5.4. MASTER PLAN FOR FISHERY COMPLEX

5.4.1. Planning Concept

(1) Concept for Fishery Complex Development

Fishery Complex Project (FC) aims at achieving the following objectives by provision of fishery facilities.

- To develop Thai fishery in the Andaman Sea and Indian Ocean.
- To promote fish processing industry, principal industry in Thailand.

Project concept is illustrated overleaf and discussed below.

1) Development of Fishing Port

As mentioned in the sub-section 5.1, the yields of fish catch in the Thai waters have been failing to increase and Thai fishermen have been obliged to operate fishing in foreign waters. Fishing boats using Ranong fishing port are mainly operated to keep their yields in Myamma waters. The fishery situation shows tendency toward decrease of a fish catch volume by present fishing operation in Thai territorial waters in the Andaman Sea.

The tendency leads Thai fishery to necessity of stock control and new fishing ground development for sustainable fishing in the Thai waters of Andaman Sea and Indian Ocean. Fishery Complex Project will be to develop Phuket Fishing Port as a pilot fishing port for future fishery development.

The Fishery Complex is expected to supply raw material to fish processing plants in Phuket and other provinces and to export fresh tuna by long line fishing to the international market(mainly in Japan) by air.

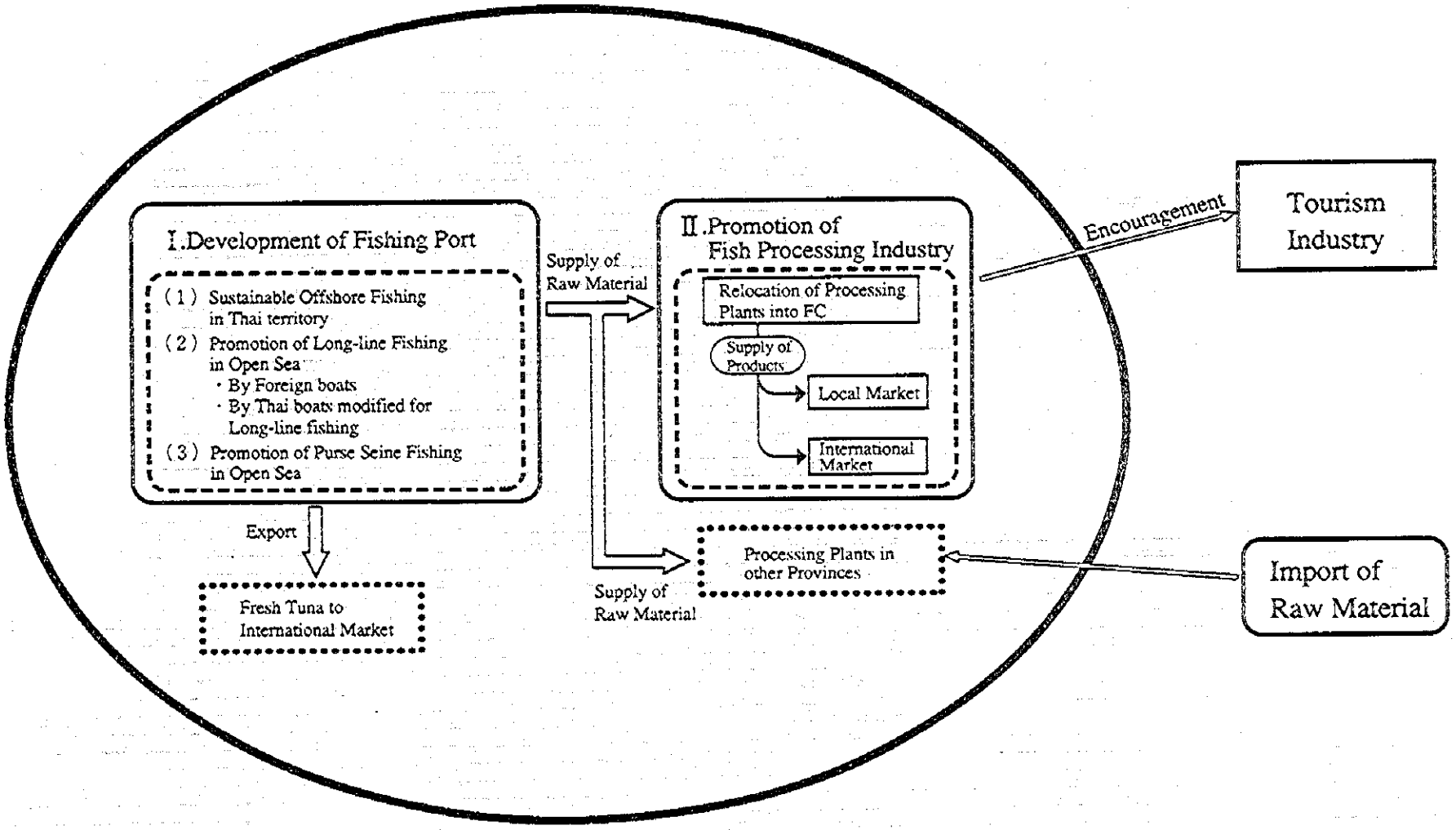
The development plan will be established with the following concept.

i) Introduction of Stock Management

Under the inclination of decrease in CPUE, Thai fishing will not be able to keep its same style, and stock management will be introduced with maintaining and nourishing fish resources for sustainable fishery development. Accurate assessment of the stock potential will be required with monitoring landing volume and fishing operation.

The project will provide facilities and system to manage fishery operation with acquiring accurate information on fish catch volume, species, fishing ground, etc.

BASIC CONCEPT OF FISHERY COMPLEX



ii) Development of Tuna Long Line Fishing

Taiwanese and Chinese long liners are operated in Indian Ocean using Phuket Fishing Port as a home port. These boats has moved from Malaysia to Phuket, seeking convenience to approach fishing grounds and Phuket International Airport. The Phuket Fishing Port will attract further number of long line boats from neighbouring countries. It is understandable, as mentioned in the previous section, that Thai fishermen will be experienced in long line fishing with training for some period because of its easy fishing technique without much amount of investment to equipment. The Study Team believes that tuna long line fishing will be indispensable to compensate decreased fish landing volume by trawlers and purse seiners.

Phuket Fishing Port under the Project is expected to play a role of not only a home port for long liners but a pilot fishing port which will promote tuna long line fishing for Thai fishing boats.

iii) Promotion of Purse Seine Fishing

DOF demonstrated purse seine fishing with Thai fishermen on deck of Mahidol, a purse seiner owned by DOF, to promote the fishing method for Thai fishermen. They have established a tuna fishing cooperative named Thai Oceanic Tuna Fishery Cooperative (TOTFIC) which intends to start purse seine fishing business with purchasing a tuna purse seiner by themselves. The cooperative is now just around the corner to commence the business.

Indian Ocean is a good tuna fishing ground for purse seiners from foreign countries like Japan, and these fishing vessels and reefer carriers call at Phuket Port to land frozen tunas. The vessels are given low priority to land their cargoes at the commercial port with deep-sea wharves.

The Fishery Complex Project, considering the above, will provide a landing station, the most convenient fishing port for Indian Ocean, for not only Thai purse seiners but foreign fishing and carrier vessels.

2) Promotion of Fishery Processing Industry

Thai Government has established the promotion policy to transfer fishery processing plants neighbouring Bangkok to southern Thailand. The policy aims at improving environment around Bangkok and at activating fish processing business being sluggish due to shortage of raw material and to shortage of labour force with high wage rates around Bangkok.

The Fishery Complex Project will help promotion of the above policy with improving the business environment to invite fish processing plants.

Implementation of the project will enable to reduce transportation costs for processing plants in Phuket and other provinces, since these plants will obtain stable supplies of reasonable raw material from the Phuket Fishing Port. The products will be distributed in the local market and exported to the international market.

3) Encouragement to Tourism Industry

Tourism industry promotion is the main policy for development of Phuket Province. Fishery industry supplies lots of fish to hotels and restaurants for tourists, being attracted by plentiful and fresh sea food, and fishery industry plays a role for supporting tourism industry in Phuket.

Phuket Fishing Port is a home port for passenger boats to Phi Phi Island, famous for its tourist spot, in Phan-nga Bay. The passenger terminal in the fishing port is being constructed on the west bank around the mouth of the canal (Khlong Tha Chin), for improving environment of the existing terminal, situated innermostly in the fishing port.

With implementation of the Fishery Complex Project, fishing boats in the port will be arranged properly and colourful fishing boats with Thai style will attract tourists gathering around the terminal. Improvement of environment around the fishing port is expected with enhancing control of odor and waste water from the existing processing plants and of cleaning water from the wharf. Implementing the Project will be an opportunity for the fishing port to be a tourism spot and will be an occasion to promote development of a marina for pleasure boats with private investment.

(2) Strategies for the Master Plan

The strategies for development of Fishery Complex will be considered as below, for reflecting the basic concept for the Project as mentioned in the previous sub-section.

1) Expansion of Development Room and Efficient Utilization of Land

Phuket Fishing Port facilities are situated on the both banks along about 200-m-wide Klong Tha Chin and the fishing port area is blockaded by forestry conservation area, residential area, etc. The east bank is utilized by FMO facilities, behind which wide mangrove forest area owned by FMO exists with permission of its deforestation for future development. The provision of expanded berths in the canal will accommodate present number of Thai fishing boats and increasing number of long liners. Berths for large purse seiners, however, will not be prepared in the canal because of its narrow waters against ship's sizes. The berth for large purse seiners will be constructed outside the canal and a link road will connect the berth and main facilities in the canal.

Layout of facilities is to be planned with utilizing the limited area designated as an industrial zone.

2) Cetralization of Fishing Port Management for Fish Resource Control

FMO facilities on the east bank and private facilities on the west bank coexist in the Phuket Fishing port. Various fishing port charges based on the act are collected from fish agents using the former facilities, however, no charges are collected in the latter facilities. Accurate information on the landing volume of the fish catch is obtained in the FMO facilities. Reports from fish agents on the volume of fish landed in the private facilities are unreliable, estimating the volume from records of consumed ice blocks.

Fishing port management without the function for confirming fish species and its catch will accelerate stock exhaustion and is to be eliminated, since stock management is required for sustainable fishing development.

The Fishery Complex Project aims at preparing necessary facilities for the said function.

3) Provision of Exclusive Berths and Separation of Berth Functions

Improvement of Phuket fishing port facilities will attract more tuna long liners, large purse seiners and reefer carrier vessels. Handling fish landed from these vessels is different from the way of handling fish from existing Thai fishing boats. For improving handling efficiency and keeping freshness of fish, exclusive berths will be provided to meet the ways for handling fish.

The sole FMO berth is chronically congested because fishing boats are moored for lay-by until their departure. FMO is preparing temporary wooden lay-by piers for relieving the congestion. The Fishery Complex Project will provide exclusive landing wharves being expected to improve landing efficiency and exclusive wharves for lay-by and preparation.

4) Provision of Landing Facility for Tuna Purse Seine Operated by a Cooperative

It is understood that development of new fishing grounds will be required for development of Thai fishery. In the course of the understanding, Thai OceanicTuna Fishery Cooperative (TOTFIC) has been established for launching a business of tuna purse seine fishing. The Fishery Complex Project is expected to support the fishing and to make provision of a landing facility. The facility is also expected to play a role to accommodate reefer carrier vessels

5) Provision of Facilities for Keeping Fish Freshness Corresponding Landing Volume

Cold rooms owned by Cold Storage Organization hold insufficient functions for keeping freshness of landed fish, since temperature is not low enough to keep frozen fish and freezing facilities are not available. Increasing a demand of ice blocks is expected for fishing boats and packing fresh tuna being exported. Shortage of capacity of making ice blocks is concerned for a future demand.

The necessary capacity of cold rooms and ice making facilities will be provided in the scope of the Project.

6) Redevelopment of Industrial Zone and Improvement of Environment

The project site is designated as an industrial zone in the Phuket Province where only a few zones exist. The land in the zone, however, has not been efficiently utilized since lack of a concrete city plan for the zone allowed free building of private fishing port facilities and fish meal factories. The Project will promote redevelopment of the zone to efficiently use the shore lines and land where fish meal plants exist.

Environment in the zone is deteriorated by odor and untreated waste water from fish meal plants. The new processing plants to be built in the area will accept services of waste water treatment meeting environmental criteria. Even existing plants should prepare necessary facilities for treating waste water and minimizing odor.

Implementation of the Project is expected to improve and/or preserve environment of the Industrial Zone.

7) Coordination with City Planning

Development policy prepared by Phuket Provincial Government gives Phuket Fishing Port a role of an important tourist spot with improving the passenger terminal for tourist boats. Due to close existence of fishery and tourist facilities in the project site, the mutual activation by the coexistence will be considered with utilizing the room for development.

The existing roads will be used as an access road to the Phuket International Airport from the Fishing Port for the Project but a bypass road will be planned to ease city traffic congestion around the project site for meeting the future increasing traffic. The improvement plan for the city roads in Phuket City will be basically considered in the development of the road system except direct investment for the Fishery Complex Project.

8) Optimization of Investment Size and Timing

The project will be composed of facilities to require much investment and those to require a long period until being operational. The most efficient investment to the project will be considered from a viewpoint of its cost minimization and timing. Appropriate phasing for investment will be planned without investment centralization to a phase and excessive advance investment.

5.4.2. Consideration of Scope and Size of Project Facilities

Fishing port facilities to be established for the project are categorized into the followings:

- Basic Facilities of the Fishing Port
  - * Channels, basins, etc.
  - * Wharves
  - * Road system
- Functional Facilities of Fishing Port
  - * Marketing hall
  - * Ice making /Ice storage facilities
  - * Freezing /Cold storage facilities
  - * Processing plants
  - * Waste water treatment
  - * Other relevant facilities

In planning the Fishery Complex, comprehensive facilities will be provided to expedite increase of raw material supply to processing plants with improving the existing fishing port. Considering the insufficient existing facilities, necessary facilities should be planned for the Fishery Complex.

(1) Basic Facilities of the Fishery Complex

1) Facilities to be Planned

The Fishery Complex will be composed of the following facilities.

i) Mooring Facilities

Fishing operated in Phuket is classified in the three categories: 1) Existing Thai style fishing , 2) Tuna long line fishing, and 3) Tuna purse seine fishing with large purse seiners. Wharves specialized for each fishing style will be provided, since landing efficiency by vessels for each fishing style is different due to different sizes of boats and to different fish handling system on wharves. Landing and lay-by wharves will be specialized to improve landing efficiency. Fishing preparation as supplying food and ice will be made at lay-by wharves.

A wharf for large purse seiners, being constructed out of the canal, will accommodate reefer carrier vessels.

ii) Channels and Basins

The existing channel of 2 or 3 m deep approaching to the fishing port is prepared in the shallow waters. A new channel to a wharf for larger vessels will be provided with connecting the open sea and a wharf situated outside the canal. A turning basin near a wharf for larger vessels will be provided for safe manoeuvring. Expanded wharves in the canal will accommodate existing Thai fishing boats and tuna long liners, and lay-by wharves, shallower than landing wharves, will be provided.

iii) Road System

A link road will be required between fishing port facilities in the canal and a wharf for large vessels outside the canal. The road will perform a role of main road in the fishing port and will be branched off to the facilities along the wharves and processing plants.

2) Sizes of Facilities

i) Forecast of Number of Fishing Boats

a. Number of Thai Fishing Boats

Records on fishing boats using the FMO wharf are solely prepared, but complete statistics on number of fishing boats using Phuket Fishing Port are not available. The volume of fish landed at the private jetties is estimated through fishery census conducted by DOF. The whole volume of landed fish in the Phuket Fishing Port is estimated with totalling the numbers from the record of FMO and from the DOF census. A number of fishing boats using the private jetties can be estimated in proportion to the landing volume at both sides.

Estimate of number of fishing boats using FMO wharf

* Volume of fish landed on FMO and private jetties

It is understood that MSY in the Andaman Sea is reaching its maximum, since total landing volume at Phuket Fishing Port has been decreasing despite increase of CPUE. Stock management will be introduced for present offshore fishing and present landing volume is expected to be maintained at a master plan stage. Landing volume at Phuket Fishing Port during 1992 and 1995 is shown as below:

Landing Volume at FMO Wharf

	1992	1993	1994	1995	Avg.
Annual volume	27,735	29,810	25,350	24,558	26,593
Avg. monthly volume	2,311	2,484	2,113	2,047	2,216

The table indicates that average annual landing volume is 26,593 tons and average annual landing volume is 2,216 tons. Landing volume at an FMO wharf is estimated to be 27,000 tons/year at the master plan stage.

Volume of fish landed at the private jetties is estimated on the basis of past landing records as landing volume outside the fishing port is negligible.

The following table shows the ratio of volume landed in between Phuket Province and Phuket Fishing Port (FMO). Since the latter is 44 % of the former, estimated volume of landing fish at the master plan stage is calculated as:

27,000 tons/year / [44/100] = 62,000 ton /year

	In Phuket Province(A)	In Phuket FMO Fishing Port(B)	B/A (%)
1988	81,379	36,817	45
1989	76,515	39,343	51
1990	68,559	30,657	45
1991	91,244	31,147	34
1992	69,121	27,735	40
1993	63,832	29,810	47
Avg.			44

* Number of fishing boats using only the FMO wharf

For planning wharves, average volume of the highest 10 of daily volume landed is applied among landing records in sequential two months for past three years. Landing records during 1993 and 1995 shows the sequential two months are January and February in 1995 as follows:

3,406,679 kg in January

3,105,466 kg in February

Average: 3,256,073 kg

This volume is 1.47 times of 2,216 tons, average monthly landing volume for past four years, and it is estimated that monthly landing volume at the height of fishing season will be 1.47 times of average monthly volume. The table listed below shows average of the highest 10 of daily volume and number of fishing boats by fishing method. This table indicates 242 tons of daily landing volume and 20 boats calling at the fishing port being broken down into 16 boats of purse seiners and 4 of trawlers.

Daily landing volume	Fishing boats	Purse seiners	Trawlers
376,852	43	37	6
355,596	19	16	3
289,947	9	6	3
271,321	15	9	6
243,257	19	15	4
237,531	22	19	3
219,282	31	26	5
219,035	15	14	1
208,032	24	21	3
199,490	21	18	3
Average : 242,085	20	16	4

In preparing a master plan, landing volume at Phuket Fishing Port is expected to be 240 tons/day and 20 fishing boats are expected to use the fishing port.

Estimate of number of fishing boats using private jetties

Number of the captioned boats is not accurately recorded and it is estimated on the basis of landing volume at FMO and private jetties, because landing volume per boat is almost same among the fishing boats using the Phuket Fishing Port. Total daily number of fishing boats using the fishing port is estimated at:

$$20 \times (62{,}000/27{,}000) = 46$$

Based on the planning policy for stock management, no increase of fishing boats is expected and the estimated daily number of fishing boats broken down as below is applied to planning a master plan.

Number of boats using FMO	:	20
Number of boats using private jetties	:	26
Total	:	46

b. Tuna Long Liners

Landing volume per boat

According to the records of catch by tuna long liners conducted by Andaman Fishery Development Centre, catch volume per trip by a long liner averages out at about 7 tons. The figure is almost appropriate as being confirmed through interviews from Taiwanese fish agents. Landing volume per boat is set to be 7 tons per trip at the master plan stage.

Number of annual trips per boat

A period for a trip by a long liner is being decreased to 15 days for maintaining fish freshness and a period staying in the fishing port is 2 - 3 days for preparation. About a month is required for repair and maintenance. Based on the operation pattern, number of trips a boat is estimated at:

$$(365 - 30) \ / \ (15+3) = 19$$

As stated in former sub-section 5.1.3 , number of long liners at target years for a master plan and a urgent plan is:

* 200 boats at an urgent plan stage

* 300 boats at a master plan stage

c. Tuna Purse Seiners

Thai Tuna Oceanic Fishery Cooperative has prepared a plan to carry out tuna purse seine fishing in Indian Ocean with purchasing three large purse seiners. A master plan will provide a facility to accommodate the fishing vessels and reefer carrier vessels on irregular service.

ii) Scale of Wharves

a. Evaluation of an existing wharf for landing

FMO wharf for landing

Berth length for landing is calculated as:

$$\text{Berth length} = \Sigma(N/r) \cdot L$$

where:

L: Berth length = LOA + allowance

N: Daily number of fishing boats landing fish

r : Berth turnover = (Service time for landing) / (Landing time per boat)

As landing time is different between a purse seiner and a long liner, berth length for two types of boats is calculated. Ratio of purse seiners among the total fishing boats for landing is 80 % in 1995 and daily number of purse seiners using the fishing port is estimated at:

16 boats for purse seiners

4 boats for trawlers

Fishing boats for landing fish at Phuket Fishing Port are mainly in the category between 46 and 60 GT and number boats over 60 GT is very small. In planning wharf length, the boat size of the major category is applied.

Breakdown of sizes of fishing boats for landing

Size	Number	Ratio
Less than 10 GT	425	10
46 - 50 GT	1,107	27
51 - 55 GT	1,418	35
56 - 60 GT	1,144	28
81 - 90 GT	4	
More than 100 GT	1	
Unknown		
Total	4,099	100

Dimensions of typical modern fishing boats are as follows:

LOA : 18.0 - 20.0 m

Breath : 5.25 - 5.75 m

Max. Draft : 2.00 - 2.21 m

Berth length for landing is calculated as :

Fishing method	Avg. LOA	Avg. Berth length	No. of boats	Sevice time	Landing time per boat	No. of berth
Purse seiner	19 m	22 m	16	8	2	4
Trawler	19 m	22 m	4	8	4	2

The table shows requirement of 6 berths and the length is 22 m x 6 = 132 m.

The calculation results in remaining 48 m length available from the existing berth length of 180 m . Berth congestion is obviously caused by mooring boats and the existing berth length will be enough to accommodate the number of fishing boats at the master plan stage without its extension, if the FMO wharf is used solely for landing the volume estimated at same as the present one.

Private jetties

Number of fishing boats using the private jetties is estimated at 26, from a viewpoint of maintaining present landing volume at the master plan stage under stock management policy. Private companies has own landing facilities as jetties or seawalls of wooden or concrete. The new policy for the Fishing Port Complex aims at unifying fishing port management and a new landing wharf to accommodate fishing boats presently using the private facilities will be required for the policy. Length for the facilities is estimated with the same method mentioned above.

Fishing method	Avg. LOA	Avg. Berth length	No. of boats	Sevice time	Landing time per boat	No. of berth
Purse seiner	19 m	22 m	21	8	2	6
Trawler	19 m	22 m	5	8	4	3

The length for required 9 berths is 9 x 22 = 198 m.

7 berths of 154m will be newly provided as 2 berths length of 44 m will be allocated to the existing FMO wharf which reserves allowance for 2 berths.

Lay-by wharf

The FMO wharf is used for both purpose of landing and lay-by because of no lay-by wharf. The usage causes congestion of the FMO wharf and a new lay-by wharf will be provided for improving landing efficiency. Considering the limited area in the fishing port, a lay-by wharf to be provided will also render services of preparation for fishing.

Daily number of offshore fishing boats using the FMO fishing port is 20 in total with 16 for purse seine fishing and 4 for trawling. 26 boats are moored for landing at private jetties. For estimation of berth length for lay-by, allowance is required for accommodating trawlers, operated in Myamma waters, which irregularly call at Phuket Fishing Port. Maximum number of trawlers calling a day at the FMO wharf during 1994 and 1995 is 10, which is applied to calculation of allowance instead of 4 of trawlers, and 5 boats for allowance for landing at private facilities are applied. The allowance results in total number of 57 fishing boats calling at Phuket. A period for staying of these boats in Phuket Fishing Port is within 24 hours. With a condition of mooring 5 boats alongside at a berth, total length of the wharf is calculated as

(26 + 31) boats x 22 (m/boat) / 5 = 250.8 (m) and planned to be 250 m.

b. Wharf for long liners

Landing wharf

In spite of present operation of long liners, unclear information is available on operational pattern of the boats for the fishing method and accurate statistics on landing time and volume from the fishing are not available. Considering the above information, berth length for these boats is calculated as

Berth length =

(Aggregate days for all boats for landing in a month)÷(Monthly service days per berth)

Calculation conditions are listed as below:

- Number of long liners: 300
- Number of trips: 19
- Months for operation: 11
- Available time for landing: 12 hours
- Landing time per boat: 3 hours
- Peak ratio to average No. of boats: 50 %

Aggregate days for all boats for landing per month are calculated as

300 x 19 x 1.5/11 x 3/12 = 194.2

The total days per month of 195 divided by monthly service days per berth of 22 is led to

195 ÷ 22 = 8.9

and the number of berth for long liners is 9. Number of calling the fishing port is calculated as

9 x 12/3 = 36

At a master plan stage Thai long liners are expected to be operated with Taiwanese and Chinese boats. The breakdown of 300 boats is:

Taiwanese	:	100 boats
Chinese	:	100 boats
Thai	:	100 boats

The sizes of the each type is listed below:

Unit in meter

	Chinese	Taiwanese	Thai
Avg LOA	32.5	16.5	19
Berth length	37.0	19.0	22
Breath	7	5	5.5

Total berth length is (37 + 19 + 22) x 3 = 234 m and design length of the berth is 235m.

Lay-by wharf

Average in-port time of long liners is 2 or 3 days and 2 days for in-port time is applied to planning a lay-by wharf. Maximum number of fishing boats staying in the port is

36 (boats/day) x 2 (day) = 72 (boats)

Since same mooring system as Thai offshore boats is applied for long liners, number of lay-by berths is 72 ÷ 5 = 14.5, namely, the number is 15.

Length of the total berths is estimated at

(37 + 19 + 22) x 5 = 390 (m)

c. Wharves for Large Purse Seiners and Carrier Vessels

Landing wharves

As discussed in the sub-section 5.1.3, purse seine fishing by large vessels is expected to be operated annually for 6 trips with founding its business in the target year of a master plan. A general operation pattern is described as 1 month for operation with steaming, 5 days for in-port activities like landing and 1 month for maintenance and repair. Same calculation method as long liners is applied with introduction of 3 purse seiners and total days for all vessels for landing per month is calculated at

3 x 6 x 1.5 / 11 x 5 = 12.3

where:

- Number of purse seiners: 3
- Number of trips: 6
- Months for operation: 11
- Landing time per boat: 5 days
- Peak ratio to average No. of boats: 50 %

Given 22 days for monthly service days of wharves, number of berths is calculated at

12.3 ÷ 22 = 0.6,

namely, one berth will be enough to accommodate the large purse seiners.

Number of berths for reefer carrier vessels is estimated as follows:

Given 45 vessels of carriers, 8 days in a port per trip and 365 service days, number of berth is estimated at one berth as

(45 x 8) ÷ 365 = 0.99

Two berths will be provided for simultaneous mooring for a purse seiner and a carrier vessel. Design ships for the wharves are purse seiner Mahidol owned by DOF and a reefer carrier of 5000 GT class, which has called at Phuket and Songkha ports. Dimensions of the ships are shown as below:

	Purse seiner Mahidol	Reefer carrier
LOA	62.53 m	115 m
Brth	12.5 m	17.8 m
Draft 4.8 m		7.0 m
GRT	1,270	5,000

Required berth length for the vessels is planned to be 210 m with allowance for mooring space and rope length.

3) Summary of wharf length

i) Landing wharves

Thai offshore fishing boats : 155 m

Long liners : 235 m

Deep-sea purse seiners : 210 m

ii) Lay-by wharves

Calculated length of lay-by wharves for the existing boats and long liners are 115 m and 390 m respectively, and total length is calculated at 505 m.

Considering limited waters in the canal and investment efficiency, length of lay-by wharves to be provided will be reduced to 320 m as effective length from the calculated length of as above. First priority for lay-by will be given to Thai fishing boats and the remaining wharf will accommodate 25 long liners. Other long liners will be moored in the 410-m-long area along the existing private jetties

Berth length : 320 m (380 m for total length)

4) Scale of channel and water basin

The fishing boats sail to the north, passing through the two islands, and take the 3 m deep channel leading to Phuket Fishing Port. The new Fishery Complex will require a new channel and a basin for accommodating larger purse seiners and reefer carrier vessels at the a deep-sea wharf near the canal mouth.

i) Design ship

The same ships, as stated in the above, as Mahidol and the reefer carrier vessel of 5000GRT are applied for design the channel and basin.

ii) Approach channel

a. Layout of the approach channel

The existing channel will be utilized as much as possible to reduce dredging costs. Two layout plans are proposed along the existing as shown in Figure 5.4.1. Appropriate layout will be proposed with examining the siltation volume in the sub-section 4.5.2.

b. Width of the channel

In Japan a few guideline or design standards on the channel are available as "Guideline for Planing Fishing Port", "Design Standards for Fishing Port Facilities" and "Technical Standards for Port and Harbour Facilities in Japan". UNCTAD and PIANC propose the similar standards on channels and basins also. Since the almost of all standards prepare design criteria on channel width as 5 or 6 times of ship breadth, the width of the channel is determined to be 100 m, equivalent with about 6 times of breadth of the design carrier vessel.

c. Depth

In designing the channel for larger ships as 5000GRT, PIANC recommends design depth of channels to be equivalent with maximum draft plus its 10 % for allowance. The present design of the facility follows the recommendation and 7.7 m deep will be required for the channel. Considering tide difference between MLWS and the chart datum, 7 m in depth from the chart datum will be sufficient with 0.7 m allowance for the design ship.

iii) Turning basin

a. Depth

Design depth of the turning basin is - 7 m below the chart datum as same as the channel depth.

b. Area for turning

Considering safe manoeuvring of a 5000 GRT carrier vessel, a circle diameter of 3 times of LOA is recommended by the above standards as the necessary area for a turning basin

5) In-port road system

The road system in the Fishery Complex consists of a main link road between the deep-sea wharf and FMO facilities and the roads branched off from the link road. The link road will accommodate larger trucks loading over 10 tons of tuna and the new road is planned with 2 lanes of 3.5 m in width, namely, a 7 m wide road will be provided.

(2) Functional Facilities of Fishing Port

1) Project Site

The planned site in Phuket is divided into two areas by a narrow canal, i.e. one area is on Phuket Island and the other is on Si Rae Island. The Phuket city government designated this area as an industrial park. The total area required for the planned site is approximately 83.9 hectares (524.4 rais), of which 65.4 hectares (408.8 rais) on Si Rae Island have already been acquired by FMO, but approximately 18.5 hectares (115.6 rais) on Phuket Island is owned by the provincial government.

The planned site contains a very large mangrove swamp in the back lot of the existing FMO landing wharf. This swamp will be filled with the sand produced by the dredging work in this project.

All of the existing facilities in the planned site will be renovated by 2005 in order to harmonize the facilities with the new surroundings. In 2012 all of the facilities on Phuket Island, including the fish meal plants will be renovated and integrated.

The elevation of the planned site on Si Rae Island was fixed at MWL + 1.75m based on the existing FMO landing wharf level, but the elevation of the mangrove swamp was fixed at MWL + 3.75m to accommodate drainage facilities from the project site to the canal.

2) Marketing Hall

The existing marketing hall will be enlarged 324m to the south, in order to meet the following conditions.

- **Projected fish landing volume**

The new marketing hall will handle the fish landed at the existing fish meal plants on Phuket Island, as well as the fish landed at the existing FMO landing wharf. In addition, fish landings by long liners will be handled as well. The projected total fish landing volume is given below.

Unit : ton/year

	2002 year	2005 year	2012 year
Existing local trawlers and purse seiners	62,000	62,000	62,000
Long liners	17,300	21,300	30,600

- **Operating hours**

Fish landing work will be carried out from 5 a.m. to 8 p.m.

- **Fish handling work at the market hall**

Fish caught by existing local trawlers and purse seiners will be packed in fish boxes, but fish caught by long liners will be not be packed in fish boxes.

3) Office and Others

i) FMO Office, Wharf Watchman Box and Auction Watchman Box

The FMO office will be located in the center of the project site, and in front of the marketing hall. It will accommodate 9 personnel in charge of fishing port operations and 3 personnel in charge of fish quality control and inspection.

The Wharf Watchman Box will be located at 3 points within the project site. The first box will be located at the fish landing wharf for existing local trawlers and purse seiners and the second will be located at the wharf for long liners, and the third will be located at the mooring wharf. Each box will accommodate 2 personnel, 2 personnel and 1 personnel, respectively.

An Auction Watchman Box which will accommodate six personnel is planned.

ii) DOF Office

One of the main service of DOF is fisheries resource control. It is very important to control the fisheries resource in Andaman Sea, therefore many kinds of researches will be necessary for the fishery resource.

On the other hand, regarding the processed fish products exported from Thai to the other countries, it is usually required that the processing factories carry out the quality control for their products in accordance with the food hygiene's regulation of the other countries. The quality control section of DOF carries out the inspection to the processed fish products. Surat-Thani branch office of DOF's quality control section is now carrying out the inspection service for the processing factories in Phuket region, but it's necessary to prepare the food inspection center in this fishery complex because this project includes many processing factories.

Therefore DOF office will be prepared for the fisheries resource control and foods quality control.

DOF office will accommodate 10 personnel including a director, 2 personnel in charge of fisheries resource control and 4 personnel in charge of foods quality control.

iii) Radio Communication System

DOF has its own radio station for the fishing boats near the project site, but this station is now used only for Thai fishing boats. If this station get a little more equipment, it's possible to contact with foreign carrier vessels and purse seiners.

Radio communication service is necessary for new FMO fishing port to contact with the foreign vessels. Therefore the supplementary equipment supply to the DOF's radio station will be carried out, and FMO office will be equipped with a radio facilities to contact with DOF's radio station.

iv) **Custom and Immigration Office**

This project includes the deep sea wharf for foreign purse seiners and carrier vessels, therefore there will be many works about the immigration control for foreign crews and the custom service for frozen tuna in this fishery complex. In the case of the Phuket commercial port, it has an office room, and the custom and immigration officers can use it as their own tentative office. Therefore a custom and immigration office is planed in FMO office.

v) **Fish Agent Office**

Existing offices will be leased by FMO to fish agents in future.

4) **Ice Plant and Ice Storage**

An ice plant with a production capacity of 180MT/day will be constructed based on the operating conditions of existing ice plants, future demand, and the following conditions delineated below. A ice storage facility with a one day production capacity will be installed; and ice will be provided to long liners by an ice crusher tower on the wharf.

- The 1995 estimated fish catch volume of the 100 long line fishing boats is 13,300 tons/year. It is estimated that by the year 2005, there will be 160 vessels producing 21,280 tons/year.
- Five ice plant companies are presently supplying ice to the fishery sector in Phuket and their total ice supply volume is estimated to be 555 MT/day. Ice supply and demand is currently balanced, but the there is a tendency for ice demand to be slightly higher than the supply.
- The fish catch volume of long liners is expected to increase to 17,290 tons/year from 1995 to 2012 and an annual shortage of 51,870 tons of ice (177.6 tons/day) is estimated (ice-fish ratio is 1:3/80% operating ratio of ice plants).

5) **Cold Storage**

A cold storage facility with a capacity of 600 tons and a temperature setting of up to -25℃, will be installed to temporarily stock the frozen tunas landed by carrier vessels.

- **Temporary stocking of frozen tunas landed from carrier vessels**

The volume of fish transported by carrier vessels for one operation is 1,500 tons. Tuna canning factories will purchase on the average, 500 tons of tuna per lot; and the transport volume of a carrier vessel for one operation is equivalent to the purchasing volume of three canning plants. The raw material consumption volume of one plant is 40 tons/day, for a total of 120 tons/day for three canning companies. Tuna canning plants customarily purchase only one day's worth of production volume. Each plant maintains its own cold storage facility which is capable of storing 25 days of consumption volume or 1,000 tons as an emergency countermeasure. The carrier vessel is able to dock at the fish landing wharf for eight days.

Therefore, 1,500MT - (40 MT/day/plant x 3 plants x 8 days) = 540MT of surplus raw material. This surplus will need to be stocked in cold storage.

6) Fuel Oil Supply Facilities

Presently, six diesel oil tanks owned by Tajeam Service Co., Ltd. with a capacity of 15MT/tank have been installed at the existing FMO fish landing wharf. But this facility is rarely used by fishermen because oil supplied on land is more expensive than oil supplied out at sea. So some of the Thai fishing boats use this oil supply facilities, but none of the foreign vessels uses this facilities. Therefore from the middle of 1996 Thai government tried to sell the diesel oil to the small vessels less than 18m in cheaper price than its market price, but the sales has not increased because fishermen have to get the oil in cash payment in this system. It is expected that foreign vessels will contribute to the increase of the fishing boats which use this port. Therefore, a supply facility for fuel oil has not been included among the functional facilities in this project, but land space will be allocated for a fuel oil supply facility that may be constructed in future.

7) Electric Incoming Station

- A total of two electric incoming stations, one on Phuket Island and the other on Si Rae Island, and electric power stations will be prepared for the FMO related facilities and the processing factories separately.

- In 2002 target year one electric incoming station will be installed on Si Rae Island, and one electric power station will be prepared for the FMO related facilities.

- In 2005 target year electricity will be supplied to the deep sea port area from the electric power station mentioned above. If processing factories move into the industrial estate at this project site on Si Rae Island, high voltage electricity will be supplied to each lot of the industrial estate. Each factory will be required to install their own electric power station.

- In 2012 target year another electric incoming station will be installed on Phuket Island. If more processing factories move into the industrial estate at this project site on Phuket Island, high voltage electricity will be supplied to each lot of the industrial estate. Each factory will be required to install their own electric power station.

- Capacities of the incoming stations in each target year is shown as follows.

Incoming station name	2002 year	2005 year	2012 year
Phuket Island	0 KVA	0 KVA	6,000 KVA
Si Rae Island	3,000 KVA	9,000 KVA	9,000 KVA

- A generator which will provide the minimum electrical power needs of FMO related facilities on Si Rae Island will be installed as an emergency countermeasure.

8) City Water Reservoir

- Three city water reservoirs will be constructed, the first on the FMO related facilities' area on Si Rae Island, the second on the industrial estate on Si Rae Island and the third on Phuket Island.
- In 2002 target year one city water reservoir will be constructed for the FMO related facilities on Si Rae Island.
- In 2005 target year one city water reservoir will be constructed for the processing factories in the industrial estate on Si Rae Island.
- In 2012 target year one city water reservoir will be constructed for the processing factories in the industrial estate on Phuket Island. Therefore three city water reservoir will be prepared in the project site by this year.
- The main elements of the city water reservoir will be a underground water reservoir tank, a elevated water tank and a pump house.
- The capacity of the underground reservoir tank will be equivalent to the consumption volume of one half day, as a countermeasure against water cut-off. The capacity of the elevated water tank will be equivalent to the consumption volume of about 2 hours.
- Capacities of the city water reservoirs in each target year is shown as follows.

Unit : m^3

Target year	Phuket Island site		Si Rae Island site	
	Underground	Elevated	Underground	Elevated
2002 year	0	0	500	100
2005 year	0	0	1,750 (500 & 1,250)	300 (100 & 200)
2012 year	500	100	1,750 (500 & 1,250)	300 (100 & 200)

"Underground" means underground reservoir tank and "Elevated" means elevated water tank.

9) Supply Facility for Sea Water

Sea water is presently used to wash the market floor of the existing FMO fish landing wharf, in order to minimize the use of city water. After receiving the treatment by filters and chlorine disinfection system Sea water is supplied to the existing wharf. Therefore this practice will be continued in future.

Capacity of the water pump: 500 litres/minute (30 ton/hours)

10) Waste Water Treatment Facilities

- A total of two waste water treatment facilities will be constructed, i.e. one on Phuket Island and the other on Si Rae Island. They will be located in an area where the unpleasant odour will not be a problem to neighbouring areas. Fish processing factories are the main source of waste water in the industrial park.
- In 2002 target year one waste water treatment facility will be constructed only for the FMO related facilities on Si Rae Island. In 2005 target year the waste water treatment facilities mentioned above will be expanded for the processing factory facilities at the industrial estate on Si Rae Island. In 2012 target year another waste water treatment facilities will be constructed for all the facilities on Phuket Island.
- Waste water will be treated according to the activated sludge method.
- Treated water will be discharged according to the national environmental standards set by the Thai government.
- Each fish processing factory will be equipped with a small septic tank unit, oil-traps, and catch basin with screens, in order to carry out preliminary treatment of waste water.
- The source and volume of waste water are given below.

a. Si Rae Island unit_Fm^3/day

Target year	Fish factories	Market hall	Fish boats	Fish meal plants	Others	Total
2002	0	350	265	0	60	675
2005	2,665	390	295	0	60	3,410

b. Phuket Island unit_Fm^3/day

Target year	Fish factories	Market hall	Fish boats	Fish meal plants	Others	Total
2012	890	70	35	60	0	1,055

11) Garbage

- Phuket region has a well functioning public system for garbage collection. Therefore the garbage from the new fishery complex will be treated by this system without any incinerators in the complex to avoid troubles between the neighbours.

- Estimated garbage volumes are shown as follows.

Facilities name	Garbage volume
Marketing Hall	3.0 ton/day
Tuna processing factories	0.9 ton/day/factory x 6 factories = 5.4 ton/day
Offices and others	0.4 ton/day
Total	approx. 9.0 ton/day

- Each facilities in the fishery complex will be equipped with 2 ton type garbage tanks and 200 litters type dustbins delivered by city government depend on its necessity. On the other hand one rubbish disposal area (approx. 50m2) will be prepared for the large garbage.

12) Workshop

Now repairing works for the fishing boats are carried out in the existing marketing hall in the night because existing FMO fishing port has not a workshop. But repairing works for the boats is not appropriate for the marketing hall. There are many troubles in the existing marketing hall e.g. oil spread on the floor, insufficient clean-up after repairing work and inadequate working hours for repairing jobs.

Therefore one workshop building (floor area : approx. 156m^2) will be constructed in the fishery complex. It will be equipped with machines and tools required to the tentative repairing works for pumps and engines, and if someone has a heavy problem in their fishing equipment they will receive the assistance from private mechanics.

13) Shipyard

The private shipyard company named Srikit Shipyard Co., Ltd. is located with neighboring of FMO fishing port. The activities of the company are maintenance and repair the fishing boats of FMO fishing port. The number of staff is approximate 200 include temporary workers. The capacity of maintenance and repair the fishing boats is approximate forty (40).

Consideration with records, capacity and technical level of the company, maintenance and repair the fishing boats of FMO fishing port will be utilized this company after implementation of the project. Construction of new shipyard owned by FMO is not included in this project. Therefore, land space for the company will be allocated for the extension of shipyard in future.

14) Fishing gear repairing area

- Small repairs will be carried out on the boat's board, while large repairs will be done on land.

- It is estimated that local purse seiners will carry out the repairs mainly, and 10 percent of all purse seiners coming into the fishing port daily will undergo major repairs, and it will take 3 day for a repair works. The number of the purse seiners coming into the fishing port daily is 12 boat both on 2002 stage and 2012 stage. Therefore it is estimated that 3 boats will carry out major repairs in a day, so area required for repairing is 600 m^2.

15) Fishing gear storage

The agents are mainly fishing boat owners, possessing several fishing boats who are in need of storage facilities for their fishing gear. There are 20 agents, therefore, storage facilities in 20 different lots are required.

16) Fish Box Storing Area

In present, the open space (40 x 40 m) near the existing FMO office is utilized for fishing box storing from local fishing boats of FMO fishing port.

The area size of fish box storing in this project will be considered with the above mentioned fish boxes and fish boxes of local boats which unload to the Phuket island side. Therefore, the fish box storing area sized 40 x 80 m will be allocated behind the mooring jetty.

17) Service Building for Wharf Workers

Service building for fishermen and truck drivers will be allocated behind FMO fishing port and center of the project site. Service building is composed with canteen (324 seats), restaurant (44 seats), kiosk and other service facilities such as shower and rest room.

(3) Fish Processing Factories

1) Long and Short Term Development Targets of the Master Plan

The industrial zone including the east and west banks of the canal will be redeveloped under the Master Plan. The FMO site located on the west bank of the canal is owned by FMO and is currently vacant. However, fishery related facilities such as fish meal factories are located on the east bank of the canal. These private firms will be relocated during the implementing stage of the redevelopment project. It is difficult to coordinate and resolve issues pertaining to negotiations, budget allocation, and location planning in a short period of time.

Therefore, factories that will be accommodated on the west bank will be relocated in 2005 which has been set as a short-term target year. The east bank area will be developed by 2012, the long term target year of the Master Plan; and the remaining factories will be relocated.

2) Number of Processing Factories To Be Relocated

As mentioned in 5.3.3, there are a total of eight factories which will be relocated due to raw material supply. The production volume of one relocated factory is 40 tons/day of raw material and one factory will require an area of about 28 Rais. When the available land area of the new site is divided by the number of factories which will be relocated, six factories will be relocated to Phuket by the short-term target year and two factories will relocate every year until the long-term target year, i.e. from 2005 to 2007. The six factories that are anticipated to move to Phuket by the short-term target year will not make the move for one year.

The area required for factories, their number, and production volume according to year are shown in the following table.

Year	Location	Required Area (Rai)	Number of Factories	Processed Volume of Raw Material Tons/Year
2005	Sirae Island	56	2	24,000
2006	Sirae Island	112	2	48,000
2007	Sirae Island	168	2	72,000
2012	Phuket Island	56	2	101,000

The demand for raw materials according to fishing grounds and target year, the fish landing volume according to type of fishing vessels landing at Phuket fishing harbor, the number of reefers, and port entry intervals are shown in Tables 5.4.1 to 5.4.3.

3) Scope and Scale of Facilities

The scope and scale of the facilities of one factory is given as follows:

- Production Plant: 40 tons/day of raw material. Operationg days are 300 days per year.
- Supplementary Facilities: Warehouse, cold storage, service facilities, dormitories, etc.

5.4.3. Outline of Project Site

(1) Land use of Project Site

1) City Plan of Phuket City

Phuket City Plan as shown in Figure 5.4.2 designates the project site as "Industrial Zone" , designation of which is given to a few places. The surrounding area is designated as residential area and forest conservation area and development in the area is strictly controlled except the designation.

Phuket Provincial Government lays emphasis on development of tourism and fishery industry performs an important role to support tourism with supplying sea food to resort hotels. When the Fishery Complex Project is implemented in the zone, the project is expected to contribute promotion of the Provincial Government by sharing the role in tourism and activating both industries.

"Industrial Zone" is separated by a canal named Klong Tha Chin. The east of the zone is occupied by FMO fishery facilities and mangrove forest area owned by FMO, which reserves a right of its deforestation. In the west area landing facilities, processing plants, fishing boats repair shops, etc. has been constructed in disorder by private firms without any city planning.

2) Land use of the project site

As indicated in Figure 5.4.3, the Project Site is divided in to 5 zones from a viewpoint of land use and each land use is outlined as below.

i) Area for Fishing Port Facilities owned by FMO and CSO

There exist fishing port facilities owned and operated by FMO and CSO. FMO provides a landing wharf of 181m long with a marketing hall, car park lots and buildings for offices and residence for fish agents. Cold stores, ice making plants, ice stores, etc. owned by CSO neighbour on the north boundary of the FMO area. There remains some room for expansion of these facilities.

ii) Area for Shipyard

A private shipyard is operated adjacent to the CSO area. The company is specialized for shipyard business in the zone except a few slipways owned by fish agents. The shipyard established 14 years ago prepares three slipways for building and repairing fishing boats.

iii) FMO Land

The land has been purchased by FMO for expansion of the existing fishing port facilities to be planned by the organization. The land is covered with mangrove forest which has been allowed to be deforested, and the land is covered with water at a high tide.

iv) Area for Fish Agents and Processing Plants

60 % of total landing volume at Phuket Fishing Port is handled at the private primitive jetties along the west bank of the canal. The facilities are used without hindrance in spit of primary structures, because manpower handling is employed without heavy equipment. Face lines of the landing facilities are generally smooth but it changes toward the land side in front of a fish meal plant.

There exist three fish meal plants using landed raw material at their front jetties. Eastern winds disperse odor widely in Phuket city from the plants. A plant operates a slipway for repairing own or chartered boats.

A passenger terminal opposite to CSO area is available for transporting tourists to Ko Phi Phi and waters around the terminal is congested with pleasure boats and fishing boats moored along the waterfront. Innermost of the canal in the area is occupied with fishing boats moored along both sides of the canal. The land along the canal is efficiently utilized as a few warehouses and buildings exist sparsely.

v) **Open land and land in filling**

There remains much room in the area with sparse density of buildings and a small lot behind a fish meal plants are used for stocking a pile of timbers. A tip area of the land is still reclaimed for constructing a passenger terminal.

3) **Private land adjacent to the Project Site**

Figure 5.4.4 shows the land privately owned, which is divided into 31 land titles and some titles are still in dispute. The designation of the land as forest conservation was given after establishing their titles.

(2) Existing Infrastructure around the Project Site

1) **Road System**

Phuket and Bangkok are linked with the well-paved road of Route 4 which is 860 km long. Route 4 and Route 407 are available for land traffic between Phuket and Songkhla, and the well-paved roads serve rapid transit due to light traffic.

Figure 5.4.5 shows the road plan in Phuket City. Road A shown in the figure will be expanded from the existing 2 lanes to 4 lanes with 3 m wide per lane. Road B in the figure is linked with Route 402 and will be improved to double carriageways with 3.5 m wide per lane. FMO has a plan to construct a new Road C to serve easy access to the Phuket International Airport.

2) **Water**

There are two (2) water supply authorities in Phuket, which are Provincial Water Supply Authority and Division of Water Supply of Phuket city. Province has water dams and water ponds, and total capacity of water supply is 24,000 m^3/day. City has nine (9) mining wells and total capacity is 15,600 m^3/day. Province water pipe is connected with city water pipe line. City buys water from province and total amount of supply by province is 11,000 m^3/day. Therefore, actual capacity of water supply by city is 26,000 m^3/day.

At present, especially in dry season, water supply by both authorities is not enough.

However, Royal Irrigation Department has planned construction of three (3) water deep wells in Phuket. The plan has a high priority and will be implemented soon. According to the above plans, water supply to the new Fishery Complex will be sufficient after completion of dams and deep wells.

The project of water deep wells has already started the study of construction. Outline of the project is shown in below;

Project sites of water deep wells and capacity of water supply

Ka-Tu	5,400 m³/day		
Sam-Kong	4,300 m³/day		
Pa-Tao	25,000 m³/day,	Total	34,700 m³/day

Time Schedule

Feasibility study	October 1996 ~ April 1997
Environmental study	July 1997 ~ June 1997
Construction	August 1998 ~

3) Electricity

The Provincial Electricity Authority (PEA) supplies electricity, 33,000 V/50Hz, to the FMO site. The Electric City Generation Authority of Thailand (ECAT), supplies electricity to PEA. Total supply and demand in 1995 are 200 MVA and 113.72 MVA respectively. Electric out off a few minutes happens once or twice a month at present. Capacity of electricity supply is sufficient. Moreover, the ECAT has a plan to construct a new power station in Phuket which capacity is 115 MVA. Therefore, electricity supply to the new Fishery Complex will be enough and no problem.

4) Garbage

Garbage collection system has been established in Phuket. The city government has one garbage dumping ground located at outside of the city area is 80 ha. The city government collects garbage from inside of Phuket city, and Provincial government collects from outside of the city. Some times they ask private companies when their capacity are not enough to collect garbage. Phuket generates 160 tons/day of garbage. The existing garbage dumpling ground has already been limited. However, the city government has already constructed new garbage furnace (250 ton/day) near the existing ground which will start from February 1997. Therefore, garbage from the new Fishery Complex will be able to be burnt at the furnace.

5) Telephone

Telephone Organization of Thailand (TOT) and Telephone and Telecommunication Network of Thailand (TTNT) operate the telephone service in Phuket. Both line is connected at Phuket Telephone Center. Existing installed capacity and used capacity are shown in below;

	Installed Capacity			Used Capacity		
	TOT	TTNT	Total	TOT	TTNT	Total
No. of Telephone Line	42,200	47,750	89,950	26,657	16,363	43,020
No. of Telephone Set	26,926	47,560	74,286	25,960	16,363	42,323

Capacity of 1,024 lines of Distribution Board (DB) of TTNT covers the project area at present. Moreover, TOT plans to construct new DB (1,024 lines) which will cover the project area. Therefore, telephone service to the project site will be sufficient.

6) Fishing port facilities

There exist a few permanent facilities in Phuket Fishing Port as the FMO wharf and related facilities, which are shown in Figure 5.4.6.

i) Landing facility

The181 m long wharf is of concrete sheet piles. It is highly occupied with fishing boats since functions for landing and mooring are not separated. The fishing port reserves insufficient water area due to concentration of their functions in the canal. The waters of 200 m wide is reduced by many fishing boats side by side mooring alongside both shorelines of the canal. To improve such congestion, FMO has been constructing a temporary wooden jetty 100 m-long and is extending additional 100 m jetty.

On the opposite side, private firms reserve own wooden jetties or concrete seawalls for landing or mooring in the 600 m range along the canal.

ii) Approach channel and basin

Figure 5.4.7 illustrates the existing approach channel to Phuket Fishing Port and dimensions of the channels tabulated below:

Width	Depth	Length	Design ship
60m	3 m	4 km	300GT

The channel and basin are maintained by annual dredging, record of which is shown as follows:

Dredging Records at Phuket Fishing Port

Unit: m^3

1991	1992	1993	1994	1995
150,829	136,930	189,980	105,980	133,980

The table mentions that annual dredging volume ranges between 100,000 and 200,000 cubic metres at Phuket Fishing Port.

Dredging for maintaining channels in the existing ports is operated by the Harbour Department, Ministry of Transport and Communication. For dredging operation in the ports in Thailand, all ports are categorized into 3 "Dredging Centre" and dredging equipment are located at each centre for maintenance dredging. Dredging Centre I located at Trang manages dredging operation in the fishing ports on the coast of Andaman Sea.

7) Fish Marketing Facilities

i) FMO Market

The fish marketing facilities in Phuket fishing port were constructed in 1977. The fish market hall is 10 meters wide and 180 meters long. This capacity is inadequate to handle the present fish landing volume. Sea water is utilized for washing the floor. There are existing pipe lines supplying potable water. However, water for fishing boats is supplied by lorry due to an insufficient water supply.

The capacity of electric substation is 1,000 KVA which sufficiently meet the demand (refer to Table 5.4.1).

Although diesel oil tanks owned by Tajeam Service Co Ltd., are available , they are infrequently used since the oil price is higher on land and cheaper when purchased from tankers out at sea.

Ice supply facilities include nine ice crushers. Block ice is supplied to fishing boats after it is crushed.

FMO planed the construction of waste water treatment pond capable of handling 1,000 tons/day of waste water from the market hall, however, realization of this plan is difficult.

ii) Ice Plant

There are five (5) large-scale block ice plants for the fishery sector and fifteen (15) small-scale cube ice plants for general food. Out of five existing ice plants, one is owned by Cold Storage Organization (CSO) under the DOF jurisdiction.

Total production capacity of these ice plant is 777 tons/day, but the actual production capacity is 555 tons/day. The ice supply for the fishery sector is roughly in balance with demand. The present status of existing ice plant is shown in Table 5.4.2.

iii) Cold Storage

There is only one (1) cold storage facility which is owned by CSO at the FMO site in Phuket. This cold storage facility has a capacity of 500 tons and it is composed of two (2) rooms, one with a 200 tons capacity and other with 100 tons capacity. The room temperature is -28℃ and -18℃, respectively. At Taiwanese fish agent leases this cold storage.

8) Fish Processing Factories

There are twelve (12) fish processing factories, three (3) fish meal, one (1) fish ball, one (1) smoked fish, two (2) salted fish and five (5) dried fish factories.

There processing factories, excluding the fish meal factories, are small-scale traditional factories. There are no modern canning and freezing factories. The total production volume of fish meal factories in 1993 was 9,313 tons of products. The present status of the factories are shown in Table 5.4.2.

(3) Related plan around the Project Site

Phuket attracts world-wide tourists for beautiful scenery of the island and islands in Phang-nga Bay. A passenger terminal for tourist boats for Ko Phiphi is available in the canal of the Phuket Fishing Port. The congested fishing port, contaminated water and odor from the fish meal factories deteriorate tourists' expectation at the terminal as an entrance to tourist resort. To modernize and improve the passenger terminal, the Phuket Provincial Government has established a plan to provide a tourist pier on the west bank of the canal. The general plan of the terminal is shown in Figure 5.4.8. Construction of the facilities has been started with a budget of 62,900,000 Baht and is scheduled to be completed in February 1997.

5.4.4. Master Plan for Fishery Complex Development

(1) Preparation of Alternative Plans

1) Basic conditions for preparing alternatives

Preparation of a master plan requires consideration for utilization of room available for the project. The project site designated as Industrial Zone is neighboured by Residential Zone and Forest Conservation Zone. The master plan should be prepared, considering the surrounding conditions with development room available for the Fishery Complex, sizes of the facilities for the complex, and functional relation with the existing facilities and city activities. Examining the above situation, the room for development in the project site is limited and there remains little flexibility in planning alternatives for the master plan.

In preparing a master plan with the above in mind, the following conditions are established.

i) Extent of possible development and size of facilities

It is premised that all the facilities should be located in the designated area as the industrial zone. In the east district separated by the canal, there exist FMO facilities and mangrove forest owned by FMO which reserves a licence to fell it. The facilities of the Fishery complex will be planned to be located in the area. Functional arrangement of the facilities in a master plan will be required with considering efficient utilization of the existing facilities of the FMO wharf, the market hall and CSO cold storage. A new wharf for long liners will be located adjacent to the existing FMO wharf, following the above premise.

In the west district, private primitive jetties are available along the canal, behind which fish processing plants, stores and offices are located. The land is not efficiently utilized with allowing free construction of buildings due to lacking any city planning to control building. The three old fish meal plants are maintained with innovation of buildings and equipment. These facilities disperse odor and waste water since they keep no deodorizing equipment and water treatment facilities. They leave dispersion of odor from raw material stocked in the field. The situation indicates the plants are source of odor and water contamination. In order to improve the environmental situation, re development of the district is being examined. The redevelopment will be considered in formulating a master plan to aim at efficient use of land and improvement of environment. The above concept is illustrated in Figure 5.4.9.

ii) Utilization of existing facilities

Regarding the landing facilities, the conditions in the fishing port is summarized as follows:

* FMO wharf of concrete structure for landing on the east bank

* Private primitive jetties of wood and of partial concrete on the west bank

The existing concrete wharf and other solid facilities will be efficiently utilized for minimizing investment to the project. A master plan to use and expand the existing facilities will be prepared as much as possible, since the facilities for cold storage and ice making on the west bank perform functional role for keeping freshness of fish.

Under the situation of the site, fishing port facilities for the project are proposed with improvement and expansion of the existing FMO facilities and the function of fishing port management will be basically centred on the east district occupied by FMO but some function will be shared to the west bank.

iii) Environment and governmental regulations

Environment Impact Assessment (EIA) has been conducted for feasibility study on the project to preserve the environment of the site.

DOF will have to confirm utilization of the waterfront around the project site through detailed discussion with Harbour Department. Acquisition of private land for the project will be a matter for DOF in implementing the project.

Some modification of a proposed plan might be required to meet alternation of given conditions, since the several issues to be settled will be remaining in a plan.

2) Alternative master plans

Alternative master plans for the Fishery Complex are illustrated in Figures 5.4.10, 5.4.11 and 5.4.12. They are prepared, mainly considering location of a deep-sea wharf and concepts for the plans are described as below:

i) **Plan A**

A deep-sea wharf is located at the tip of Laem Tukkae and connected with an access road to the heart of the Complex. Two options are prepared for alignment of the access road on both east and west sides of the Cape. Noise from the traffic, which is not expected to increase so much with implementation of the project, will be a slight impact to the residents of the Sea Gypsy village facing a beach at the east of the Cape. High costs for a western route will be required for constructing a piled trestle to prevent shoreline change. Even if any route is applied, acquisition of private land will be indispensable.

The plan shows improvement of the existing FMO facilities with leaving landing places on the west bank as same as at present. A wharf for landing fresh tunas from long liners will be specialized in the plan because of using boats larger than Thai boats and of handling tunas in a different way from trawlers and purse seiners. The new wharf will be located with extending the existing FMO wharf for functional centralization of the fishing port. Lay-by wharves will be provided on the east bank and separated from landing wharves.

ii) **Plan B**

The plan aims at providing a deep-sea wharf at the tip of the west bank (reclaimed) and location of the facility will be environmentally acceptable. The wharf will be located southward to keep area for a turning basin and a trestle to minimize an impact to sea and seashore will be provided for connecting it to the west bank Considering traffic flow for a passenger terminal and processing plants, an access road will be arranged to the west end of the land.

The plan will be more effective when processing plants be operated but the plan posses a disadvantage that functions of the fishing port will be separated on the both banks

iii) **Plan C**

The plan is generally same as Plan A, but except that all landing wharves will be located on the east bank without locating a wharf on the west bank. The plan will present a advantage for fishing port management to control fish landing and flow of landed fish.

Efficient investment at each construction phase is considered in the plan as to provide appropriate size of facilities at each phase.

(2) Evaluation of alternatives

1) Evaluation criteria

Proposed alternatives are evaluated on the following criteria.

i) **Convenience**

* Land use : convenience for traffic flow of landed fish from viewpoints of layout of facilities and road system

* Management & operation: capability to cope with stock management

ii) Economy

* Total construction cost : minimization of total cost with considering topographic conditions and balance between filling and dredging.

* Initial investment : maximization of effect with minimum investment for prompt commencement of service

iii) Flexibility of a plan

* Adaptability to changing conditions : flexible change of the plan for following change of surrounding circumstances

iv) Workability

Method and phased schedule : ease of construction and phasing of works

2) Evaluation

For identifying an appropriate layout plan, evaluation on the three plan are conducted in terms of the criteria mentioned above by giving marks of three grades of 1,2 and 3 which present "more desirable", "desirable" and "less desirable", respectively. The results are tabulated as follows:

Criteria		Evaluation		
		Plan A	Plan B	Plan C
Convenience	Land use	1	2	1
	Management	2	3	1
Economy	Total costs	2	3	1
	Initial investment	1	2	1
Flexibility	Adaptability	1	1	1
Workability	Method and phasing	1	1	1
Total		8	12	6

There remains only a little room to consider options for a master plan because of being limited area. The project will be implemented with the objectives of stock management for offshore fishing and of promoting expanding fishing grounds by effectively utilizing existing fishing boats on the coast of Andaman Sea. With the above objectives in mind, three alternate layout plans are prepared in the limited area and Plan C is recommended to be a more desirable layout from viewpoints of convenience and economy criteria through the above evaluation. The detailed layout plan is illustrated in Figures 5.4.13, 5.4.14 and 5.4.15.

5.4.5. Preliminary Design of Fishing Port Facilities

This sub-section presents the preliminary design of each facility of the fishing port planned in the master plan. The structural design is tentative because of no soil data available at this stage. The design will be modified in the draft final report after conducting site investigation.

(1) Mooring wharf

1) Design conditions

i) Design vessel

* Thai trawler & purse seiner: 60 GT
* Long liner: 170 GT
* Large purse seiner: 499 GT
  Reefer carrier : 5,000 GT

ii) Design depth

a. Landing wharf

* Thai trawler & purse seiner : 3 m
* Long liner : 3.5 m
* Large purse seiner
  Reefer carrier : 7.5 m

b. Lay-by wharf

* Long liner, purse seiner and trawler : 2.5 m

No berth is planned for larger ships

iii) Surcharge

* Landing wharf : uniformity load w = 1.0 ton / m^2
* Lay-by wharf : uniformity lord w = 0.5 ton / m^2
* Large purse seiner & carrirer vesel : uniformity lord w = 1.0 ton / m^2
  live loads wheel loads (T - 20)

iv) Seismic force

* Horizontal seismic force coefficient : Kh = 0.05

v) Tide

Highest High Water (HHW)	1.72 m
Mean High Water Spring (MHWS)	0.91 m
Mean High Water Neap (MHWN)	0.14 m
Mean Sea Level (MSL)	0.00 m
Mean Low Water Neap (MLWN)	-0.70 m
Mean Low Water Spring (MLWS)	-1.53 m
Lowest Low Water (LLW)	-2.29 m

vi) **Approach velocity of a vessel**

* Thai trawler & purse seiner : 0.35 m/sec
* Long liner : 0.3 m/sec
* Carrier vessel : 0.2 m/sec

vii) **Soil characteristics**

Wharf for smaller boats :

Silt, N value 0 - 1 (up to 6m deep from sea bottom)

Deep-sea wharf :

Silt, N value 1 - 2 (up to 9 m deep from sea bottom)

Silty sand, N value more than 20 (deeper than 9 m)

2) **Design of landing wharves for smaller boats**

The existing wharf structure is of concrete sheet piles measuring 12 m in length. Soil conditions in the canal is assumed as soft from mangrove forest on the accumulated land. Under the soil conditions, gravity type structure for a wharf is not applicable because of requiring improvement of soil for its stability. The situation results in selecting only types of steel sheet pile structure and steel pipe structure. The types are compared for identifying appropriate one as shown in Figure5.4.16. Major differences are not found in acquisition of material and construction methods while steel sheet pile type is a little advantageous in an aspect of construction cost. The steel sheet pile type will be applied for landing wharves as illustrated in Figure 5.4.17.

3) **Design of deep-sea wharf**

Minimization of impacts to sea and seashore environment from currents and littoral drift is expected when larger structure like the deep-sea wharf is constructed in the waters in the project site. Impermeable structure as steel sheet pile type, concrete caisson and blocks are not applicable because of the reason. The structure of the deep-sea wharf will be an open-type wharf with steel pipe piles.

An access road will be of a trestle type founded with pipes of the same material so as not to change topography of the shore with provision of the structure. The structure is illustrated in Figure 5.4.18.

(2) **Design of channel and basin**

There will be no difference of a scale of the approach channel between the master plan stage and short-term plan stage because of same design ships. Layout and cross sectional design will be determined with applying numerical simulation on sedimentation in the channel. The detail will be discussed in the sub-section "6.3.1 Design of Channel and Basin".

(3) Preliminary Design of Functional Facilities

1) Policies

The functional facilities in the project were designed according to the factors delineated below.

i) Architectural planning has taken the natural conditions surrounding the proposed site into consideration, i.e. its ocean site, high humidity, and characteristic rainfall of the area. The type, structure, specifications, and layout of each functional facility will reflect these considerations.

ii) Construction methods and materials predominantly used in the project area will be utilized as much as possible, in order to keep construction costs down and to insure easy maintenance of completed facilities.

iii) The area for functional facilities will be divided into zones according to function, in order to ensure easier and more efficient use of the facilities.

iv) The objective of the layout plan is to effectively use the limited area of the port, while maintaining a balance between its surrounding environment.

2) Layout Planning

The layout plan of the functional facilities in 2012 target year are given in Fig.5.4.13.

i) Legal restrictions pertaining to the existing road and others

The Building Control Act B.E. 2522 restricts the building height in Thailand to one half the distance from the building on the opposite side of the adjacent road boundary. It also restricts the distance between the adjacent pedestrian sidewalk and the building front. There must be a distance of six meters between the pedestrian sidewalk boundary (or sidewalk center line) and the face of the building (if the sidewalk width exceeds six meters, the distance from the sidewalk center line to the building face will be used and if the sidewalk width is less than six meters, the distance from the sidewalk boundary to the building face will be used). The layout plan must incorporate these regulations.

However, according to the Regulation about Zone Area, Control and Protect Environment in Phuket: 1992, 1995, the height of a building is restricted to 12 meters only in the famous resort area of Phuket. Some functional facilities planned in the project, such as the elevated water tank, will exceed 12 meters. As a result, further study and research in Thailand is required in order to resolve this problem.

ii) Zoning Condition

Conditions which are pertinent to the zoning of functional facilities are explained below.

- All existing facilities in the project site on Phuket Island, including the fish meal plants, will continue in their present form until 2005 target year. But they will be renovated and integrated by 2012 target year.

- The existing fish agent office, ice plant, ice storage, shipyard, and dry fish processing plant in the projected site on Si Rae Island will be integrated in the layout plan. The existing FMO office will be demolished and a new office will be constructed.

iii) Plan

A general outline of the zoning plan is shown in Fig.5.4.19. The zoning of functional facilities and processing plant facilities were carried out according the following policies.

- The project site on Si Rae Island has been largely divided into two areas by the internal road (R) that links the jetty for large purse seiners and carrier vessels at the cape and the adjacent paved main road. The west side of (R) includes the fish landing, distribution, as well as other fishing related facilities (Zone A, Zone C), and a part of the industrial park (Zone B-2). The east side of (R) contains the entire industrial park (Zone B-1). In particular, an adequate back lot for the fish landing jetty and mooring wharf was secured when drawing up Zone A.

- The entire project site on Phuket Island was allocated as an industrial park (Zone B-3).

- The entrance gate to the project site on Si Rae Island has been set up at the north end of the internal road (R) and entrance to the project site from the neighboring main road is permitted only through this gate. The existing access road from the neighboring main road will remain, but the north end of this road has been cut before the neighboring main road.

- In the Zone A in Si Rae Island an open space approximately 50m x 370m and 50m x 275m have been secured in the back lot of the fish landing and mooring wharf respectively. It contains a trucking berth, a parking lot and internal roads. The fishing related facilities have been located in the zone created by above mentioned open spaces and the internal road (R).

- A service road has been planned around the industrial park (Zone B-2) in Si Rae Island and a green belt has been left along the adjacent boundary of this industrial park.

- The waste water treatment facilities have been located at a sufficient distance from the neighboring residential area to reduce the effects of unpleasant odors, etc.

3) **Infrastructure**

Incoming and main line of utility service in the project site will be prepared gradually depend on the target years.

i) City Water (and Sea Water)

- 2002 target year: City water will be supplied only to the city water reservoir for the FMO's facilities on Si Rae Island from an existing 8 inch main pipe running parallel to the neighboring paved main road, and it will be supplied to all of the FMO's facilities from this reservoir. On the other hand, sea water will supplied to the FMO fish landing wharf and mooring wharf by sea water supply system including the sea water reservoir tank and the chlorine disinfection system.

- 2005 target year: City water will be supplied to the city water reservoir for the processing plant facilities on Si Rae Island from an existing 8 inch main pipe running parallel to the neighboring paved main road, and it will be supplied to the processing plant facilities from this reservoir.

- 2012 target year: City water will be supplied to the city water reservoir on Phuket Island site from an existing 8 inch main pipe running parallel to the neighboring paved main road, and it will be supplied to all of the facilities on Phuket Island site from this reservoir.

ii) Electricity

- 2002 target year: High voltage electricity (33,000V/50Hz) from a main line running parallel to the neighboring main road will be used. High voltage electricity will be supplied only to the electrical sub-station for the FMO's facilities through the electrical incoming station on Si Rae Island site. Then this sub-station will supply low voltage electricity (220V/440V/50Hz) to all of the FMO's facilities on Si Rae Island site.

- 2005 target year: High voltage electricity will be supplied to the electrical sub-stations prepared for the each industrial estates and the deep sea wharf. Then these sub-station will supply low voltage electricity (220V/440V/50Hz) to the processing plant facilities and deep sea wharf facilities.

- 2012 target year: High voltage electricity will be supplied to the electrical sub-station prepared for Phuket Island site through the electrical incoming station on Phuket Island site. Then these sub-stations will supply low voltage electricity (220V/440V/50Hz) to all the facilities on Phuket Island site.

iii) Telephone

The main telephone line running along the neighboring main road will be connected to each facilities on the project site using the electrical wiring post. It will be prepared depend on the target years.

iv) Water Treatment Facilities

- 2002 target year: One waste water treatment facility will be constructed only for the FMO related facilities on Si Rae Island. Waste water and drainage lines form related facilities will connected to this facility.

- 2005 target year: The water treatment facilities for fish processing factories will be constructed on Si Rae Island. Waste water and drainage lines form processing factories will connected to this facilities.

- 2012 target year: The water treatment facilities will be constructed on Phuket Island site which covered waste water and drainage for facilities of Phuket Island.

The main electricity lines, water and main drainage lines are shown on Figures 5.4.20, 5.4.21 and 5.4.22, respectively. Each figure shows these main utility lines for the target years, 2002, 2005, and 2012.

Total floor areas, types of foundation and structures of main functional facilities and processing plant facilities in master plan are shown in Table 5.4.3.

5.4.6. Implementation Plan

(1) Construction schedule

Table 5.4.4 shows implementation schedule for the master plan with a plan for raising necessary fund. As described in the table, almost of all the fishing port facilities will be provided in the short-term plan stage and additional dredging to prepare lay-by wharf will be conducted in the master plan stage. Provision of a deep-sea wharf will be required in order to supply raw material from carrier vessels to processing plants in the short-term plan stage. It is assumed that six plants as planned number of plants will be relocated into the estate for 3 years. The period seems longer than usual planning but this is proposed as a standard model due to uncertainty of the relocation financed by private sector. Relocation and construction of processing plants on the west bank of the canal will require re-development of the district in the master plan stage in year 2012.

Planning premises and construction methods are described in the sub-section "6.5 Implementation Plan" for the short-term plan.

(2) Construction cost

Preliminary cost is estimated as shown in Tables from 5.4.5 to 5.4.6 and estimate conditions are described in the same section as above.

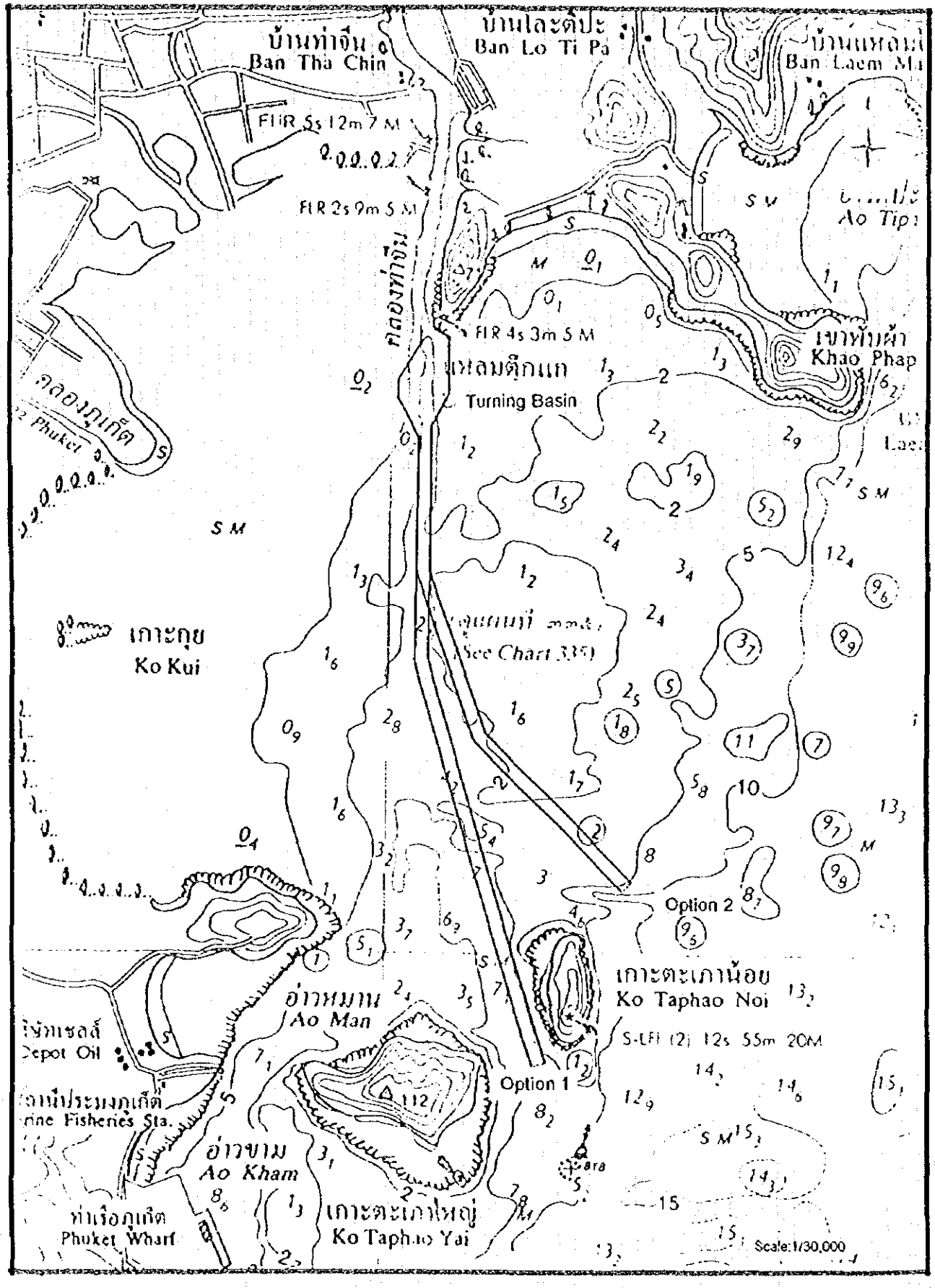


Figure 5.4.1 Layout of Approach Channel

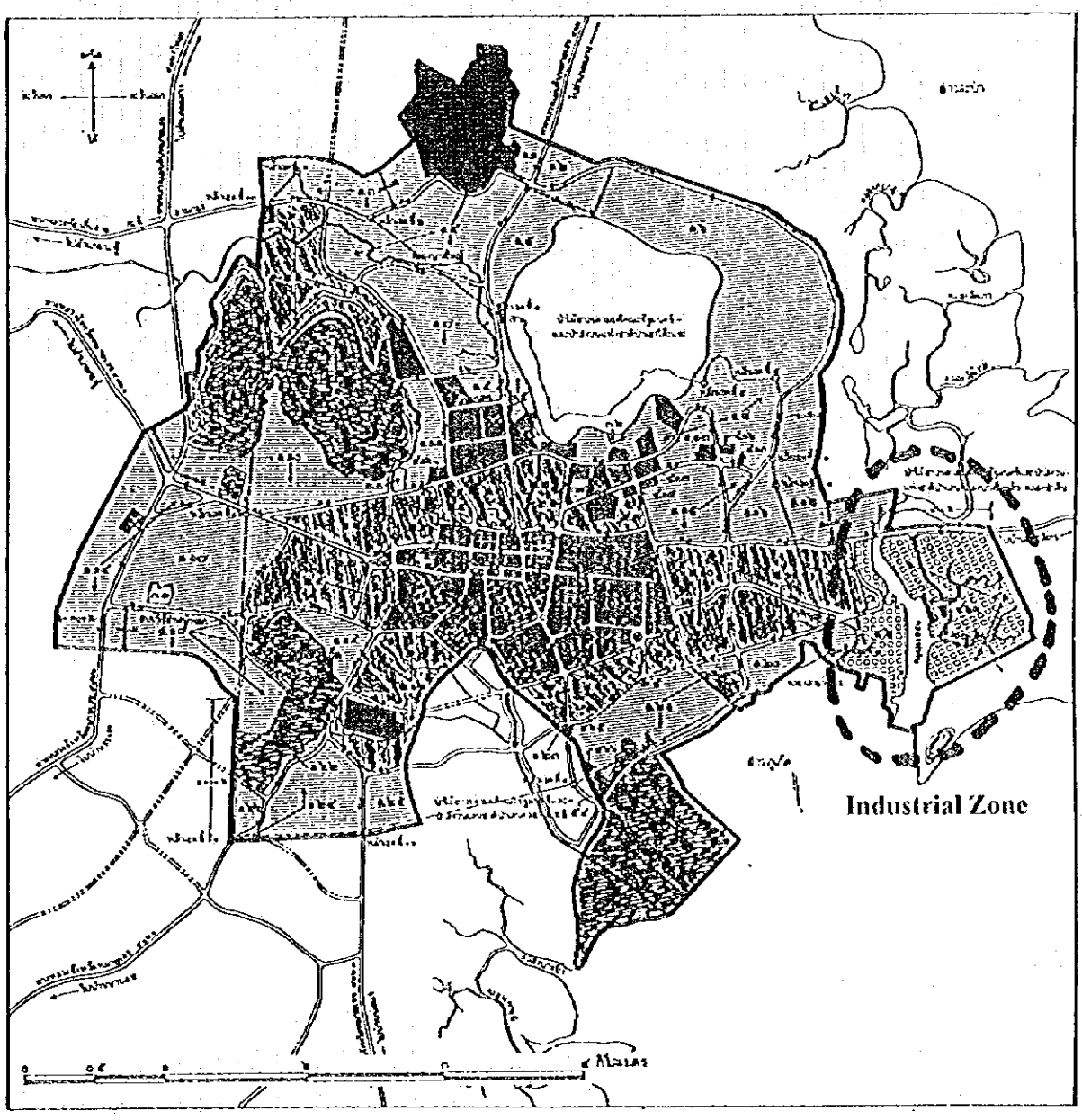


Figure 5.4.2 City Plan of Phuket City

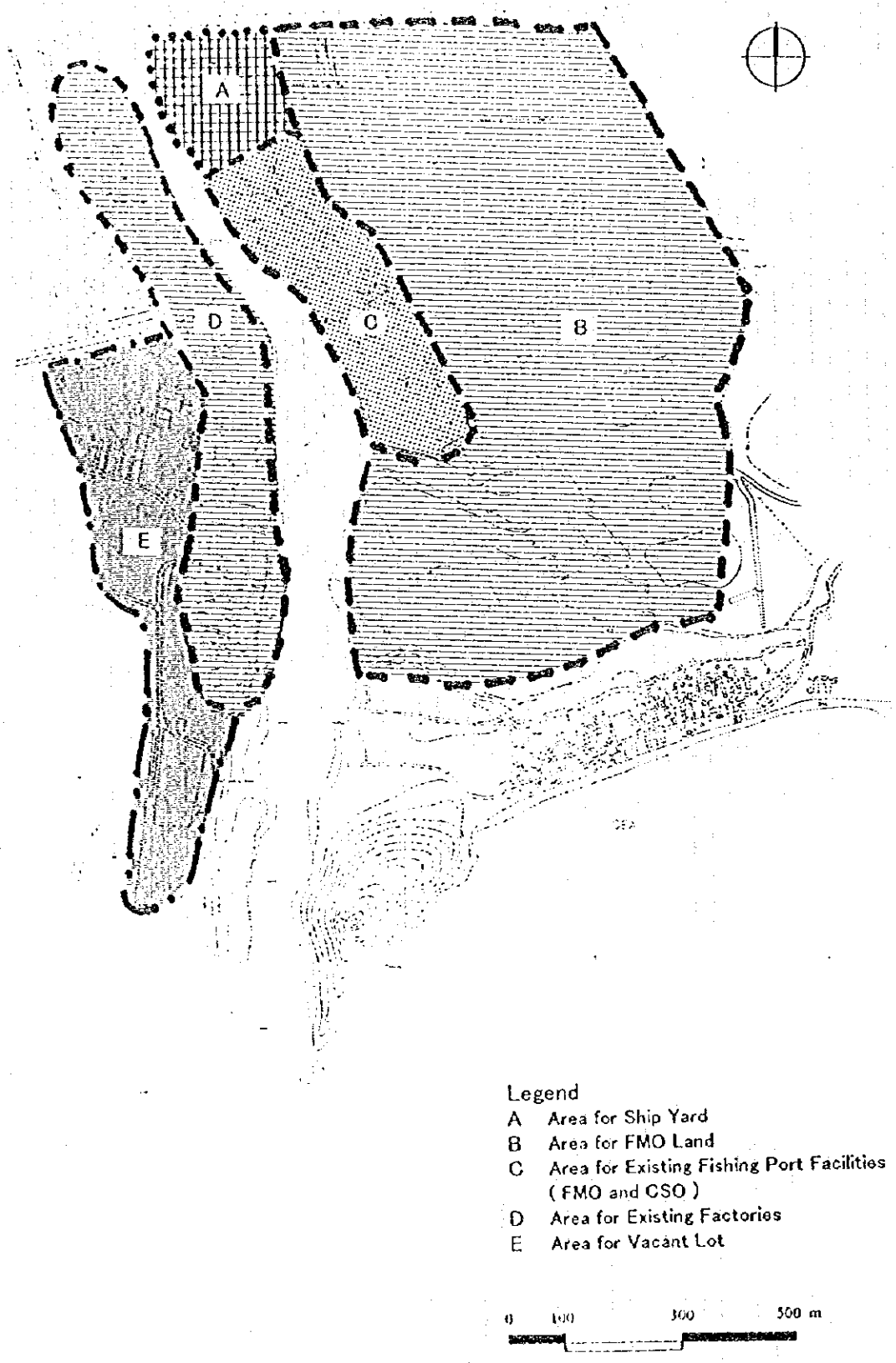


Figure 5.4.3 Land Use of the Project Site

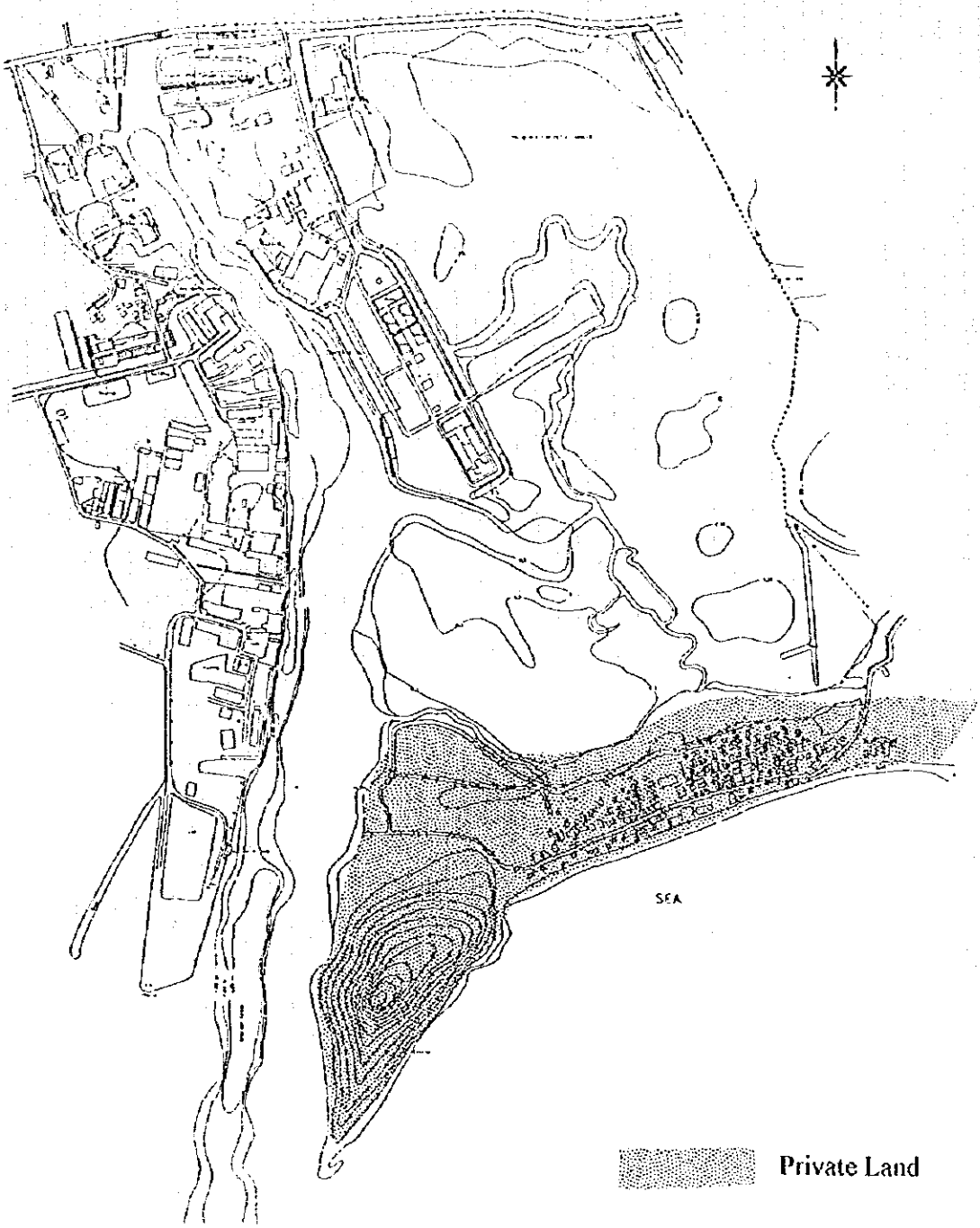


Figure 5.4.4 Private Land Adjacent to the Project Site

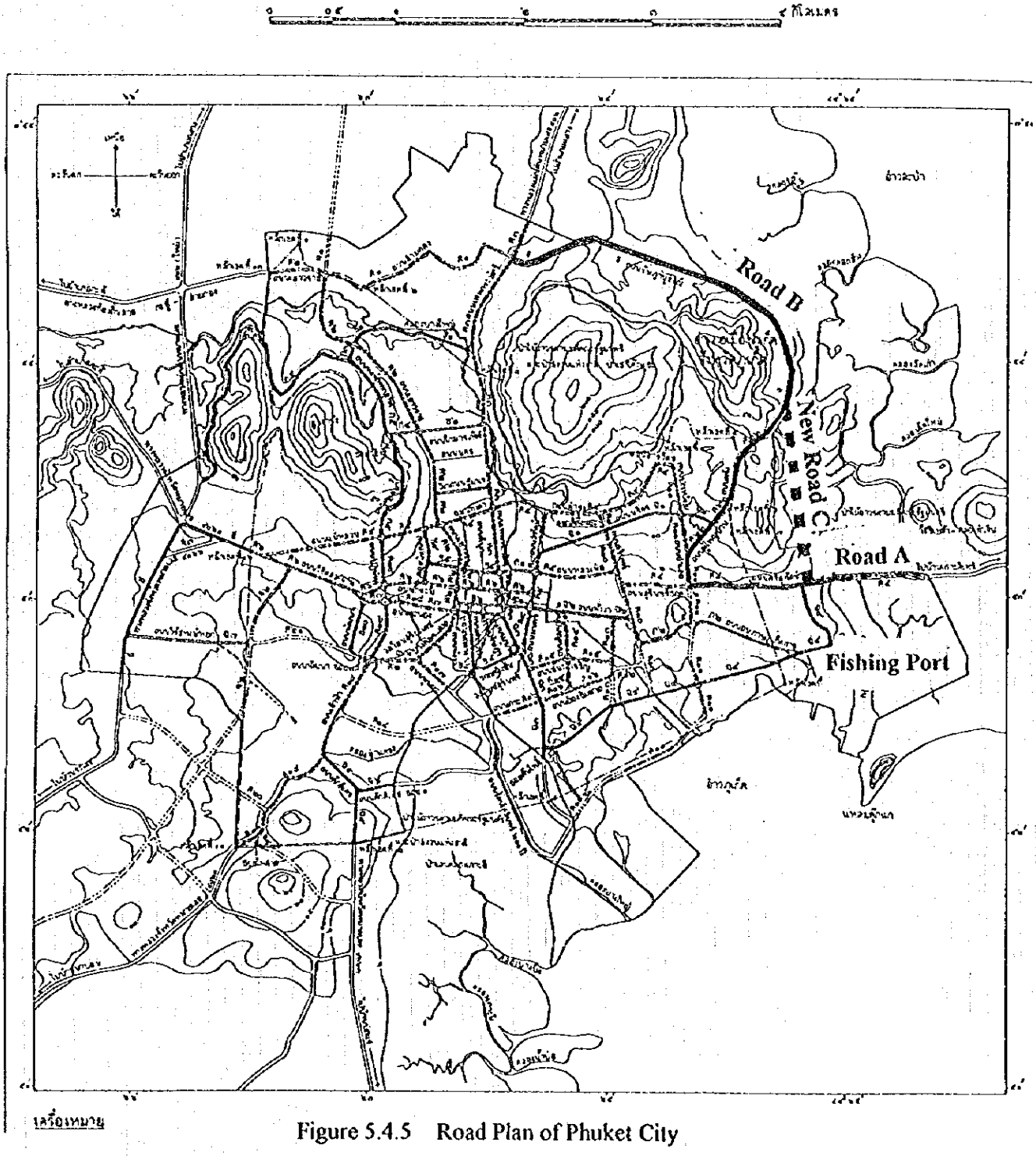
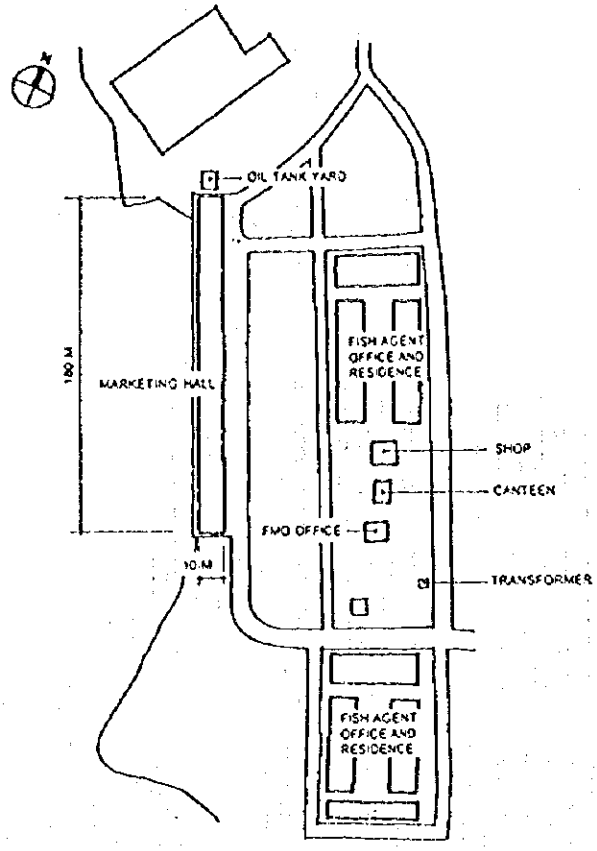
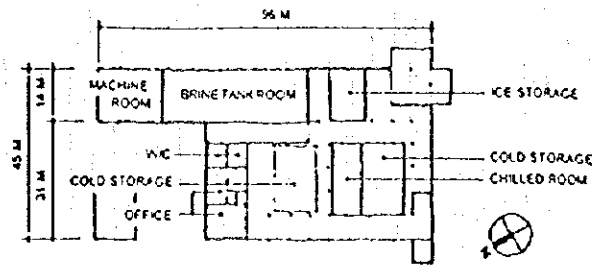


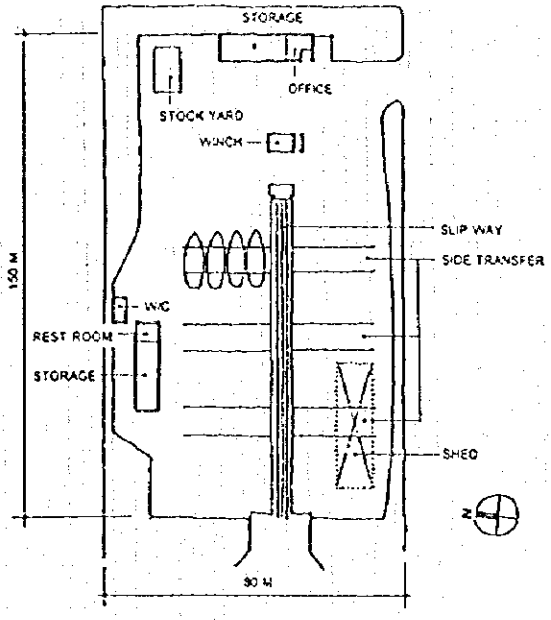
Figure 5.4.5 Road Plan of Phuket City



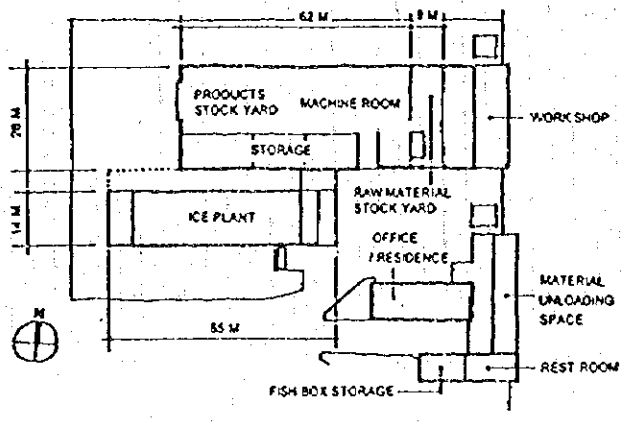
PHUKET FMO FISHING PORT S = 1 / 4000



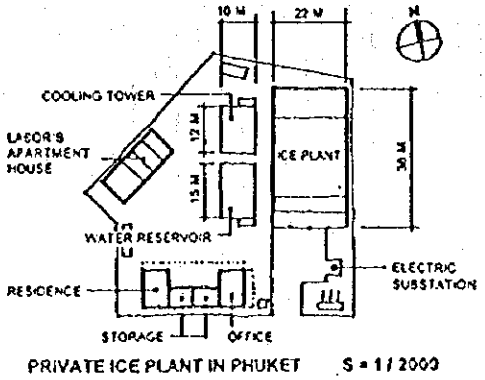
ICE PLANT IN PHUKET FMO FISHING PORT
(COLO STORAGE ORGANIZATION) S = 1 / 2000



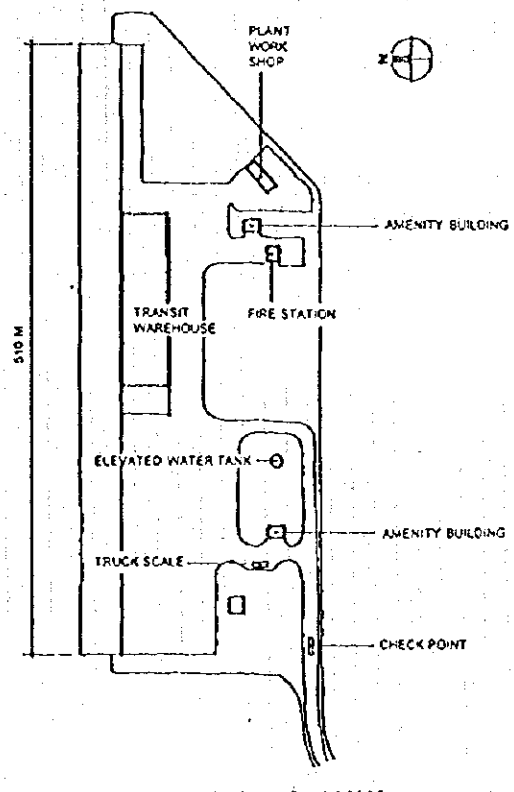
SHIP YARD IN PHUKET FMO FISHING PORT S = 1 / 2000



PRIVATE FISH MEAL PLANT IN PHUKET S = 1 / 2000



PRIVATE ICE PLANT IN PHUKET S = 1 / 2000



PHUKET DEEP SEA PORT S = 1 / 6000

Figure 5.4.6 Permanent Facilities in Phuket Fishing Port

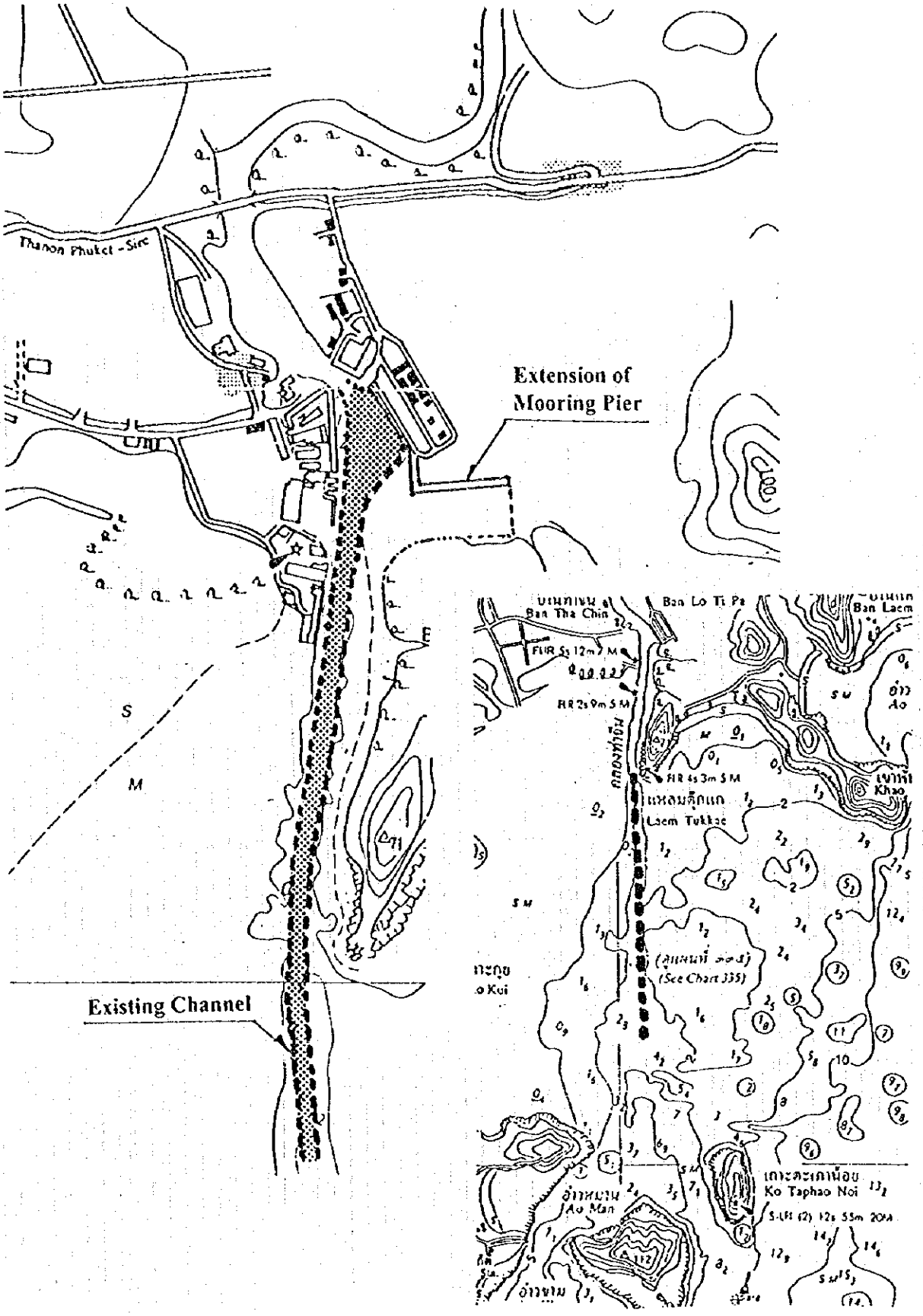


Figure 5.4.7 Location of Existing Approach Channel and Basin

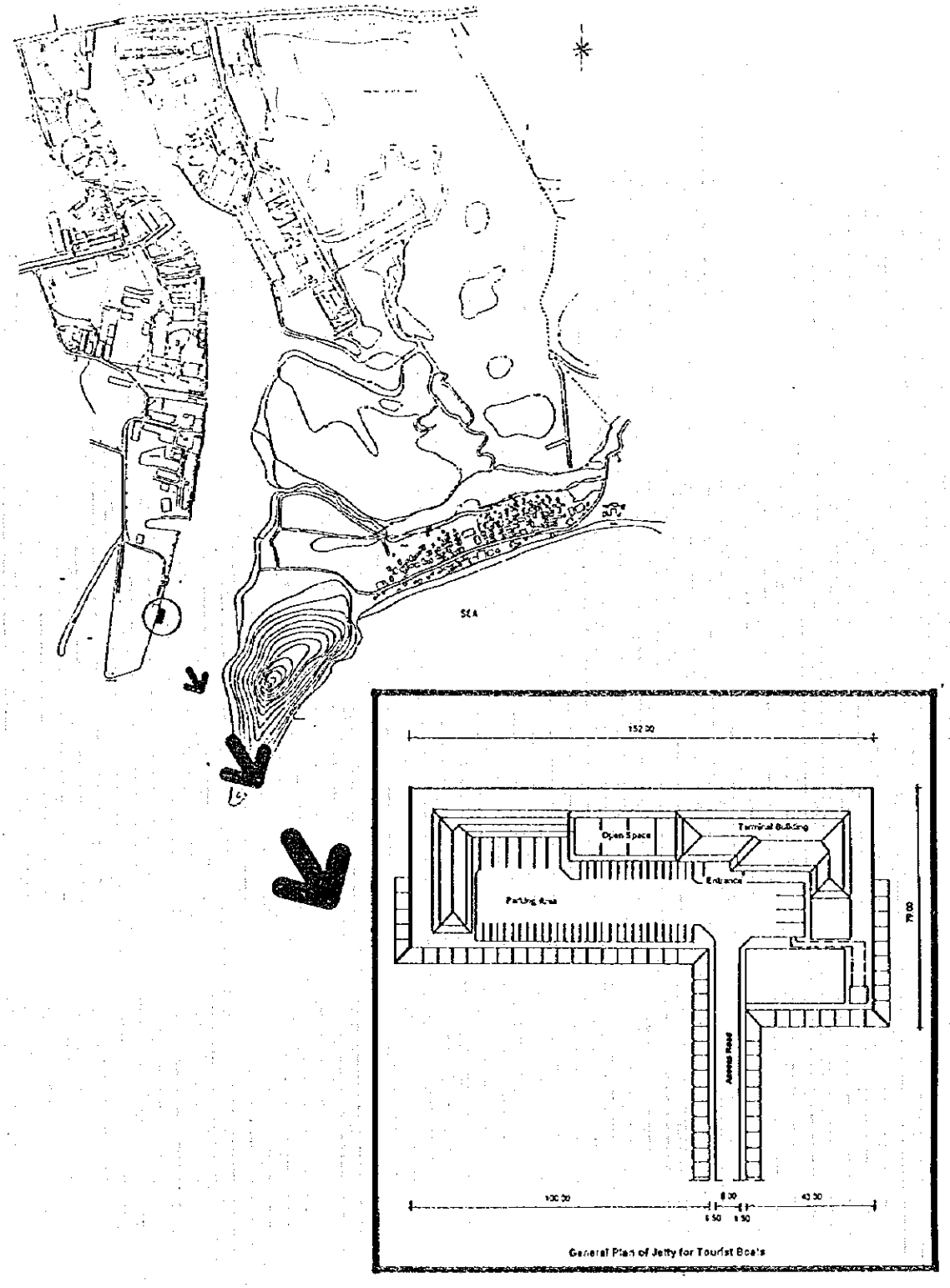


Figure 5.4.8 General Plan of New Passenger Terminal

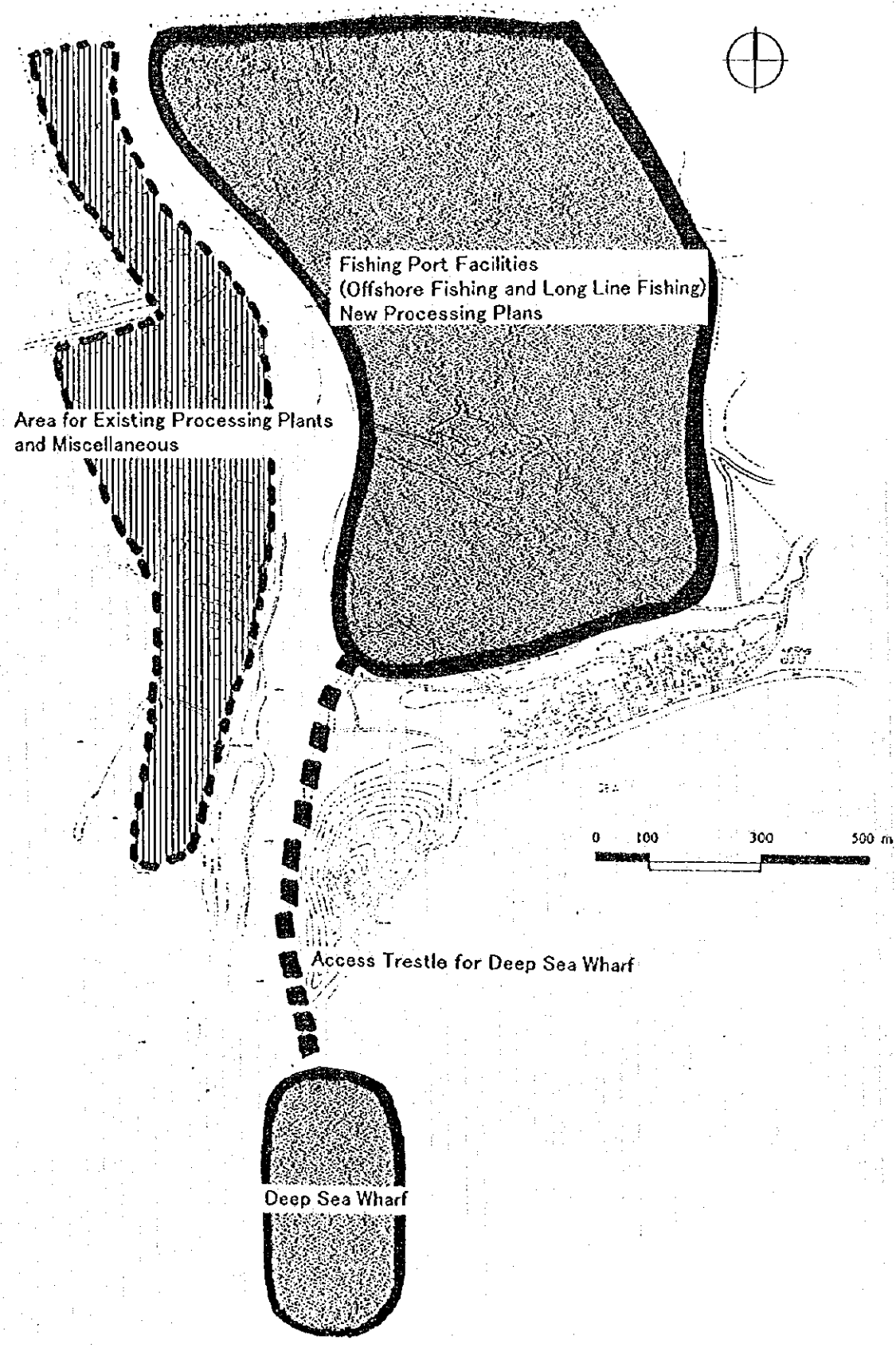
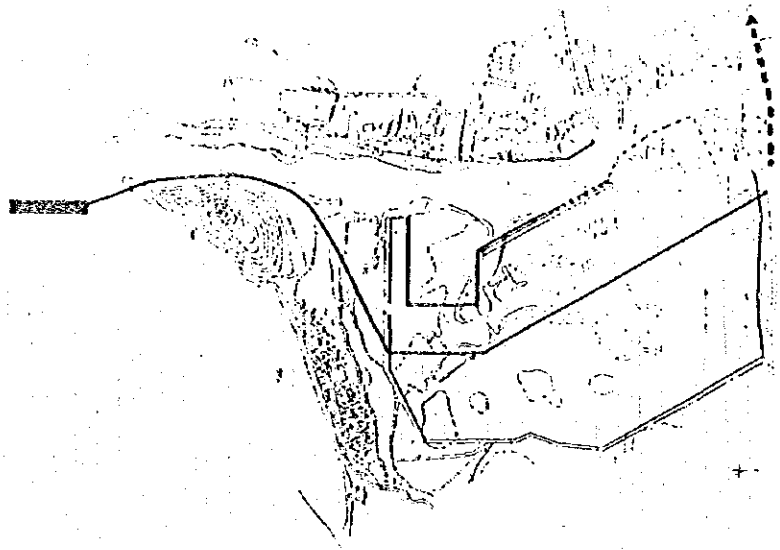
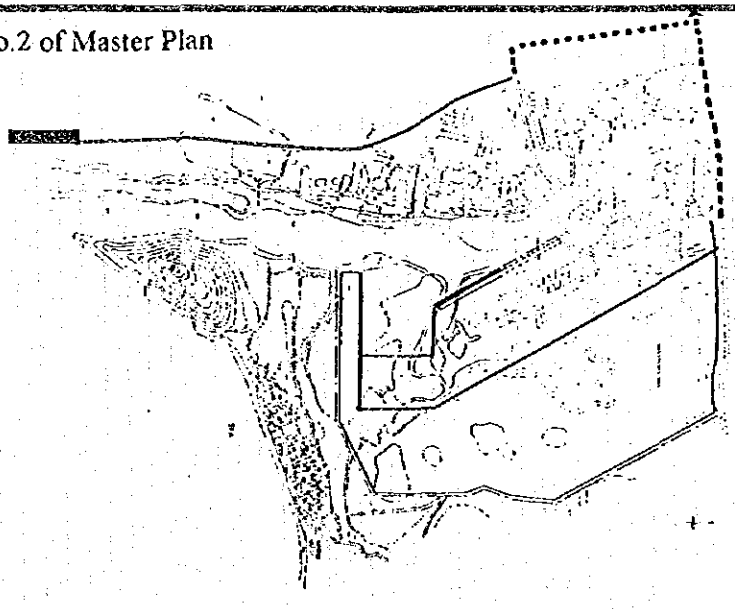


Figure 5.4.9 Conceptual Zoning of Master Plan

Alternative Sketch No.1 of Master Plan



Alternative Sketch No.2 of Master Plan



Alternative Sketch No.3 of Master Plan

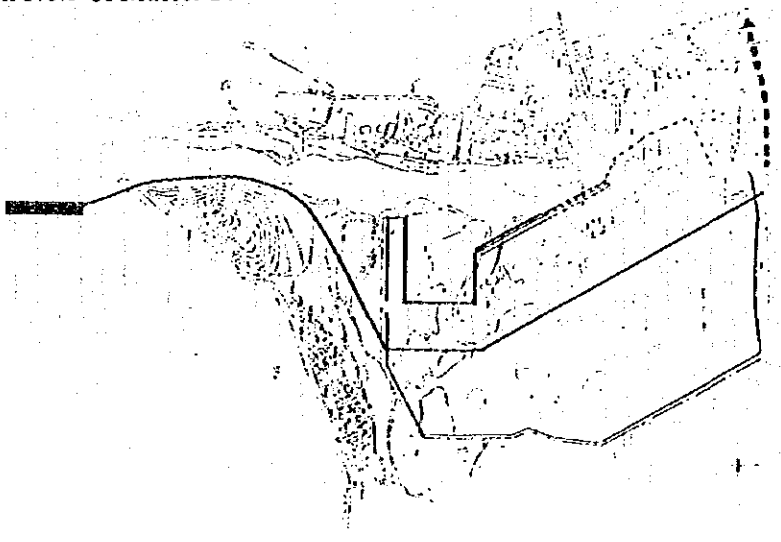


Figure 5.4.10 Alternative Sketch of Master Plan

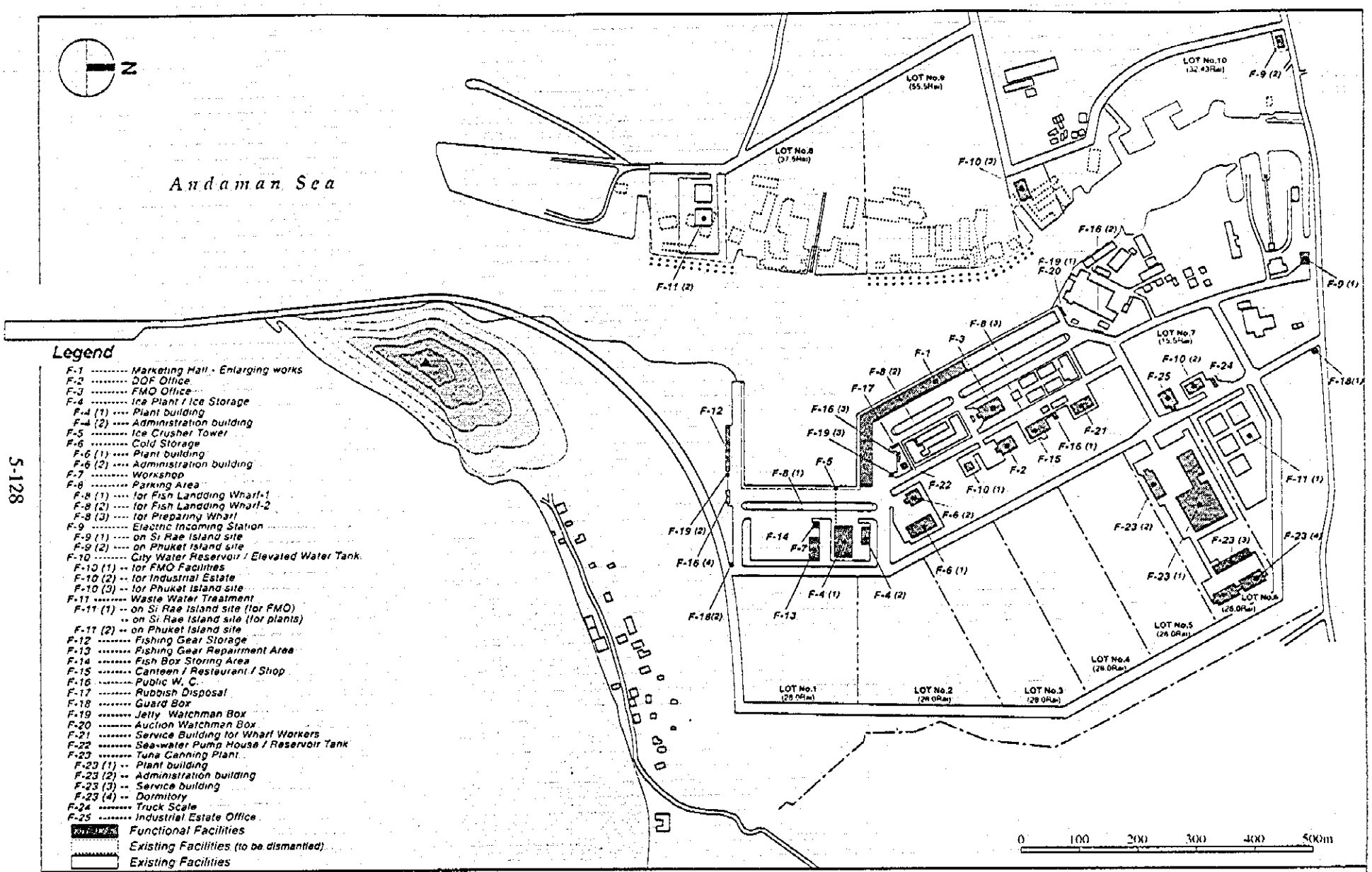


Figure 5.4.11 Detailed Layout Plan of Phuket Port

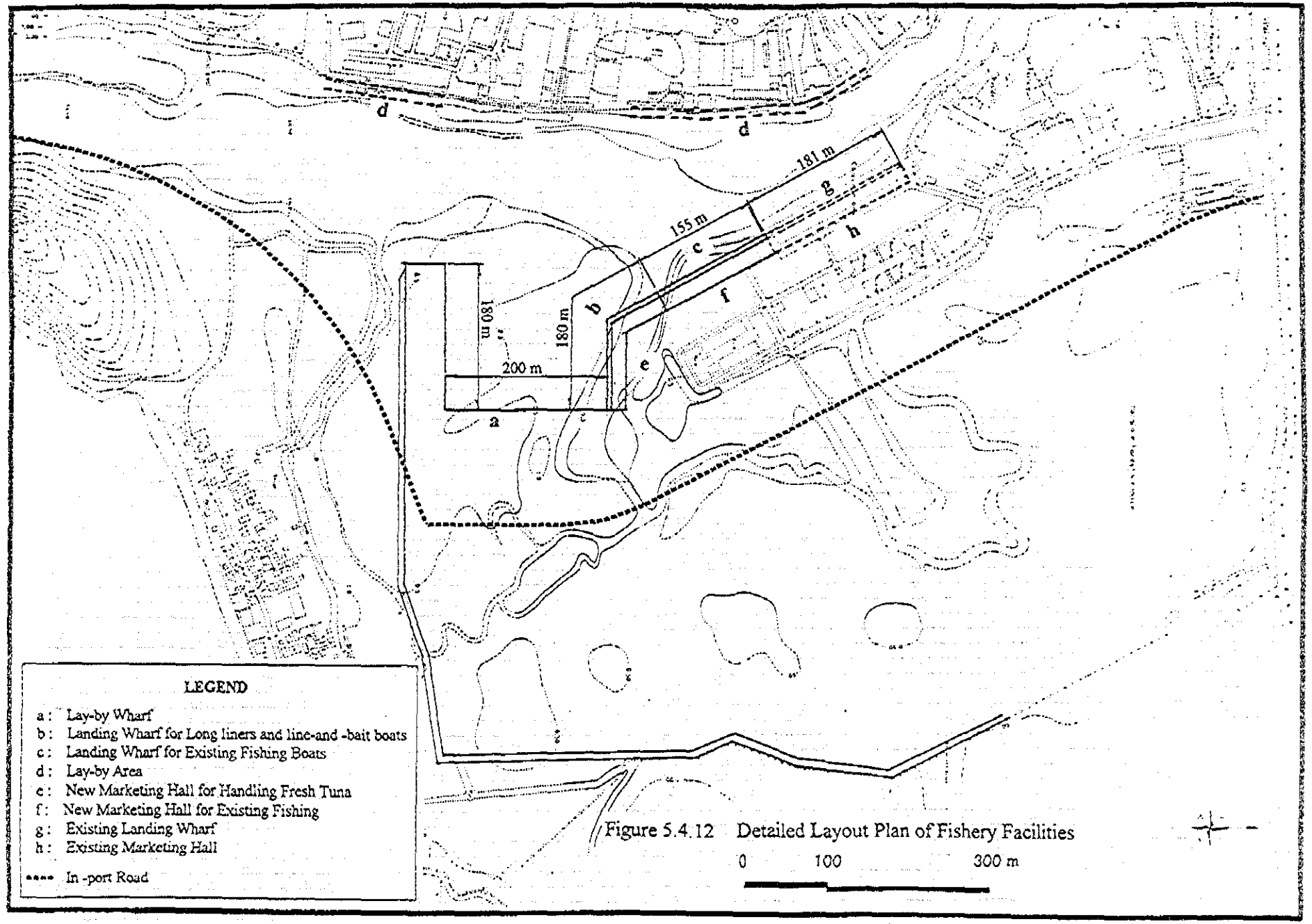


Figure 5.4.12 Detailed Layout Plan of Fishery Facilities

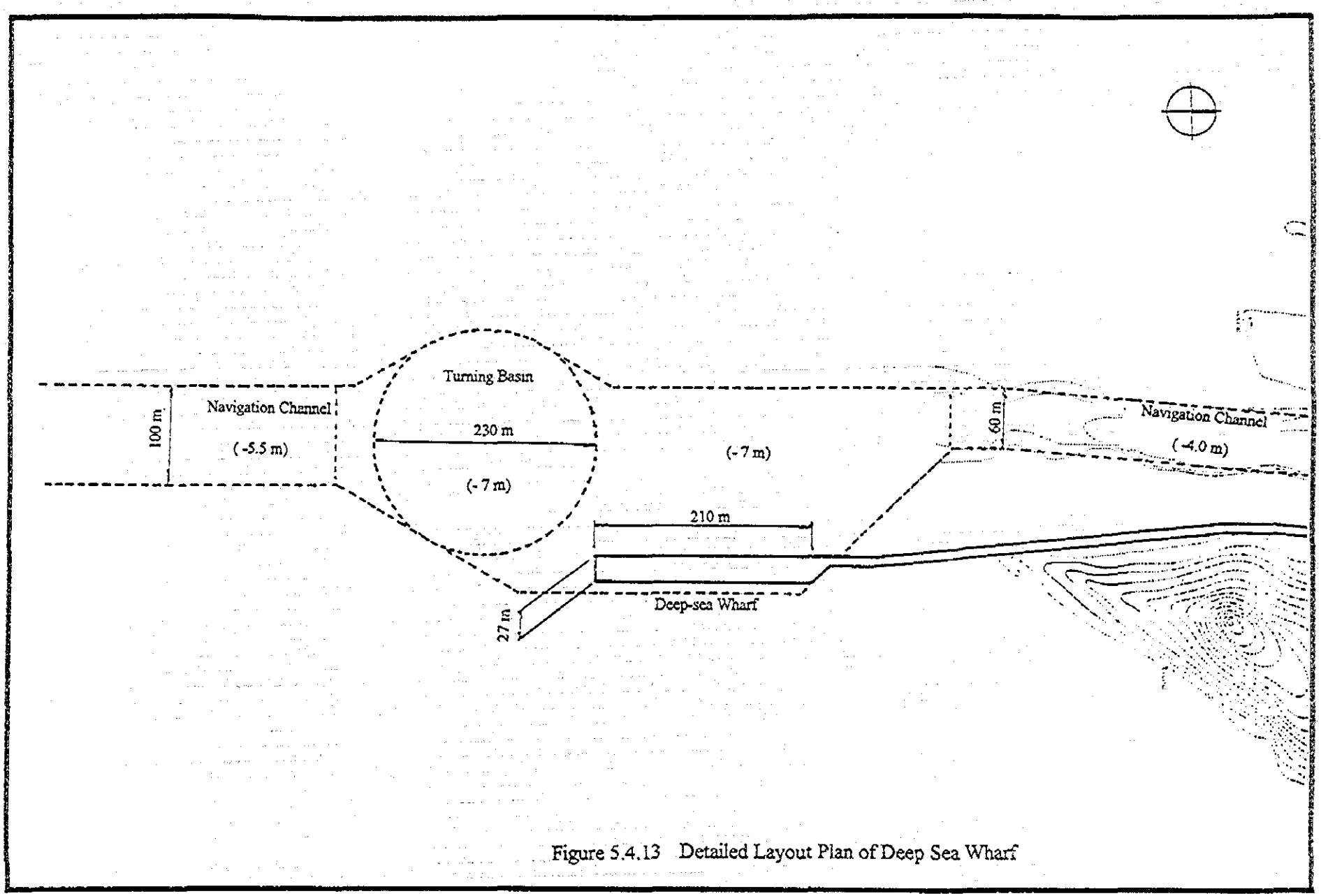
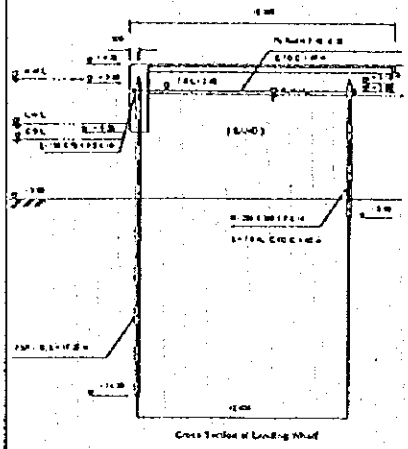
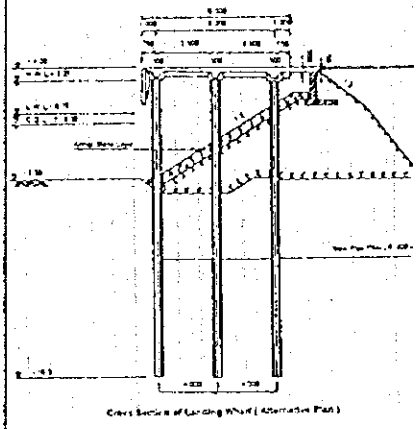


Figure 5.4.13 Detailed Layout Plan of Deep Sea Wharf

Figure 5.4.14 Alternative Structure of Landing Wharf

		Steel Sheet Pile Type	Steel Pile Type
	Cross Section		
Materials	Quantity of Concrete	a little	more than steel sheet pile type
	Steel	import	import
	Gravel	very few	Armor stones are required.
Construct-ion	Method	from land side without special temporary work	same with steel sheet pile type
	Machines	crane and vibration hummer	Bigger machines are required.
	Period	Urgent work is possible.	Urgent work is difficult.
Maintenance		Cathodic protection or allowance against corrosion is required.	same with steel sheet pile type
Ratio of construction cost		1.00	1.15

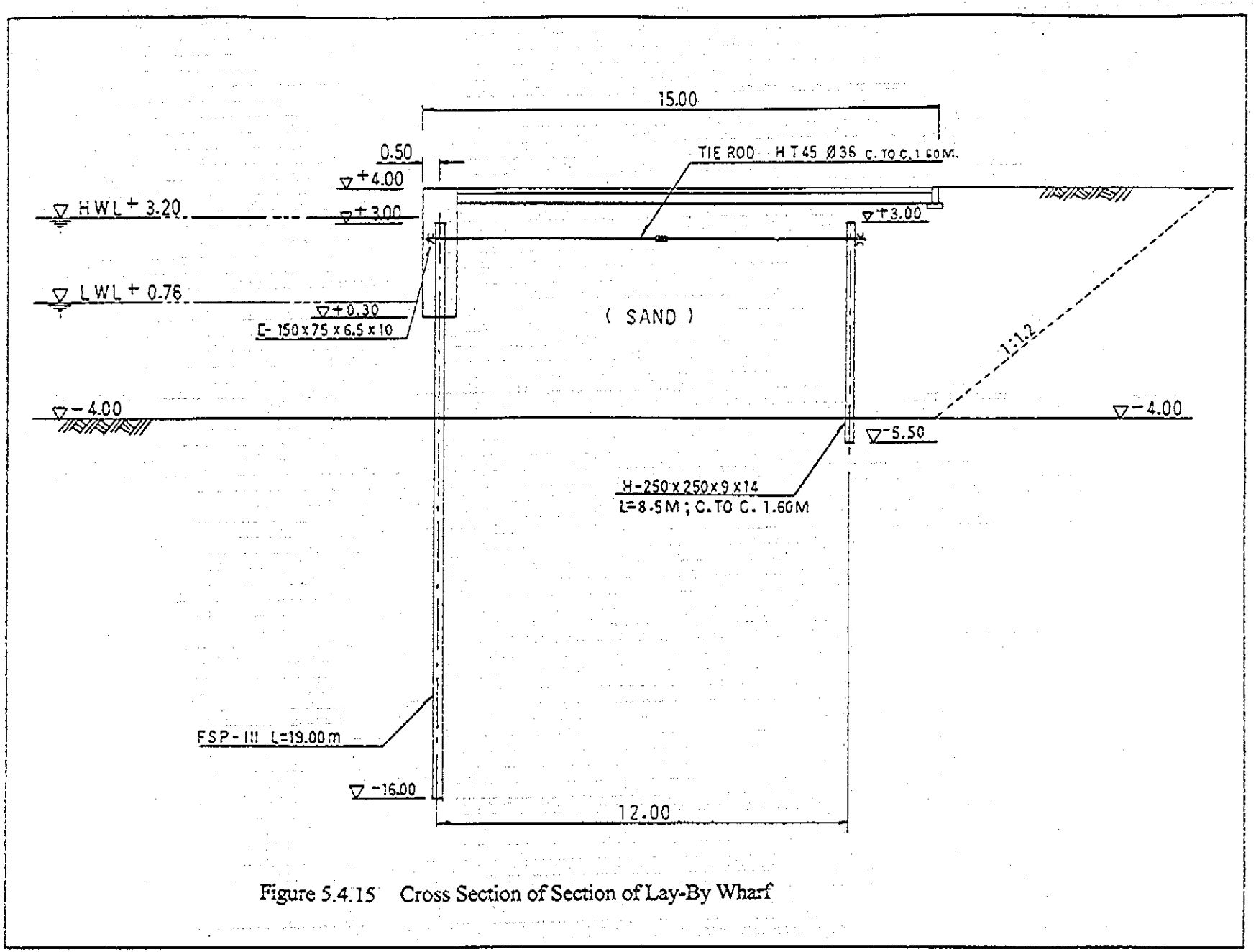


Figure 5.4.15 Cross Section of Section of Lay-By Wharf

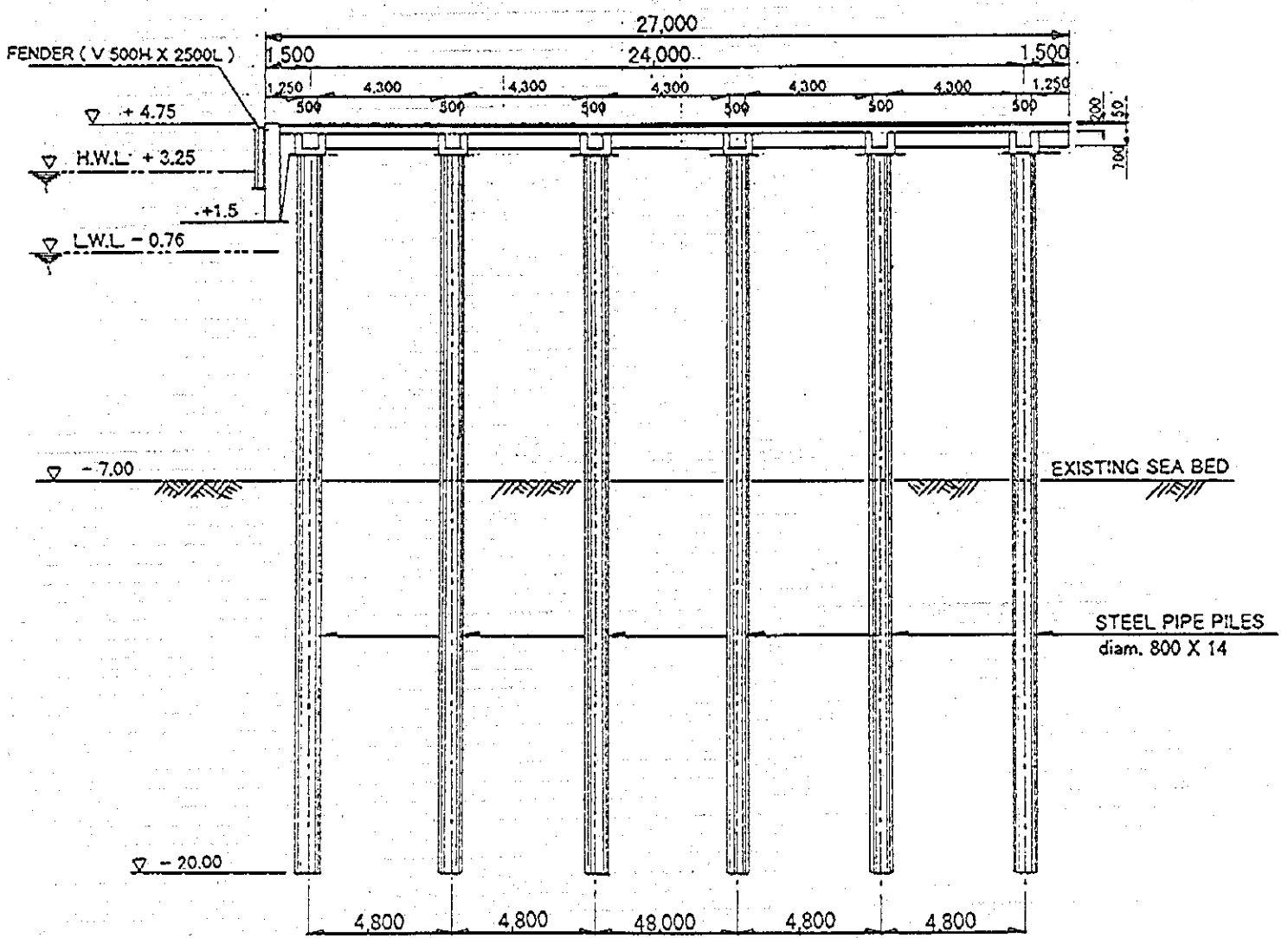


Figure 5.4.16 Cross Section of Deep Sea Wharf

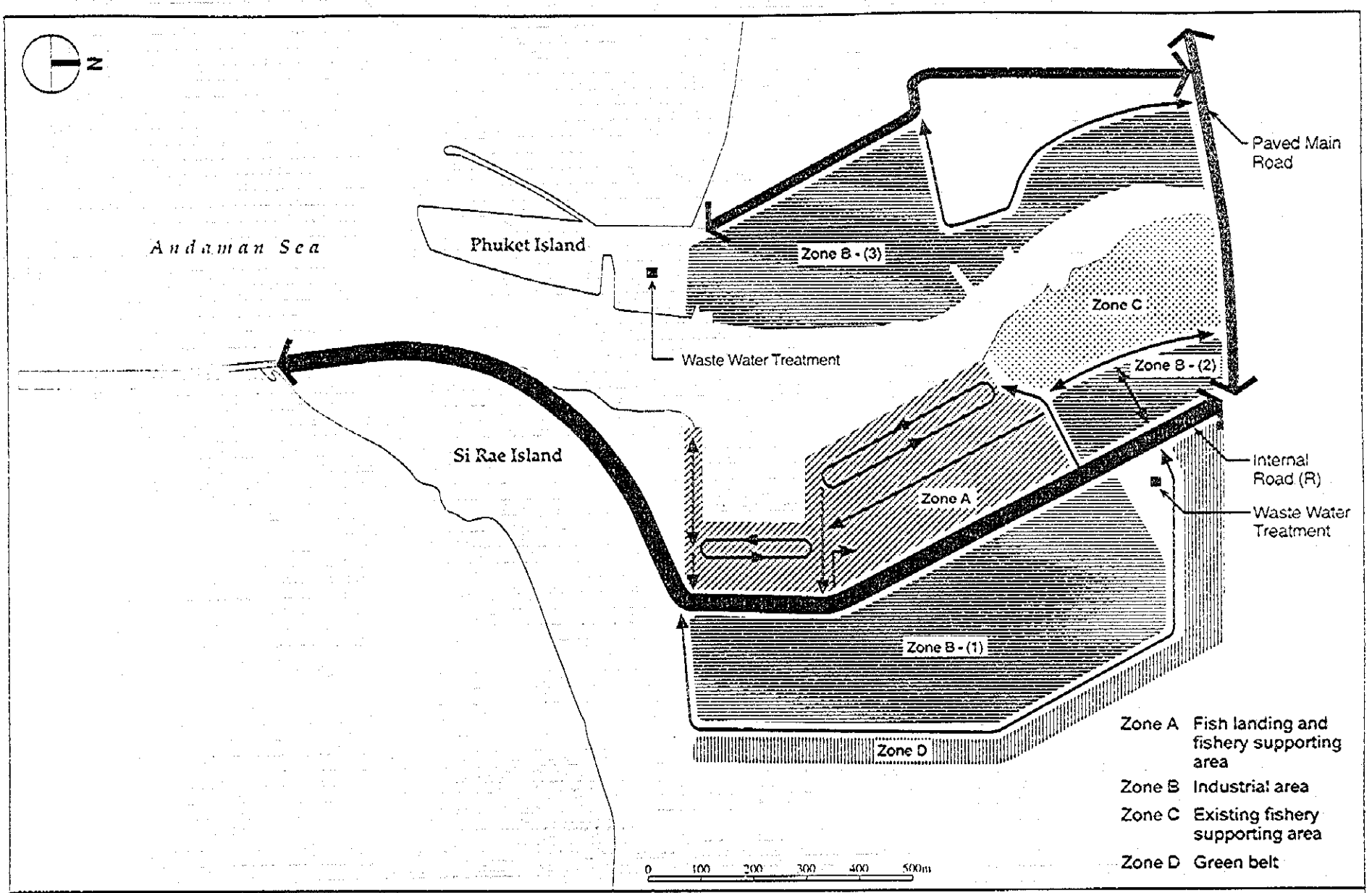


Figure 5.4.17 Zoning of the Port Facilities

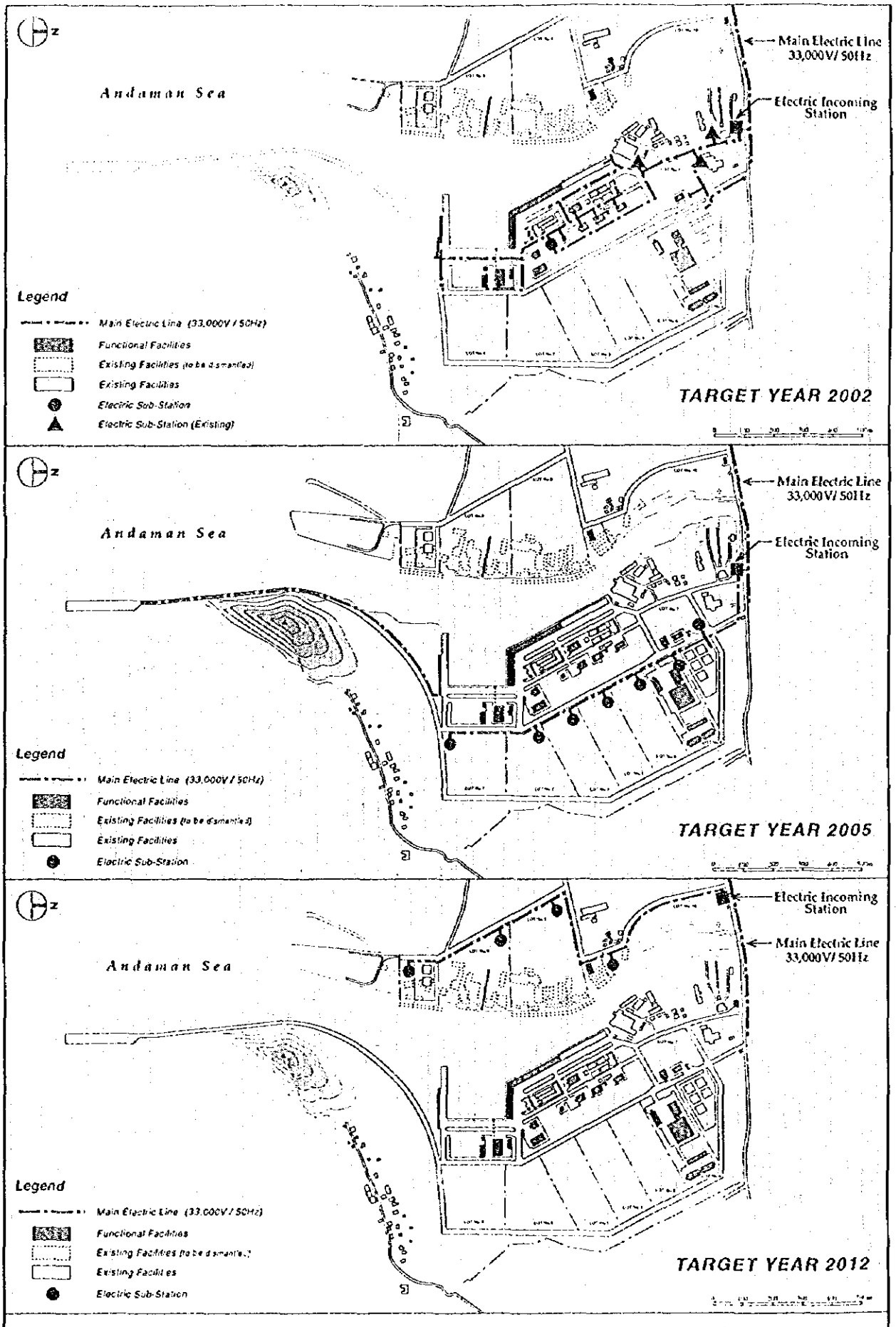


Figure 5.4.18 Main Line of Electricity

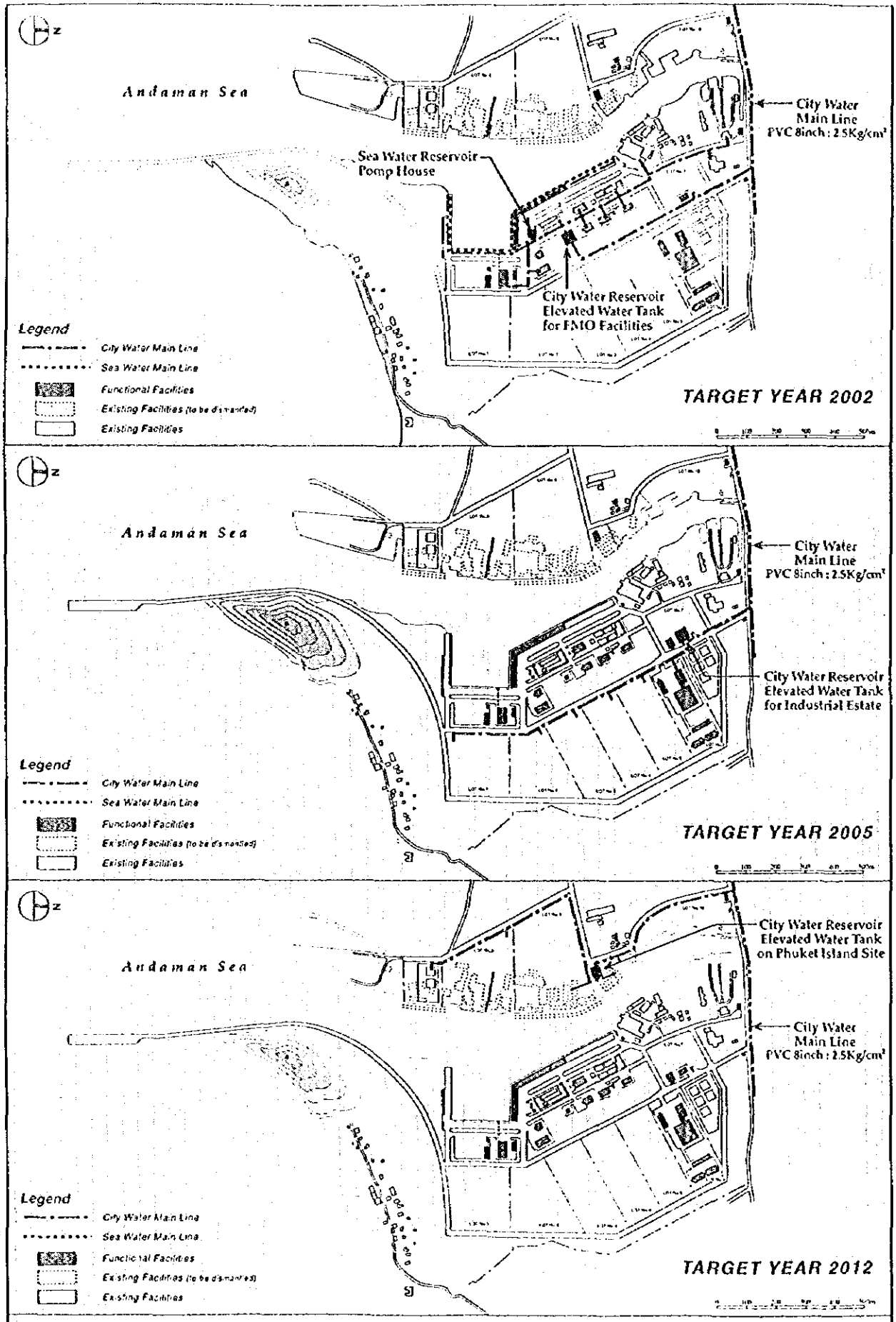


Figure 5.4.19 Main Line of City/Sea Water

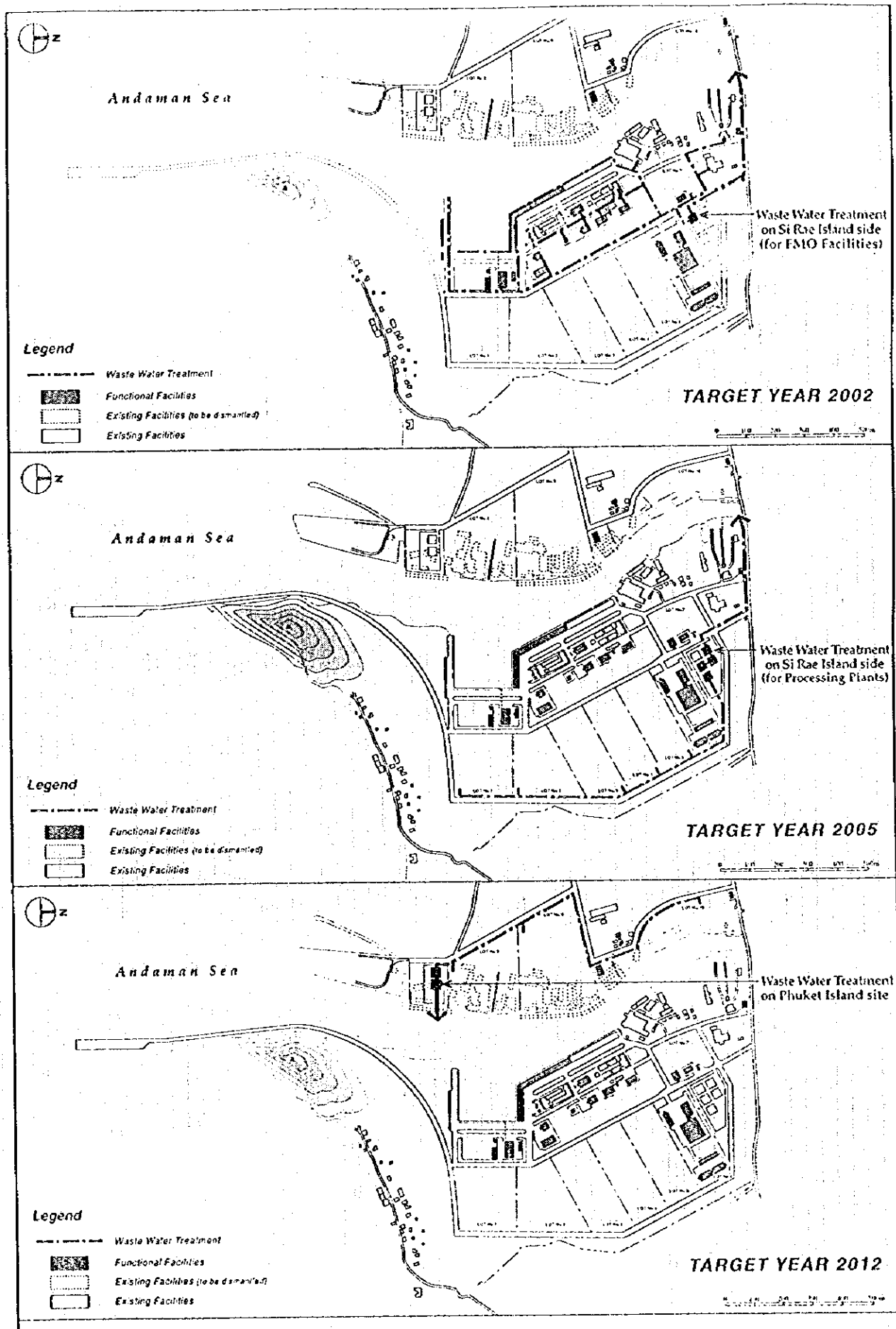


Figure 5.4.20 Main Line of Drainage

Table 5.4.1 Outline of Fish Marketing Facilities in Phuket FMO Fishing Port

Marketing Hall	
Establishment	1977
Area	8m x 180m
No. of Staffs	
Officer	6
Service	4
Worker	3
Other	6
Office	70 sq. m
Storage for Equipment	12 sq. m x 1
Water	
Sea Water	Floor Washing x 6 faucets Fish Washing 14 faucets Reserver Tank 40t Elevated Tank 34t
Portable Water	Main Line 8" - 4" - 2" Private Water Companies supply to Fishing Boats
Capa. of Electricity	1,000KVA
Dust	City Service (1 time/3days) 1.0 t/day
Water Treatment	Fish Washing Water adds Chlorine
Lighting	Light House x 1
Diesel Tank	15t x 6 Tajeam Service Co., Ltd.
Telecommunication	Cable Line (Telephone Authority in Thailand) DOF has Radio Station for Fishing Boats
Other Equipment	
Hoist	4.0H x 4.5L (m) x 1
Ice Crasher	(15t/h) x 9
Machine	
Working Table	1.5W x 4.0L x 0.8H (m) x 17
Fluid Fish Conveyor	1

Ice Plant	
Establishment	1977
Construction Area	3,320 sq. m
No. of Staffs	
Manager	1
Officer	5
Engineer	1
Technician	7
Other	14
Total Capa. of Electricity	1,000KVA(400,000B/month)
Water	City Water (4" Main pipe) 50,000B/month
Maintenance Cost	50,000B/month
Compressor Oil	4,000B/month
Refrigerant	14,000B/month
Construction Cost	80,000,000 B (ADB)
Ice Plant	
Capa. of Production	90 t/day
Actual Production	75 t/day
Efficiency	83%
Working Day	300 days
Refrigeration System	Ammonia Liquid Pump
Refrigerant	Ammonia / Chlorid Kalium
Compressor	Single Stage:150hp x 6 Multi-Stage:150hp x 3
Temperature of Brine	-12 degree Celsius
Crane Capacity	8 Block Ice
Ice Storage	
Capacity	45.5 t(350 Block) 12W x 12L x 5H (m)
Temperature	-10 degree Celsius
Cold Storage	
Capacity/Temperature	200t(-28 deg.) x 2 12W x 19.5L x 5H (m) 100t(-18 deg.) x 1 8W x 19.5L x 5H (m)
Other Equipment	
Cold Truck	10t x 2
Truck	40Block x 3
Ice Crusher Machine	(15t/h) x 2

Ship Yard	
Establishment	1982
Area	1.2 ha
No. of Staffs	
Officer	4
Worker	150
Temporary	50
Office	40 sq. m
Storage for Equipment	130 sq. m
Slip Way	Side Slide System
Winch	180hp
Winch up Capacity	300 t
Cradle	5W x 10L (m)
Main Rail	3 Rails
Slide Rail	2 Rails x 6 Directions
Main Activity	Sealing, Mending, FRP Work, Ship Building
Yard Capacity	40 boats/month Fish Boat:16 boats/month Leisure Boat:25 boats/month
Working Day/Boat	7 days
Average Charge/Boat	4,000~5,000 Baths
Frequency/Boat	Good Fisher Man :3 times/year Nornal:1~2 times/year
Ship Building Capacity	Large Scale:1 year Small Scale:3 months
Water	
Portable Water	City Water (for Washing) 3,000~7,000B/month
Electric	20,000B/month

Table 5.4.2 Present Status of Ice Plant, Cold Storage and Processing Factory in Phuket

A Company	
Type of Factory	Ice & Fish Meal
Location	Phuket
Establishment	-
Factory Area	1.6 ha
No. of Staffs	
Manager	1
Officer	5
Ice Plant	15 (Engieer x 5)
Fish Mill	25
Others	14
Electricity	
Total Capacity	1,800 KVA
Consumption	500,000B/month
Generator	150KVA (for Fish Mill)
Water	
Source	70% Well Water 30% City Water Floor Washing:Sea Water
Consumption	35,000B/month (for City Water)
Ice Plant	
Establishment	1989
Capacity of Production	150 t/day
Actual Production	150 t/day
Efficiency	100%
Working Day	300 days
Price	40 B/block
Refrigeration System	Ammonia Liquid Pump
Refrigerant	1st:Ammonia 2nd:Chlorid Kalium
Compressor	Single Stage:110hp x 4
Crane Capacity	10 Block Ice
Ice Storage	100 Block (2t x 2) Non Refrigerated
Cold Storage	Nil
Customer	Self Consumption 60% Fish Agent 40%
Fish Mill	
Establishment	1984
Capacity of Production	200 t/day
Actual Production	20~30 t/day
Efficiency	10~15%
No. of Processing Line	2 Lines
Production/Law material Ratio	25%
Major Market	Domestic (100%)
Other Facility	
Truck Scale	40 t
Garbage	1 t/day for burn
Other Equipment	
Truck	10 t x 6
Oil Tank	10 t x 2
Air Compressor	15kw x 1
Belt Conveyor	2
Shovel Roader	1

B Company	
Type of Factory	Ice
Location	Phuket
Establishment	1988
Factory Area	0.4 ha
No. of Staffs	
Manager	1
Account	2
Engineer	4
Driver	6
Others	10
Electricity	
Total Capacity	600 KVA
Consumption	300,000B/month
Water	
Source	100% Well Water (29m depth) Reservoir Water Tank 30W x 45L x 4H (m)
Ice Production	
Capacity of Production	150 t/day
Actual Production	150 t/day
Efficiency	100%
Working Day	300 days
Price	46 B/block
Refrigeration System	Ammonia Float Switch
Refrigerant	1st:Ammonia 2nd:Chlorid Kalium
Brine Temperature	- 12 degree Celsius
Compressor	Single Stage (190hp x 2)
Crane Capacity	10 Block Ice
Cold Storage	Nil
Customer	95% Fish Agent 5% Shrimp Pond
Other Equipment	
Cold Truck	10 t x 6
Construction Cost	25,000,000 B
Operation/Maintenance Cost	80%:Salary, Fix Cost 20% :Repairing for Equipment & Facilities

Table 5.4.3 Floor Area, Foundation and Structure of Functional Facilities and Processing Plant Facilities in Master Plan

	Functional Facilities	Number of Bldg.	Number of Story	Total Floor Area (sq.m)	Type of Foundation	Structure	Remarks
(Functional Facilities)							
1	Marketing Hall - Enlarging works	1	1	6,240	Pilling	R.C.	Folklift
2	DOF Office	1	1	414	Pilling	R.C.	Food inspection equipment
3	FMO Office	1	1	558	Pilling	R.C.	Radio communication system
4	Ice Plant / Ice Storage						
	4.1 Plant building	1	1	1,265	Pilling	Steel	Brine tank, Overhead crane
	4.2 Administration building	1	1	360	Pilling	Steel	
	4.3 Ice Crusher Tower	1	1	-	Pilling	Steel	Ice crusher, Shooter
5	Cold Storage						
	5.1 Plant building	1	1	1,404	Pilling	Steel	
	5.2 Administration building	1	1	324	Pilling	Steel	
6	Workshop	1	1	156	Pilling	Steel	Repair tools
7	Electric Incoming Station						
	7.1 On Si Rae Island Site	1	1	252	Pilling	R.C.	
8	City Water Reservoir / Elevated Water Tank						
	8.1 for FMO's facilities in Si Rae Island Site	-	-	144	Pilling	R.C.	Water pump
9	Waste Water Treatment						
	9.1 for FMO's facilities in Si Rae Island Site	-	-	-	Pilling		
10	Fishing Gear Storage	1	1	400	Spread	Steel	
11	Fishing Gear Repairment Area	1	1	600	Spread	Steel	
12	Fish Box Storing Area	-	-	6,750	-	-	
13	Canteen / Restaurant / Shop	1	1	1,008	Pilling	R.C.	
14	Public W. C.	4	1	72 x 4	Pilling	R.C.	
15	Rubbish Disposal	-	-	50	Spread	R.C.	
16	Guard Box	2	1	6.25 x 2	Spread	R.C.	
17	Jetty Watchman Box	3	1	6.25 x 3	Spread	R.C.	
18	Auction Watchman Box	1	1	19	Pilling	R.C.	
19	Service Building for Wharf Workers	1	1	432	Pilling	R.C.	
20	Sea-water Pump House / Reservoir Tank	-	-	100	Pilling	R.C.	Water pump
21	Truck Scale	1	1	25	Pilling	R.C.	Scale
(Processing Plant Facilities)							
1	Electric Incoming Station						
	1.1 On Phuket Island Site	1	1	252	Pilling	R.C.	
2	City Water Reservoir / Elevated Water Tank						
	2.1 for Industrial Estate in Si Rae Island Site	-	-	540	Pilling	R.C.	Water pump
	2.2 On Phuket Island Site	-	-	216	Pilling	R.C.	Water pump
3	Waste Water Treatment						
	3.1 for Industrial Estate in Si Rae Island Site	-	-	5,000	-	-	Airation Pump
	3.2 On Phuket Island Site	-	-	1,600	-	-	Airation Pump
4	Tuna Canning Plant						
	4.1 Plant building	8	1	7,174 x 8	Pilling	Steel	Processing machine, Cold storage
	4.2 Administration building	8	1	738 x 8	Pilling	R.C.	
	4.3 Service building	8	1	1,296 x 8	Pilling	R.C.	
	4.4 Dormitory	16	2	2,744 x 16	Pilling	R.C.	

Table 5.4.4 Implementation Schedule

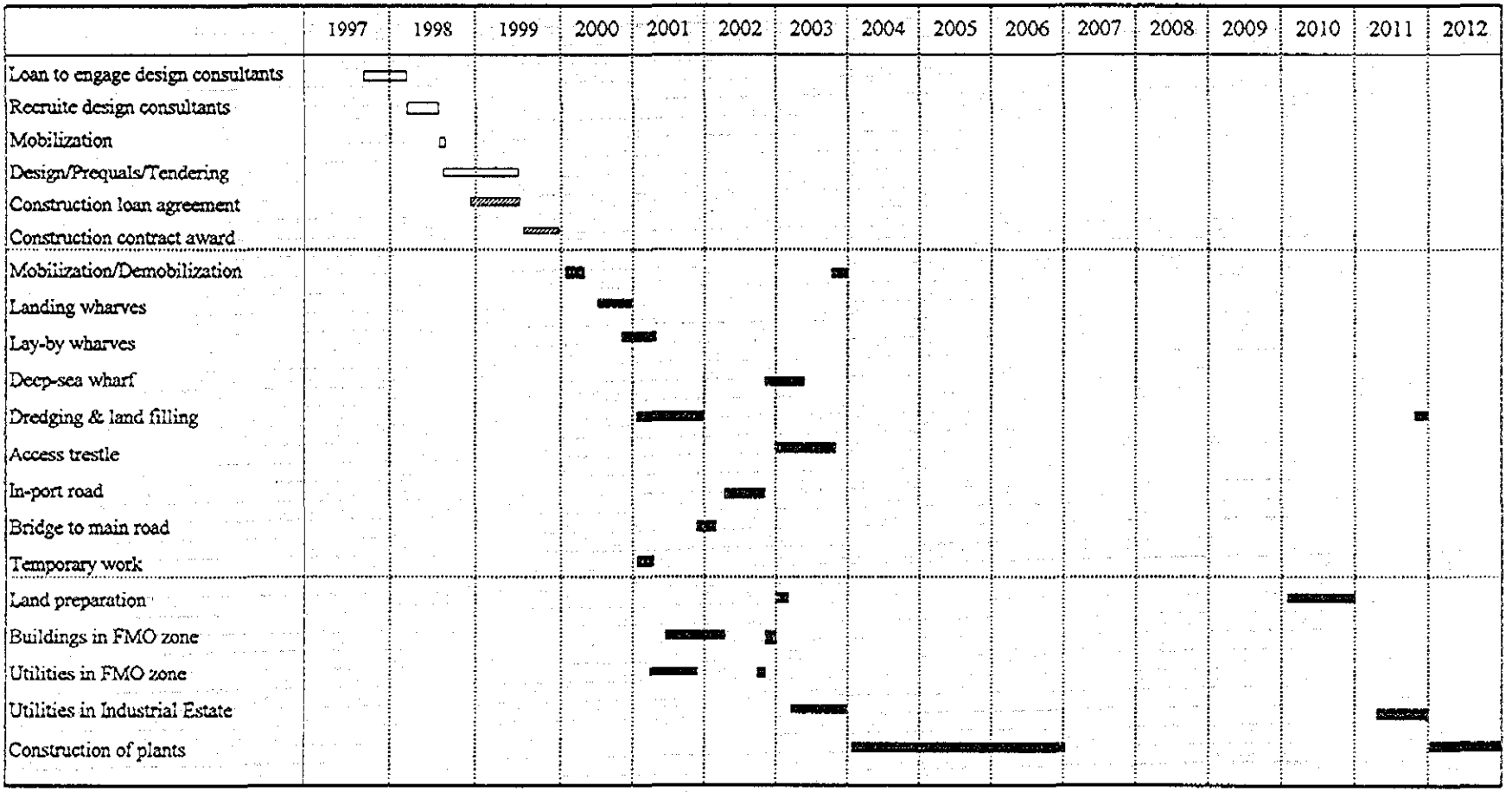


Table 5.4.5 Construction Cost

	Item	Quantity	Total Cost	Foreign Currency	(Unit: ,000 Baht) Local Currency
1	Landing Wharf for Existing Fishing Boats and Long liners	335 m	83,750	40,200	43,550
2	Lay-by Wharf	380 m	91,240	42,418	48,823
3	Deep-sea Wharf	210 m	111,563	78,094	33,469
4	Access Trestle	700 m	113,750	45,500	68,250
5	Dredging	1,800,000 m^3	450,000	360,000	90,000
6	In-port Road	1,600 m	27,000	0	27,000
7	Bridge to City Road	15 m	3,375	0	3,375
8	Aids to Navigation	Lump sum	20,740	18,715	2,025
9	Temorary Jetty	Lump sum	4,800	0	4,800
10	Mobilization/Demobilization	Lump sum	31,250	29,688	1,562
	Total		937,468	614,614	322,854
11	Detailed Design and Engineering Investigation		93,648	60,871	32,777
12	Contengency		84,064	48,932	35,132
	GRAND TOTAL (excluing VAT)		1,115,181	724,417	390,763
	VAT 7%		78,063	50,709	27,353

Table 5.4.6 Construction Cost of Fishing Port Facilities (Master Plan)

I. Fishing Port Functional Facilities and External/Infrastructure unit : 1,000Bahts

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Fishing Port Functional Facilities								
1	Marketing Hall - Enlarging works	Lot	1	6,240.00	6,240.00	37,985	0	37,985
2	DOF Office	Lot	1	414.00	414.00	23,941	16,560	7,381
3	FMO Office	Lot	1	558.00	558.00	11,637	2,530	9,107
4	Ice Plant / Ice Storage / Ice Crusher Tower	Lot	1	2,258.00	2,258.00	123,004	75,738	47,265
5	Cold Storage	Lot	1	1,704.00	1,704.00	45,014	19,550	25,464
6	Workshop	Lot	1	156.00	156.00	10,838	8,947	1,891
7	Electric Power Station	Lot	1	252.00	252.00	2,217	0	2,217
8	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	9,863	0	9,863
9	Waste Water Treatment	Lot	1	-	-	11,995	0	11,995
10	Fishing Gear Storage	Lot	1	400.00	400.00	2,706	0	2,706
11	Fishing Gear Repairment Area	Lot	1	600.00	600.00	4,600	0	4,600
12	Canteen / Restaurant / Shop	Lot	1	1,008.00	1,008.00	12,076	0	12,076
13	Others	-	-	-	-	13,599	368	13,322
	Sub-total					308,506	123,694	184,872
14	Detailed Design and Engineering Service					13,416		
15	Overhead and Profit					18,782		
	Total - 1					340,764		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					145,098	0	145,098
	Sub-Total					145,098	0	145,098
2	Detailed Design and Engineering Service					6,309		
3	Overhead and Profit					8,932		
	Total - 2					160,240		
Total - I						501,003		

II. Industrial Estate in Si Rae Island unit : 1,000Bahts

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Facilities								
1	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	16,057	0	16,057
2	Waste Water Treatment	Lot	1	-	-	70,380	0	70,380
3	Estate Office	Lot	1	414.00	414.00	6,403	0	6,403
	Sub-Total					92,840	0	92,840
4	Detailed Design and Engineering Service					4,036		
5	Overhead and Profit					5,651		
	Total - 1					102,527		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					180,835	0	180,835
2	Detailed Design and Engineering Service					7,862		
3	Overhead and Profit					11,007		
	Total - 2					199,704		
Total - II						210,231		

III. Industrial Estate in Phuket Island unit : 1,000Bahts

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Facilities								
1	Electric Power Station	Lot	1	252.00	252.00	2,217	0	2,217
2	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	11,680	0	11,680
3	Waste Water Treatment	Lot	1	-	-	36,513	0	36,513
	Sub-Total					50,410	0	50,410
4	Detailed Design and Engineering Service					2,192		
5	Overhead and Profit					3,068		
	Total - 1					55,670		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					85,643	0	85,643
2	Demolish Work of Existing Building and Site Clearance					25,000	0	25,000
	Sub-Total					110,643	0	110,643
3	Detailed Design and Engineering Service					4,824		
4	Overhead and Profit					6,753		
	Total - 2					122,526		
Total - III						178,196		

IV. Processing Plants unit : 1,000Bahts

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Private. Processing Factory								
1	Tuna Canning Plants and related facilities	Lot	8	14,698.00	117,508.00	1,334,475	42,228	1,292,247
	Sub-Total					1,334,475	42,228	1,292,247
2	Detailed Design and Engineering Service					58,021		
3	Overhead and Profit					81,229		
Total - IV						1,473,725		
Grand Total (excluding VAT)						2,363,155		