BASIC DESIGN STUDY REPORT
ON
THE FISHING COMMUNITIES DEVELOPMENT PROJECT
IN
TUVALU

February 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

BASIC DESIGN STUDY REPORT ON THE FISHING COMMUNITIES DEVELOPMENT PROJECT IN TUVALU February 1988

BASIC DESIGN STUDY REPORT

ON

THE FISHING COMMUNITIES DEVELOPMENT PROJECT

IN

TUVALU

February 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of Tuvalu the Government of Japan has decided to conduct a basic design study on the Fishing Communities Development Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Tuvalu a study team headed by Mr. Masaru Okamoto, Deputy Director, International Affairs Division, Oceanic Fisheries Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries from October 26 to November 15, 1987.

The team had discussions on the Project with the officials concerned of the Government of Tuvalu and conducted a field survey in Funafuti and Vaitupu areas. After the team returned to Japan, further studies were made, a draft report was prepared and, for the explanation and discussion of it, a mission headed by Mr. Satoshi Kamise, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries was sent to Tuvalu from February 3 to February 17, 1988. As a result, the present report has been prepared.

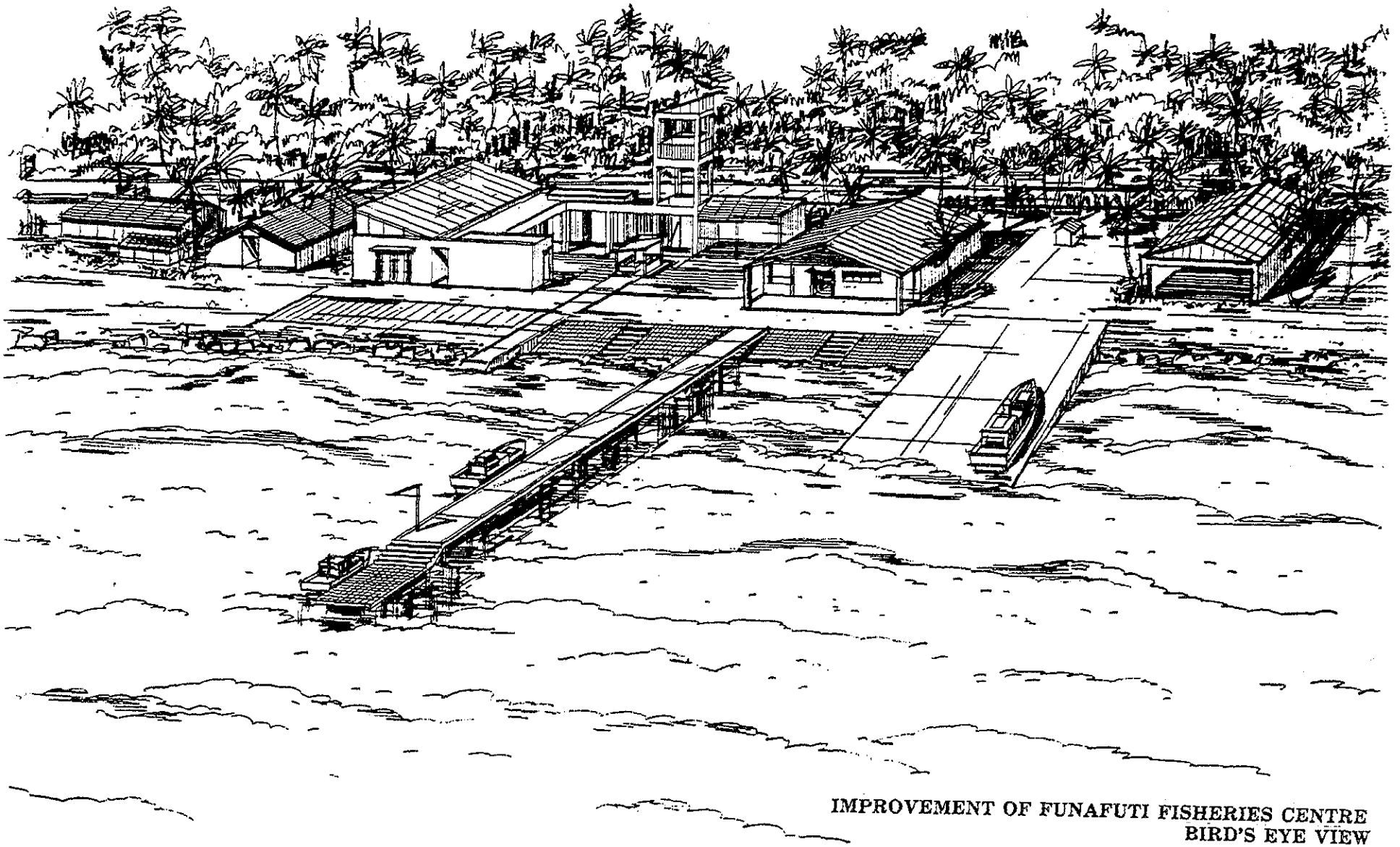
I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

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

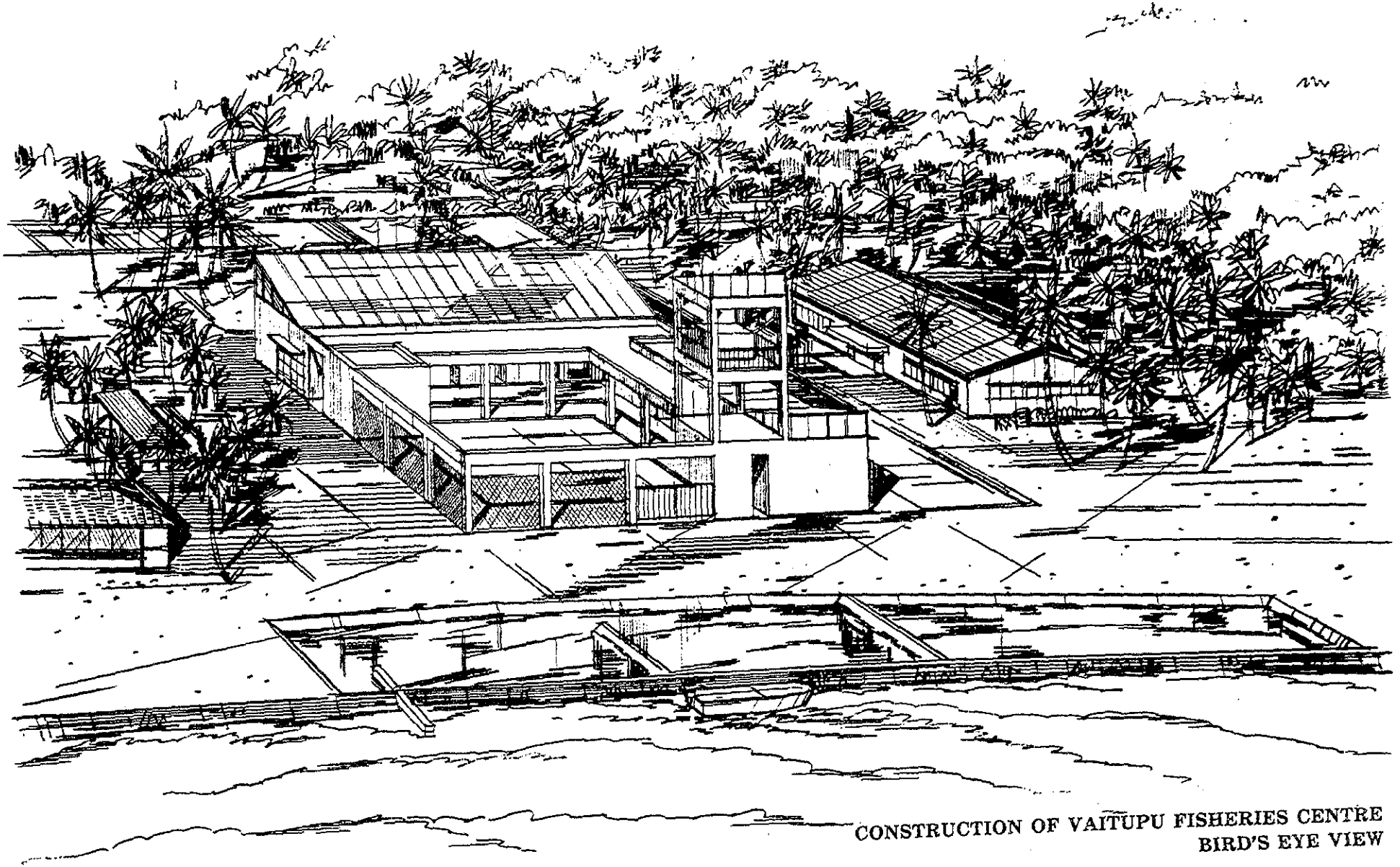
February, 1988

Kensuke Yanagiya

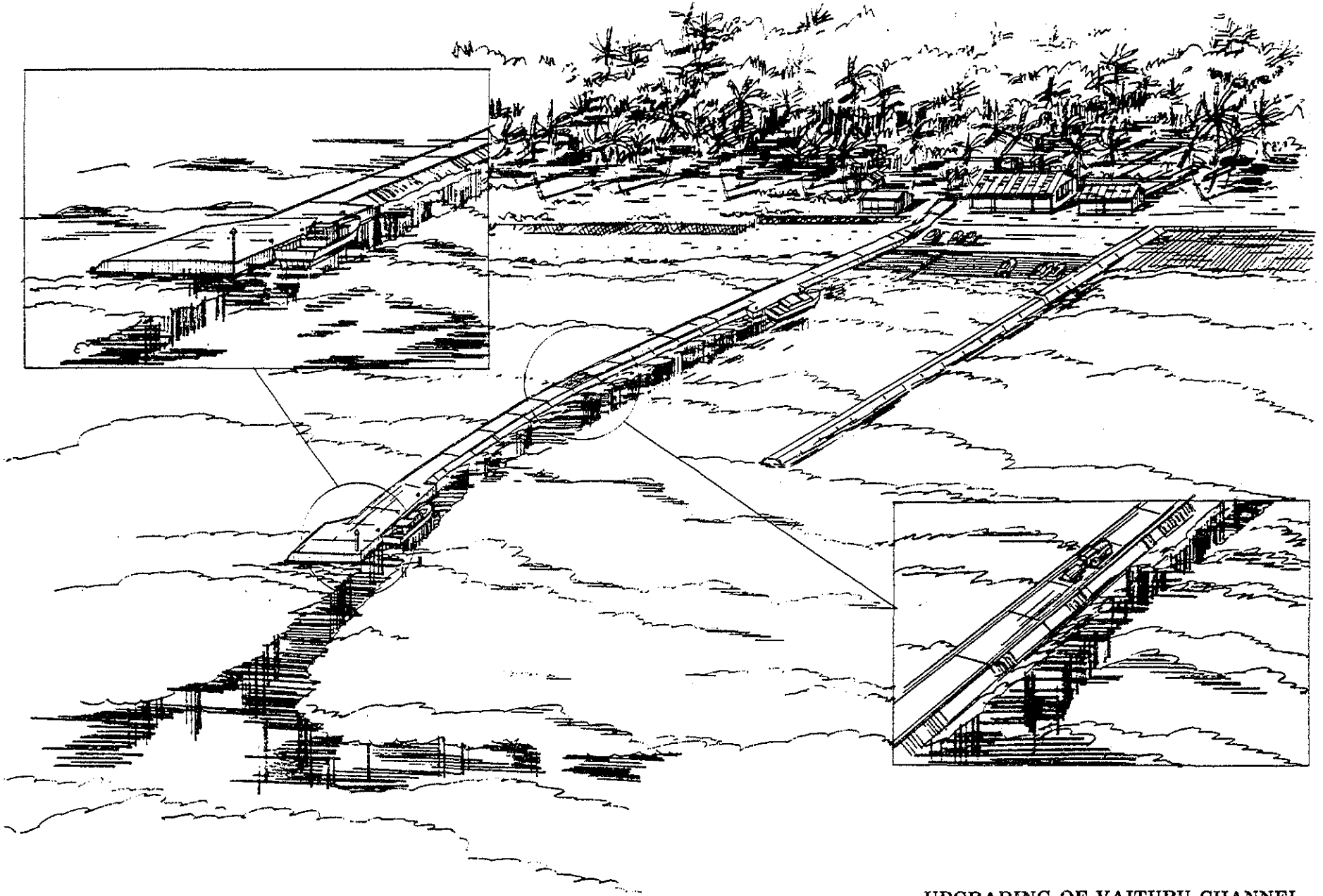
Kensuke Yanagiya
President
Japan International Cooperation Agency



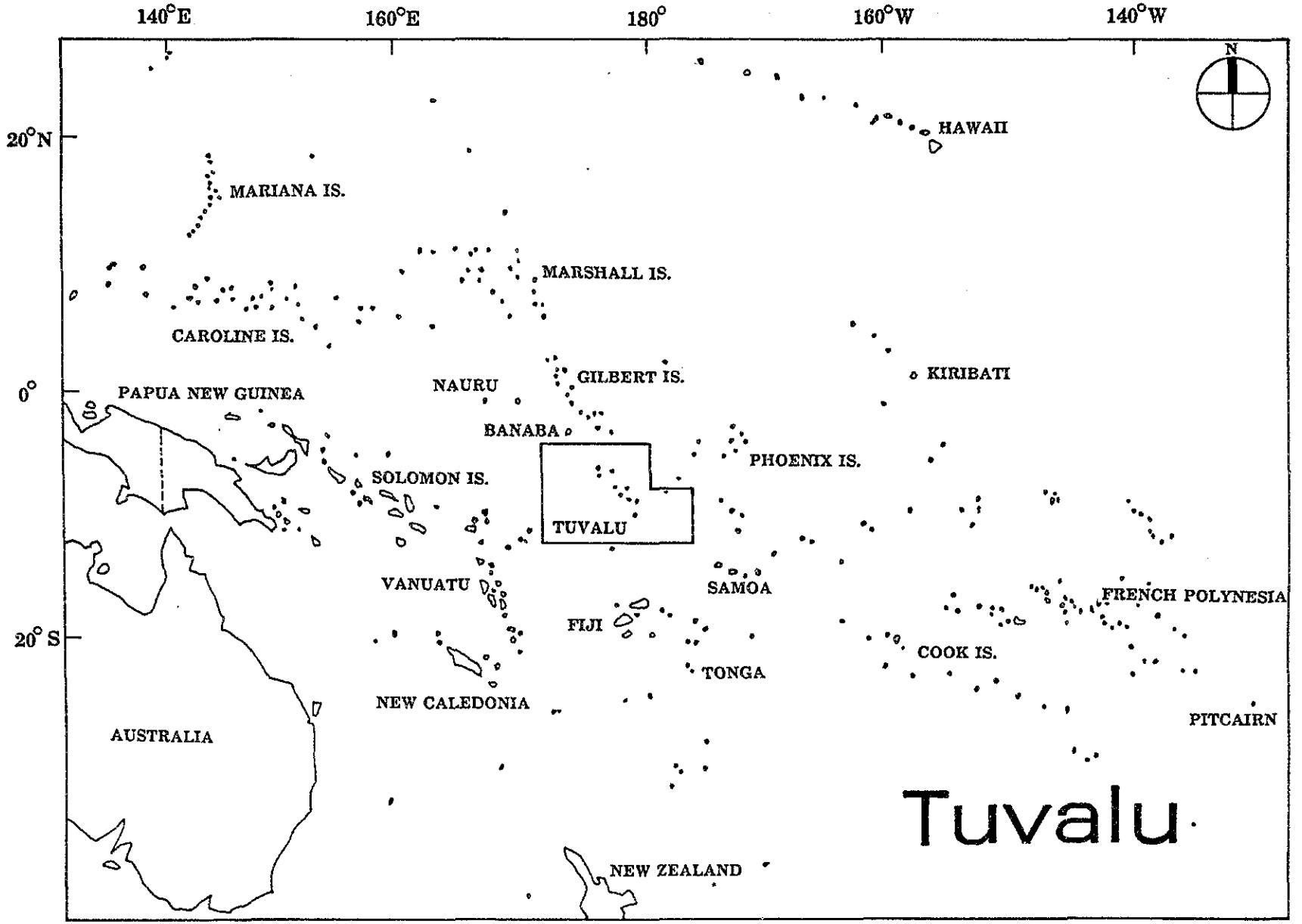
IMPROVEMENT OF FUNAFUTI FISHERIES CENTRE
BIRD'S EYE VIEW

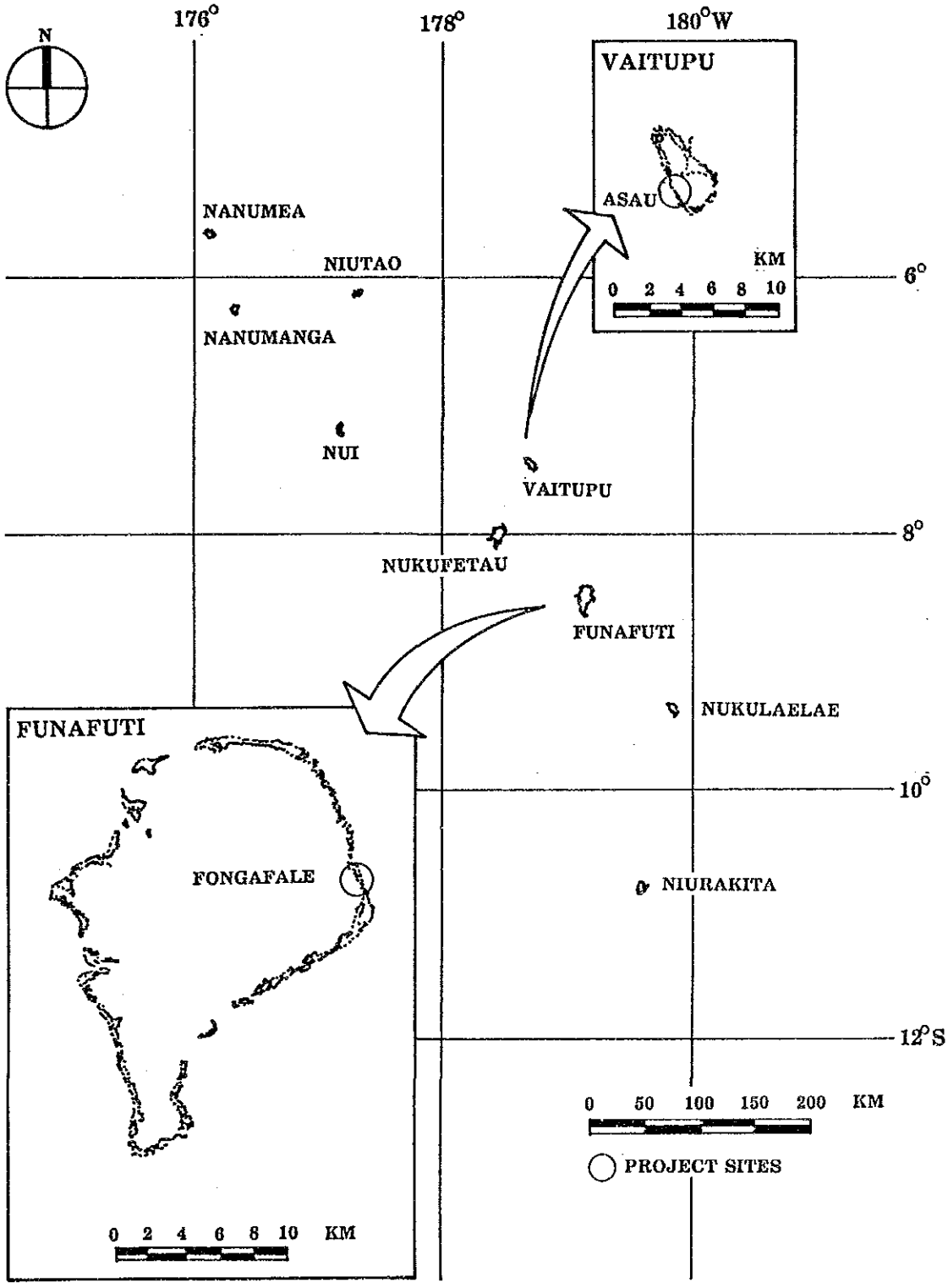


CONSTRUCTION OF VAITUPU FISHERIES CENTRE
BIRD'S EYE VIEW



UPGRADING OF VAITUPU CHANNEL
BIRD'S EYE VIEW


140°E
160°E
180°
160°W
140°W
N
20°N
0°
20° S
HAWAII
MARIANA IS.
MARSHALL IS.
CAROLINE IS.
KIRIBATI
NAURU
GILBERT IS.
PAPUA NEW GUINEA
BANABA
PHOENIX IS.
SOLOMON IS.
TUVALU
VANUATU
SAMOA
FRENCH POLYNESIA
FIJI
COOK IS.
TONGA
NEW CALEDONIA
PITCAIRN
AUSTRALIA
NEW ZEALAND
Tuvalu



LOCATION OF PROJECT SITES

SUMMARY

SUMMARY

Tuvalu became independent from the Gilbert and Ellice Islands British Protectorate in 1978. It is an island country comprising nine (9) islands lying on a chain in the South Pacific stretching between 5 and 11 degrees South latitude and 176 and 179 degree East longitude. Tuvalu's land area is very small with 26 km^2. However her exclusive economic zone (EEZ) is vast with 750,000 km^2. Tuvalu belongs to the zone of tropical oceanic climate with consistently uniform temperature and high humidity. The annual rainfall is more or less 3,500 mm without clearly defined wet and dry seasons.

The population at the time of the 1985 census was 8,200. The growth rate has averaged 1.9 percent per year since 1979. Funafuti where the nation's capital is located accounts for 34 percent of the country's population or2,810 persons, and its average annual growth rate of 4.8 percent during the period was high. Funafuti is expected to account for 42 percent of the national population by year 2000 or4,600 persons.

In 1985, approx. 15 percent of the population (1,166 persons) were classified in cash economy. The remaining approx. 85 percent of the population is involved in non-cash economy. Out of total GDP, agriculture/fishery sector occupied approx. 10 percent and industry sector 2.1 percent. In terms of economic development, the agricultural development is restricted in view of the limited land area and poor quality of soil. To promote economic development it is placing much hope on the development of fisheries resources in its vast area of EEZ.

Since independence in 1978, Tuvalu has brought down three development plans: First Plan (1978-80); Second Plan (1980-83) and Third Plan (1984-87). The Fourth Plan (1988-90) has just been drafted.

In the First Plan the objective was to improve the living standard of the people to reasonable levels that will ensure a secure, healthy and productive family life within the traditional social system and customs of all the islands. Some of the priorities emphasized as the implementation strategy were to improve internal and external communications; to expand agricultural and fishery production for local and export markets; to create employment opportunities in Tuvalu and overseas; to achieve balanced development of all islands; to expand health and education services, etc.

The Second Plan continued the long term primary objectives contained in the First Plan, and the Plan emphasized the development of resources with the greatest potential i.e. the ocean that surrounds the islands of Tuvalu.

The objectives of the Third Plan are, in general terms, unchanged from those of its predecessors. Fishery development was again considered to be one of the objectives to provide the most potential for economic development, and the Plan was directed towards balanced social and economic development of rural areas on all islands through increasing fish landings, promotion of commercial activities and the development of employment opportunities. In the Third Plan, three definite targets: small-scale fishery; licensing of foreign fishing vessels and commercial tuna fishery were emphasized for development of fisheries. The licensing of foreign fishery vessels has achieved great progress in terms of much increase of licensing fee. However, in the case of the other two the achievement of target has been restricted by constraints such as lack of landing facilities, fishermen training boats, marketing facilities, etc.

Under these circumstances, the Government of Tuvalu has formulated a "Fishing Communities Development Project" (hereinafter described as "the Project") for the purpose of undertaking the modernization of its coastal fishery, and requested a grant aid from the Government of Japan for the provision of equipment for fishermen's training, fish landing and marketing facilities, infrastructure in fishing communities.

In response to this request the Government of Japan decided on the implementation of basic design study in order to examine the significance and appropriateness of the project and to formulate the most suitable plan, and dispatched a basic design study team through the Japanese International Cooperation Agency (JICA) from October 26 to November 15 in 1987 to study the significance and appropriateness of the request.

During the field survey, the team examined the appropriateness of the Project sites, conditions of relevant infrastructure, conditions of implementation of fisheries development by the Government and conditions of construction, discussed with Government officials and prepared minutes of the discussion on the fundamental items agreed by both sides. On return to Japan, the team examined the significance and appropriateness of the Project, formulated a basic plan and construction plan of the Project, which is described in this report in its final form.

The Government of Japan dispatched a Draft Final Report Mission through JICA from February 3 to 17 in 1988 for final discussion and confirmation on the contents of the basic design study report.

The purpose of the Project is to upgrade the living standard of fishermen, to stabilize supply of fisheries products and to create a base for future export of fisheries products by activating fisheries through modernization of fisheries itself and infrastructure of coastal fishery. The Project provides, through the grant aid of the Government of Japan, improvement of landing and marketing facilities, fishing vessels for fishermen training, equipment and an extension vessel for activating fisheries in the outer islands, repair tools of fishing boats, spare parts, etc. in Funafuti and Vaitupu.

The basic design was prepared based on the examination of the results of field survey on facilities and equipment, taking into due consideration the organization of operation and maintenance, technical level, natural conditions, conditions of constructions, etc.

The outline of designed facilities and equipment is shown in following table.

Facilities/equipment	Outline of contents	Scale/Quantity
1. FUNAFUTI		
1) Equipment	Communication and safety equipment, outboard engine repair tools, fishing gears, spare parts, etc.	
2) Training vessels	Overall length; 9.0 m, FRP, Depth (moulded registered); 0.7 m	6 vessels
3) Extension vessel	Overall length; 17.0 m, FRP, Depth (moulded registered); 1.8 m	1 vessel
4) Funafuti Fisheries Centre		
- Building	Consisting fuel depot, storage, watchman room, water tank, garage in one building. RC structure, wooden truss	316m^2
- Improvement of slipway	Extension of concrete slope Steel rail, motor winch.	15m wide 40m long
- Improvement of jetty	Extension of jetty with grating landing step.	5m long
	Replacement of wooden board with pre-cast concrete slab. Installation of jib-crane and lighting. Repainting of steel beam.	45m long
- Construction of sea wall	Concrete seawall on the shoreline facing Fisheries Centre.	28m long
- Vehicles	Transportation vehicle, water tank lorry, machines for road maintenance.	
2. Vaitupu		
1) Construction of Fisheries Centre	Consisting fuel depot, work-shop, ice making machine, water tank, training/meeting hall in one building. RC structure, wooden truss.	301m^2
2) Upgrading of existing channel	Concrete landing pier, anchorage for extension vessel, channel for fishing vessel and training vessel, boatyard, slipway, etc.	Pier; 210m Groyne; 150m Channel;130m

The portion of construction cost to be borne by the Tuvaluan government is estimated at A$38,670.

The implementation schedule of the Project is divided into four (4) phases taking into consideration that project sites are located in two islands that are separated by ocean, and that the contents of the project are divided into provision of equipment and construction of facilities.

Construction Phase	Items
Phase 1	Provision of equipment and training vessels
Phase 2	Provision of extension vessel
Phase 3	Improvement works of Funafuti Fisheries Centre
Phase 4	Construction works of Vaitupu Fisheries Centre, and improvement works of existing channel

The executing agency of the Project is the Fisheries Division under the Ministry of Commerce and Natural Resources, and the recruitment of the Division's staff of approximately 10 persons including those for the Project, are being planned by the year 1989 when Project operation commences.

The operation cost of the Project is to be allocated from the recurrent budget of the Fisheries Division. The estimated cost of A$55,500 - A$61,800 needed annually from the fifth year after commencement of the operation should be allocated in the annual recurrent budget.

On the other hand in the same period the revenue earned is estimated to be A$55,200. As to the balance, although it is calculated to be a small deficit of A$300 - A$6,700 from the fifth year of operation, it is expected that the income increase from the increase in fishing efficiency will balance the operation cost and income. It is considered that the operation of this project is financially viable.

The project will contribute directly to the increase of fish landing, and domestic supply of protein through upgrading of catchability and increase in fishing frequency by the provision of landing facilities, repair and maintenance tools, fishing vessels, fishing gears, etc. By the extension of the Share Fishing Scheme, and collection service of extension vessel, there will be increase of income or income earning opportunities of fishermen and promotion of fishing activities and self-reliance among fishermen. The project will further provide the base for future export potential of fishery products. Hence the provision of Japanese grant aid is very significant.

TABLE OF CONTENTS

APPENDIX

1. INTRODUCTION

1. INTRODUCTION

Tuvalu which became independent in 1978, is situated in the South Pacific and it is comprised of nine islands. It has an Exclusive Economic Zone of about 750,000 km^2. The Government of Tuvalu has placed importance on the development of fisheries as one of its most important policies. However, the country has insufficient facilities such as landing and marketing facilities, training vessel, transportation, etc. and these have placed constraints on the development of fisheries.

The Government has formulated a "Fishing Communities Development Plan" in order to modernize the coastal fishery and it has made a request to the Government of Japan for Grant Aid. The contents of the request were provision of fishing gears and equipment for fishermen training, improvement of landing and transportation facilities, fishing village infrastructure, and others.

In response to the request, the Government of Japan decided to conduct a basic design study in order to examine the significance and appropriateness of the Project and to formulate the most suitable plan, and the Japanese International Cooperation Agency (JICA) dispatched a basic design study team headed by Mr. Masaru Okamoto, Deputy Director, International Affair Division, Oceanic Fisheries Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries from October 26 to November 15, 1987.

During the study the team confirmed the background of request and objectives of the Project, explained the grant aid system, and confirmed the roles of implementation by both the Governments. Based on the study on the appropriateness of the sites, present condition of infrastructures, state of fisheries development, architectural conditions, etc., the basic design of the Project has been formulated.

JICA dispatched a Draft Final Report Mission headed by Mr. Satoshi Kamise, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries from February 3 to 17, 1988 for explanation and final discussion of the contents of the basic design of the Project.

This report is an analysis of results of the above described surveys. Members of study teams, itineraries and minutes of discussions are attached in the Appendix 1.

2. BACKGROUND OF THE PROJECT

2. BACKGROUND OF THE PROJECT

2.1 General Description of Tuvalu

2.1.1 Profile of the Country

In October 1975 the Ellice Islands separated from the Gilbert and Ellice Island Colony to form the separate British Colony of Tuvalu. In October 1978 Tuvalu became a fully independent state.

Tuvalu is comprised of nine islands lying in the South Pacific, stretching over about 590 km between 5 and 11 degrees South latitude and 176 and 179 degrees East longitude. The nine islands are all low lying atolls, seldom rising to more than 4.5 meters above sea level, and composed of coral islets formed on submerged ridges. Five of the islands; Nui, Nanumea, Funafuti, Nukufetau and Nukulaelae are coral atolls where reefs and islets enclose sizable lagoons. Only Funafuti and Nukufetau are navigable. The rest of the islands; Niutao, Nanumanga and Niulakita are true reef islands composed of single islets or pinnacles of rock formations that rise from the ocean bed thousands of metres below. Vaitupu is intermediate between the two types, with a large but virtually land-locked central lagoon

The total land area of Tuvalu is about 26 km^2 and the land itself is composed of rock, coral and sand with little or no soil in the usual sense of the word. There is no surface water and no forest vegetation. Vaitupu is the largest island with an area of 5.6 km^2 and Niulakita the smallest with 0.5 km^2, while the capital Funafuti has a land area of 2.8 km^2. Funafuti lies about 1,050 km from Suva (Fiji) and 4,000 km from Sydney (Australia).

1) Climate

Tuvalu has a tropical and oceanic climate, and consistently has uniform temperature. Mean monthly air temperature lies within the range 26.9°C to 28°C. Humidity is high ranging between 70 percent and 90 percent with little variations between day and night. The mean annual rainfall is high ranging from 2,226 mm to 4,833 mm in Funafuti. There are no clearly defined wet and dry seasons.

2) Population

Tuvaluans are Polynesians with close cultural, linguistic and historical ties with Samoans, Tongans and Tokelauans on islands to the east. Table 2.1 shows Tuvalu's population from 1968 to 1985 and projection for 1990 and 2000 by island.

The population at the time of the 1985 census was about 8,200. The growth rate has averaged 1.9 percent per year since 1979. Eighty percent of the increase occurred in Funafuti, emphasizing the dominance that the national capital is rapidly acquiring in terms of both population and economic activity. The 1985 population bulletin predicts Tuvalu's population to rise to nearly 11,000 by the year 2000, based on the above mentioned average annual population growth rate of 1.9 percent. Funafuti is expected to account for 42 percent of the national population by year 2000 or 4,600 persons.

In 1985 census, approx. 15 percent of population (1166 persons) were classified in cash economy. The remaining approx. 85 percent of the population are involved in non-cash economy. Fishing industry provides an important source of employment for those in the non-cash economy. Those involved in fishing are over 15 years of age either as established fishermen who own their own boats or as casual fishermen who use boats from the Fisheries Division on a Share Fishing Scheme. Almost of island people are thought to participate in fisheries activities.

2.1.2 National Economy

Tuvalu's economy depends on subsistence agriculture and fisheries. Manufacturing and commerce are underdeveloped and the major constraints are lack of essential infrastructure and services. Agricultural and livestock development is also difficult in view of the limited land area and poor quality soil. The resource with the greatest potential is the ocean that surrounds the islands of Tuvalu.

The estimated gross domestic product (GDP) from 1981 to 1985 is shown in Table 2.2. Agriculture, livestock and fisheries contributed approximately 10 percent to the total GDP while the manufacturing contributed about 2.1 percent. In 1985 the total GDP and per capita GDP were A$5,034,457 and A$ 612, respectively. Agricultural productivity is limited and centres on coconut and subsistence crop production of which Pulaka and Taro are the most important. Poultry and pigs are the only livestock maintained.

Tuvalu depends on imports for almost all domestic consumption items, materials and equipment, foods, etc. (Table 2.3, 2.4). In 1984 about 25 percent of the imports were food and live animals chiefly for food. With regard to fishery products the country imported fish, crustaceans and molluscs to a value of A$13,842; of which about 96 percent was from Japan.

The balance of trade is always in the deficit as shown in Table 2.5. Remittances from Tuvaluans working overseas, philatelic sales, revenues from licensing of foreign vessels, and export of some copra are the only foreign earnings at present. Exports of copra which accounted for A$163,000 in 1979 have dropped in value and accounted for A$28,000 and A$19,000 in 1980 and 1981, respectively. The export of fish in 1982 and 1983 recorded A$191,000 and A$250,000, respectively, due to sales of fish (to Fiji) that were caught by the newly acquired fishing vessel, the "Te Tautai" from Japan.

The country consequently shows a balance of payment deficit and has to depend on foreign aid for various capital works and public sector expenditure. In fact since independence in 1978, Tuvalu has relied on aid funding for capital development and technical assistance and for part of its recurrent budget expenditure. The main aid donors have been United Kingdom, Australia, New Zealand, Japan, EEC and UNDP.

The recent establishment of A$27 million Tuvalu Trust Fund in June 1987 will allow the Government greater stability and independence in financial management in future years. The main contributors of initial capital are Australia, UK, New Zealand and Tuvalu. The Fund will provide annual budget support to meet the country's recurrent budget deficit. The Fund will also release the outside donors from funding all the local costs associated with other bilateral forms of assistance.

2.1.3 National Development Plans

(1) National Development Plans

Since independence in 1978, Tuvalu has brought down three development plans: First Plan (1978-80); Second Plan (1980-83) and Third Plan (1984-87). The draft of the Fourth Plan (1988-90) is scheduled to be prepared by the end of 1987.

Before independence there was low level of investment to this country. Hence there was particular need to strengthen the country's economy by improving both internal and external communications, and

essential infrastructure especially wharves and reef passages, electric power and telecommunications, and by developing its agricultural, fisheries and human resources.

The primary objective of the First Plan was to improve the standard of living of the people to reasonable levels that will ensure a secure, healthy and productive family life within the traditional social system and customs of all the islands. Hence, following implementation strategies were put as the highest priority; to improve internal and external air and sea communications; to expand agricultural and fisheries production for local and export markets; to create employment opportunities in Tuvalu and overseas; to achieve balanced developments of all islands; to expand health and education services, etc.

The Second Plan continued the long term primary objectives contained in the First Plan, and the Plan emphasized the development of resources with the greatest potential i.e. is the ocean that surrounds the islands of Tuvalu.

The objectives of the Third Plan are, in general terms, unchanged from those of its predecessor.

(2) Fisheries in the National Development Plans

With regard to the development of the marine resources in the First and Second Plans, the main objectives centered around investigation work into resources, fishing methods and market for fish products as well as setting up of a fish market and a loan scheme to help fishermen to purchase boats, engines and equipment.

In the Third Plan (1984-87), fisheries development was again considered to be one of the objectives to provide the most potential for economic development, and the Plan was directed towards balanced social and economic development of rural areas on all islands through increasing fish landings, promotion of commercial activities and the development of employment opportunities. In the Third Plan three definite targets: small-scale fishery; licensing of foreign fishing vessels; and commercial tuna fishery were emphasized for development of fisheries. The licensing of foreign fishery vessels has achieved great progress in terms of much increase of licensing fee. However, in the case of the other two the achievement of target has been restricted by constraints such as lack of landing facilities, fishermen training boats, marketing facilities, etc.

The Fourth Plan (1988-90) is to follow the Third Plan, indicating that the development of marine resources is the important objective for economic and social advancement of the nation. The specific aims for the fisheries sector from 1988 to 1990 are:

- to develop a commercial fishing activities based on the artisanal, small-scale fisheries;
- to pursue the possibilities of export-earning for fish and fish products while meeting those local demand;
- to encourage participation in this development by fishermen on all islands;
- to promote fisheries related activities such as processing;
- to promote the development of aquaculture and other miscellaneous fish species; and
- to maximize the returns from vessels fishing in Tuvaluan waters.

1) Strategies of fisheries development in the Fourth Plan

There are five major strategies to be pursued during the Fourth Plan period as indicated below:

- to invest in fisheries infrastructure, shipping and fishing vessels to expand and support production by artisanal and commercial fishermen on the outer islands and to set up a rational fisheries marketing system by integrating a national and export marketing structure;
- to investigate and negotiate export market opportunities for fish and fish products and to organize international shipping services to transport products to these markets;
- to facilitate the development of a commercial fishing by fishermen through support of appropriate commercial organizations and through upgrading of extension, advisory and financial services;
- to improve the resources and capacity of the Government's management in fisheries development and its dealings with foreign fishing nations; and
- to encourage foreign investment in joint venture arrangements in industrial fisheries.

2) Programmes and Projects of fisheries development in the Fourth Plan

Four programmes (commercial fisheries, licensing of foreign fishing vessels, agriculture development and institutional development) are indicated in the Fourth Plan. The Fishing Communities Development Project is composed of several projects categorized into commercial fisheries.

Programmes Indicated Fourth Development Plan

(1988 - 1990)

Programmes	Projects
1. Commercial Fisheries:	a) Commercial Fisheries Management b) Fish Marketing and Processing Centre c) Improvement of Jetty and Slipway d) Community Fishing Centres e) Extension/Collection/Research Vessel f) Commercial Fishing Vessels g) Artisanal Fishing Loan Scheme h) Extension Services i) Channel Improvement, Vaitupu j) Survey of Ciguatoxic Fish Poisoning
2. Licensing of Foreign Fishing Vessels :	a) Foreign Fishing Agreements b) Delineation of EEZ c) Surveillance and Enforcement Programme
3. Aquaculture Development:	a) Trochus Production b) Production of Corals c) Seaweed Production d) Giant Clam e) Feasibility of Milkfish
4. Institutional Development:	a) Restructuring of the Fisheries Division b) Training c) Resources Assessment

Source: Fourth Development Plan 1987-1990 (Draft)

2.2 Description of Fisheries Sector

2.2.1 Present Condition of Fishery Activities

(1) Marine Fisheries

Tuvalu has widely scattered islands and it has a vast span of ocean of approx. 750,000 km^2 as her exclusive economic zone (EEZ). This zone has rich resources of skipjack, yellowfin and bigeye tuna as well as plentiful stocks of some deep water fish such as snapper.

A series of survey of Tuvalu's fisheries potential have been carried out since 1970 by Japan, Taiwan, Korea and other countries, and results of these surveys gave encouraging indications of fish stocks in Tuvalu waters. Resources survey undertaken in 1985 and 1986 by Te Tautai and Ika Corporation vessel also have indicated a potential resource of snappers in Tuvalu waters.

Most fishing operations are still a subsistence activity. The traditional canoes of 2-4 m make up the bulk of Tuvalu's fishing craft. In Funafuti a fleet of plywood, fiberglass and aluminum powered and non-powered boats are being used in an artisanal fishery. The majority of the fishing boats are suitable only for operation in nearshore waters and lagoons. The Fisheries Division operates diesel inboard powered launches for fishery training.

An artisanal commercial fishery is developing on the capital island, Funafuti, supported by the availability of loans for boats and engines through the Business Development Advisory Bureau (BuDAB) and National Bank of Tuvalu. This development practice was initiated by Fisheries Division which is placing particular emphasis on the upgrading of the country's small-scale fisheries to meet the local demand for fish and generate exportable surplus. In order to achieve this purpose various fisheries programmes are being implemented as follows:

- promotion of commercial fishing through Share Fishing Scheme;
- installation of fish aggregation devices;
- demonstration of new fishing techniques particularly for deep bottom fishing;
- supply of gear and fishing tackle and provision of general instructions to fishermen (outboard engine maintenance, boat safety, etc.); and
- establishment of a fish processing and marketing centre in Funafuti.

(2) Licensing of Foreign Fishing Vessels

Tuvalu has agreements with four foreign nations; Taiwan, South Korea, Japan and USA, to allow their vessels to fish for Tuna in the EEZ waters. Revenues from licensing increased substantially over the period of 1980 to 1986 (Table 2.7). Revenue during the Plan Period (1984-87) contributed about 36 percent of the total Government revenue.

(3) Aquaculture

There are opportunities for culture of trochus, coral, clam and seaweed production in Tuvaluan waters. A study on the technical feasibility for establishing an aquaculture project for Trochus niloticus was carried out in early 1987 in Funafuti, Nukulaelae and Nukufetau. Suitable sites were identified and planting of seed has been carried out in the lagoons or outer edge of the reef.

(4) Fish Landings and Fish Consumption

Limited data is available on both fish catch and fishing effort in the country. Until last year fish landings were estimated on simple basis, but have now been replaced by a six-days per month fish landings survey for Funafuti, and are extrapolated to other islands.

The total landings in 1985 and 1986 on this basis were estimated at 893 MT and 270 MT, respectively as shown in the Table below. No prior fish landings or marketing data are available within Fisheries Division, making analysis of fish landings and market trends impossible.

Estimated Fish Landings and Per Capita Consumption in 1985 and 1986

	1985 Landing (Ton)	Per Capita (kg) Consumption	1986 Landing (Ton)	Per Capita (kg) Consumption
Funafuti	111.7	39.8	102.7	36.5
Outer Islands	781.7		167.4	
TUVALU	893.4	108.3	270.1	32.7

Source: Fisheries Statistics, 1985 & 1986
Fisheries Division of GOT

With the population of 2,810 in Funafuti the estimated per capita consumption of fish were 39.8 kg and 36.5 kg in 1985 and 1986, respectively. The estimated per capita consumption in the country as a whole with the population of 8,250 were 108.3 kg and 32.7 kg in 1985 and 1986, respectively. The per capita consumption can not be easily determined with these figures due to limited data. However based on fish landings available for Funafuti a reasonable figure could be about 40 kg.

Fish is the most common protein source in Tuvalu. Tuvaluans consume fish daily and they prefer fresh fish, though small quantities of fish are preserved by sun drying and salting for local consumption. Fish are generally marketed by hawking or direct sale at the landing sites. In Funafuti there is a fish store in the Fisheries Centre operated by Fisheries Division and a market operated by the Cooperative. Retail prices in the market range from A$1.45 to A$1.60 per kilogram of fish.

According to SCF (Save the Children's Fund) study in 1980 about 90 per cent of people in Vaitupu consumed meat and eggs once a month while about 60 per cent in Funafuti consumed once a week. This indicated their only source of animal protein is through fish

(5) Constraints on Fisheries Development

In the the Fourth Plan, following constraints are considered to be hampering the achievement of the objectives.

- Non-availability of data on fisheries including catch and landing conditions;
- the fluctuations in the abundance of the resources, particularly baitfish resources;
- lack of physical infrastructure on the outer islands to store and transport fish and to provide maintenance services to fishing vessels and equipment;
- the irregular internal shipping to carry perishable foodstuffs and there is no refrigerated transport system;
- lack of slippage and docking facilities as well as spares for repairing and ancillary services for large commercial fishing vessels;
- fishermen are mainly artisanal and adopted small-scale technology, and thus they are less skilled in the maintenance of equipment, gear, boat and engine and in the management of commercial operations;

- fishermen lack the capital necessary to purchase equipment and for operation.

2.2.2 Fishery Administrations

(1) General

Fisheries Division, established in 1976, is in the Ministry of Commerce and Natural Resources. The organization chart of the fishery administration in the Fisheries Division is shown in Figure 2.1. It undertakes the responsibility for fisheries development and management. Its major activities include the upgrading of small-scale fisheries to meet local demand and generate an exportable surplus; and to license foreign vessels in the EEZ and monitor their activities.

(2) Development Budget for Fisheries Division

1) Recurrent budget

The recurrent budget from 1981 to 1987 of the Ministry of Commerce and Natural Resources and including that of the Fisheries Division is shown in Table 2.7. Since 1985 the revenue of the Ministry of Commerce and Natural Resources increased rapidly to about 90 percent. This increase was due the income brought in by the license fee of the foreign fishing vessels in Tuvaluan waters. The income-expenditure balance showed a large surplus of A$200,000-300,000. On the other hand, the revenue of the Fisheries Division was A$10,000-20,000, and its expenditure was increasing 20 - 30 percent annually. The deficit in 1987 alone was about A$50,000.

Since the revenue-expenditure balance in the National Budget is always in the deficit, the Ministry of Finance has planned strict control on expenditure. With regard to fisheries the allocation of essential expenditure could be approved, since the government has recognized the importance of fisheries development.

2) Development budget

The trend of the development budget for fisheries from 1983 to 1987 is listed in Table 2.8. The budget is increasing every year; from A$ 132,500 in 1983 to A$ 755,870 in 1987. In terms of total budget it has kept the level to about 10 percent during the period.

(3) Other Agencies Related to Fisheries Division

The agencies listed below is also closely involved with the activities of the Fisheries Division

- NAFICOT

The National Fishing Corporation of Tuvalu (NAFICOT) was established in 1981 to operate the "Te Tautai" with the responsibility for developing offshore fisheries. Fisheries Division is considering to transfer its fish market activity to NAFICOT.

- BuDAB

The Tuvalu Business Development Advisory Bureau (BuDAB) was established in 1982 and along with the National Bank of Tuvalu it provides low cost credit to small businesses. In the fisheries sector its loans are primarily for boats and engines.

- Maritime School

The Tuvalu Maritime School was established in 1979, and was primarily designed to train Tuvaluan and other Pacific island youth to work on foreign merchant vessels. Due to few job opportunities Tuvaluan graduates in each year do not have any other choice except to be a semi-skilled labourer in fishing industry at least for a period prior to securing overseas position.

2.3 Present Conditions of Funafuti Fisheries Centre

2.3.1 Organizations

Fisheries Division consists of the following five units:

- Management and Administration Unit;
- Extension Unit;
- Research Unit;
- Processing and Marketing Unit; and
- Maintenance and Repair Unit.

The Management and administration unit has its office in the central government building and the other four units are in the Fisheries Centre which is the practical foothold of the Fisheries Division's activities.

The Fisheries Centre, which is 3 km from Funafuti town, has office building, jetty, slipway, workshop, etc. The Centre is managed by 17 staff members (including temporary staff) distributed in each unit.

2.3.2 Activities

Activities of the Fisheries Centre are described below.

- Administration of Fisheries Division
  (Planning, Fisheries statistics, Extension service, and others)
- Administration of NAFICOT
- Share fishing scheme
  Fishing vessels of Fisheries Division are operated by fishermen and the whole catch is bought by the Division. Fifty percent of cash value of the catch less fuel cost is allotted for the costs of maintenance of vessels, fishing gears and others.
- Fishing craft evaluation
  Survey for the unification of fishing vessel's type most suitable to fishing activities around the waters of Tuvalu.
- Storage of machinery/equipment and repairing works
  Storage of fisheries machinery and equipment, and repairing of fishing vessels and engines. Repairing workers have been acquiring technology of repairing through on the job training by a UNDP expert.

- Fish processing and marketing
  Fresh fish landed at the Centre are bought and sold in its fish shop. Surplus fish are kept in cold storages with a chilled or frozen form after gutting and cleaning. Some of the pelagic and demersal fishes are sun dried or smoked.
- Landing jetty and slipway
  Landing of fish, loading to fishing vessels, and repairing and periodical inspection of fishing vessels

2.3.3 General Conditions of Existing Facilities and Equipment

1) Fisheries Division's office (120 m^2)

The office was constructed in 1987 with the aid from United Kingdom and it consists of chief fisheries officer's room, extension service room, research room, NAFICOT manager's room, library/meeting room, reception/ clerk room, toilet and water tank.

2) Old workshop

The workshop is a small wooden building sheltering rain and wind and it has the following spaces.

- Equipment storage (16 m^2)

  It consists of shelves where fishing gears, repair tools, spare parts of engine, handy talkies, etc. are kept.

- Workshop (38 m^2)

  It is has a small working space, and repair tool and machinery are old.

3) New workshop (219 m^2)

The building is under construction by a local contractor with the funds provided by Canadian government and USAID (in November 1987). The workshop consists of repair rooms for engines and other equipment and for fishing vessels.

4) Fish processing & marketing centre (300 m^2)

The building constructed in 1986 has an office, fish sales space (with showcase and weighing machine), processing room and water tank. Processing facility and equipment were provided by Australian Aid in 1987. The facility and equipment are as follows:

- Ice making machines (flake ice and cube ice types x 1 each)
- Cold storage (5 ton x 2), freezer, chilled room (10 ton x 2)
- Band-saw, smoking machine, working table, weighing machines, etc.

5) Jetty (Total length 46 m)

It was constructed in 1984. It has wooden board on the 'I' section steel structure.

6) Slipway (Total length 26 m)

It is concreted and it has small manual winch.

7) Solar powered ice making plant

It was provided by UNDP as a trial and it is not functioning because of insufficient power output or other factors.

8) Various types of fishing vessels (6-9 m)

There are nine vessels at present, and three of them have been landed for repair of engines .

2.4 Present Programmes Related to Fisheries

2.4.1 Fisheries Development Programmes

In 1985 the Government of Tuvalu formulated its fisheries development programmes by 1990 in which contents of each project by foreign aid are indicated. During the field survey, the progress and future schedule of each project were confirmed. The results are reviewed in Table 2.9.

2.4.2 Programme Related to this Project

"Tuvalu Fisheries Development Programme" is the one related to this Project the field survey of which has been undertaken by the Government of Australia. In this programme, the importance of a collection/extension vessel has been emphasized as one of the key components for the development of fisheries in the outer islands. Community fishing centres are proposed for Nukufetau and Nanumea with similar objectives as in this Project.

2.5 International Aid to Fisheries Sector

Foreign assistance is the only source of fund for projects that are implemented in accordance with stated national development plans since independence in 1978. External aid is thought to be needed for some considerable time to finance the country's fisheries development programme. It is presently receiving technical assistance from the United Kingdom, Japan, New Zealand, Australia, South Korea, West Germany, USA and UNDP for fisheries development.

2.6 Background and Contents of the Project Request

2.6.1 Background of the Request

In Tuvalu Third Development Plan the government has placed the development of fisheries as one of the important targets. However the country has insufficient landing and transportation facilities, and well-equipped training vessels. These have posed constraints on the realization of the targets. Under these circumstances, the Government of Tuvalu has formulated Fishing Communities Development Plan to modernize its coastal fishery. In view of the above circumstances, the Government of Tuvalu has requested to Japanese Government for Grant Aid for providing machinery and equipment for fishermen training, and improvement of landing and transportation facilities improvement of fishing village infra-structure and others.

The proposed site in the requested are located in Funafuti Island which is the capital of Tuvalu, and Vaitupu Island which is the largest among the islands.

2.6.2 Contents of the Request

The contents of the request that have been finally confirmed between both Governments based on the results of the field survey of the basic design study are listed in following table.

Requested Facilities and Equipment

Items	Funafuti	Vaitupu
1. Modernization and training of coastal fisheries		
A. Training		
(a) Training vessels (6 vessels, approx. 6-9 m)	O	V
(b) Extension vessel (1 vessel, approx. 17-19 m)	O	-
(c) Training facilities and equipment on shore	-	O
(1) Training and meeting room	-	O
(2) Outboard engines, spare parts, tools, fishing gear	O	V
B. Modernization		
(a) Fuel depot and store room facilities, etc.	O	O
(b) Upgrading of jetty and slipway at Fisheries Centre	O	-
(c) Communication/safety equipment	O	-
(d) Workshop	-	O
2. Promotion of marketing operations		
(a) Construction of water tanks	O	O
(b) Equipment for fish handling and marketing		
(1) Insulated fish boxes	O	V
(2) Pick-up trucks, fork-lift tractor, motorcycles	O	V
(3) Ice making machine, generator, and cold storage	-	O
3. Improvement of fishing village infrastructure		
(a) Provision of essential equipment and machine for road improvement	O	-
(b) Provision of water tanker (approx. 3 tons capacity)	O	O
(c) Upgrading of existing channel	-	O

Note: O = to be provided directly to Funafuti or Vaitupu
V = to be provided from Funafuti Fisheries Centre

3. OUTLINE OF PROPOSED SITES

3. OUTLINE OF PROPOSED SITES

3.1 Description of Funafuti

3.1.1 Present Condition of the Site

The projected site is located in Fongafale Island of Funafuti atoll where the capital of Tuvalu is situated. The atoll is the size of 24 km in major axis and 18 km in minor axis, and Fongafale which is the main island in the atoll lies from north to south 12 km and its maximum width is 650 m. The site is in the area of the Fisheries Centre which is located in the northern part of Fongafale island and is about 3 km away from the centre of the village (Fig. 3.1). The road connected to the Centre is unpaved of 6 m wide. A power station is supplying electricity in 24 hours in this island, and its substations and distributors are installed along the road. The main trunk cables of electricity and telephone are laid underground. Pipings of water and gas are presently not installed.

Land area of the Project site in the Fisheries Centre is under the management of the Government provided for public facilities. The land is flat with an area of approx. 900 m^2 rectangular shape extending 30 m east-west and 30 m north-south. Presently, There are a old storage and a ice making house in the site. The storage is scheduled to be demolished.

Seaside area of the site consists of existing structures of slipway (6 m wide x 26 m long, 9.3% slope) and jetty (3.6 m wide x 45 m long), and 26 m eroded shore line on both sides of the abutment of the jetty (Fig. 3.2).

According to the result of tide observation, the height from water level to top board of the jetty was recorded to be about 1.6 m at high tide and about 3.0 m at low tide.

Water depth on the lower end of the slipway measured 1.1 m at high tide, which is the lower limit for drawing up of existing inboard-engine vessels of the Fisheries Division. The lower end, however, emerges out of the water at low tide, when not even the outboard-engine boat can be pulled up to the slipway.

The influence of rainstorm on the site is not severe, since the site is facing the lagoon. However, during bad weather due to westerly winds, high waves occur in the lagoon and wash the area above the normal shoreline.

The surface soil layer consists of about 1 - 2 m of sand mixed with gravel, and the second layer is of coral rock (Fig. 3.9).

3.1.2 Natural Conditions

(1) General climate

The projected area is in the tropical zone and there is little fluctuation of temperatures throughout the year and the mean temperature is 28°C. There is comparatively much rainfall and the mean annual rainfall is about 3,500 mm. Daily or monthly fluctuations of rainfall is large and has no periodicity. Sometimes more than 100 mm of daily rainfall has been registered, while less than 100 mm of monthly rainfall has been recorded. So there is water shortage in some years or months. Monthly rainfall in Funafuti from 1978 to 1987 is shown in Fig.3.6.

As Tuvalu is located in the northern limit where hurricanes originate, the threat of hurricane in Tuvalu is not frequent. A strong hurricane, however hit Tuvalu waters in 1973, which recorded more than 30 m/sec of wind speed and damaged buildings in Tuvalu. According to the observation data of the Meteorological Division (1978-1985), the mean annual wind speed is comparatively high at 4.9 m/sec and the percentage of wind speed of more than 11 m/sec is about 3.8 % of the total observations. As for wind direction, the east wind originating in the trade winds is most frequent and the percentage of easterly, northeasterly and southeasterly winds is about 61 % of the total observations when the wind direction is divided into eight directions. Seasonally east winds are frequent from April to November and north or west winds increase from December to March. The percentage of north-westerly winds reaches about 48 % of the total especially in January.

(2) Sea Conditions

The tide level at the Funafuti lagoon where the jetty is located, daily low and high tide levels are forecasted based on the measurements from 1975 to 1981 conducted by the Marine Department of University of Hawaii. When the survey team carried out tide observations using a tide staff near the site and checked the results with the forecasted tide table, the measurements were approximate in accordance with the tide table. The tide level is shown as follows:

	At Datum level	(At land mark)	
Mean spring high water level	: DL + 2.17 m	(8.73 m)	
Mean high water level	: DL + 1.76 m	(8.32 m)	
Mean water level	: DL + 1.22 m	(7.78 m)	1.90 m
Mean low water level	: DL + 0.63 m	(7.19 m)	
Mean spring high water level	: DL + 0.27 m	(6.83 m)	

The datum line (DL) for tide level, established in 1977, is zero line of tide staff. Figures in the parenthesis indicate the level when the datum line was temporally established as the bench mark for the land survey.

There is no data at Funafuti lagoon on waves. According to observations on the east coast of Fongafale island by the Meteorological Division in 1985, the maximum height and wave period at the shore are as follows.

- Maximum wave height
  - Observed max. height : 1.79 m
  - Theoretical max. height : 3.80 m
- Wave period
  - Minimum period : 6.74 sec.
  - Mean period : 10.61 sec.
  - Maximum period : 18.74 sec.

3.1.3 Architectural Conditions

(1) Buildings

Most of the buildings in Funafuti are traditional houses; thatched or simple wooden houses. Several public facilities are made of concrete block or reinforced concrete and only a few buildings donated from other countries are of steel-frame construction.

Windows and doors of the building are large because of tropical climatic conditions. Building materials such as aluminum roofing and sash, wood, plastic, etc. are used to prevent corrosion. Most of the materials meet the British Standard (B/S) and Australian Standard (A/S).

(2) Labour

In Funafuti labour related to construction works is very less. There are about 50 skilled labourers involved in other jobs and in particular there is a shortage of welders and electricians. There are four construction contractors operating on a small scale. Manager,

foreman and labourers are employed by the project. At present the Public Works Division's (PWD) main office, Red Cross Hospital, engine repair and boat building, and others are under construction. Therefore there is a shortage of labour and some labourers have been brought from other islands.

3.2 Description of Vaitupu

3.2.1. Present Condition of the Site

Vaitupu Island, where the other project site is located, is a small island 5 km in major axis, and is about 140 km away from the Funafuti atoll. There is a lagoon the size of 1.3 km in major axis and 700 m in minor axis, with a mouth in the north-east. The village is located in the west side of the island, and concentrated in the rectangular area with approx. 400 m side between the lagoon and the open sea. The road is unpaved but arranged cross-meshed layout. There are no facilities such as electricity, water-works, sewage, etc., except for one radio telephone.

The site of the Fisheries Centre is located in the public land in the east side of the village which faces the lagoon (Fig.3.3). Public buildings, primary school, meeting hall, guest house and others are concentrated around the site, and the site is approximately in the centre of the island. The site facing the road (about 6 m wide) in the west and the lagoon in the east is flat with an area of approx. 2,000 m^2 rectangular shape extending 55 m east-west and 35 m north-south (Fig.3.4). On the site, coconut trees are planted and two small wooden houses and one wooden storage house are located facing to the road. These houses are scheduled to be transferred.

Since the site is facing relatively small lagoon, the effect of rainstorms and bad weather is less.

The surface soil layer consists of about 1 - 2 m of sand mixed with gravel, and the second layer is coral rock.

On the other hand, the site of the channel that is to be upgraded is located on the shallow reef stretching to about 200 m from the shore on the west side of the village (Fig.3.3). The reef is nearly flat and the end of the reef rises about 30-50 cm, which is a typical reef shape usually found in South Pacific islands (Fig.3.5).

In the Project site, there exists a shallow channel with depth of 30 - 50 cm excavated by the aid of New Zealand. the reef is 1.5 - 2.0 m

deep during high tide and it is exposed to about 150 m from the beach line during the low tide. The channel is presently used for local fishing vessels. Sand beach the width of 50 m on the shore side of reef is neither transformed nor eroded by water currents generated by the existing channel and maintains a shoreline with a stable section profile.

On the shore side there is a slipway connected to the channel for unloading and drawing up fishing vessels. Land level within the sand beach is about 3.0 m high from the reef and there is a boat yard, cooperative store, fuel depot, convention hall and a big church, which is the gateway to the island.

3.2.2 Natural Conditions

(1) General climate

Although there are less continuous climatic observations in Vaitupu, temperature, wind speed and direction is assumed to be similar to those in Funafuti. Monthly rainfall (1978-1987) in Vaitupu is shown in Fig.3.7.

(2) Sea conditions

There is no available data of tide level at the site. Comparing the results of the measurement of tide level using tide staff during survey with the tide table in Funafuti, it is confirmed that the tide fluctuation at the site is nearly coincident with that of Funafuti (Fig. 3.8).

There is no observation data on waves. They are also assumed to be similar to those of Funafuti. As the site of the channel to be upgraded is located on west side of the island, waves are less affected by easterly trade winds during the period from April to November; and the channel is considered to be largely affected by waves generated by north-westerly winds during the period December to March. It is however expected that the energy of the waves decreases to some extent by surf-breakings at the edge of the reef, as the reef stretches 200 m off the shore with a water depth of only 2.0 m even at high tide.

3.2.3 Architectural Conditions

(1) Buildings

In Vaitupu most buildings are of traditional thatched roof cottages or simple wooden houses. The public buildings like the church and the council hall are made of concrete and concrete block. The church which is

the symbol of the island is a big building (about 100 m^2). The public hall for islanders with the traditional thatched roof is also a big building which has the long span of approximately 15 m between beams and reveals high traditional/architectural technology.

(2) Labour

According to the information through survey, there are very few labourers engaging in construction works and only 30-40 labourers are in Vaitupu Island. They are usually sailors and fishermen. There is a need to bring labour from other islands in the implementation of this project.

4. CONTENTS OF THE PROJECT

4. CONTENTS OF THE PROJECT

4.1 Objectives of the Project

The objectives of this project are to improve and modernize the basic facilities of coastal fisheries so as to encourage fishing activities in order to upgrade the livelihood of the fishermen, to maintain stable supply of fish and to lay the foundation for export of fisheries products.

For these objectives the Government of Japan is providing assistance for the improvement of landing and marketing facilities, fishing vessels and equipment for training of fishermen, extension vessel for the development of the outer islands, repair tools, spare parts, etc.

4.2 Consideration of the Requested Project Contents

4.2.1 Consideration of the Plan

The requested facilities and equipment are arranged by site and facilities/equipment as indicated below.

(1) Improvement of Funafuti Fisheries Centre
Construction of fuel depot, water tank facility, equipment storage, and improvement of jetty, slipway, etc.

(2) Construction of Vaitupu Fisheries Centre
Training and meeting room, workshop, ice making machine, generator, fuel depot, etc.

(3) Upgrading of channel in Vaitupu
Excavation of channel, construction of slipway and landing facilities

(4) Vessels
Training vessels, extension vessel

(5) Fisheries related machinery and equipment
Outboard engines, repair and maintenance tools, spare parts, fishing gears, insulated boxes, transportation vehicles, etc.

(6) Facilities for improvement of fishing village infrastructure
Machines for maintenance of roads, transportation vehicles, water tanker/lorry

Among the above items, some portions of items 1, 2, 3 and 6 are basic fishing facilities for promoting fishing activities. The items 4 and 5 are related to the modernization of coastal fishery. As seen from the objective level, proposed facilities and equipment mainly are related to activities to promote small-scale fishery, and are appropriate for the present technical level.

The detailed explanation of the main facilities and equipment is shown below.

4.2.2 Consideration of Facilities, Machinery and Equipment

(1) Improvement of Funafuti Fisheries Centre

The present condition of the Fisheries Centre is shown in Fig. 3.2. At Funafuti Fisheries Centre development and survey programme are being implemented and some projects are actively carried out for the provision of necessary facilities as the main base for all fisheries activities. Under these circumstances there is a request for improvement of the facilities such as fuel depot, water storage complex, store room, jetty, slipway, etc.

The request does not aim at high target, but is to lessen the hindrance and obstacles presently confronted during usage of the existing facilities. So the reformation of facilities and equipment is urgently needed from the standpoint of present fisheries activities.

1) Fuel Depot

At present fuel is supplied in drums using a hand pump. This method of supply has problems in maintenance and safety and also there is not enough drums for fuel supply. For these reasons it is necessary to secure safe and easy maintenance by provision of an underground type of fuel tank and mechanical pump with fuel meter, and also by fencing in the fuel depot. The fuel supply from the projected fuel depot is assumed to be the quantity required by the Fisheries Division vessels (including the training vessels) and 50 percent demand of vessels in Funafuti.

The daily fuel consumption for fishing boat was estimated from per vessel consumption and fishing frequency of inboard and outboard based on the data from the fishing log and the survey by the Fisheries Division (See table below).

Fuel	Vessels	Consumption per Vessel	Fishing Frequency	Total Consumption
Gasoline	Outboard engine 96 vessels (50% of total)	20 lit/day/ vessel	30%	576 lit/day
Diesel	Inboard engine 12 vessels (includes planned vessels)	30 lit/day	80%	288 lit/day

At present the capacity of the fuel tank lorry supplied by the British Petroleum Company (BP) is two tons. The frequency of transportation to the power station is two to three round trips daily. When the planned fuel depot is established the frequency of the transport could be twice daily according to BP. Hence, there will be sufficient supply for the Fisheries Division's Centre. A supply for five days is planned for storage based on work efficiency, and allowance is also made for the diesel tank in consideration of supply for the vehicles of Fisheries Division. Consequently the capacity of fuel tanks are as follows:

Gasoline tank: 576 lit/day x 5 days = 2.9 ton: planned capacity 3 ton

Diesel tank : 288 lit/day x 5 days = 1.4 ton: planned capacity 2 ton

2) Water Tank

The Fisheries Centre depends on rain water collected from the roofs and stored in the existing four tanks (approx. 36 tons) for uses such as drinking, processing, washing, etc. However during the days of less rainfall there is a water shortage. In this plan a water storage facility is to be constructed to collect water from the roofs of the planned

building and the existing main building. The required water tank capacity is designed at about 40 tons which could continuously supply water even in a dry season of ten years probability, based on simulation analysis on water volume fluctuation in the tank taking into consideration two factors of water consumption 8about 3 tons/day) for processing and daily use by staff and daily available water obtained from relation between the roof area (584 m^2) and daily rainfall pattern for past ten years.

3) Storage

The existing storehouse which is dilapidating will be demolished to secure a site for the fuel depot. A storage facility will be nearly constructed to house the existing materials and tools and those provided in this Plan. The storage will have a room of 26 m^2 to house outboard engines, machinery and equipment related oil, and a room of 52 m^2 for fishing gear and materials not related to oil.

4) Watchman Room

There is no resting room in the Fisheries Centre, even though it is operating for 24 hours. A watchman room is planned as a resting place for the watchman. The room will be about 26 m^2, and a toilet and a storage room will be constructed in one building.

5) Upgrading of Slipway

The existing slipway is 26 m in length and 6 m in width (the slope is 9 percent). The boats are being taken up on a platform by hand winch. The drawing up of the inboard vessels of the Fisheries Division takes a long time and requires much labour using the present slipway. Furthermore the lower end of the slipway under the water is short and the depth is shallow; and these conditions are extremely dangerous.

In this Plan, the shallow area at the lower end of the slipway will be excavated, and then, the lower end of the slipway will be extended by 15 m, in order to enable the extension vessel (maximum length; 17 m and mould depth; 1.3 m) to be easily taken up at mean high tide.

The slippage method of the boats will be on rails using an electrically operated winch. As sufficient space on land would be allocated for parking the boats and also in case of emergency, the width of the slipway will be extended to 15 m (the extension vessel and the training vessel can be parked side by side).

There are plans for construction of boat yards through other assistance programmes. Hence the construction of a boat yard in this plan will be excluded.

6) Upgrading of Jetty

The existing jetty particularly made for fishing vessels was built in 1984, and its length is 45 m and its width is 3.6 m. The jetty is built on a steel pier by installing an I-section steel beam; and the top floor board is wooden. The top part of the jetty above water level is high; at low tide it is 3.2 m and at high tide it is 1.4 metre. Under these conditions the operations of loading and boarding of goods and passengers seem to pose problems. Furthermore the joints and bolts with the wooden parts are loose due to corrosion and rusting.

In this Plan the existing jetty will be extended with a landing step which has a reasonable height for loading and boarding even for outboard engine types. The lower part of the jetty will be protected by guard beam in order to facilitate siding of vessels along the jetty. The existing part of the jetty can be utilized by the planned extension vessel at all times except during low tide and by the inboard engine vessel at high tide.

There are two peaks of time daily around which the fishing boats depart for fishing: one is around four in the morning and the other peak is around four in the evening. The return of fishing boats is continuous 24 hours and hence there is no particular peak. In this circumstance the jetty space is sufficient to accommodate the fishing boats.

The decaying wooden slab of the jetty will be changed to concrete and the present I-section steel structure will be given anti-corrosion treatment.

7) Others

The Fisheries Centre faces the west, and its shore is heavily eroded by waves generated by strong westerly winds from December to March. During the extension of the slipway, the seawall 28 m long will be constructed in front of the Fisheries Centre. Steps together with it will be constructed to enable a small boat such as a canoe to access.

(2) Construction of Vaitupu Fisheries Centre

Vaitupu has no fisheries facility at present. The requested training and meeting room, workshop, generator, oil depot are to be gathered in one place, and a facility of a fisheries centre is to be constructed as a core for fisheries development in Vaitupu Island (Fig.3.4). This Plan will play an important role as one of the fisheries development programmes for the outer islands. In Nukufetau and Nanumea Islands, a basic design study has been conducted by Australia as a similar plan.

1) Training and Meeting Hall

This training and meeting hall is for conducting training in the improvement of fishing technology, promotion of processing technology and quality control, and also serve as an assembling and meeting place for exchange of information among fishermen. This hall will be of an area of 39 m^2 and can accommodate 20 to 30 persons.

2) Workshop

Presently repair and and maintenance of outboard engines is carried out by PWD or in some corners of copra factory. There are insufficient tools and spare parts.

In this plan workshop facilities for repair and maintenance of outboard engines and vehicles and sale of fishing gears will be provided. The planned workshop is of an area of 24 m^2 and will have sufficient space for storing the machinery and tools and working.

3) Ice Making Facility

In Vaitupu, except for a few kerosene type refrigerators in a cooperative or so, there is no cold storage or ice making machine. Daily fish catch is consumed and whatever preserved is sun dried. Hence there is a need for an ice making machine for preservation of fresh fish and stable supply.

In Vaitupu there is no data on the fish catch. Based on the per capita consumption of about 37 kg of fish in Funafuti, it is estimated that an annual catch would be about 48 tons. Assuming that there are 200 fishing days in a year, the daily catch would be 240 kg. Based on the ice /fish ratio of 1:1, the minimum quantity of ice required would be 240 kg.

In this Plan a block ice making machine of 240 kg capacity for 14 hours of operation is considered. The minimum available ice making machine operating for 24 hours can produce 400 kg of block ice. The reason for selecting block ice is the long preservation time of the fish. In addition the ice block making machine has a simple structure, long durability, and repair and maintenance are simple. Whereas the cube and flake ice making machines are troublesome and easy repair and maintenance can not be done. Space for ice storage along with fish storage of 5 m^2 is allocated.

4) Fuel Depot

In Vaitupu there is no inboard engine boat except for the training vessel to be provided in this plan. The daily fuel consumption will be estimated as follows in the same way as Funafuti.

Fuel	Vessels	Consumption per Vessel	Fishing Frequency	Total Consumption
Gasoline	Outboard engine 18 vessels (All skiffs)	20 lit/day/ vessel	30%	108 lit/day
Diesel	Inboard engine 1 vessel (planned vessel)	30 lit/day	80%	24 lit/day

Presently a transportation vessel calls once a month at Vaitupu and hence storage tanks with 30-day reservation should be planned. The generator at the planned Vaitupu Fisheries Centre for the ice making machine, lighting, etc. is expected to consume daily about 48 liters of diesel. Based on these factors, the capacities of tanks are planned as follows:

Gasoline tank: 108 lit/day x 30 days = 3.2 ton: Planned capacity 3 ton

Diesel tank: (24+48)lit/day x 30 days = 2.1 ton: Planned capacity 2 ton

5) Water Tank

The water tank capacity is decided by same method as that of Funafuti; the surface area of the roof (275 m^2), and daily water consumption estimate of the staff (2 tons). Based on simulation analysis a water tank capacity is about 50 tons.

6) Others

Other facilities such as office for supervisor, marketing and sales space will be allocated. Further, drying of fish and other working are to be conducted on the concrete space between the centre and the lagoon.

(3) Upgrading of Channel in Vaitupu

There are no fisheries statistics available for Vaitupu. Based on the field survey the present fishing conditions and problems are as indicated below.

Population	: Approx. 1,300 [about 1/2 of Funafuti island]
Length of outer	: 14 km [about 1/5 of Funafuti reef Island]
Number of	: Skiff, 18 [about 1/10 of Funafuti fishing boats Island]
	: Canoe, 20 [about 1/16 of Funafuti Island]
Fishing methods	: Motorized skiff is used mainly for fishing of migratory species such as tuna, bonito, etc. by trolling, and hand line or small gill net are implemented using unmotorised canoe within the reef area. Under the circumstances of facilities and technological level available in Funafuti, an average of 40 kg per trip is possible. The landings from canoes are 5-15 kg per trip.
Constraints and	: The fishing village is situated problems on the west side and the fishing boats depart and arrive on the west side. However, the present channel used by the fishing boats is shallow and there is no easy movement of the boats to the outer reef.

Considering the above circumstances, investigations were carried out to improve the channel of the west side for stable and safe movements of boats, and easier landing operations.

The existing channel is shown in Fig.3.5. The outer reef from the coast is about 250 m and the width of the existing channel is 3-5 m and depth of excavation is 0.3-0.5 m. This water level is shallow as more than 100 m of the shore from the land is exposed during the low tide. Thus the fishing vessels have to depart and arrive at right time to avert the trouble or hindrance. The channel has accumulated about 10 cm layer of sand.

Therefore if the channel is widen and excavated, and prevent the drifting of sand, the fishing vessels can go and come throughout the year and contribute greatly to the fishing activities. The inter-island service vessels and large size vessel like the proposed extension vessel can approach the island western side. It will contribute to easy loading and unloading operations.

As to contents of projected facilities, the existing channel is to be extended sufficiently in width and depth for landing of planned training vessel, and slipway is to be constructed. Groyne are also constructed so as to prevent sand accumulation at both sides of the channel, and the end of one of these is designed as a landing pier for extension vessel and others. Depth of the channel at landing pier should be secured enough for extension vessel.

(4) Fishing Vessels

1) Coastal Fishery Training Vessel

The present fishing vessels of the Fisheries Division are listed below.

Boat Type	Length (m)	Width (m)	Depth (m)	Draft (m)	Type of Engine	Material
1. Fiji Type	8.87	2.50	0.90	0.15	Inboard(20HP)	Wood
2. Samoa Type	8.50	2.13	0.80	0.10	Inboard(20HP)	Wood
3. Tuvalu Type	6.00	2.20	0.85	0.10	Inboard(25HP)	Wood
4. Tuvalu Type	6.00	2.20	0.85	0.10	Inboard(25HP)	Wood
5. Tuvalu Type	6.00	2.20	0.85	0.10	Inboard(25HP)	Wood
6. Tuvalu Type	6.72	2.20	0.85	0.10	Inboard(30HP)	Wood
7. Catamaran	8.90	2.40	0.90	0.20	Outboard(40HP)	Aluminum
8. Skiff	5.50	1.97	0.60	-	Outboard(25HP)	Aluminum
9. Canoe	7.12	0.85	1.05	-	Outboard(10HP)	Wood

These fishing vessels are mainly managed and operated under the Share Fishing Scheme. By this scheme each boat is operated by a crew of one to four fishermen. The crew will receive 50 percent of cash value of the catch, after deduction of fuel cost. The balance goes to the Fisheries Division to cover the cost of repair and maintenance of fishing gear and vessel.

For this purpose the Fisheries Division is keeping records daily on the fish catch, fuel consumption and operational hours. Based on these records the following data were obtained. The catch per trip of a boat is about 29 to 44 kg. The fuel consumption of inboard engine vessels (No.1 - No.6) is 12-23 liters. The fuel consumption of outboard engine boats (No.7-No.9) is varying depending on the horse power (HP) of the engine; 53 liters for 40 HP engine (No.7) and 24 liters for 10 HP engine (No.9). Even though there are boats that go fishing for more than 25 days a month, but generally it is 10 to 20 days because the existing fishing boats have not enough draft length and can hardly get stable navigation. However, these calculations are based on operationable vessels and some vessels are usually waiting for repair and are not involved in fishing.

Even under these conditions the Share Fishing Scheme started off smoothly. Each fishing trip under this scheme brought in an average cash value of A$30-40 (catch value - fuel cost). This amount is considerably attractive income for the fishermen.

In view of the above points, the introduction of seaworthy vessel and the provision of repair tools along with spare parts would develop the Share Fishing Scheme and improve fishing techniques. This would further create incentives to fishing among fishermen and promote fishing activities.

The specification for the fishing vessel is drawn, with safety as priority, based on the sea condition of the area, simple in repair and maintenance, and benefits in terms of fish catch and operating cost.

2) Extension Vessel

The extension vessel will be based in Funafuti Fisheries Centre to carry important measures in the development of fisheries of all islands. It is indicated in the request that the extension vessel will be involved in such activities as repair and maintenance service of fishing boats, supply of fishing gear and spare parts, training in fishing, resource survey, trial fishing, collection and transport of fish at all islands.

Vaitupu as the first among the other islands to be developed has no center similar to the Funafuti Fisheries Centre. Besides there are lack of fishing gear and spare parts, and level of repair technique and knowledge on fisheries including the incentive among fishermen is low. The activity of the extension vessel is indispensable to the fisheries development in other islands and is expected to bring greater benefits.

The specification for the extension vessel should be designed with due consideration of safety in the ocean and should include sufficient cruising range for extension service to outer islands, adequate equipment and space for resource survey, training and transportation activities. The vessel should of minimum scale with all the necessary facilities so as to minimize operation and maintenance cost.

4.3 Contents of the Project

4.3.1 Executing Agency

This project is under the responsibility of the Fisheries Division which is in the Ministry of Commerce and Natural Resources. The Fisheries Division is the executing agency for the operation and maintenance of the facilities and equipment. However the machinery and equipment related to the fishing village infrastructure will be operated and managed by Public

Works Division in Funafuti and the Island Council in Vaitupu. The organization chart of the Fisheries Division is shown in Fig. 2.1.

4.3.2 Operation Plan

The Fisheries Division has about 7 regular staff and about 10 casual workers at present. In 1988 there are plans to increase the staff by about 9 including for the extension vessel.

The operation plan of the planned facilities, vessels and equipment is described below.

(1) Funafuti Fisheries Centre

After the improvement of the facilities at Funafuti Fisheries Centre, it will be continued to be managed by the Fisheries Division's staff.

(2) Vaitupu Fisheries Centre

This centre is planned to be managed by the Fisheries Division. A manager will be assigned from the Fisheries Division and another person to assist, will be employed from Vaitupu.

(3) Coastal Fishery Training Vessel

These vessels will be mainly used under the Share Fishing Scheme along the boats of the Fisheries Division. The Share Fishing Scheme was started about a year ago and it is being operated beneficially. Approximately 20 - 30 fishermen are participating in this scheme now. There are many fishermen who are willing to join in this scheme. However the existing conditions do not allow to expand this scheme. The fishing boats are old and the fishing frequency is low. Three vessels are to be provided for replacement of old boats in future and another two fishing vessels to be provided in this project are for two fisheries centres; Vaitupu and Nukufetau, respectively. Another training vessel is also provided for additional purpose of research vessel as requested before this survey.

(4) Extension Vessel

The operation plan of the extension vessel was already planned in 1985. Based on this plan the following appropriate activities were formulated.

Activities

- survey for fishing grounds and trial fishing (sea basin, etc.)
- extension service to outer islands (repair service, transport of fishing gears and spare parts, installation of fish aggregating devices (FADs), and collection and transport of fish (increase of cash income for outer islands)
- Other activities (charter service, etc.)

Annual navigational schedule

- Survey operations
  Bottom fishing : 8-day trip/voyage x 5 times/year = 40 days/year
  Pelagic fishing : 12-day trip/voyage x 5 times/year = 60 days/year
- Collection service : 14-day trip/voyage x 10 times/year
  (2 islands/trip) = 140 days/year
- Charter service : Schedule unpredictable

Personnel schedule

The captain and engineer for the extension vessel are indicated in the organizational plan of the Fisheries Division. They are planned to be employed with the cooperation of Ministry of Works and Communication (Marine Division).

Details of the operating cost and expected income are explained in Chapter 7.

(5) Fisheries related machinery and equipment

Among the fisheries related machinery and equipment, repair tools and spare parts, etc. will be stored in the existing workshop and the planned workshop of Vaitupu Fisheries Centre. These equipment will be managed under the guidance of foreign expert. Some of the fishing gears and outboard engines will be loaned to the private owners of fishing vessels.

4.3.3 Outline of Facilities and Equipment

The outline of the facilities, machinery and equipment are listed as follows.

(1) Improvement of Funafuti Fisheries Centre

Facility/ equipment	Contents/ capacity	Location	Purpose
1) Fuel depot	Gasoline tank; 3ton Diesel oil tank; 2ton	Funafuti Fisheries Centre	Fuel supply for fishing boat & vehicle
2) Water tank	Ca. 40ton	-ditto-	Supply for fish processing & drinking
3) Storage	For machines; $26m^2$ For fishing gears; $52m^2$	-ditto-	Stock of provided equipment, etc.
4) Watchman room	Accommodation; $26m^2$	-ditto-	For night accommodation
5) Slipway (improvement)	Extension of existing slipway; 15m(W), 40m(L)	-ditto-	Drawing up of extension vessel, etc.
6) Jetty (improvement)	Extension with landing step Installation of guard beam Replacement of slab	-ditto-	Facilitate unloading of fishes, etc.
7) Seawall	Length; 28m	-ditto-	Secure working space

Remarks; Items 1) - 4) are to be constructed in one building.

(2) Construction of Vaitupu Fisheries Centre

Facility/ equipment	Contents/ capacity	Location	Purpose
1) Training/ meeting hall	1 room; 39m^2 for 20-30 persons	Vaitupu Fisheries Centre	Training & meeting for fishermen
2) Workshop	1 room; 24m^2	-ditto-	Repairing of outboard engine and vehicle
3) Ice making facility	Ice making machine; Cap. 240kg/day Ice storage Cap. 5m^3	-ditto-	Ice making and ice storage for fish & fishing
4) Fuel depot	Gasoline tank; 3 ton Diesel tank; 2 ton	-ditto-	Supply for fishing boat, generator and vehicle
5) Water tank	Cap. 50ton	-ditto-	Supply for fish process-ing & drinking
6) Working yard		-ditto-	For drying of fish, etc.

Remarks; Items 1) - 6) are to be constructed in one building.

(3) Upgrading of Vaitupu channel

Facility/ equipment	Contents/ capacity	Location	Purpose
1) Channel	Width; 10m Depth; 1.8 - 2.3m (at low tide)	West coast of Vaitupu Island	Facilitate access of vessels and unloading.
2) Landing pier	Length; 210m	-ditto-	-ditto-
3) Slipway	Width; 15m	-ditto-	Facilitate lifting up of vessels
4) Groyne	Length; 150m	-ditto-	Prevention of sand deposit

(4) Vessels

Facility/ equipment	Contents/ capacity	Location	Purpose
1) Training vessel	6 vessels (6 - 9m) Coastal type	Funafuti Fisheries Centre and other islands	Training of fishermen and survey works
2) Extension vessel	1 vessel Ocean-going type (17-19m)	Funafuti Fisheries Centre	Extension service for all islands

(5) Fisheries related equipment

Facility/ equipment	Contents/ capacity	Location	Purpose
1) Communication & safety equipment for navigation	Radio telephone Distress signal	Fishing vessels of Fisheries Division	For safety navigation
2) Outboard engine	Approx. 15 - 25 Hp	Fishing boats	Replacement of old engines
3) Repair tools and machines for fishing vessels	Necessary and minimum for existing vessels	Workshops in Funafuti & in Vaitupu	For vessels
4) Spare parts	-ditto-	-ditto-	-ditto-
5) Fishing gears	Trollings, hand lines, gill nets vertical lines, long line, etc.	Funafuti Fisheries Centre	Upgrading of fish catchability
6) Others	Echo-sounder, insulated box, fuel tank, thermometer, etc.	-ditto-	For catchabiliy, freshness, transportation, fishing ground
7) Transportation vehicles	Pickup track, forklift, tractor and motorcycle	Fisheries Centre in Funafuti & Vaitupu	Transport of fish, FAD, equipment, towing of trailer sales of fish.

(6) Machinery and equipment for fishing village infrastructure

Facility/ equipment	Contents/ capacity	Location	Purpose
1) Road repair & maintenance machines	Motor grader, vibration roller, pickup truck	Public Works Division	Maintenance of unpaved road
2) Water tank lorry	Approx. 3 ton	-ditto-	For general service
3) Repair tools & machinery	For the above vehicles	-ditto-	For repair of vehicles

5. BASIC DESIGN

5. BASIC DESIGN

5.1 Basic Design Principles

The basic designs of facilities, machinery and equipment were considered based on natural condition and construction condition prevailing at the sites. The basic design principles are as follows:

1) The tropical climate, damage due to salty air and other marine conditions were considered in the facility design, layout and structures. The transportation cost of building materials and its durability, and construction schedule, were also taken into consideration. Operation and maintenance should be simple so as to be suitable for the existing level of technology and management.

2) With regard to the design of the vessels, the primary concern was placed on the safety of the vessel in the sea. The marine condition in Tuvalu was sufficiently considered in the design and structure of the vessels. Simplicity in operation, fishing and transportation and other activities were adequately considered in the arrangement of facilities; and its maintenance is to be simple.

3) The machinery and equipment to be provided will be considered sufficiently, so as to suit the existing level of technology. The machinery and equipment selected will be of high durability to withstand salt damage and will have no impediment in operation and in maintenance.

5.2 Basic Design Conditions

5.2.1 Basic Design Conditions of Building Structure

1) Wind load: In consideration of past damages by cyclone with wind speed of 30 m/sec over in Tuvalu, wind speed of 60 m/sec is considered in the design condition of the building structure as stipulated under the *Japanese regulations*.

2) Earthquake: Since there is no record of earthquake in Tuvalu, earthquake force is not considered.

3) Soil condition: The surface layer is of sand with gravel and the second layer is coral rock.

4) Concrete: The design strength of concrete is to be 210 kg/cm^2.

5.2.2 Basic Design Conditions of Civil Structure

[Jetty in Funafuti]

1) Load to main beam:

Dead load of 0.15 ton/m^2 as concrete slab weight of jetty.

Live load of 300 kg/m^2 as weight of fuel and fish carrier.

2) Load to precast concrete slab:

Live load requirement of 350/m^2 kg to beam, taking into consideration the allowance.

3) Lateral load to guard beam:

When small vessel comes along side of jetty, the lateral load on the guard beam is to be 250 kg.

4) Steel beam for extension of jetty:

Steel beam required for the extended landing step should be thicker than the existing steel beam.

5) Concrete:

The design strength of concrete is to be 210 kg/cm^2.

[Slipway in Funafuti]

1) Loading to steel rails:

When the extension vessel is winched up the slipway by the 16-wheel roller trolley, the loading exerted to the rails is 26 tons.

2) Concrete:

The design strength of concrete is to be 180 kg/cm^2

[Seawall in Funafuti]

1) Load to seawall:

Wave pressure is considered in the load requirement of seawall.

2) Concrete:

The design strength of concrete is to be 180 kg/cm^2

[Landing Pier in Vaitupu]

1) Soil loading:

TERZAGHI's formula is used to calculate soil pressure. Horizontal soil pressure is 4.35 t/m^2 and vertical soil pressure is zero.

2) Extra loading:

Concrete covering of the pier will exert extra loading of 0.14 t/m^2. This extra loading is equivalent to 0.602 t/m.

3) Hydrostatic pressure:

Assuming the low water level as the basic level, the hydrostatic pressure will be 1.81 t/m.

4) Wave force:

Lateral load to embankment is caused by wave action. Assuming that the wave height is 1.2 times of maximum water depth, active pressure due to wave breaking and the counter passive pressure can be assumed to be lateral load.

5) Unit weight:

Unit weight of concrete is to be 2.3 ton/m^3 and coral backfill material is 1.6 ton/m^3.

6) Concrete:

The design strength of concrete is to be 180 kg/cm^2.

7) Safety factor:

When the stability analysis is calculated, the safety factor of 1.2 for overturning and sliding of the structure is considered.

5.2.3 Basic Design Conditions of Vessels

[Coastal fishery training vessels]

1) Ship form : To adopt a chine type to minimize fuel consumption. To adopt a deep skeg type for ship form under water line to reduce rolling angle against steep wave because of the frequent occurrence of high waves with about 1.5 m height and about 60 m length around the project sites. To adopt a displacement type to keep ample stability.

2) Deck : To adopt completely extended deck type to avoid steep wave intrusion into the vessel.

3) Fish hold : To adopt a separate type to preserve freshness of fish as well as to extend stocking period of ice.

4) Fishing equipment : To provide fishing equipment to enable the operation of bottom longline, trolling and gill net

5) Hull arrangement : To arrange fishing deck in the front to avoid main engine trouble caused by wave intrusion in the rough sea, and to arrange engine room in the back with casing.

[Extension vessel]

1) Ship form : To adopt an ocean going type for ship form under water line, because seas around the outer islands commonly have swells and steep waves occur at the surface. To adopt a displacement type to keep ample stability in the rough sea. To have a sunken forecastle with ample flare at bow to maintain good seaworthiness.

2) Deck : To adopt completely extended deck type to enable to do various works such as repair work of outboard engine, fishing training, resources survey work, collection of fish and fishery product, etc. To separate living quarters from fishing space and to have a wider stern part of the deck to enable to achieve various kinds of fishing survey such as bottom longline, trolling, pole and line, gill net, etc.

3) Cruising range :To adopt a cruising range of about 950 km taking into consideration the round trip distance between Funafuti and the furthest island (Nanumea) to achieve extension services covering any of the outer islands from Funafuti Fisheries Centre.

5.2.4 Basic Design Conditions of Equipment

1) Equipment for fishing vessel

It is necessary to adopt anti-corrosion materials such as stainless steel, brass, etc. for metal portion of the equipment which may have high possibility of seawater contact.

2) Electrical equipment

To adopt 415V, 50Hz in three phase or 230V, 50 Hz in single phase

3) Outboard engine

As for transom height, it is to adopt an ocean type

4) Fishing Gear

- Trolling lure :to be used mainly for tuna and bonito
- Gill net :to be used for pelagic fish such as mackerels, flying fish and sprat
- Bottom long line :vertical line; are to be used for bottom fish in depth of 400 m

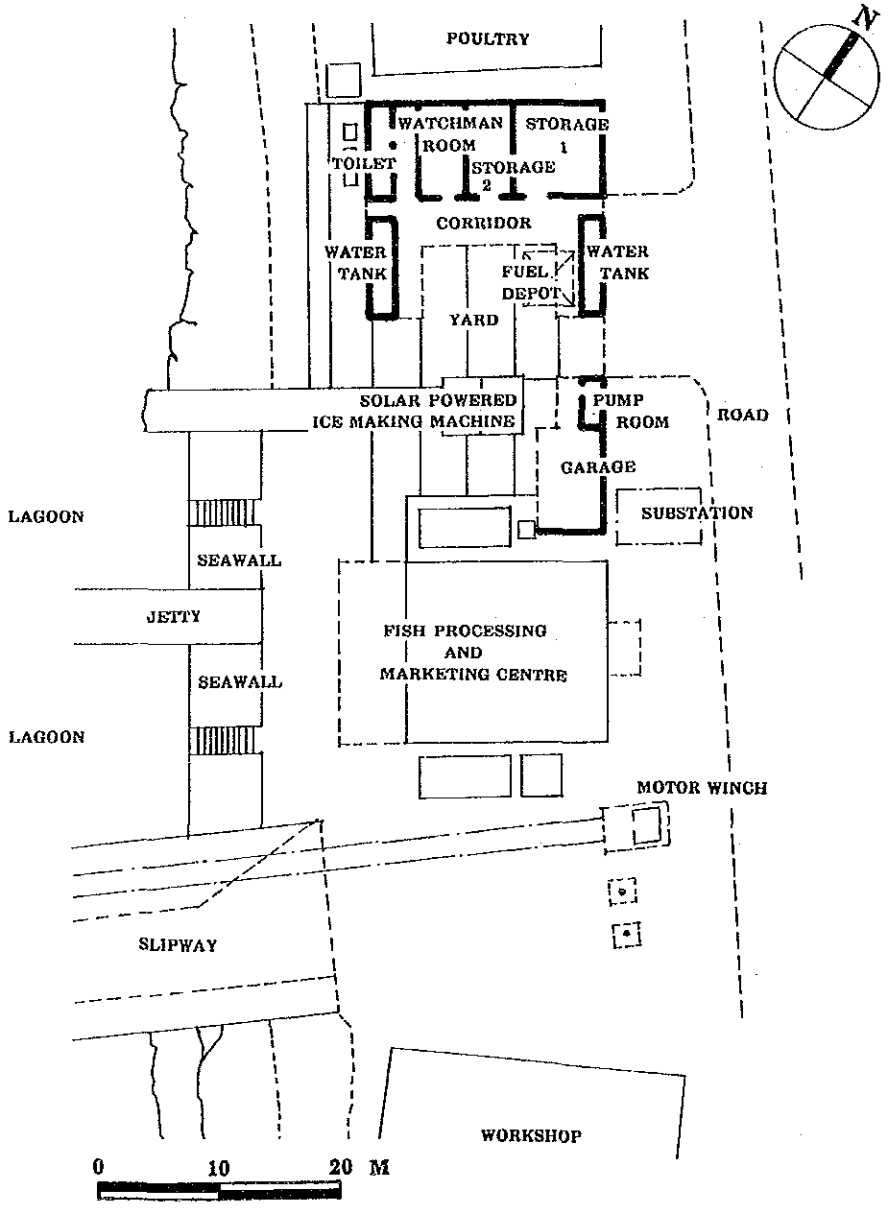
5.3 Basic Plan of Facilities

5.3.1 Improvement of Funafuti Fisheries Centre

[BUILDING]

(1) Layout plan

Building is to be located between the existing two buildings (fish processing & marketing centre, and poultry) and it is to be close to the north side of the poultry building in order to secure the working yard for drying fish and nets. Water tank, elevated tank and garage are located facing the road and to be lined in the same distance from the road as the existing building. The layout plan of the building is shown below.



(2) General plan

The facilities consist of the following.

Facilities	Purpose
Fuel depot	for diesel, gasoline, machine oil
Storage 1	for spare parts and fishing gears
Storage 2	for machines
Watchman room	for watchman accommodation
Toilet 1,2	for fishermen and staff
Pump room	for water pump
Garage	for vehicles
Corridor	for road and drying area (rainy days)
Yard	for drying fish and fish nets
Water tank	for rainwater stocking
Elevated tank	for water pressure by gravity

The storage 1 and 2, watchman room and toilet are located beside the yard to secure a wide view from the watchman room to facilitate maintenance and service of watchman to fishermen. Fuel tank is of the underground type for effective use of the site. For safety reasons the fuel pump is to be installed outdoor under the eaves near corridor.

(3) Section plan

This building is one storied because it is for loading and unloading equipment. In view of tropical climatic conditions, ceiling height of about 2.7 m is designed adopting the Tuvaluan building style.

(4) Elevation plan

Building elevation is designed to layout beam height, window and door to the same level. Elevated tank tower of three stories are designed to be open type to decrease the effect of wind force.

(5) Structural plan

Direct foundation is adopted on sand-gravel layer and coral rock layer to bear loading of single story and 3-story elevated tanks. The structure of the building is adopted on a rigid frame of reinforced concrete for durability and to prevent corrosion. Wooden truss is adopted for roof frame. This construction method is common in Tuvalu and there is no problem in this method.

(6) Mechanical and electrical service

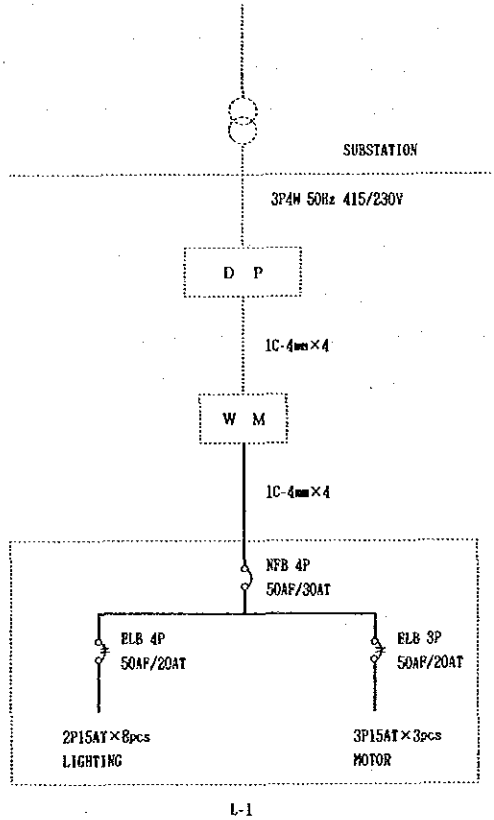
1) Electrical service

a) Power supply

Substation near the site is to supply 415V, 50 Hz three phase for machine use and 230V 50Hz single phase for lighting purpose

b) Wiring

Wiring from switch board of substation to panel board in the building will be carried out. Wiring to each point of use will also be carried out. Schematic diagram of wiring is shown below.



L-1

c) Power for machines

Electricity will be distributed to water pumps for elevated tanks.

d) Lighting

Fluorescent lights are to be installed indoors, vapour-proof or water-proof of anti-corrosion type to be installed out-doors. Explosion proof lighting around fuel depot are to be installed.

e) Receptacle outlet

Receptacle outlets of indoors to be wall-mounted type and those of outdoors are to be water-proofed.

f) Radio telephone

Transceiver is provided for training vessels and the receiving station is to be installed in the watchman room.

2) Plumbing service

a) Water supply

Water collected from roofs is to be pumped up to the elevated tank and supplied with stable pressure for processing and drinking by gravity to each facility.

b) Water drainage

As there is no existing sewage, septic tank and penetration sump are installed together for soiled water. Waste water is to be directly drained to the sump.

c) Fuel depot

Fuel tanks for gasoline and diesel are underground and dispensing pump with measuring gauge is to be installed.

d) Plumbing fixture

Toilet bowl of western type of ceramic, wash basin and deep sink are to be installed.

3) Ventilation service

Ventilation fan for toilet and ceiling fan for watchman room are to be installed.

(7) Material plan

Exterior finish

Roof : corrugated aluminum sheet
Wall : mortar, paint finish
Door/window: aluminum glass louver window, plywood flash door
(working yard: concrete)

Interior finish

Ceiling : hardboard, paint finish
Wall : mortar, paint finish, tiles (toilet)
Floor : mortar, mosaic (toilet)

(8) Plan around the Building

Along the access road three flag poles and plaque are to be installed. Road within the site is to be compacted but not paved.

[SLIPWAY]

(1) General plan

The width of the slipway is to be 15 m for the extension vessel and two training vessels that could be accommodated side by side. Steel rails 62 m in length are to be installed at slope area and ship yard. Electrical winch is to be installed on top of the rails, and pulleys are also to be installed to winch up training vessels.

(2) Section plan

Slipway is extended by 15 m and sloped at 9-10% to winch up extension vessel (length 17 m; mould depth 1.8 m) at mean high tide level and training vessels (length 9 m; mould depth, 0.7 m) at mean low tide level, respectively.

(3) Mechanical and electrical services

Electrical winch for tonnages of about 26 of extension vessel and about 3.5 of training vessel will be installed.

(4) Material plan

Slope : concrete, steel rail (flash mounted type)
Shipyard: concrete (not included in this Project), steel rail

[JETTY]

(1) General plan

Items of improvement of existing jetty are shown below.

1) Anti-corrosion paint to steel beam
2) Replacement of wooden slabs with precast concrete
3) Installation of lighting fixtures for night work
4) Extension of jetty for loading/unloading
5) Installation of guard beam and rubber fenders for vessels

(2) Section plan

The existing jetty will be extended with landing steps. The steps will be about 50 cm above mean high tide to prevent collision with vessels and about 160 cm above mean low tide to facilitate unloading of outboard engine boats.

The upper part of the jetty will be constructed of I-section steel and the lower part will be C-section steel in order to prevent damage to vessels. Rubber fenders and ropes will be provided on these steel beams to prevent damage. At the landing step two vessels can be accommodated at the same time.

(3) Mechanical and electrical services

A manual jib crane will be installed at the end of the existing jetty for loading and unloading of heavy loads.

(4) Material plan

Slab : Precast concrete panel grating for landing step
Beam : Paint finish
Guard beam : C-section steel, paint finish rubber or rope fender

[SEAWALL]

(1) General plan

After excavating some part of the shoreline, a seawall will be provided till the existing abut, and the land area will be extended.

(2) Section plan

Small steps will be provided to the seawall for canoes and small vessels.

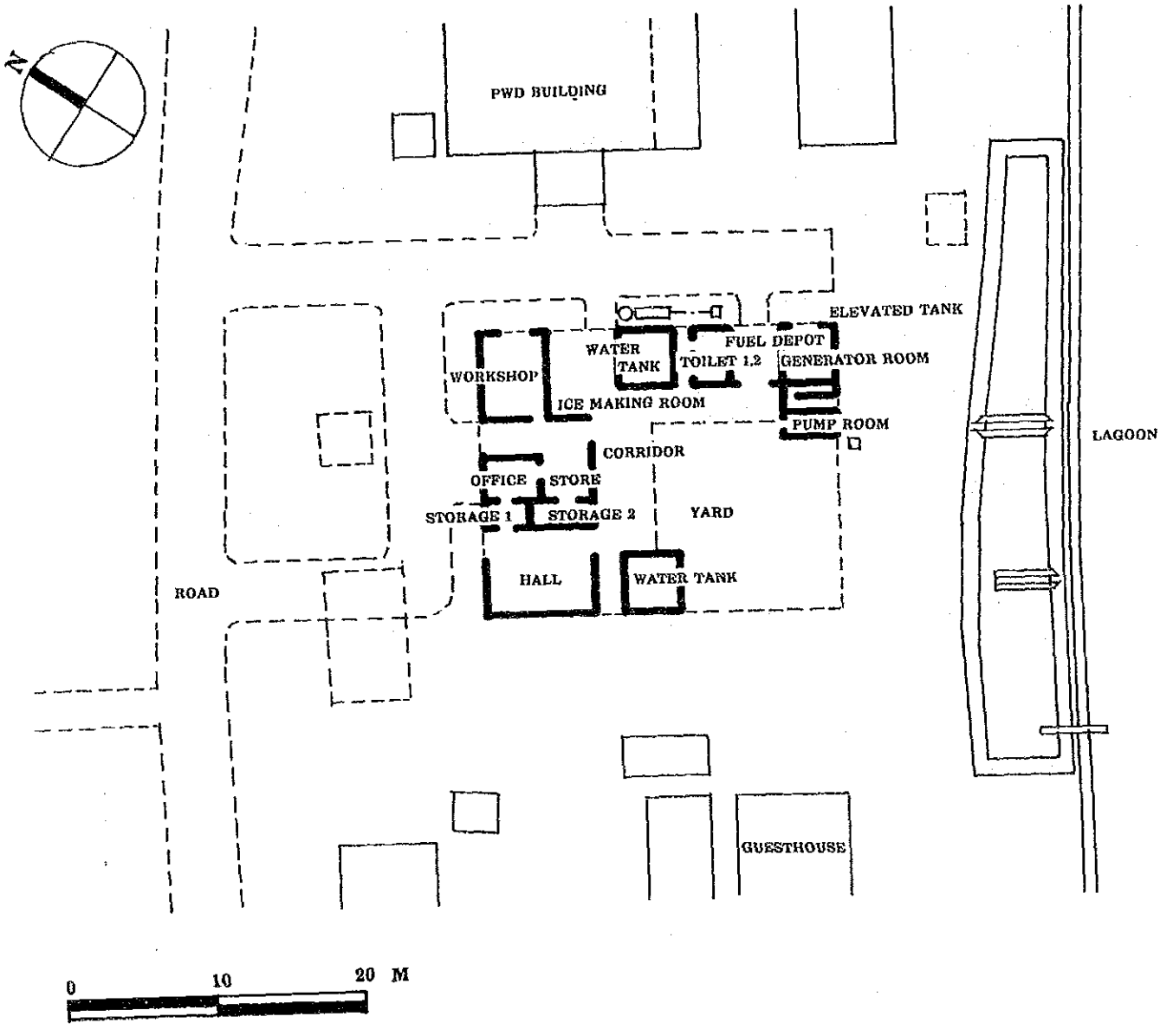
(3) Material plan

Slope : Concrete
Yard : Concrete

5.3.2 Construction of Vaitupu Fisheries Centre

(1) Layout plan

Since the Vaitupu Fisheries Centre is one small building, appropriate space is to be secured between the PWD building and the guest house. Distances from the road and lagoon to the building are kept the same as that of the neighboring public buildings. The layout plan is shown below.



(2) General plan

The facilities are composed of the following.

Facilities	Purpose
Training/meeting hall	for training & meeting of fishermen
Storage 1	for equipment of office and hall
Storage 2	for fishing gears and sales space
Office	for administration
Sales space	for sales of fish
Workshop	for repairing of engines and vehicles
Ice making room	for making ice and storage
Toilet 1,2	for guest and officer
Fuel depot	for diesel, gasoline and machine oil
Generator room	for generator, panel board
Pump room	for water pump
Corridor	for drying fish during rainy days
Yard	for drying fish and nets
Water tank	for stocking rain water
Elevated tank	for gaining water pressure by gravity

Layout of hall, office, sales space, workshop and ice making room is arranged on to the road side for easier accessibility by fishermen and other users. On the other hand, layout of fuel depot, generator, toilet and working yard is arranged on to the lagoon side which is separated from people's residents, taking into consideration safety noise, odor and/or fishy smell.

(3) Section plan

This building is to be one storied considering easier access by fishermen and staff and easier operation and management of the store. In view of tropical climatic conditions, ceiling height of about 2.7 m is adopted in the same way as Tuvaluan buildings.

(4) Elevation plan

Building elevation is designed to layout beam height, window and door to the same level. Elevated tank tower of three stories is designed to be a open type to decrease the effect of wind force.

(5) Structural plan

The plan is to follow the same as that in Funafuti.

(6) Mechanical and electrical service

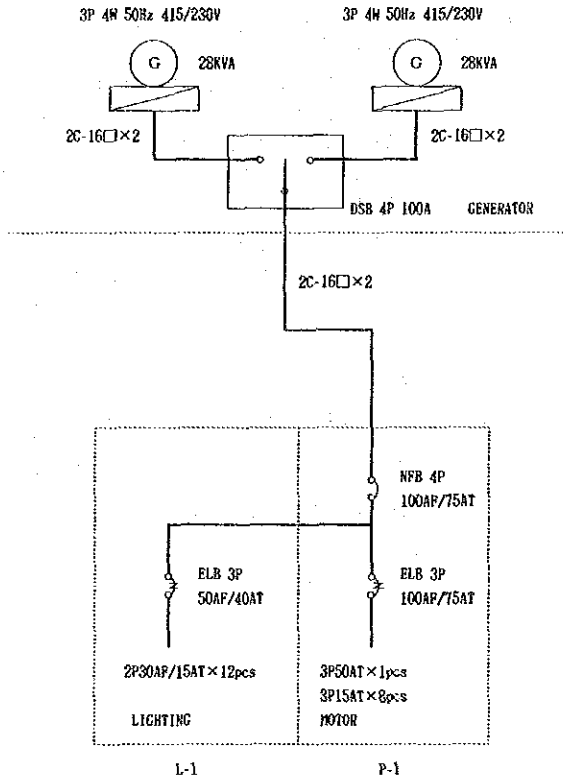
1) Electrical service

a) Power supply

A generator is to supply 415V, 50 Hz three phase for machine use and 230V 50Hz single phase for lighting purpose, which are presently standardized in Funafuti.

b) Wiring

Schematic diagram of wiring from the generator to each point of use is shown below.



c) Power for machines

Electricity will be distributed to pump of elevated tanks, ice making machine and cold storage facility, etc.

d) Lighting

Fluorescent lights are to be installed indoors and vapour-proof or water-proof type of lights and anti-corrosion to be installed out-doors. Explosion-proof type lighting around fuel depot to be installed.

e) Receptacle outlet

Receptacle outlets of indoors to be wall-mounted type and that of outdoors are to be water-proofed.

2) Plumbing service

a) Water supply

The plan is to follow the same as that in Funafuti.

b) Water drainage

Soiled water treatment is by penetration method as same as that of Funafuti; waste water of fish processing is to be drained through an oxidation pond.

c) Fuel depot

The plan is to follow the same as that in Funafuti.

d) Plumbing fixture

The plan is to follow the same as that in Funafuti.

3) Ventilation service

Ventilation fan for toilet and ceiling fans for training and meeting hall, office, workshop are to be installed.

4) Ice making machine

Block ice type machine (capacity: 240 kg/day) which is simple and easy for maintenance, and ice crusher and ice storage (capacity 5 m^3) are to be installed.

(7) Material plan

Exterior finish

Roof	: corrugated aluminum sheet
Wall	: mortar, paint finish
Door/window	: aluminum glass louver window, plywood flash door
	(Working yard: concrete)

Interior finish

Ceiling	: hardboard, panel finish
Wall	: mortar, paint finish, tiles (toilet)
Floor	: mortar, mosaic (toilet)

(8) Plan of external works

Beside the access road three flag poles and plaque are to be installed. Road within the site is to be compacted but not paved.

5.3.3 Upgrading of Vaitupu Channel

(1) General plan

1) Anchorage

Anchorage will be constructed at the end of the existing channel for easy entry of the extension vessel and for saving excavation cost. The anchorage has operational zone of a semi-circle with radius 1.5 times the vessel length to facilitate turning round by itself. Width of access channel is to be a minimum of 15 m.

2) Landing pier

Taking into consideration the influence of waves generated by strong westerly wind which is the specific weather condition in the Site, a landing pier is to be constructed. It has a berth of 35 m long at north side of the anchorage and its access dyke along by the existing channel. The access dyke will be slightly curved which will act as protection against rough seas.

Another berth of 20 m length will be provided near the slipway for supplementary use of the extension vessel during high tide. This berth will also be used by the training vessel and other fishing boats.

3) Groyne

To prevent sand accumulation to be the channel caused by littoral drift, a groyne is to be constructed to the south side of the anchorage with the same level as the land for its first 50 m portion from the shoreline and with the level not lower than mean high tide level for the remaining 100 m portion (overall length; 150 m).

4) Channel

Channel of 10 m width for fishing boats and the training vessel is to be excavated from the anchorage to the slipway.

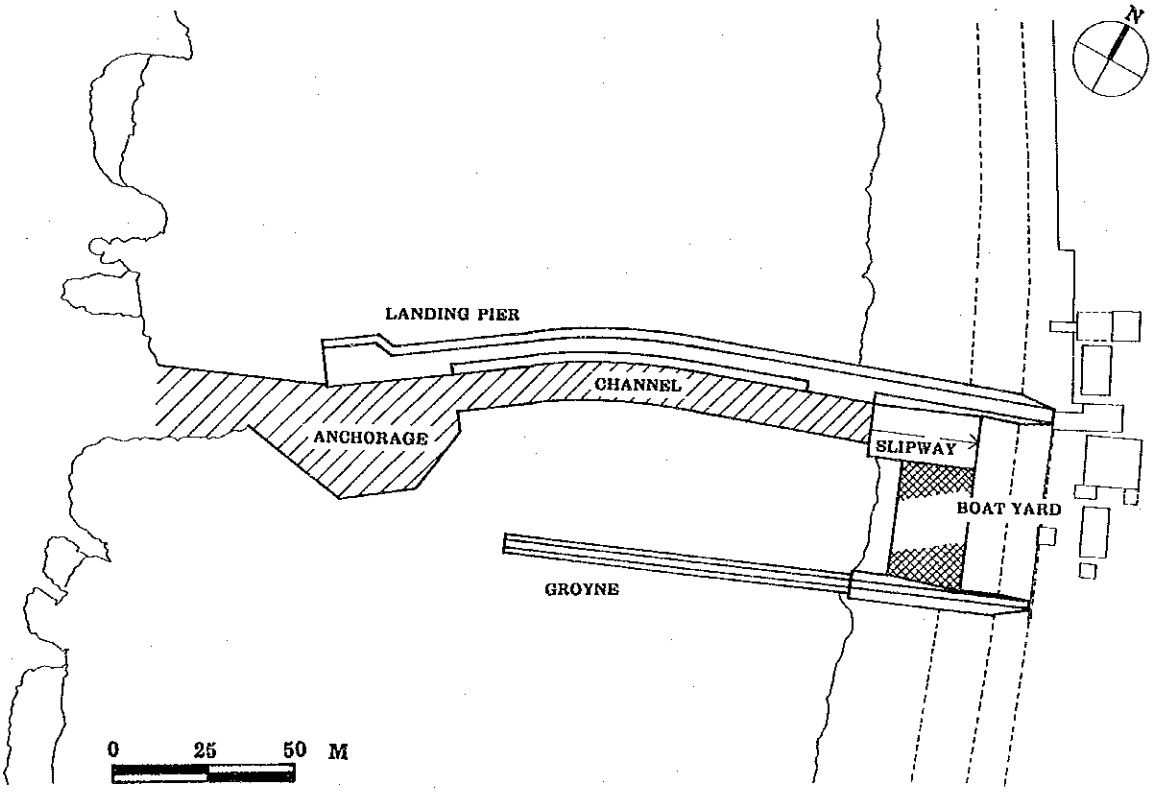
5) Slipway

The slope of slipway is to be 10% suitable for winching up. Slipway width is to be adopted to the same width of upper portion of the channel (15 m). The shore slope is 15 m. The shore slope between the slipway and

the groyne is to be protected by stone pitching to the same 10% slope.

6) Boatyard

Adjacent to upper end of the slipway a dry boat yard of 50 m long and 20 m wide is to be provided to accommodate more or less 40 fishing boats.



(2) Section plan

1) Anchorage

To anchorage the extension vessel, a minimum 2.3 m depth at mean spring low tide is to be secured for the depth of the anchorage.

2) Landing pier

The berth portion was vertical face and the top level is to be 0.8 m higher than the mean high tide level. The levels both of berth and the access dyke are to be same.

3) Groyne

Top level of groyne for the first 50 m length is to be at the same level as the ground level. The level of the rest is to be not less than the mean high tide level.

4) Channel

Water depth of 1.8 m of channel is to be secured for the training vessel to gain access to the slipway during mean spring low tide.

5) Slipway

Slipway slope will be 10% for winching up fishing boats. Sufficient water clearance at the lower is to be secured for common skiffs even at mean spring low tide.

6) Boatyard

The boatyard level is to be the same as the top of the landing pier with a 2% slope for water run-off.

(3) Structural plan

Existing coral rock of the reef is considered to have sufficient bearing capacity for the bearing of civil structures in this Project. Both of landing pier and groyne are to be gravity retaining structure. The section of these structures is examined and designed to prevent over turning, sliding and uneven settlement due to lateral load from wave action.

Thickness of levee crown of the landing pier along carriage load is calculated using a design load of 5 tons of transportation vehicles.

(4) Others

1) Navigation marker

A shore beacon light for navigation is to be provided at appropriate location of the landing pier.

2) Jib crane

Two manual jib cranes (250kg) are to be provided to the berths of of the landing pier for loading/unloading of fishing vessels and the training vessel.

3) Bollard

Bollards are to be provided to the berths for the extension vessel berthing.

4) Lighting

An appropriate lighting is to be provided for preparation of fishing at night.

5.3.4 Environmental Impact and Countermeasures

(1) Improvement of Funafuti Fisheries Centre

Environmental impact to the surroundings of Funafuti during and after the construction works and the methods to prevent environmental pollution are shown below.

Construction Works	Environmental Impact		Prevention Method	
	During Construction	After Construction	During Construction	After Construction
1) Building works	-	Pollution by soiled water from toilet	-	Installation of septic and penetration sump
2) Civil works				
- Improvement of Jetty	-	-	-	-
- Improvement of slipway	Leakage of cement paste during concreting works	-	Pollution is negligibly small due to small-scale construction works	-

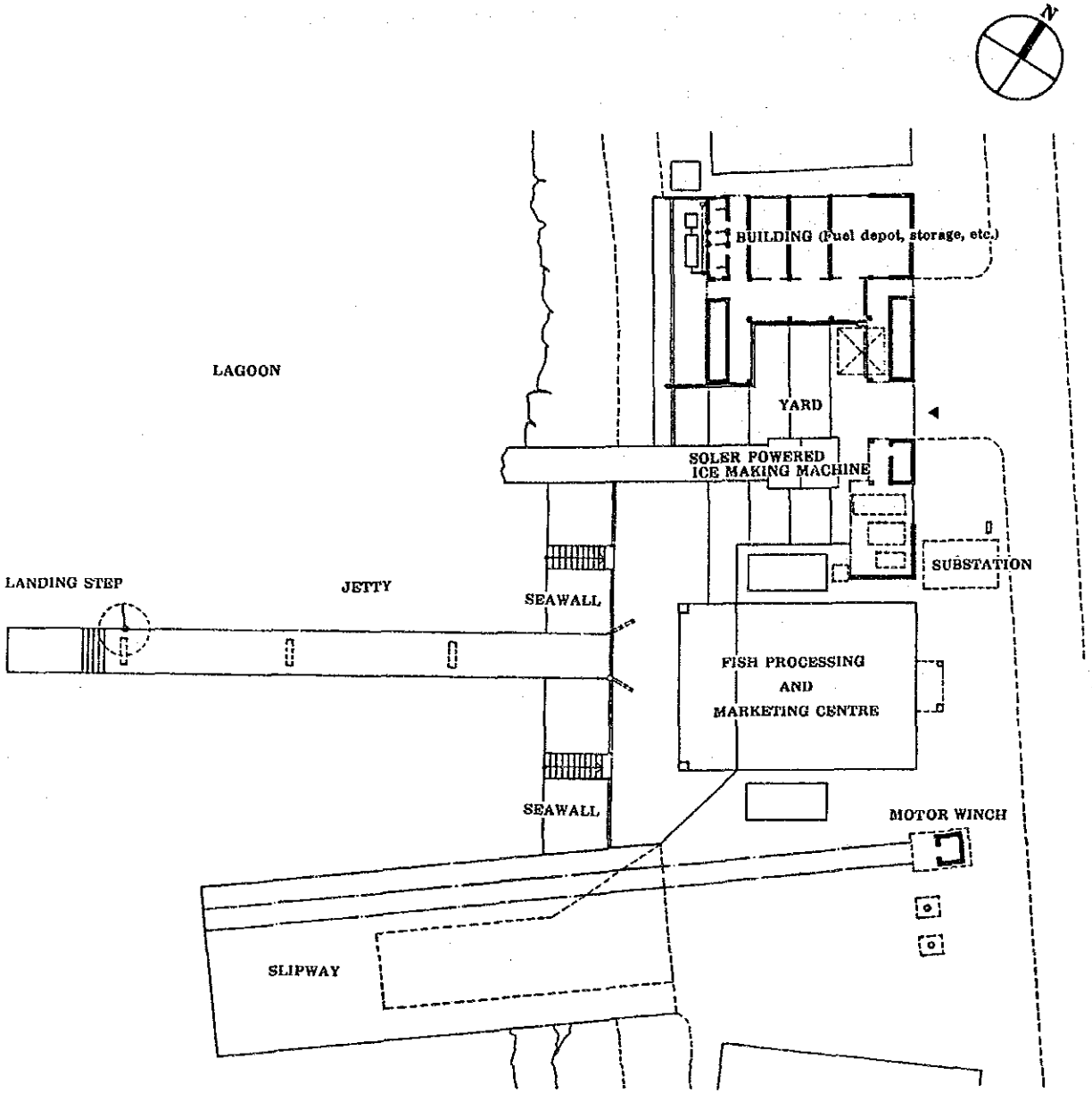
(2) Construction of Vaitupu Fisheries Centre and upgrading of existing channel

Environmental impact to the surroundings of Vaitupu during and after the construction works and the methods to prevent environmental pollution are shown below.

Construction Works	Environmental Impact		Prevention Method	
	During Construction	After Construction	During Construction	After Construction
1) Building works	-	Pollution of lagoon by soiled water from toilet	-	Installation of septic and penetration sump
		by waste water from processing		Provision of oxidation pond for biological treatment
2) Civil works				
- Improvement of existing channel	Destruction of some coral reefs during blasting with dynamite	-	No counter-measures to be taken because affected range is minor	-
	Leakage of cement paste during concreting works	-	Damage is negligible because there is no live coral within the reef and exchange of water by tidal current is expected twice a day.	

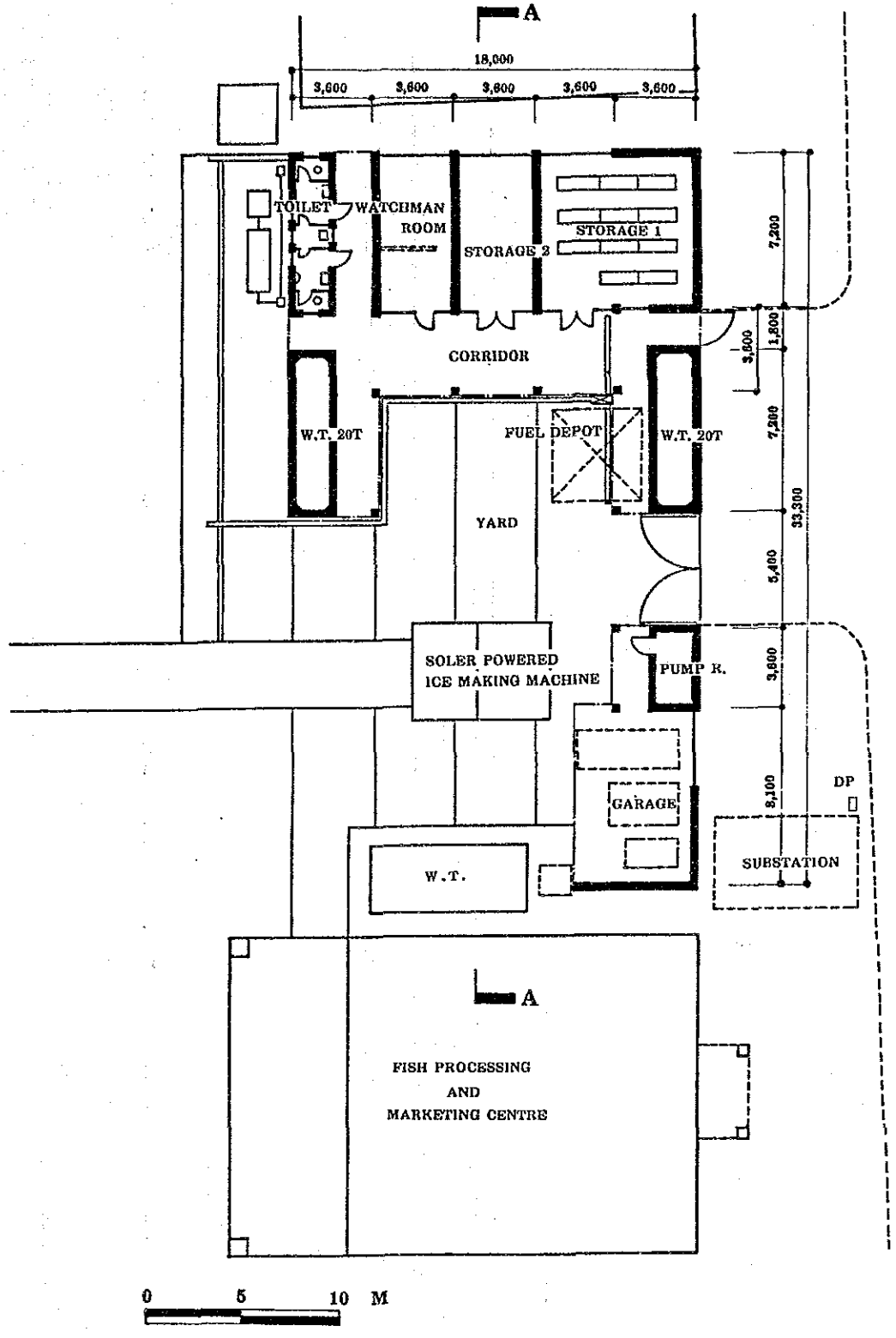
5.3.5 Basic Design Drawings of Facilities

Basic design drawings of the facilities are shown as follows.



01

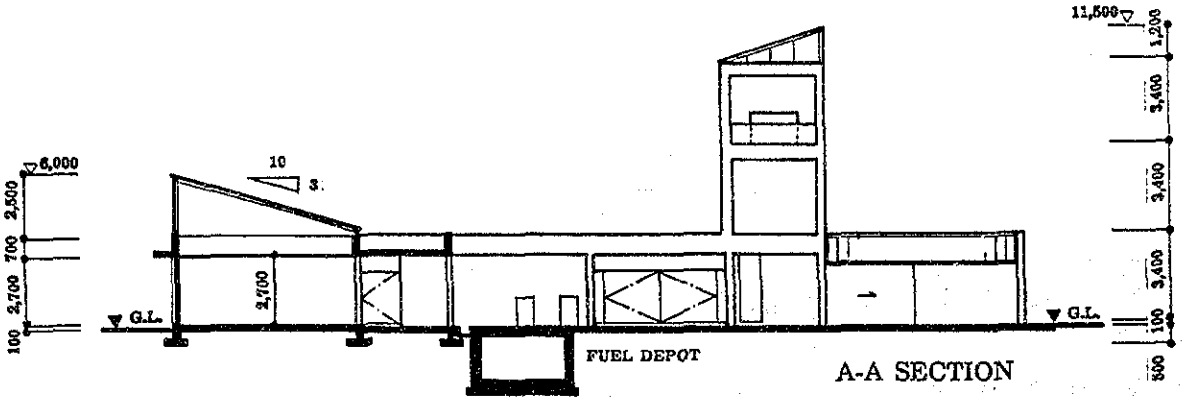
IMPROVEMENT OF FUNAFUTI FISHERIES CENTRE SITE PLAN	THE FISHING COMMUNITIES DEVELOPMENT PROJECT IN TUVALU



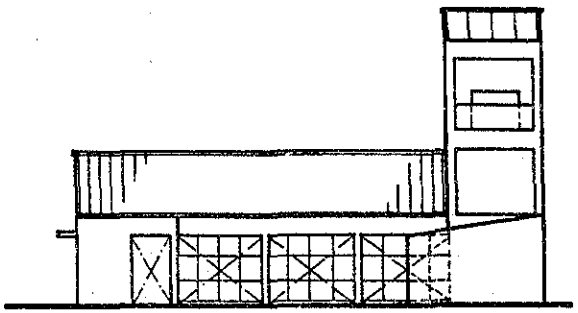
02

IMPROVEMENT OF FUNAFUTI FISHERIES CENTRE BUILDING PLAN

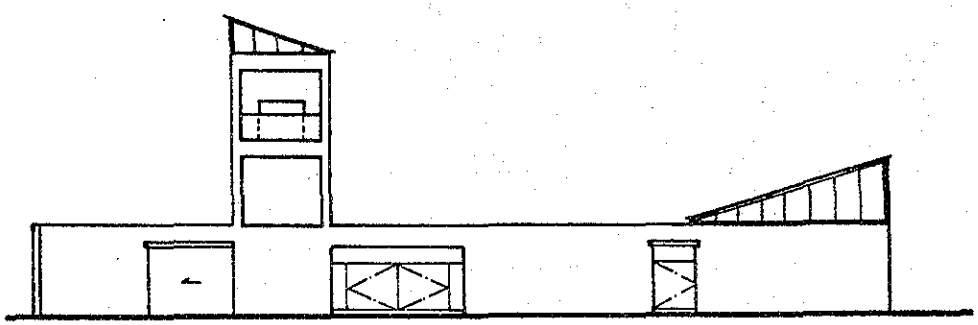
THE FISHING COMMUNITIES DEVELOPMENT PROJECT IN TUVALU



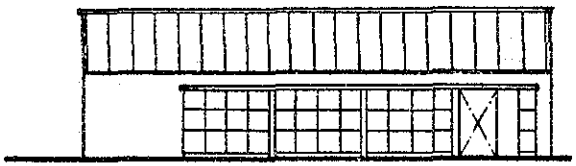
A-A SECTION



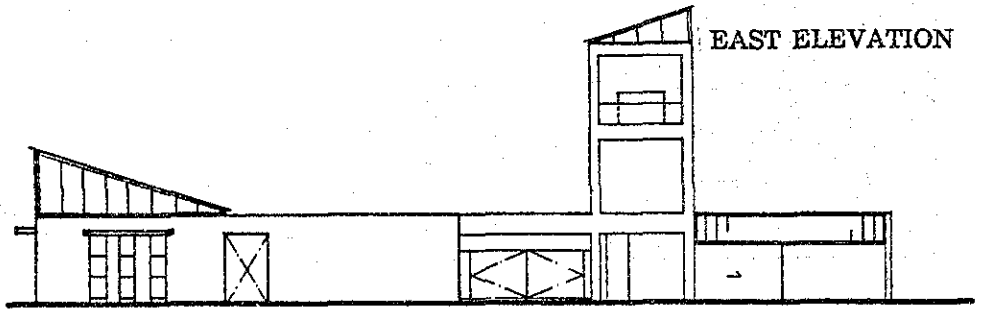
SOUTH ELEVATION



EAST ELEVATION



NORTH ELEVATION



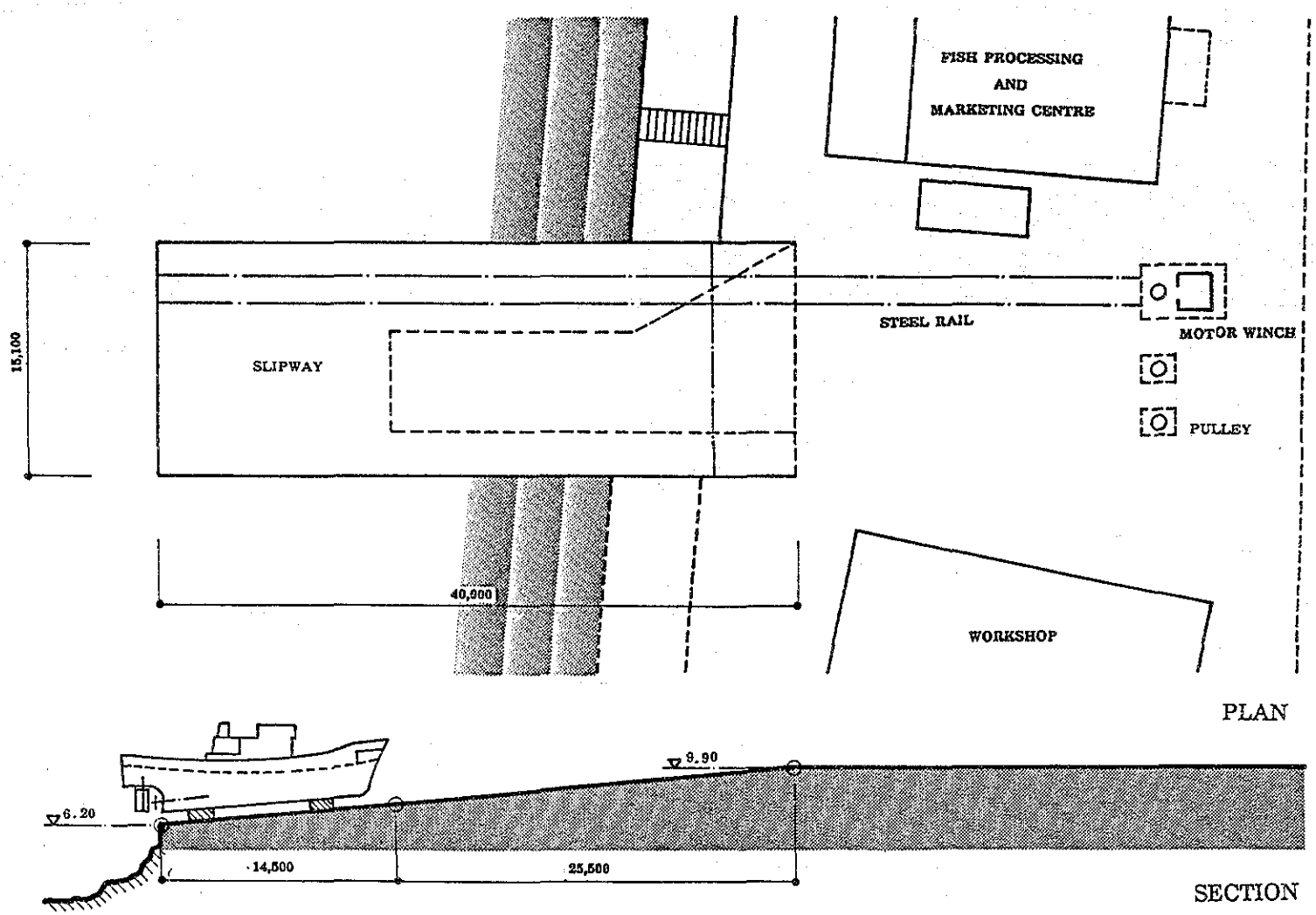
WEST ELEVATION

0 5 10 M

IMPROVEMENT OF FUNAFUTI FISHERIES CENTRE
BUILDING SECTION & ELEVATION

03

THE FISHING COMMUNITIES
DEVELOPMENT PROJECT
IN TUVALU

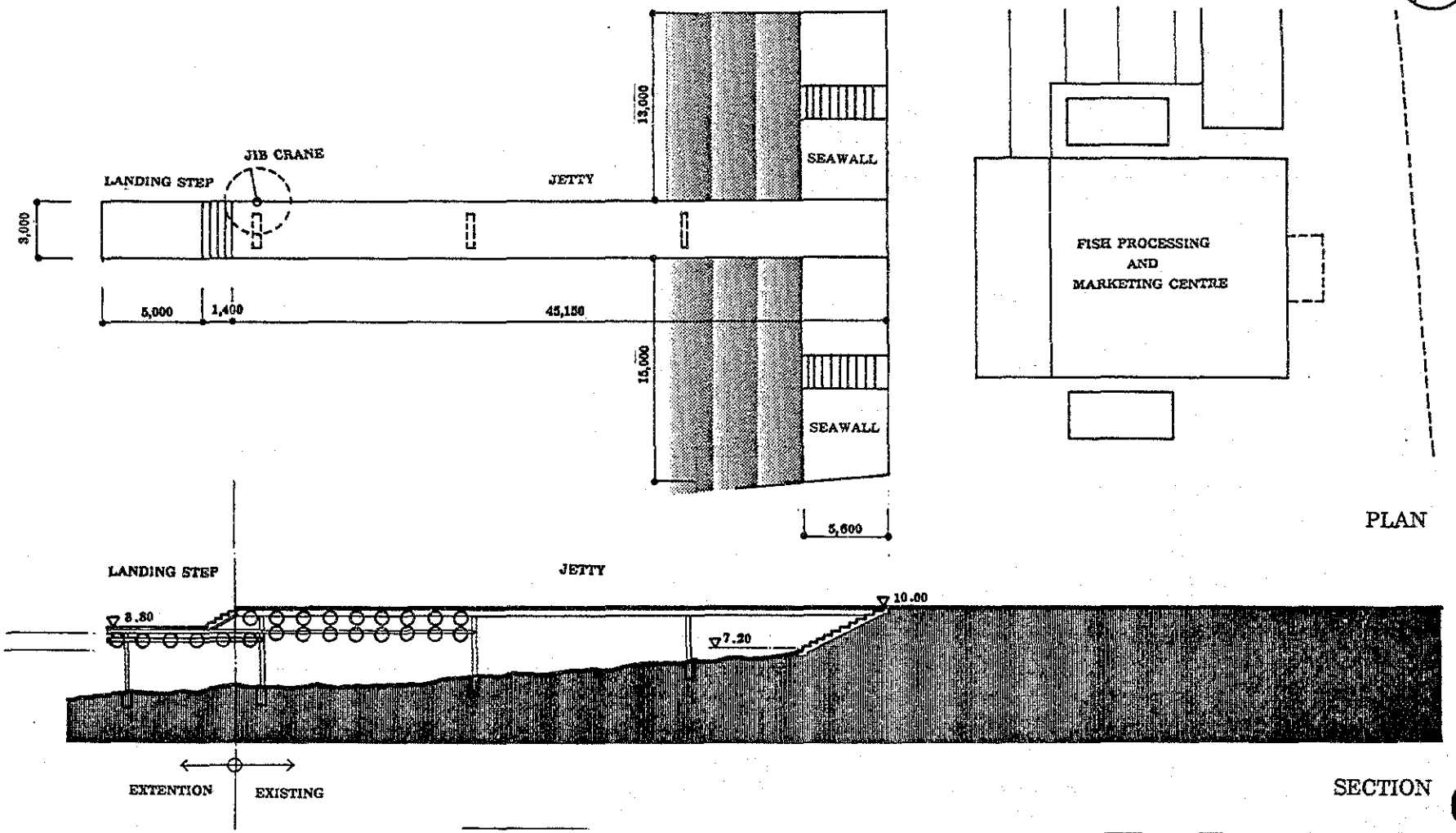


0 5 10 M

IMPROVEMENT OF FUNAFUTI FISHERIES CENTRE
SLIPWAY PLAN & SECTION

04

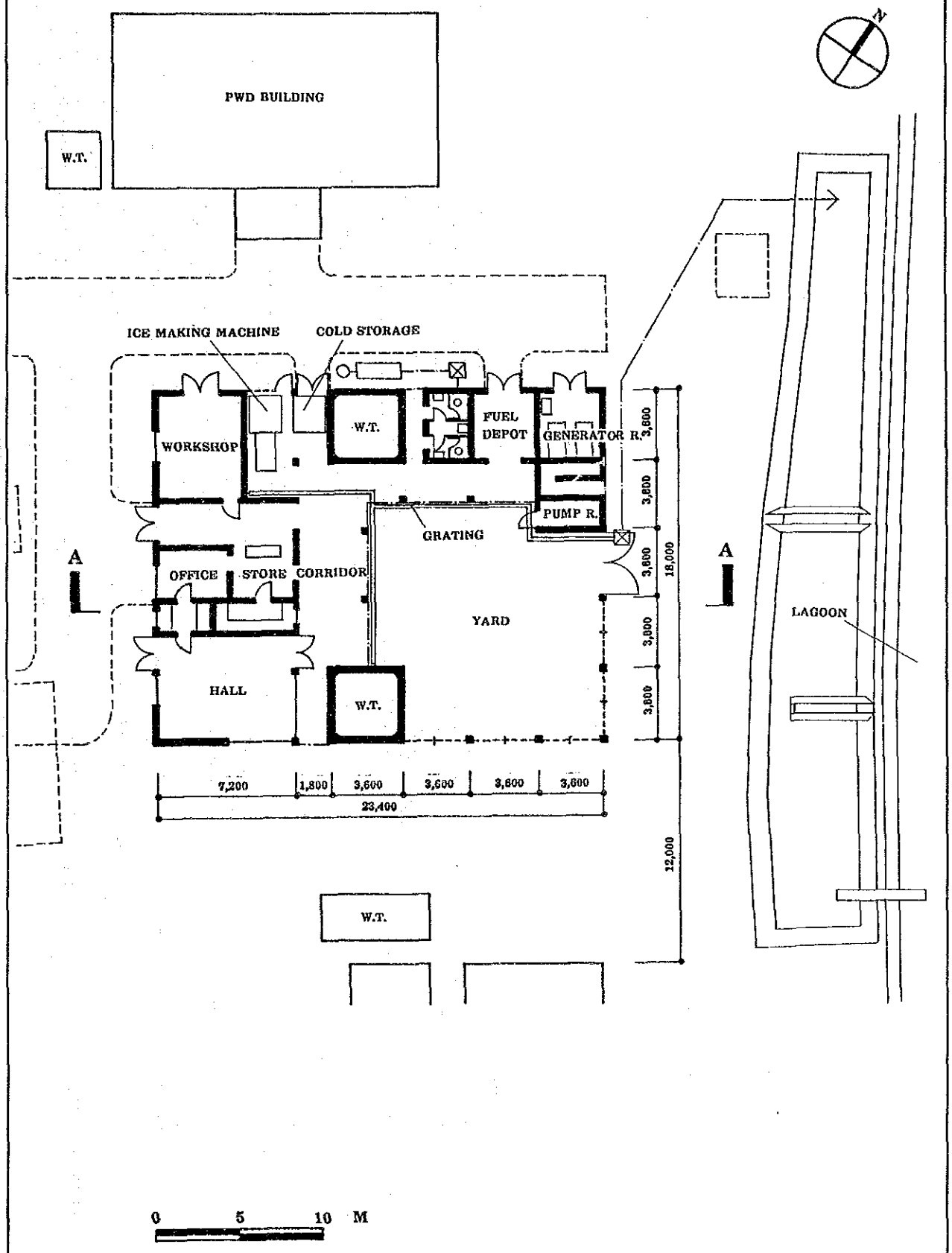
THE FISHING COMMUNITIES
DEVELOPMENT PROJECT
IN TUVALU



05

IMPROVEMENT OF FUNAFUTI FISHERIES CENTRE
JETTY & SEAWALL PLAN & SECTION

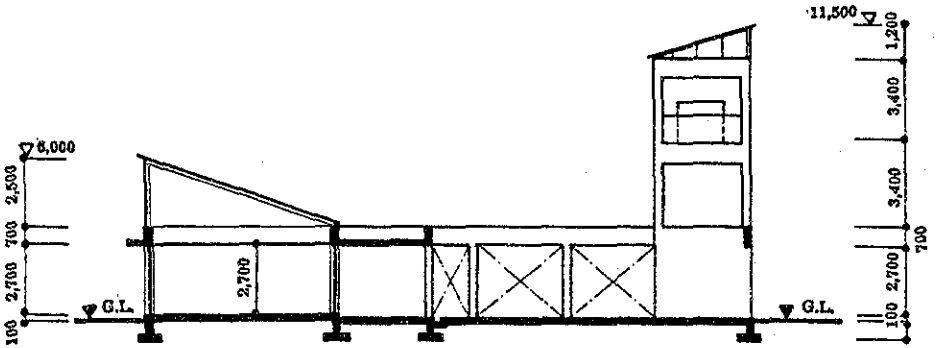
THE FISHING COMMUNITIES
DEVELOPMENT PROJECT
IN TUVALU



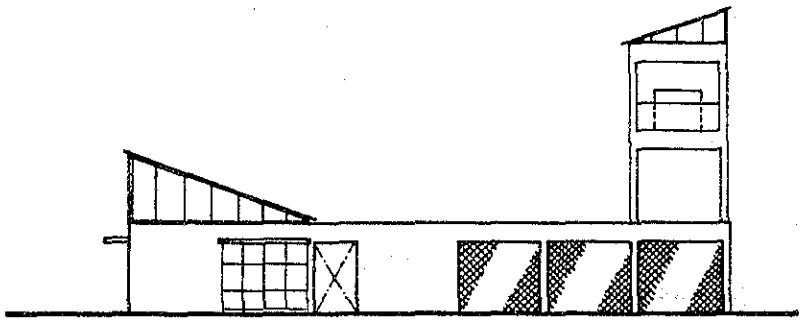
06

CONSTRUCTION OF VAITUPU FISHERIES CENTRE
PLAN

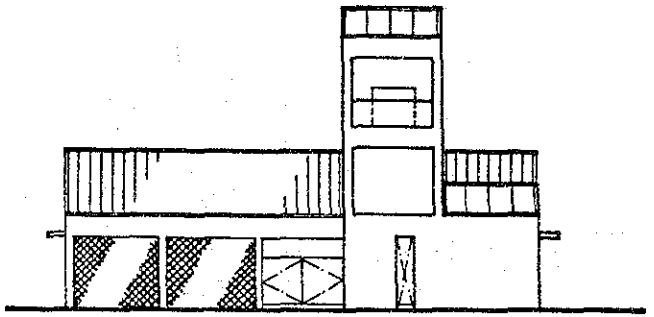
THE FISHING COMMUNITIES
DEVELOPMENT PROJECT
IN TUVALU



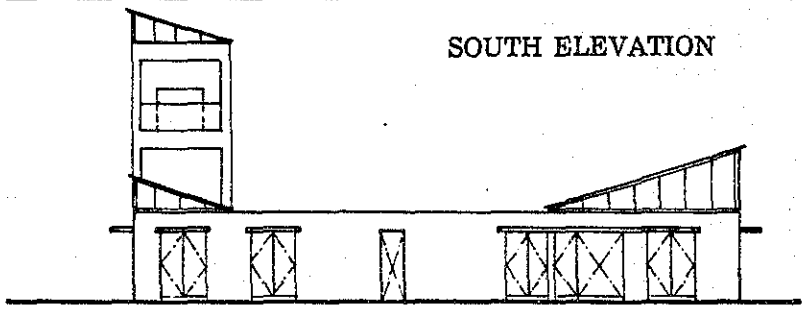
A-A SECTION



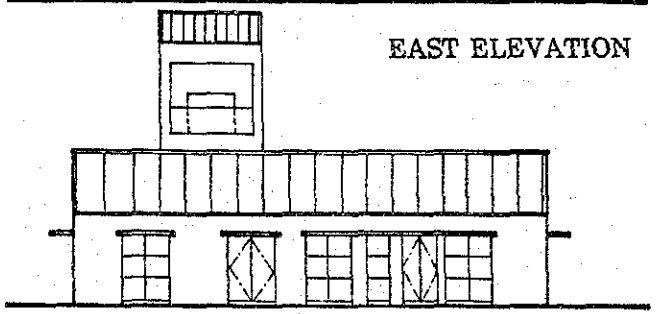
SOUTH ELEVATION



EAST ELEVATION



NORTH ELEVATION



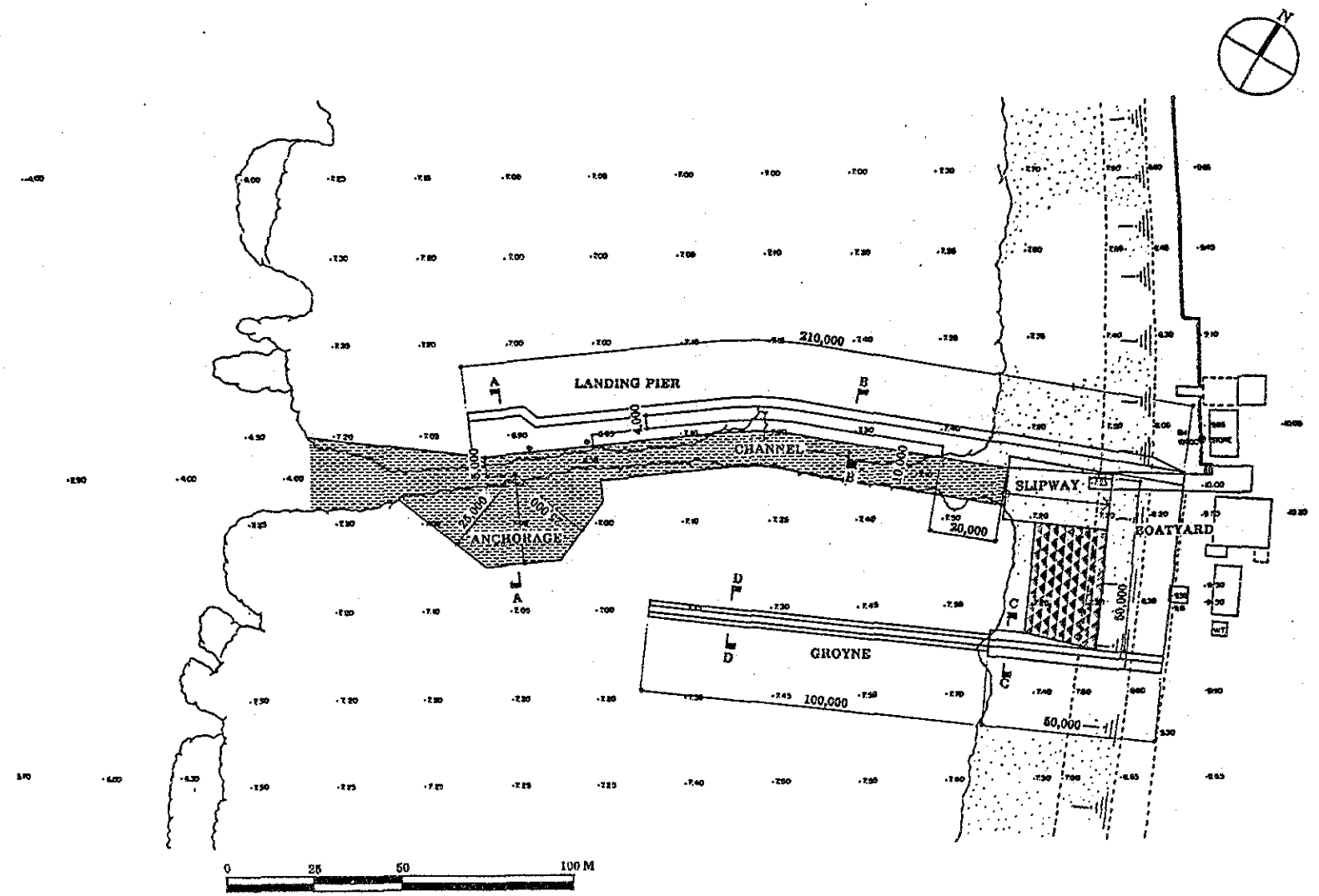
WEST ELEVATION

0 5 10 M

07

CONSTRUCTION OF VAITUPU FISHERIES CENTRE
SECTION & ELEVATION

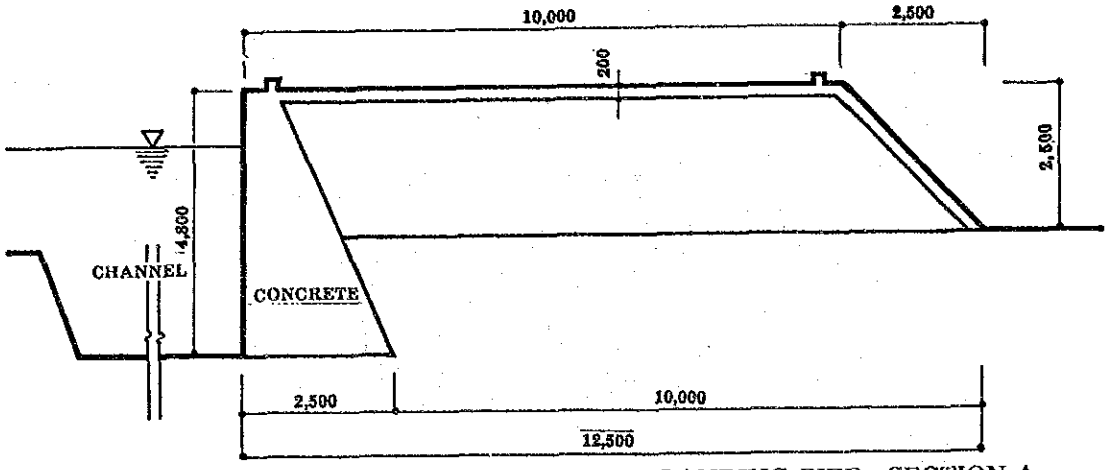
THE FISHING COMMUNITIES
DEVELOPMENT PROJECT
IN TUVALU



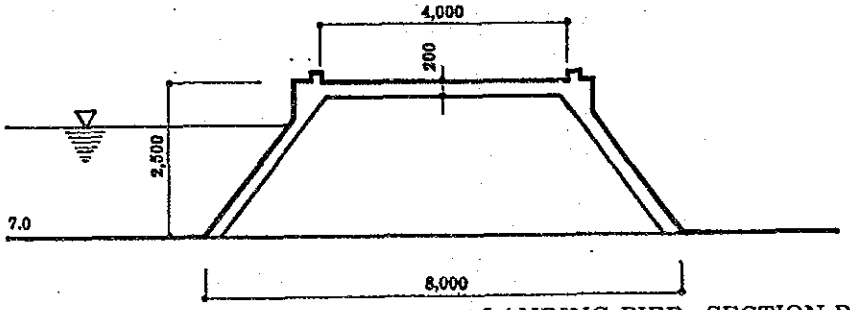
08

UPGRADING OF VAITUPU CHANNEL
LANDING PIER, CHANNEL ETC. PLAN

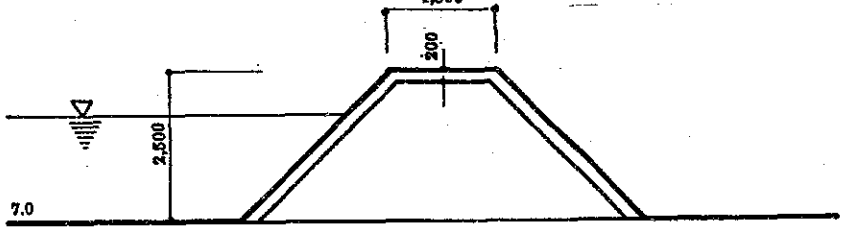
THE FISHING COMMUNITIES
DEVELOPMENT PROJECT
IN TUVALU



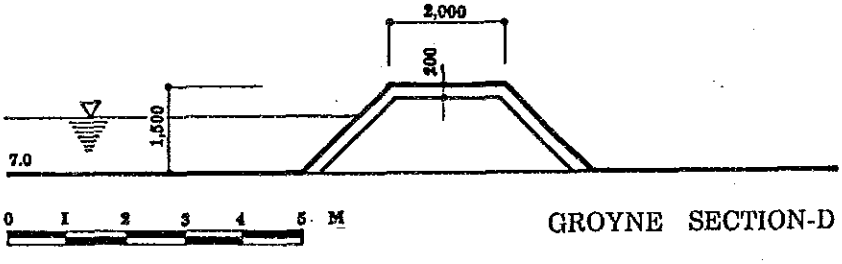
LANDING PIER SECTION-A



LANDING PIER SECTION-B



GROYNE SECTION-C



GROYNE SECTION-D

09

UPGRADING OF VAITUPU CHANNEL LANDING PIER, CHANNEL ETC. SECTION

THE FISHING COMMUNITIES DEVELOPMENT PROJECT IN TUVALU