protection Div., Fishing Port Dept., Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries. The team visited the Marshall Islands from March 3 to March 26, 1988. The field survey involved reviewing the request by the Marshall Islands Government, the program for the Plan and its appropriateness. The team also conducted the site survey of the existing Dock including bottom topography and soil analysis around the Dock as well as the implementation organization for the project.

During the visit of the team, various discussions were held between the Marshall Islands Government and the team. The results were compiled into a Minutes of Discussions, copies of which were signed and exchanged. The team, after returning to Japan, was to analyze the survey findings, evaluate the effect of the project implementation to the development of the outer islands of the Republic, and prepare the most appropriate basic design of the Dock. The contents of the basic design has been compiled as a draft final report and, in order to explain the contents of the report,

another team led by Mr. Kunihiro Shinoda, Technical Staff, Construction Div., Fishing Port Dept., Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, was sent to the Marshall Islands from June 6 to June 13, 1988. The team has reviewed with the concerned officials of the Marshall Islands Government the basic design study included in the draft final report.

This report incorporates the above results and contains the most appropriate basic design of the facilities for the Plan, the implementation plan, project evaluation, recommendations, etc.

CHAPTER 2 BACKGROUND OF THE PLAN

2.1 National Development Plan and Compact of Free Association

The Republic of the Marshall Islands is composed of 29 atolls and 5 independent islands. While these are scattered over some 1,900,000 km^2 of ocean, the actual land area is only 181 km^2. Since the land is low-lying coral atolls and the soil elements are mainly calcareous, the organic content is low. As a result, with the exception of copra, there are virtually no agricultural products that offer any prospects for earning foreign exchange, while the country is also poor in other land-based resources. These natural conditions, compounded by the adverse geographic position of the Marshall Islands, quite remote from the developed areas of the Pacific, impose serious constraints in terms of economic development.

The Marshall Islands Government was established in 1979, when the country gained its political independence, following the Trust Territory administration by the U.S. after the World War II.

In connection with the end of the trust administration, a series of talks were held with the United States resulting in a decision by the people of the Marshall Islands, expressed through a referendum in September, 1983, to enter into a Compact of Free Association with the U.S. This compact was approved by the U.S. Congress in January, 1986 and came into effect in October of that year.

The Compact of Free Association with the U.S. is to run for 15 years, during which period the U.S. has agreed to extend financial assistance of various sorts to the Marshall Islands Government. The share of this assistance in overall fiscal revenues will average about 80% over the 5 year period from 1986/87 to 1990/91, which represents a substantial increase from the 68% average during 1980 - 1985, when the Islands were still a trust territory of the U.S. Thus, the influx of U.S. funds under the Compact of Free Association, will have a powerful influence on the fiscal administration of the new country.

Based on the Rephased 5-Year Plan, the government revenues during the plan period are projected as shown in Table 2.1:

Table 2.1 Government Fiscal Revenue

($ mil.)

	1986/87	1987/88	1988/89	1989/90	1990/91	Total
Income from the Compact	42.8	41.5	42.3	43.2	44.0	213.8
Domestic Revenues	13.7	14.0	14.7	15.4	16.2	74.0
U.S. Federal Grants	11.7	8.0	4.8	1.6	1.6	27.4
Capital Improvement Project	9.0	7.5	1.9	-	-	18.4
Investment Development Fund	6.0	-	4.0	-	-	10.0
Four Atoll Health Care	2.0	2.0	2.0	2.0	2.0	10.0
Claims Tribunal	0.5	0.5	0.5	0.5	0.5	2.5
Total Revenues	85.7	73.5	70.2	62.7	64.3	356.4

(Source: Rephased 5-Year Plan)

The revenue sources in the above table are all, with the exception of domestic revenue sources (e.g., taxes, fishing fees, stamp sales, etc.), linked to the Compact of Free Association. Total revenues over the period of the Rephased 5-Year Plan are anticipated at $282,400,000, averaging $56,480,000 per year.

Apart from the above items that are built into the government budget, the Marshall Islands will also receive, under the Compact, payments to land owners for the use of the Kwajalein base as well as compensation payments for the people affected by the nuclear testing program. Receipts from these two sources are estimated at $9,000,000 and $18,000,000, respectively.

The ultimate purpose of the Compact is to make the Marshall Islands economically viable. At the present time, the funds generated under the Compact are estimated to produce over $1,500 per year per capita, and so the Marshall Islands economy will obviously be extremely depending on Compact revenues. However, in order to achieve economic self-sufficiency during the 15 year period of the Compact, the Marshall Islands Government is seeking to implement a development plan designed to create an economic

infrastructure during the first five years that will insure adequate economic growth during the remaining years of the Compact.

2.2 The Rephased 5-Year Plan

The original 5-year Plan was drafted by the Marshall Islands Government in 1984, but was extensively overhauled in conjunction with the coming into force of the Compact of Free Association in October, 1986. The essential effect of this review was to accord each project a priority rating in terms of its industrial or commercial potential. Those projects targeted for implementation during the plan period were labeled Priority A and those which are to be implemented as funds became available were given a Priority B status. The 5-Year Plan was also subjected to rigorous budgetary scrutiny, resulting in a rearrangement and curtailment of the original program, which was felt to have distinct cosmetic overtones.

The total development funding required for the Rephased 5-Year Plan, excluding Priority B projects, is estimated at about $109 million. Looking at the requirements by sector, the largest share (60%) is allocated to social infrastructure development, followed by education and social welfare (20.4%), government administration (12.2%), and industry (6.9%).

There has been a conspicuous emphasis on infrastructure development since the Trust Territory Administration days, notably the early 1970's, with the bulk of developmental funds having been allocated to roads, ports, airports, and public buildings. There is a feeling in certain quarters that the production sector has been ignored in this program, but, in the case of the Marshall Islands, as distinct from the Federated States of Micronesia and Palau, land-based resources are scarce, while the country's many atolls are widely scattered, and so there would seem to be a need for further expansion of the social infrastructure for the economic development of the country.

From 1976 to 1982, expenditures in Mircronesia, by area, under the U.S. CIP (Capital Improvement Project) were as shown in Table 2.2, which demonstrates the extent to which the Marshall Islands has lagged behind other areas in infrastructural development.

Table 2.2 CIP Expenditures by Area (1976 - 1982)

($000)

Area	Expenditures
Palau	$40,445
Yap	30,165
Truk	35,040
Pohnpei	22,569
Kosrae	32,317
Marshalls	17,664

(Source: A Brief Economic History of Micronesia, Francis X. Hezel)

Among the infrastructure items in the Rephased 5-Year Plan are: power and water mains (accounting for 24.1% of total planned investment), followed by communications (17.1%), land transport (10.8%), marine transport (7.2%), and energy and airport facilities (0.6%each).

Out of 34 atolls and islands of the Marshall Islands which are spread over a wide area, 26 islands are populated. The total population in 1987 was 39,500. This is an official figure based on a population forecast developed by ESCAP from the 1980 census. Average population density is 218 persons/km^2, but the density is estimated to exceed 1,550 on Majuro Atoll, where the country's population is concentrated. According to data for 1985, 38% of the total population are living on Majuro and 21% on Ebeye, while in the other 24 islands, the average population is 617, which is considered in general insufficient to sustain a reasonable scale of market economy.

The population concentration in Majuro and Ebeye is causing the housing and other public utilities problems as well as pressure on unemployment. The Government clearly recognizes in its Rephased 5-Year Plan the need to equalize the benefits of regional development by achieving balanced development of outer islands for building a sound economic base for the Marshall Islands.

For this purpose, the 5-Year Plan envisages implementation of a series of measures, including development of outer island natural resources through expansion of fisheries and diversification of agriculture; development of

road, sea, and air transportation services; making available cheaper sources of energy from solar, wind and wave power; and provision of greater facilities for assisting market economy in outer islands. However, the Rephased Plan also describes that the major constraints in implementing these programs lies in the lack of economic infrastructure including transportation and also well developed administrative structure capable of implementing these programs.

Based on the existing conditions mentioned above, the following projects have been given a Priority A rating within the marine transportation sector under the Rephased 5-Year Plan:

Lagoon boats:

Construction of FRP vessels of about 8m length to transport copra, other cargo and passenger between the outlying villages and the load centers. The boat is also intended for fishing purposes.

Load centers:

To construct one load center on each atoll and improve transport efficiency by providing a base for trans-shipment between inter-island vessels and the above lagoon boats.

Navigational Aids and Channel Marking:

To ensure navigational safety through the placement of light buoys marking the channels and coral heads.

New Main Engines for Inter-island Vessels:

Three 790 ton inter-island vessels were built in 1970 but, from the point of view of fuel economy, the plan is to install new, fuel-saving main engines.

Majuro Old Dock Repair:

To make structural repairs to the Majuro Old Dock, which is located in the optimum place for loading inter-island vessels and also convenient for refueling fishing vessels and for use by small boats.

Commercial Dock Repair:

To make extensive repairs to equip the New Port for the anticipated growth in the number of calls by large vessels.

The reconstruction plan for the Majuro Old Dock has been accorded a Priority A rating in the Rephased 5-Year Plan for securing efficient operations of the inter-island fleet.

2.3 The Present State of the Inter-island Fleet

As set forth in the Rephased 5-Year Plan, the Old Dock at Majuro is used as the home port for the Marshall Island transport fleet. The fleet at present includes 5 passenger/cargo vessels which are operated by the Ministry of Transportation and Communications. Fleet composition is as follows:

Passenger/cargo vessel	486GT	(1)
Passenger/cargo vessel	790GT	(3)
LST	458GT	(1)

Their specifications are shown in Annex VI-1.

All of these vessels were built in Japan, with the smallest, M/S Militobi, constructed in 1961. In view of its advanced age, Militobi will be eventually scrapped. The three 790 GT class vessels were built between 1978-79 and so are still in an excellent state of maintenance, but, in order to reduce fuel costs, which constitute a major component of operating costs, a plan is being implemented to change over to more fuel-saving new engines. One such installation has already been completed, with the other conversions to be done in turn. The LST is a new vessel built in 1985.

The inter-island vessels are presently operated by the Ministry of Transportation and Communications. However, the Marshall Islands Government, with a view to improving operating efficiency and raising the return on expenditure from the present 35% to 50%, plans to privatize the operations of these vessels some time in the future. For this purpose, a law to establish a Marshall Islands Shipping Corporation was enacted in 1987, though work on the organizational structure for this new corporation has not yet started.

In view of the wide dispersion of the Marshall Island atolls, operations for the inter-island fleet are divided into six areas: Far North, North, East, South, West, and Central, and the intent is to apportion vessel calls as equally as possible within each area. The operation route for the fleet is given in Annex VI-2. However, situated in the far north, Eniwetok and Ujelang atolls are approximately 1,200km north west of Majuro and their population totals only to 285 (as of 1985), these atolls were called by the inter-island vessel 4 times in 1987. Meanwhile, the central island group received 10 calls in 1987.

Each vessel carries both passengers and cargo, but the loading of cargo at Majuro is handled by a private stevedoring company.

The fare for a cabin is 10 cents per nautical mile and that for a deck passenger 6 cents. For example, from Majuro to Kwajalein, the fare for a cabin, based on the published fare schedules, is $23.50, vs. $14.10 for deck passenger. Cargo rates are a flat $1.00 per 40 cu. ft. regardless of distance.

The most important cargo carried by the inter-island vessels from the outer islands to Majuro is copra, while the main outbound cargoes are construction materials, vehicles, and foodstuffs. During 1987, some 2,830 tons of inbound cargo were carried, vs. about 5,350 tons* of outbound. (* This figure is so-called "revenue tons", which, in this case, is considered almost identical to cu. m from the nature of the cargo.) The number of outbound passengers in that year totaled 4,000, with arrivals about 3,500, for a two-way total of approximately 7,500.

Except for Majuro and Ebeye where the population is concentrated, Arno Atoll has the largest number of inhabitants -- 1,766 people -- but the smallest population is less than 100, making the average population of outer islands only 617. Excluding Arno and Mili atolls which are located close to the capital Majuro, the livelihood in the outer islands in general is heavily dependent on subsistence activities in agriculture and fishery. From this respect, the inter-island fleet is acting as an umbilical cord to sustain a viable livelihood and other economic activities in the outer islands by providing residents of the outer islands with a means of transportation for daily necessities and equipment.

Copra is virtually the only cargo brought in from the outer islands to Majuro at present and, in order to refine this into coconut oil for export, it is unloaded at the New Port, which incorporates a refining plant. On the other hand, most of the goods moving out of Majuro comprise essentials for the outer islands. As a result, there are warehouses for storing cargo at the Old Dock, around which the vendors of such products are clustered, making this an ideal leading site. The Dock is quite worn, having been built back in around 1946. Since it is in the location that is most sheltered from the prevailing northeasterly winds, small to medium-size vessels can be ideally accommodated.

The New Port at Majuro was built on reclaimed land about 3 km from the Old Dock across the Majuro Lagoon. Completed in 1978, it is an international port, with a depth of 13m, a total wharf length of 250m, and a container yard, and has been designed to receive large cargo vessels. In the vicinity of the New Port are a copra refining plant and a thermal power station, while the surrounding area is used as an industrial site. Adjoining the New Port are a fishing dock and refrigerated warehouse that were built with Japanese aid.

The Marshall Islands Government plans to cope with the growing demand for marine transport by dividing the functions between the New Port, serving as a foreign trade port, and the Old Dock, serving as a home port for the inter-island fleet and as mooring area for other small vessels.

2.4 Fishery Development Plan

The Old Dock at Majuro is used for inter-island vessels, refueling Japanese fishing vessels, and for unloading copra and fish brought in by small fishing and cargo boats from nearby islands. During 1986, 116 Japanese fishing vessels called at the Old Dock, with 141 arrivals during 1987, almost all for refueling purposes. At present, the only fishing operations permitted within the Marshall Islands' 200 mile zone are those directed at skipjack and tuna under the Fisheries Agreement with Japan. Japanese catches within Marshall Island waters during 1985/86 totaled 9,938 tons, vs. 14,916 tons in 1986/87.

While definitive data are not available, the amount of fuel taken on by Japanese fishing vessels at the Old Dock, using an average of 37.5 kiloliters per vessel for the 335 vessels visiting port from October, 1984 to November, 1986 inclusive, it may be estimated that the fueling requirements for these vessels came to about 4,350 kl in 1986 and 5,290 kl in 1987.

The Japanese skipjack and tuna fishing vessels are refueled at the Old Dock because of a master refueling contract with Mobil Oil, Micronesia, Inc., whose refueling facilities are located there. However, Shell Oil has refueling facilities at the fishing wharf adjacent to the New Port, which has been completed with Japanese aid. This suggests that, if, at some future time, the Japanese vessels were to shift their refueling contract from Mobil to Shell, they could then use the fishery wharf for their refueling operations.

Since fishing activity in the Marshall Islands is almost entirely artisanal, the fortunes of Japan's skipjack and tuna vessels operating in Marshall Island waters have very little bearing on fishery development in the country. However, the fishing, port entry, and docking fees paid by these vessels as well as their refueling expenditures do have an important economic effect in the Marshall Islands.

The artisanal fishery occupies an important niche, particularly on the outer islands, as a source of animal protein for the Marshall Islands people. The population of the capital atoll (Majuro) is about 15,000, but, even here, the number of commercial fishermen--those who make their livelihood from fishing--are estimated to number only about 40 to 50 persons. There are about 60 small fishing boats, equipped with outboard engines, whose annual catch is estimated at 90-100 tons.

These small boats, however, are not dedicated fishing vessels but rather all-purpose vessels. The Old Dock is used by 8 - 12 m vessels equipped with inboard motors that bring copra and fish to Majuro from nearby Arno and Mili Atolls, returning with subsistence commodities. The fish transported by these vessels tends to be mainly relatively high-value species, such as lobster, and so contribute little to fish supply to Majuro in terms of actual volume.

The Marshall Island Government recognizes the importance, in terms of the country's economic self-sufficiency, of developing its rich fishery resources and of promoting outer island fisheries, one of the locally available resources with high economic potentials, and thus has accorded fisheries development the largest investment budget within the industrial sector. The following three fishery projects have been given Priority A ratings in the Rephased 5-Year Plan:

Fisheries Development in the Outer Islands:

To develop artisanal fisheries in the outer islands through the creation of a fishing infrastructure, modernization of fishing gear, and improvement of fish distribution by encouraging a commercial fishery. The initial target area within the Plan period will be Arno Atoll, with the program to be extended gradually to other islands.

Mariculture Laboratory:

To conduct research on the production of fish and shellfish seed for the purpose of sustaining resources in the outer islands, particularly within the reef.

Development of Rearing Pens on the Outer Islands:

To temporarily store fingerlings distributed to the outer islands and develop rearing pens for lobster, trepang, and other high-value products while awaiting transport.

It is felt that there is considerable potential for developing the Marshall Islands' rich skipjack and tuna resources in nearby waters. The focus of this development can take place in two directions -- small commercial fishery operations, evolving from the artisanal fishery, and large-scale fishery development through the medium of joint ventures with other countries. For the former purpose, an indispensable condition will be the establishment of distribution channels for moving fish off island, for which the essential prerequisite is the provision of marine transport facilities. In this context, the efficient operation of the inter-island fleet becomes a major pillar of outer-island development and thus has profound implications for fisheries development.

2.5 Background and Nature of the Request:

The Majuro Old Dock was built in around 1946 and, until the New Port for large-size freighters was completed in 1978, was the only dock capable of receiving foreign cargo vessels. Even after completion of the New Port, the Old Dock continued to be used on a regular basis by the inter-island fleet, skipjack and tuna vessels, and small fishing boats. However in 1980, a 7,700 ton freighter rammed the dock, causing serious damage to the pilings and the concrete platform. The Marshall Islands Government then, in order to maintain effective inter-island services, which are so vital to overall national development, incurred a U.S. dollar loan from the Republic of Nauru Finance Corporation to make underwater repairs to prevent collapse of the dock. These included pouring resin concrete into the supporting pillars and the installation of braces. But the dock, which is now over 40 years old, has become quite obsolete, and the original design drawings have been lost. It has, therefore, been decided that permanent repairs will not be feasible, and so a plan has been developed to dismantle the existing dock and build a new one in the same area, which is called in this report as 'The Project for Reactivation of Damaged Old Dock at Majuro (the Plan)'.

The Plan was included in the original 5-Year Development Plan drawn up by the Marshall Islands Government in 1984 and has been accorded a Priority A rating in the Rephased 5-Year Plan of 1987. In October, 1986, the Marshall Islands Government requested a grant-in-aid from the Government of Japan for the purposes of implementing the above Plan.

During our confirmation of the subject Plan, we established that the government officials concerned specifically desire a land-fill type of structure rather than the existing pile construction. The reason for this is that, in the event of a similar ramming by a large vessel, with pile construction, such an accident would affect the entire piling, as was the case with the existing dock, while, with the land-fill type of construction, the damage would be localized. In addition, there is a plan to develop the shore area to the rear of the dock, and so the construction method should be capable of fully protecting the area from the high waves that develop from the occasional strong westerly winds.

Details of the request of the Marshall Islands Government are as follows:

(1) A wharf having the capacity of berthing the largest size of the existing inter-islands vessel at the front side and smaller vessels on both sides and back. The water depth at the front side should be greater than 7m. Steel sheet-pile wall type structure is preferable.

(2) Pavement of wharf and its access road portion

(3) Provision of functional facilities including lighting, water and oil supply pipelines

CHAPTER 3 DESCRIPTION OF THE PLAN

3.1 Plan Objectives

The Rephased 5-Year Plan was prepared by the Marshall Islands Government in December, 1986. Sixty percent of development expenditures under the 5-Year Plan are allocated to social infrastructure and, in view of the special characteristics of the country's geography, with numerous atolls spread over some 1,900,000 km^2, various plans have been drafted for improving marine transportation.

The Old Dock at Majuro is used as a home port for the Marshall Islands inter-island vessels and as a refueling station for the Japanese skipjack/tuna vessels operating in the country's 200 mile zone. This dock, built in around 1946, is now quite old; in 1980, it was rammed by a freighter, raising a grave danger of collapse. The Government has, therefore, accorded the rebuilding of the Old Dock a Priority A rating in the Rephased 5-Year Plan and has requested a grant-in-aid from Japan to permit speedy implementation of the project.

The objective of the Plan is to rebuild the Old Dock at Majuro, which is structurally in a very precarious condition and functionally considerably over-taxed, in order to insure efficient operations by the inter-island fleet, which plays a major role in the development of the many islands in the Marshall Islands group; to improve facilities for refueling foreign fishing vessels operating in the country's 200 mile zone; and to improve facilities for mooring local small size fishing and cargo boats.

Accordingly, the Plan calls for the construction of a new dock, the building of a warehouse and other shore facilities, and the preparation of supporting facilities such as a floating dock for small boats.

3.2 Description of the Plan Site

3.2.1 Environmental Conditions

(1) Geology

The Majuro Atoll is believed to have been formed from coral limestone out of coral growing in the vicinity of volcanic islands; with the disappearance of these volcanic islands, the coral grew above the water surface.

The resulting coral limestone was granulated by rain and wave action, and further deposited as a mixture of coral sand, gravel and boulders. A portion of these deposits resolidified into coral sandstone. Along the lagoon, other organisms worked on the coral to form reef rock. As a result the geology of the present Majuro Atoll has been formed from a compound of a mixture of coral sand, gravel and boulder, sandy limestone and reef rock. A geological cross-section of the Atoll is shown in Fig. 3.1.

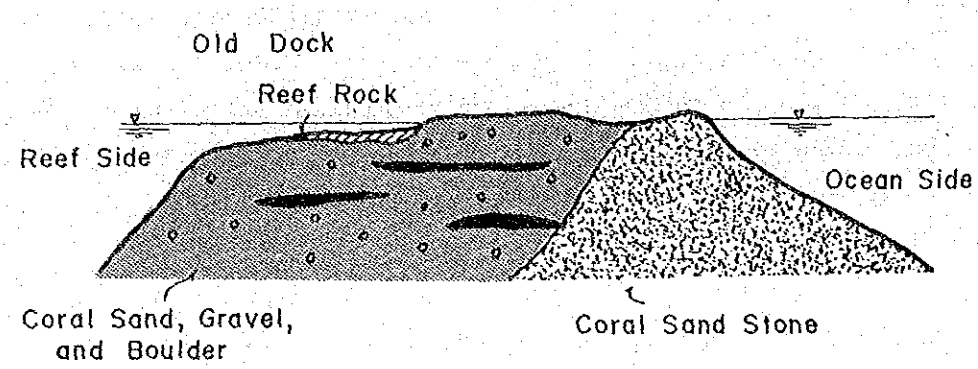


Fig. 3.1 Geological Cross Section of Majuro Atoll

(2) The Soil

1) Soil Composition

In order to develop an understanding of the properties and composition of the soil for purposes of the dock design, boring tests were conducted at the three locations shown in Fig. 3.2. The assumed soil profile, based on these boring tests, is given in Fig. 3.3.

On the basis of the boring survey at the three locations, we found the soil within the bored depth to be composed only of coral sand (a mixture of coral sand, gravel and boulders). This soil is, for the most part, composed of fine-to-medium grain coral sand, but with a substantial mixture of both gravel and boulders.

Based on the results of the standard penetration test, the N value of the sand layer ranges from 4 - 30, reflecting a relatively light to medium density, but this value rose to 50 in each of the three boring test locations in which boulders were present. Thus, there was a notable dispersion of relative soil density values.

In addition, a cavity was detected in the upper part of the No. 1 boring location, which is believed to account in part for the large dispersion of relative densities. The borehole log is shown in Annex VI-3.

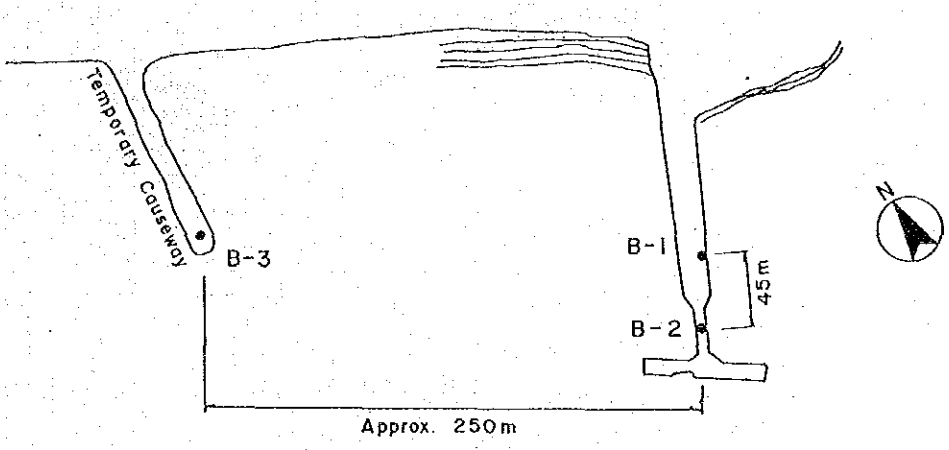
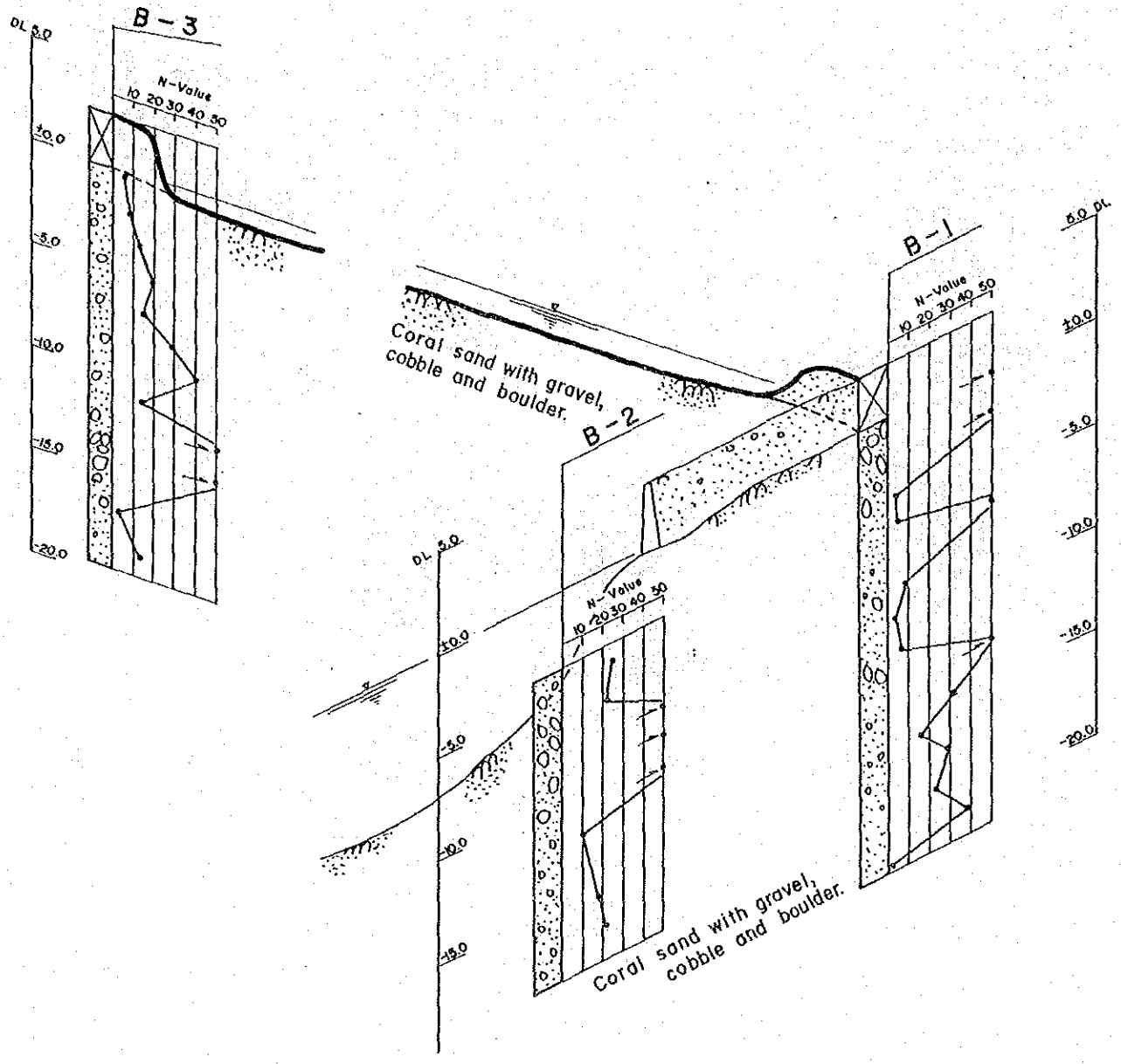


Fig. 3.2 Boring Locations

Fig. 3.3 Assumed Soil Profile



2) Soil Characteristics

Using the data obtained from the standard penetration tests, we conducted specific gravity and particle size tests for the coral sand.

Specific gravity

The specific gravity exhibited general values ranging from 2.50 - 2.79, with the average at 2.67.

Particle size characteristics

Fig. 3.4 shows comparative particle size distribution curves. Since the soil is of uneven consistency, particle size was distributed over a wide range. The passing particle tests at 60% and 10% were 1.00 - 15mm and 0.04 - 0.42mm respectively. The evenness coefficient ranged 11 - 25, which is classified into SWR or GW (soil or gravel with good particle distribution) under the consolidated classification.

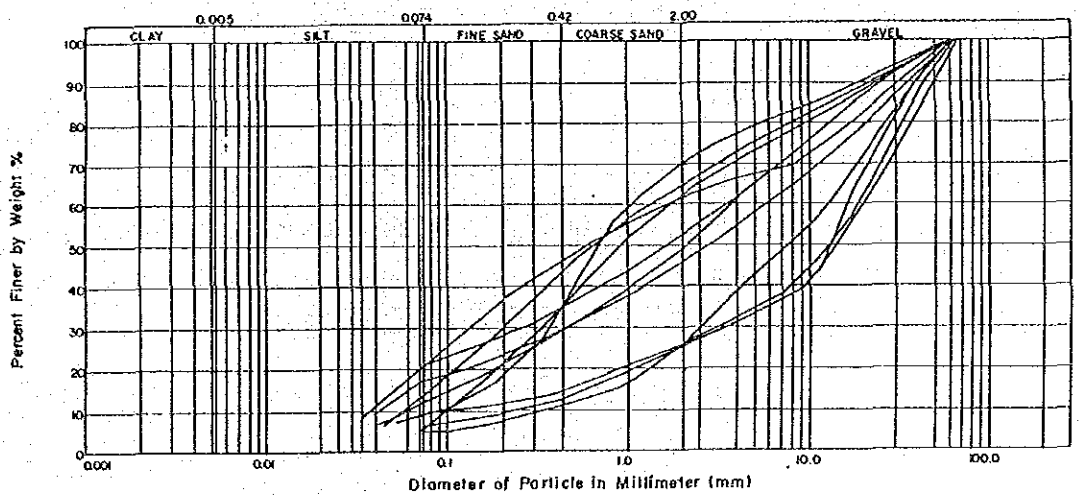


Fig. 3.4 Particle Size Distribution Curves for Coral Sand

(3) Climate

1) Rainfall

Fig. 3.5 shows average monthly rainfall over the period 1956 - 1985 inclusive.

Average annual rainfall at Majuro is 3,400 mm. While the period from June through November is known as the rainy season, the differences between

rainy and dry season are not particularly great. The rainfall is in a squall pattern, with persistent rainfall rare.

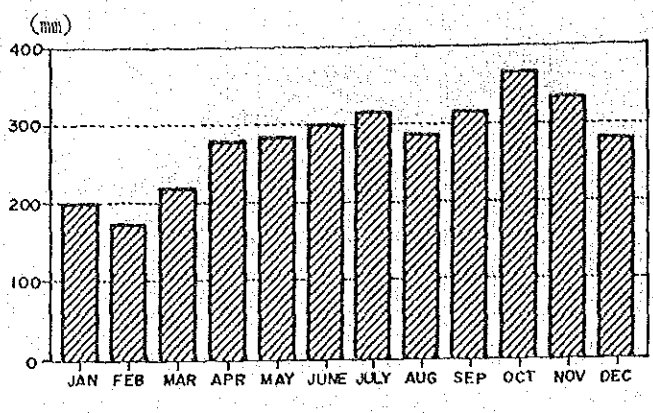


Fig. 3.5 Average Monthly Rainfall

2) Temperature

Fig. 3.6 gives average monthly temperatures for the period 1956 - 1985. Temperature variations over the course of the year at Majuro are small, with average monthly highs of 30°C and lows of about 25°C.

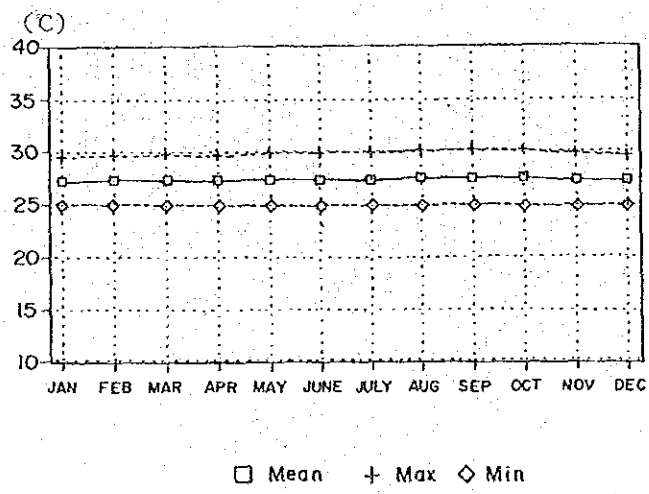


Fig. 3.6 Average Monthly Temperatures

3) Winds

Figures 3.7 and 3.8 show wind velocities and wind directional frequencies, based on observations taken every three hours during 1987. At Majuro, there is about an 80% probability of wind coming from a northeast (NE) or east-northeast (ENE) direction.

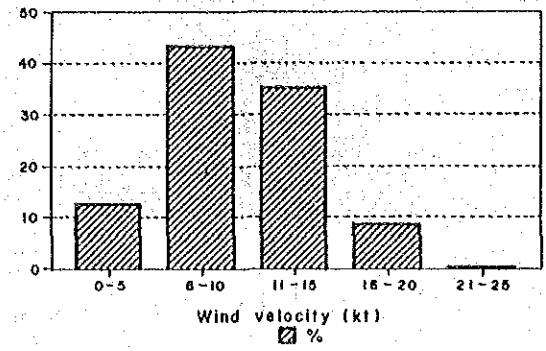


Fig. 3.7 Wind Velocity Frequencies

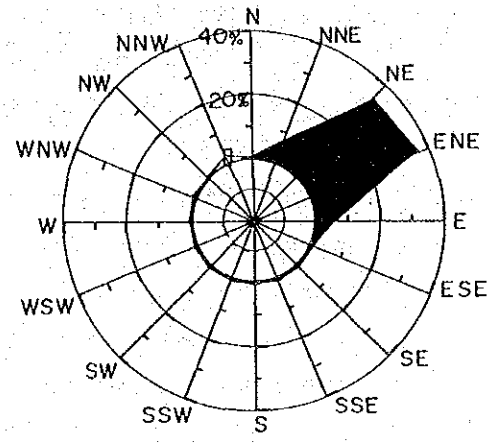


Fig. 3.8 Wind Directional Frequencies

Table 3.1 shows average maximum wind velocity by month for the period 1959 - 1985. The maximum wind velocity during the subject period was about 40 mph (18m/sec.) from a NE, ENE and E direction but, in November, 1982, there was a strong SW wind of 45 mph.

Month	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Direction	NE	E	ENE	ENE	ENE	ENE	ENE	NE	E	E	SW	E
Speed (MPH)	38	35	36	35	38	38	34	32	36	38	45	38

Table 3.1 Maximum Wind Velocity by Month (1959 - 1985)

(4) Oceanographic Conditions

1) Tidal levels

A tide recorder has been set in the vicinity of the connecting bridge of the Majuro Old Dock which automatically records continuous measurements of tidal levels. A tide gauge is also set at the same location; the zero point of this marker corresponds to the chart datum level (CDL). Depth measurements carried out during our survey were based on CDL. Fig. 3.9 shows tidal relationship within the Majuro lagoon.

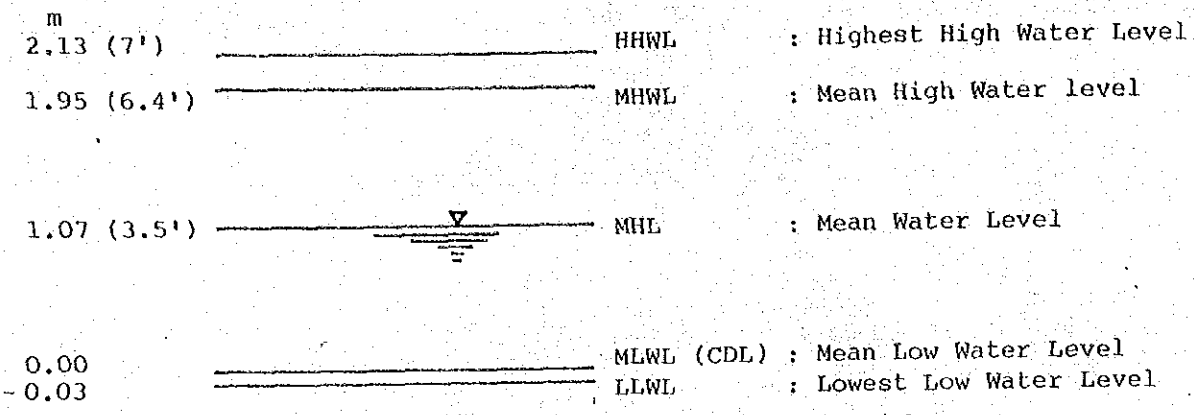


Fig. 3.9 Tidal Levels in Majuro Lagoon

During March 18 - 19, 1988, we observed an abnormally high tidal level of 2.4m. The Director of the Weather Bureau, which handles the tide recorder said he had never experienced so high a reading. However, since even a tide of this height has never hampered operations at the existing dock, indicating that the present dock height is appropriate.

2) Wave conditions

No data are available on wave conditions at Majuro Atoll. However, as noted in the above section on wind conditions, ENE and NE winds are particularly prevalent in Majuro and so the area around the Old Dock, which is on the leeward side, is exceedingly calm. From 1959 - 1982, only once was a SW wind of 18m maximum velocity recorded. Estimating the wave action at the Old Dock from the direction and velocity of this wind, using the S.M.B. method, we arrived at the following values:

Significant wave height	H = 1.0m
Cycle	S = 3.0 sec

The dock crown height is 2 m above mean water level and about 1 m above mean high water level. And, since this type of wind is exceedingly rare, we see no problems with respect to wave action. Our wave estimates are given in the Annex VI-4.

3) Tidal current

Tidal current observations were taken at high tide, using a buoy in the area of the Old Dock, but no measurable currents were recorded. According to a diver familiar with local waters, the maximum tidal current is only about 0.25 knots. In any event, tidal current is clearly small and so the likelihood of sand drifts or erosive effects from the tidal current is quite small.

(5) Drift Sand

In order to establish drifting characteristics, a sieve test was conducted for the bottom surface samples collected in the vicinity of the dock . The distribution curves for this material are shown in Fig. 3.11.

The middle particle diameter for this sampled bottom soil was 0.25mm - 1.8mm, and so it is composed of sand with a relatively large particle diameter. With the D50 at 1.0mm, and using the estimated wave values from the previous section (H = 1.0m, T = 3 sec.), the depth for the moving limits of the bottom surface sand was established at 1.4m, using the Sato-Tanaka formula. This means that if the depth is 1.4m or more, there is no movement of the bottom soil, and so virtually no problem exists vis-a-vis the erosion or silting of sand at the front face of the dock.

In fact, at the extension of the Old Dock, a causeway has been constructed in a jetty shape, but, given the absence of any trace of silting on either side of the causeway, it may be presumed that there is virtually no drift sand.

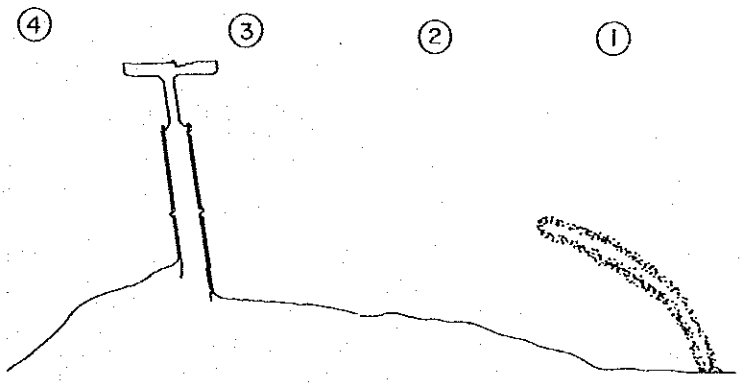


Fig. 3.10 Bottom Sampling Position

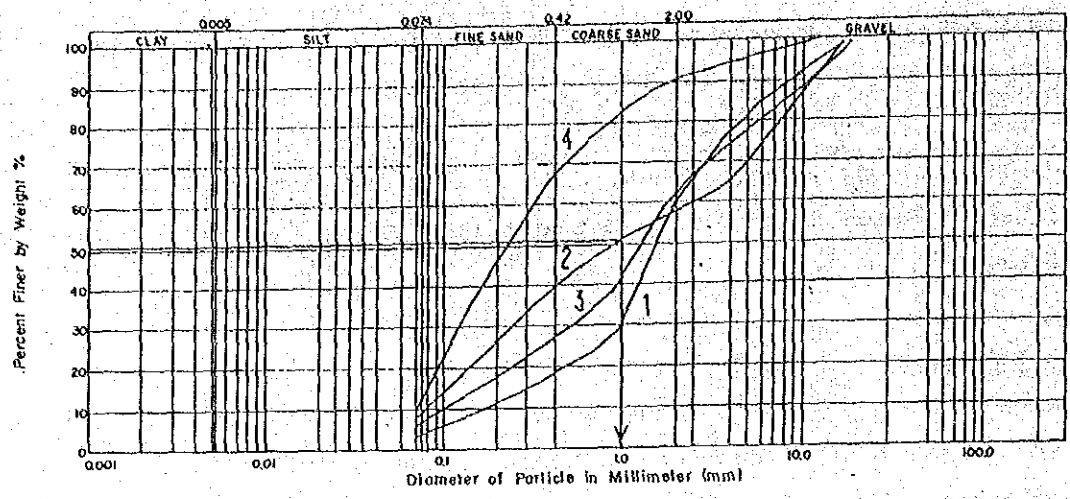


Fig. 3.11 Particle Size Distribution Curve for Bottom Soil

3.2.2 The Condition of the Present Dock

(1) Location

The Majuro Atoll is oval-shaped, extending 40 km from east to west and 10 km from north to south, with an enclosed lagoon. A 50 km asphalt road traverses about half of the southern part of the oval from Laura on the west to Darrit on the east.

The area formed by Dalap, Uliga, and Darrit on the eastern side of the atoll (commonly called the DUD area) contains the political and economic heart of the Marshall Islands. The Old Dock is located along the lagoon side of Uliga, which is relatively built up, even by the standards of the DUD zone. It is linked to an access road of some 90 m extending from the paved road to the shoreline and the tip of a causeway jutting out about 110 m from the adjoining shoreline.

Bordering the area where the access road to the existing dock and the trunk road meet are the offices of the Port Director, fuel facilities, warehouses, supermarkets, shops, restaurants, hotels and other commercial buildings, a bank, post office, museum, library, and other public buildings as well as a large number of private firms. The existing dock then is located in an area that lies at the core of this urban and distribution complex and plays a vital role in cultural interchanges with residents of the outer islands. A vicinity map is shown on the following page as Fig. 3.12.

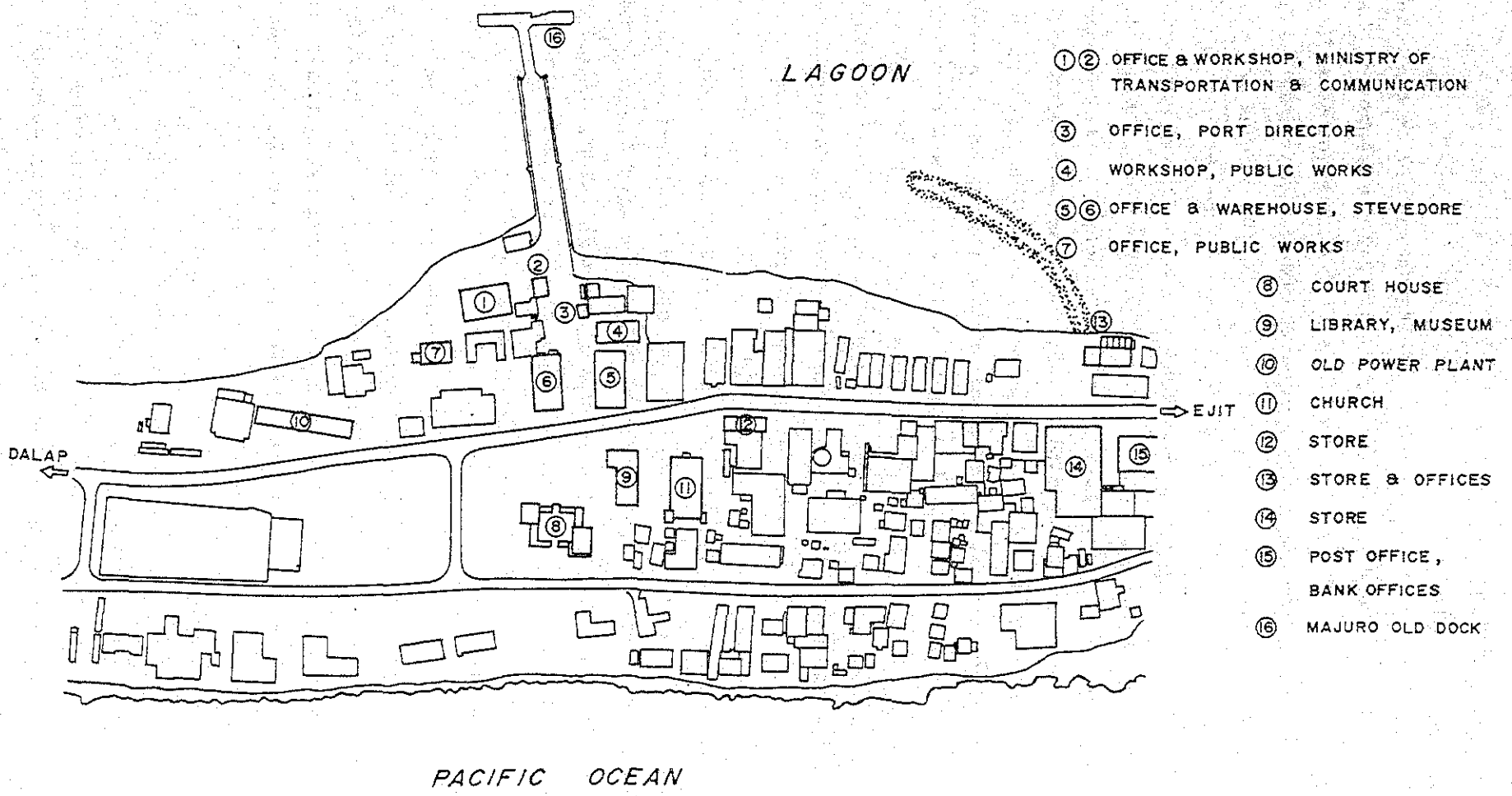


Fig. 3.12 VICINITY MAP

(2) Condition of the Existing Dock

1) Outline, size, and structure

The existing dock is a T-shaped dock on pilings comprised of the main dock at which vessels moor and a connecting bridge to the causeway. A mooring dolphin of pile construction has been built at a point some 70 m away from each edge of the main dock, while a tidal gauge has been installed at the junction point between the connecting bridge and the causeway.

The main dock is approximately 7.35 m wide x 55.60 m long, while the connecting bridge is 6.47 m wide x 30.86 m long. The depth in front of the dock is an average 9.04 m from chart datum level (CDL), as measured at five locations directly under the front face of the dock, while the depth at the back of the dock averages 6.38 m, based on four readings. The crown height averages 2.86 m from CDL, based on 6 readings, and is 0.91 m above mean high water level.

The concrete slabs of both the main dock and connecting bridge are supported by a beam 40 cm wide and 80 cm high, spanned at about 3.5 m running in both directions of the beams and the girders. They are supported by straight and diagonal piles of 55 cm diameter. Both the girder and piles are of reinforced concrete construction, with an H-shape steel imbedded in the center of the concrete along its entire length. The piles are further buttressed by steel pipe about 6 mm thick along the outer side of the concrete.

2) Extent of the damage

Some 40 years have passed since construction of the subject jetty in around 1946. On two occasions, in 1979 and 1980, foreign freighters (139 m long, 18.6 m wide, weighing 7,763 tons) rammed the front of the dock, dealing lethal blows not only to the base, girder, and pilings in the area of impact but to the entire dock structure as well. As a result, the dock became structurally unsafe, and there is no telling when the structure will collapse under some unexpected external force.

The concrete platform of the pier was shifted some 15 cm from its original position by the 1979 accident, and another 45 cm by the 1980 mishap, in a lengthwise direction on the southern side. The main structural elements --

viz. the joint between the pile and the beam and the pile legs -- are now not able to endure further weakening. The dock is thus in its last throes and extremely dangerous. Photos of the damage are submitted in Annex VI-5.

When inter-island vessels berth at the pier or when heavy cargo, such as concrete blocks, is standing on the dock during loading operations, one can actually feel the shifting of the main dock and can readily see the resulting change in horizontal position at the expansion joint between the main dock and the connecting bridge.

3.3 Use Patterns at the Existing Facility

The only two places at which vessels are presently able to dock at Majuro Port are the "New Port", completed in 1978, and the Old Dock, which is the target facility for this Plan. The principal vessels using these facilities include scheduled cargo vessels of foreign registry, foreign fishing vessels, the Marshall Islands inter-island fleet, small fishing and cargo boats, and certain other types of vessels.

According to Customs data, an average of 276 foreign vessels per year called at Majuro during the 3-year period 1985-1987. Large-size cargo vessels (carrying foodstuffs and other necessities, vehicles, construction materials and other imported items on regular schedule) comprised 10% of all arrivals. Japanese skipjack and tuna fishing vessels, operating within the country's 200 mile zone and entering port mainly to refuel, accounted for 80%, and other work and research vessels for 10%. The main vessels of Marshall Islands registry using the port are the inter-island passenger/cargo vessels, small fishing boats equipped with outboard motors, and small cargo boats with inboard engines that bring in copra from Arno and Mili Atolls and other nearby points.

The inter-island fleet is presently made up of 5 vessels: 3 passenger/cargo vessels of the 790 ton class; 1 of the 486 ton, and one LST of 458 tons. Each of these vessels makes 8 - 10 scheduled runs per year.

The main vessels using the New Port are large freighters. Dock space is allocated to the various size classes as follows: large vessels -- 260 m,

medium sized cargo vessels -- 85 m, medium sized fishing vessels -- 76 m, and small boats -- 146 m. During 1987, 84 large freighters and other merchant ships were received at the New Port. Considering that 79% of these vessels remain in port for less than 24 hours, it appears that capacity is ample for these large and medium sized vessels.

The primary vessels using the Old Dock are: inter-island vessels, foreign fishing vessels, and small fishing and cargo boats. About once every 2 - 3 months, a 4,400 ton tanker calls to fill the shore-based oil tanks.

Berthing area by vessel type comprises the following: 2 locations (55.6 m to the front of the dock and 25 m to the rear of the T-shaped portion) are reserved for inter-island vessels, foreign fishing vessels, and tankers; another 2 locations (supplemental sections of 30 m) are reserved for small fishing and cargo boats. During the four years from 1984 to 1987, the call patterns for Japanese fishing vessels taking on fuel at Majuro were as shown in Table 3.2.

Table 3.2 Calls by Japanese Fishing Vessels at Majuro

	1984	1985	1986	1987	Monthly Total	Average for 4 Yr
Jan.	9	11	5	8	33	8.25
Feb.	8	24	9	17	58	14.5
Mar.	13	34	24	19	90	22.5
Apr.	25	19	20	18	82	20.5
May	18	14	6	12	50	12.5
Jun.	10	13	6	11	40	10
Jul.	16	9	10	6	41	10.25
Aug.	20	6	9	8	43	10.75
Sep.	11	6	5	4	26	6.5
Oct.	25	11	10	10	56	14
Nov.	13	5	8	20	46	11.5
Dec.	21	8	4	8	41	10.25
Total	189	160	116	141	151.5 (Annual Average)	12.6 (Monthly Average)

Based on the above data, an average of 12.6 vessels visited Majuro each month during the subject period. The peak of the tuna fishing season in Marshall Island waters is February, and so the number of arrivals is also highest at this time of the year, with an average of over 22 vessels during March.

The number of arrivals for foreign fishing vessels at Majuro has been on a gradually declining trend. However, the decline has reversed itself in recent years, with the number of arrivals rising from 116 in 1986 to 141 in 1987. The mid-west Pacific, including Marshall Islands waters, are among the best tuna fishing grounds in the world. Considering its rich resources as well as its geographic proximity to Japan, the area around the Marshall Islands has major fishing potential and so, for the foreseeable future, the number of fishing vessel arrivals should hold at present levels.

The Marshall Islands Government owns the following five inter-island vessels:

1.	Ms. Micro Chief	805 tons
2.	Ms. Micro Pilot	790
3.	Ms. Micro Palm	790
4.	Ms. Militobi	486
5.	Ms. Ailine Kein AD	458

All these inter-island vessels use the Old Dock as their home port. This dock is used to load and unload passengers and cargo, to take on food and water, for other sailing preparations, and to tie up vessels for extended stays in port. Total cumulative vessel days in port during 1986 came to 1,187, vs. 1,084 in 1987.

In addition, some 10 cargo boats carrying mainly copra from neighboring atolls spend 80 - 100 vessels days in port per year, and the dock is also used daily by 10 - 20 other small fishing boats.

The inter-island vessels take on and discharge their cargo and passengers at the front of the dock. If their visits happen to overlap with those of other vessels, the rear and side faces are used to refuel and reprovision for foreign fishing vessels and for the tying up of cargo boats.

Cargo operations for the small fishing vessels and copra boats take place at the connecting bridge portion of the dock but, given the average 2.0 m tidal variation, the small boats find it difficult to use the facility during low tide, owing to the excessive height of the dock surface from water level at such times. In addition, during rising tides, there is a continual danger of accidents caused by vessels sliding under the pier beams, and so it is desirable that structural repairs be made to enable small boats to use the dock safely.

While the facility can hardly be termed adequate, the Old Dock is presently offering three berthing areas -- one for loading and unloading the inter-island vessels that can be moored directly at the dock, a second for vessel tie-up, and a third for refueling and reprovisioning of foreign fishing vessels. There is also a dock for use by small boats.

During 1987, the use distribution of the Old Dock by vessel category showed the following pattern:

	Large and medium-sized vessels
Inter-island	1084 cumulative vessel days
Fishing vessels and others	294

The total number of vessel days in port for both the inter-island fleet and the fishing and other medium-sized vessels thus come to:

1,084 + 294 = 1,378 vessel days

Accordingly, a simple calculation suggests that the number of vessels that cannot be berthed directly to three berthing area will reach to 283 per year.

1,378 vessel days - (365 days x 3 berths) = 283 vessel days

When the number of vessels in port exceeds the capacity of the Old dock, this bottleneck is relieved by:

(1) mooring idle inter-island vessels off-shore;
(2) double berthing; and
(3) using the New Port.

Based on data for 1987, the number of days on which arrivals exceeded docking capacity by more than 3 vessels came to 217 days. It is true, therefore, that, although the Old Dock is quite congested, the port of Majuro as a whole, including the New Port, is still able to handle the present number of calls within the existing facilities. However, it would be desirable to provide calm berths to shield the smaller vessels from the waves generated by the prevailing easterly winds and the occasional westerly winds. Also, as supplemental facilities, there is a need for a small landing ramp to facilitate small fishing boat maintenance, loading, and storage, a floating dock to permit the loading and unloading of these boats at any tidal level as well as a fuel supply and a potable water supply facility.

3.4 Evaluation of Required Facilities

Based on the specific requests from the Marshall Islands Government, the natural and environmental conditions in the surrounding area, and the current dock utilization patterns, we have carefully evaluated the various functions designated in the subject Plan and determined the types of facilities required.

The existing dock facility is being used by inter-island vessels and foreign fishing vessels, for the loading and unloading of small fishing and cargo boats, for tying up vessels, and for refueling operations. The replacement facility will essentially carry on the activities and functions of the current facility: viz.,

(1) to serve as a home port for the inter-island fleet;
(2) to refuel, and provide water and other provisions to mainly foreign fishing vessels;
(3) loading and unloading, berthing, and mooring of small boats.

Accordingly the required facilities will include those for loading and unloading, berthing facilities for refueling and reprovisioning use, shore facilities, and certain auxiliary facilities.

3.4.1 Facilities for Loading, Unloading, and Reprovisioning

(1) For inter-island vessels using the facility as a home port:

1) Sailing and arrival dock for the loading and unloading of cargo and the embarking and disembarking of passengers;

The inter-island fleet has been using the most convenient front side of the existing T-shape jetty. The facility for cargo loading/unloading and passenger embarking/disembarking is one of the basic requirements and has high priority. Naturally, this facility is indispensable for the Plan.

2) Dock for vessel tie-up;

The inter-island vessels tie up in the dock between the voyages for usual maintenance works. The average number of vessel staying at the Old Dock was 2.18 per day in 1987. The dock for tie-up is therefore necessary for the Plan.

(2) Reprovisioning dock, mainly providing fuel and water to foreign fishing vessels:

The fuel oil and water have been supplied to medium and large-size vessels including foreign fishing boats at the existing Old Dock. During 1987, a total of 294 foreign vessels received this service at the Old Dock and the Plan should also retain this function by providing a dock for reprovisioning and equipment for medium and large-size vessels.

(3) A dock for loading, unloading, and tying up small fishing and cargo boats plus a landing ramp:

At present, the connecting bridge portion of the dock is being used for these operations but, since this area was not specifically planned for small vessel use, it is inconvenient in many ways, such as the excessive crown height of the dock from water level. The landing ramp, to be provided as an auxiliary facility, will be used for the berthing, storage, and maintenance of small fishing and cargo boats and so is an essential facility for handling these vessels. The existing facilities in the area are inconvenient in the sense that their construction does not permit use during periods of low tide, and so careful attention must be given to this point in the facility plan.