

The provisional plan will be formulated taking into consideration the above conditions. The provisional plan will include the east floodway and minor river improvement. The scale and dimensions of the facilities will be studied in more detail during the feasibility study stage to be carried out from January 1990 to March.

## **CHAPTER 13**

### **OVERALL IMPLEMENTATION PROGRAM**



## CHAPTER 13 : OVERALL IMPLEMENTATION PROGRAM

In the planning of the implementation schedule, it is necessary to establish the required facilities in stages based on the urgency of need and effectiveness to be derived. Staged construction will have advantage to minimize the excessive initial investment. Accordingly, the study for order of priority for construction of the project will be developed in the Feasible Study stage which will be started from January 1990 by the Study Team.

Therefore, in this chapter, the major factors effecting the order of priority is discussed owing that further suitable consideration of overall implementation program can be developed.

Also, a basic conception on the implementation schedule is described dividing into 2 component of sewerage construction and improvement of drainage and flood control in the following.

### 13.1 Sewerage Construction

#### (1) General

Implementation schedule is made based on the premise that 100 % of the planned sewerage facilities will be completed by the target year 2006.

It is recommended that implementation of sewerage facilities be constructed dividing into 2 stages of urgent subject area and then surrounding.

The first stage of the implementation schedule is to aim mitigation of water pollution of Bang Yai river and sea water as well as the surroundings in the central area of the city.

Fig. 13.1 indicates an idea of urgent subject area for construction by the first stage.

Outline of the area is as follows:

- |   |                     |
|---|---------------------|
| - Area: 293 ha                              | (14 % out of total) |
| - Population: 24,800 ps                     | (32 % " )           |
| - Sewage quantity: 15,800 m <sup>3</sup> /d | (45 % " )           |

#### (2) Implementation schedule

Overall implementation schedule of the sewerage construction is shown in the Fig. 13.2.

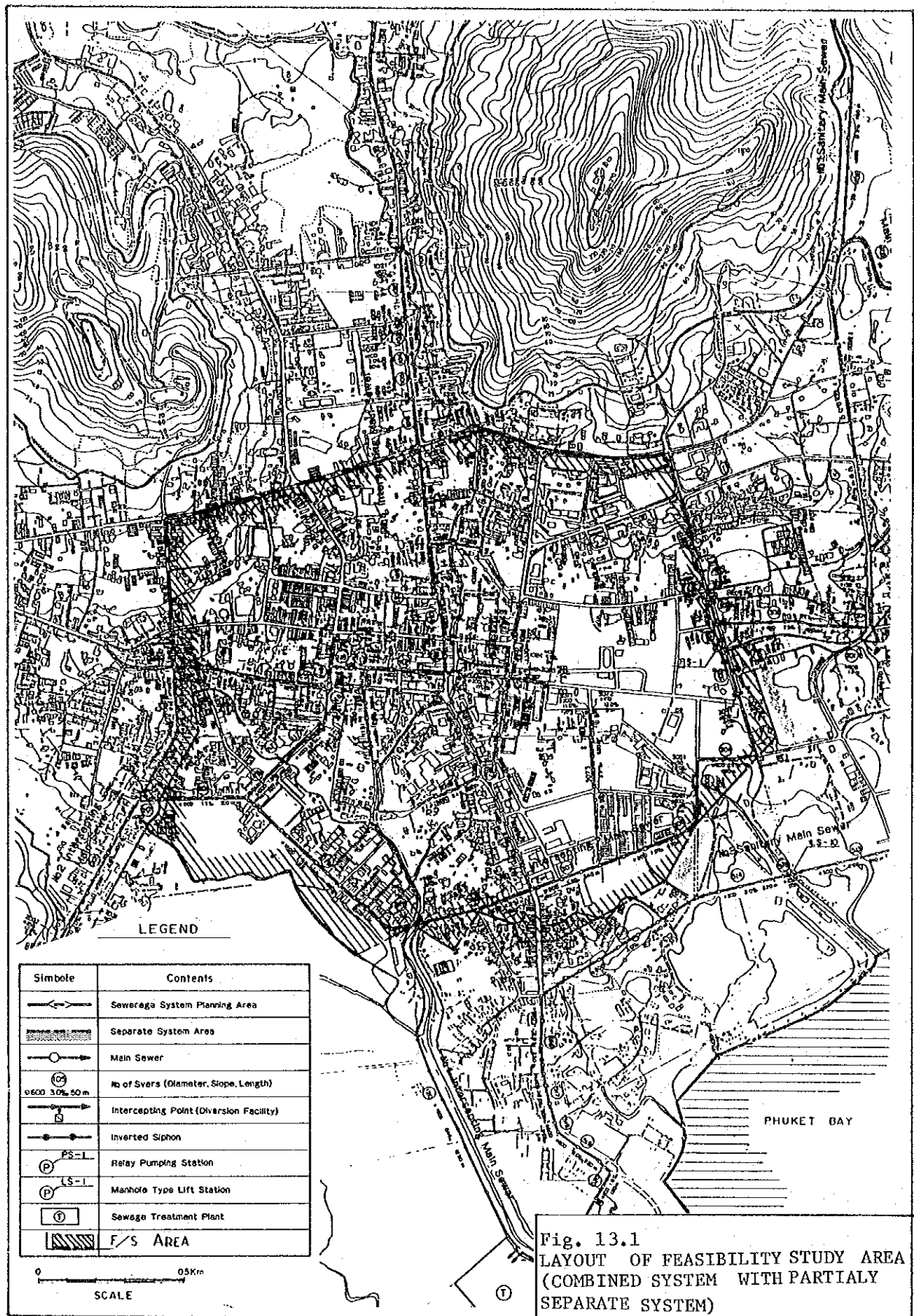


Fig. 13.2 Implementation Schedule for the Sewerage Project

	F/S Area ( Stage I )						Other Area ( Stage II )				
	1st	2nd	3rd	4th	5th	6th	10th	11th	12th	13th	Total
Sewer											
Basic Design	<u>Budget</u>										
Detailed Design											
Construction											
Sewage Plant											
Basic Design	<u>Budget</u>										
Detailed Design											
Construction											
Cost (Baht)											
Sewer		27.2									
Design	10.3	16.9		169.6			5.2	11.2			38.4
Construction			42.4	42.4	42.4	42.4		6.0	30.0	60.0	229.6
Engineering (10%)				16.8							
Contingency (30%)	3.1	5.1	42.4	42.4	42.4	42.4	1.6	1.8	30.0	30.0	22.8
Treatment											
Design	31.8						15.7				
Construction	10.3	21.5		215.2			15.7		157.6		47.5
Engineering (10%)			71.7	71.7	71.8			52.5	52.5	52.6	372.8
Contingency (30%)	3.1	6.5	7.1	7.1	7.1				15.6		36.9
Total	26.8	50.0	23.6	23.6	23.6	60.6	4.7	17.3	17.3	17.3	56.6
			163.0	163.0	163.1		27.2	82.8	117.9	118.0	892.0

## 13.2

### Implementation Plan for Flood Control

The master plan is formulated in order to protect Phuket municipality from 30-year probable flood by the construction of the retarding ponds and east floodway.

In order to discuss about the implementation schedule with PWD and Municipality office, the preliminary implementation plan of the master plan is presented in Fig. 13.3. The master plan will be expected to be accomplished in two stages, provisional plan and mid-term plan of which the design flood is 30-year probable flood.

It is assumed that the engineering services for detailed design and tender takes one year respectively. The detailed design for the provisional plan and mid-term plan will be carried out at one time. The construction period is estimated based on the annual earth work of 500,000 cu.m which is derived assuming that the amount of earth work for one day is 2,000 cu.m and the number of workable day for one year is 250 days.

It is expected that the construction of the provisional plan will be completed in April 1995 and the construction of the mid-term plan will be completed in April 1998.

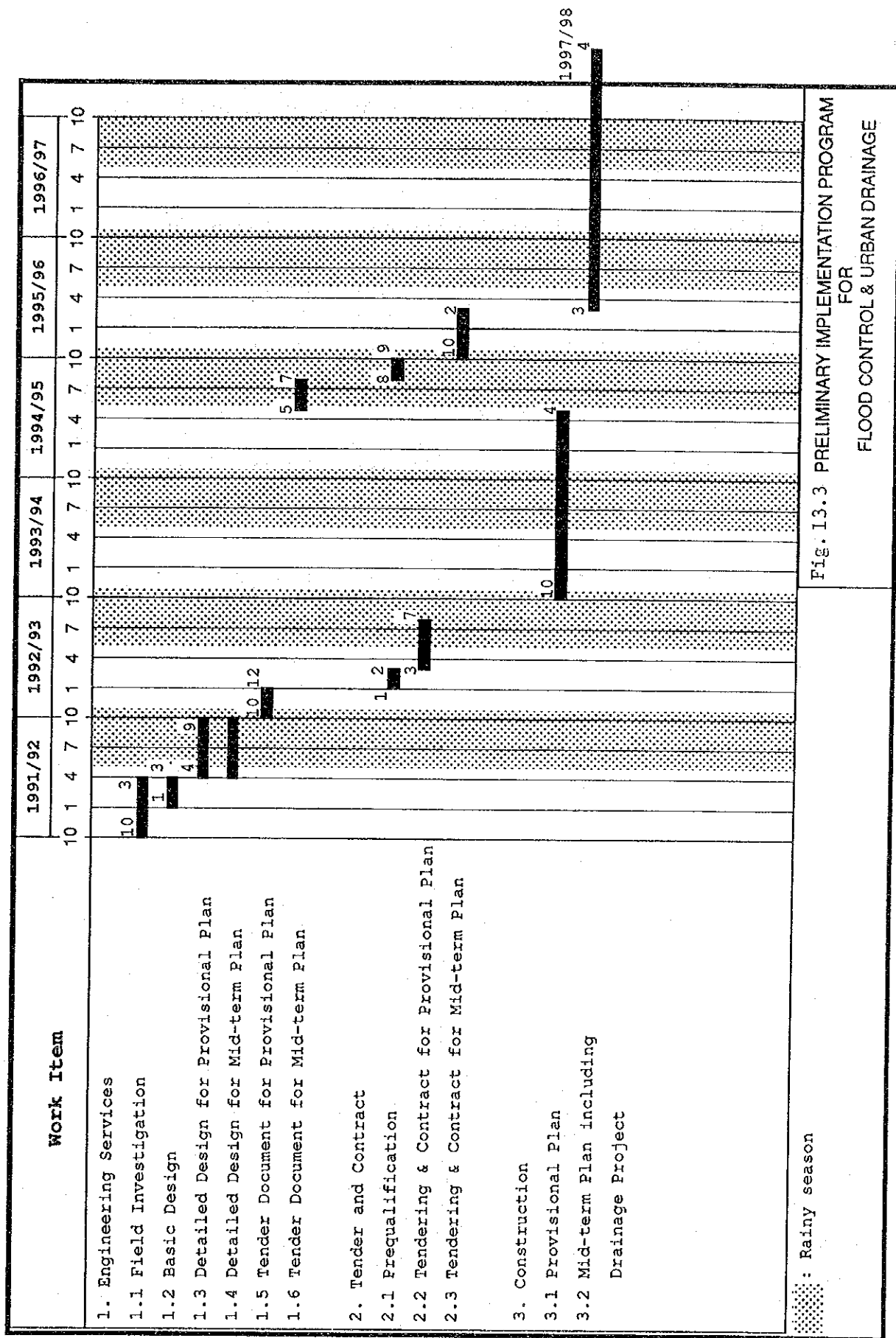


Fig. 13.3 PRELIMINARY IMPLEMENTATION PROGRAM  
FOR  
FLOOD CONTROL & URBAN DRAINAGE





**CHAPTER 14**  
**ADMINISTRATIVE AND FINANCIAL STUDY**



## CHAPTER 14 : ADMINISTRATIVE AND FINANCIAL STUDY

### 14.1 Existing Administrative System

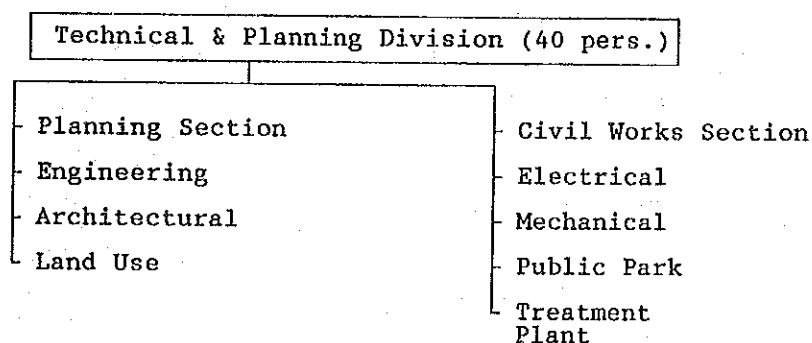
The Phuket Municipality has no distinct section responsible for implementing sewage works. At present the related works are shared by a few sections, that is to say, the public hygiene division is in charge of collection and treatment of septic tank sludge and removal of deposit in street drains and the engineering division is responsible for the construction of street drains.

In other municipalities which have sewerage systems in operation, the administrative systems are described below:

#### (1) Pattaya Sewerage System

According to the master plan for the Pattaya Sewerage System, there are two treatment districts: (1) Soi Kasemsuwan and (2) Soi Pattaya. The construction period is divided into two phases. In Phase I (1985-1988) the Soi Kasemsuwan Sewage Treatment Plant with a treatment capacity of 4,000 m<sup>3</sup>/d is now in operation, which is scheduled to be expanded to 8,000 m<sup>3</sup>/d in Phase II (1989) as well as the construction of the Soi Pattaya Sewage Treatment Plant with a treatment capacity of 5,000 m<sup>3</sup>/d. However, those expansion/construction works has not yet commenced due to budgetary constraint.

In the organization of the City of Pattaya, the technical and planning division is responsible for implementation of sewage works as shown below. The engineering section is in charge of expansion of a sewer system and the treatment plant section, although having not yet promoted to a section, is responsible for operation and maintenance of a treatment plant. The sewage fee collection is undertaken by the financial division.



Two permanent staff, namely one engineer for repair of equipment and one scientist for water quality analysis are stationed at the Soi Kasemsuwan Treatment Plant. Ten temporary workers are employed there besides them. The electrical and mechanical engineers in other sub-section may help the plant work as required. The water quality analysis of influent and effluent is daily conducted. The analytical parameters include BOD, COD, pH, SS, dissolved solid, residual chlorine, etc. but not T-N and T-P. The analysis is now suspended due to the expansion work of

the laboratory and analytical instrument trouble. The BOD values were reportedly 100 to 150 mg/l in influent and less than 20 mg/l in effluent before the suspension of analysis.

There are now 40 connections which cover almost hotels in the treatment district in Phase I. According to the plant staff, the problem is in the high sewage fee. One hotel with 477 rooms hesitates to connect its pipe to a sewer system due to the annual payment with an amount of 2 million Baht. The sewage fee system was reviewed at the committee composed by PWD, Chulalongkorn University, NEB and TISTR and approved by the City Council. The annual budget for sewage works is 2 million Baht.

#### Estimation of Expenditure

Power for a Sewage Treatment Plant	0.186 Baht/m <sup>3</sup>
Power for Pump Stations	0.217
Personnel	0.195
Maintenance (2% of Construction Cost)	0.377
Sub-total	0.975
Depreciation for Equipment (10% of Equipment Cost)	0.685
Depreciation for Structures (3.3% of Construction Cost)	0.396
Sub-total	1.081
Total	2.056

#### (2) Patong Sewerage System

The Patong Sewerage System is composed of sewers, a pump station and a sewage treatment plant, which was constructed by PWD with the government budget and has been in operation since July 1989.

The Patong Sanitation Office is divided into three sections under the control of the Sanitation Board: (1) police, (2) engineering and (3) public health. There are four personnel in the public health section responsible for sewage works. This section is responsible not only for sewage works but also for other public health matters, therefore, no one exclusively works for sewage works in the office. Two laborers are also employed for operation and maintenance of the sewage treatment plant. The Chief of the Patong Sanitation Office considers the three staff, namely one engineer, one electrician and one administrative staff as necessary for implementation of sewage works and will request DOLA to dispatch at least one of them at government expenditure.

The office expects that the expenditures for operation and maintenance will be 1.0 million Baht in 1989 and 1990, respec-

tively, while the income from the sewage charge was estimated at 0.5 million Baht in 1989. The people consider the sewage fee as one of many duties imposed them and doubt the necessity to pay since they consider that they have no obligation to pay for public service.

At present, 100 hotels/houses are connected to a sewerage system, but 30% out of them did not follow the guidelines for house connection works to install the house inlet for solid removal and the grease trap in the connection line to sewers. The neglect of these guidelines brings the sewer cleaning works once in every three months.

The sewage fee is defined as follows:

#### Sewage Fee System

Category	Fee	Permission Fee for Connection
1. Residential House Commercial House	100 Baht/house	400 Baht/house/yr
2. Residential House with not more than three floors	100 Baht/house	400 Baht/house/yr
3. Residential House with more than three floors	200 Baht/house	500 Baht/house/yr
4. Restaurant/Food Shop	10 Baht/m <sup>3</sup>	40 Baht/m <sup>3</sup> /yr
5. Hotel	50 Baht/room	600 Baht/room/yr

Remark: When the hotel with its own private sewerage system discharges effluent to a public sewerage system, both fees are reduced by 20% provided such a system adheres to the national environmental quality standard.

## Estimation of Expenditure and Income

---

### 1. Expenditure

1.1 Power	0.40 Baht/m <sup>3</sup> sewage
1.2 Chemical	0.44
1.3 Wage	0.16
Total	1.00

Daily Sewage Flow : 2,250 m<sup>3</sup>/day

Daily Expenditure : 2,250 x 1.00 = 2,250 Baht/day

### 2. Income (In Service Area I)

2.1 Hotel/Bungalow 2,068 rooms

2.2 Residential/Commercial 300 houses

Annual Income from Hotel/Bungalow 2,068x600  
= 1,240,800 Baht/yr

Annual Income from Residential/Commercial 300x400  
= 120,000 Baht/yr

Total = 1,360,800 Baht/yr

Daily Income 3,728 Baht/day

### 3. Profit

Daily Profit 3,728 - 2,250 = 1,478 Baht/day

Annual Profit 1,478 x 365 = 539,470 Baht/yr

According to the above estimation, the office intends to cover the expenditures for operation and maintenance with the income from the sewage fee, but worries whether they can fully collect the sewage fee as expected.

## 14.2

### Existing Financial Situation

The financial statements of the municipality for 1983 - 1988 and their projections up to 1991 are summarized in Table 14.1, from which budgetary trend can be observed. However, under a fluctuating upward economy in the industrial structure, further study and analysis is necessary in the course of the feasibility study, provided with updated information.

On household income and disbursement, no proper information for the municipality was found available. The latest household

socio-economic survey was held in Feb. 1986 - Jan. 1987 by the Central Government. Table 14.2 shows those of regional average and municipal area mean in Southern Region. In the case of Phuket Municipality, such expenditure will be higher than that and is suggestive in the determination of the sewerage fee.



Table 14.1 : Financial Statements and Projection  
of the Phuket Municipality

Unit: 10<sup>3</sup> Baht

Year:	1983	1984	1985	1986	1987	1988	1989	1990	1991
<b>REVENUE:</b>									
Local Tax									
Fixed asset	4,308	6,621	7,192	7,308	7,405	8,500	11,900	13,993	16,461
Land reclamation	1,086	1,036	1,084	1,209	1,148	1,180	1,527	1,667	1,819
Signboard	311	310	344	483	533	500	392	412	433
Slaughter	223	237	246	262	271	280	354	386	421
Tax (Subsidy)									
Business	18,182	20,970	22,852	22,716	24,713	22,852	30,056	33,010	36,253
Liquor	487	726	210	836	738	838			
Crops	69	96	110	37					
Excise	151	146	118	416	490	416	234	238	243
Entertainment	180	174	85						
Tax (Grant)									
Automobile	8,004	7,867	8,621	8,939	10,364	9,000	12,124	13,363	14,729
Duty & Fine	2,185	2,018	3,056	3,460	4,044	4,139	5,147	6,215	7,506
Asset Income	3,242	4,624	5,184	4,588	5,331	5,027	3,818	3,818	3,818
Utility Income	220	306	182	526	0	390			
Miscellaneous	3,329	3,037	5,927	2,966	461	392	3,268	3,268	3,268
General Grant	2,935	2,821	2,942	3,003	3,054	3,078	2,954	3,013	3,073
Special Grant	10,113	13,328	14,403	11,828	14,785	13,243	23,779	27,108	30,903
Reserve			7,555				605	605	605
Loan Fund					2,556				
<b>Total Revenue:</b>	<b>55,025</b>	<b>64,318</b>	<b>80,112</b>	<b>68,579</b>	<b>75,892</b>	<b>69,835</b>	<b>96,158</b>	<b>107,096</b>	<b>119,532</b>
<b>EXPENDITURE:</b>									
Administration	(42,990)	(46,311)	(50,441)	(48,376)	(58,710)	(51,189)	56,541	62,973	70,285
Salary	11,292	11,638	12,942	13,732	14,328	15,851			
Casual salary	5,911	6,734	7,744	6,688	6,982	7,268			
Supply	12,735	12,482	14,146	16,291	14,873	13,320			
Utility	2,130	1,893	2,044	2,280	788	629			
Grant	112	384	560	9	5	5			
Others	1,331	2,732	3,991	1,804	578	2,332			
Equipment & land	9,478	10,449	9,015	7,571	21,157	11,784			
Investment	(1,718)	(1,782)	(3,005)	(2,378)	(2,680)	(4,934)	21,674	24,139	26,942
Carry over	1,449	1,206	2,370	1,302	1,893	1,882			
Reserve	140	175	115	189	297	296			
Specific aid	128	400	520	887	490	2,757			
Loan repayment									
Special Aid	(9,512)	(13,323)	(21,912)	(11,974)	(11,289)	(12,636)	16,020	17,842	18,814
Specific grant	9,512	13,323	14,356	11,974	11,289	12,636			
Surplus			7,555						
Loan									
<b>Total Expenditure:</b>	<b>54,219</b>	<b>61,416</b>	<b>75,357</b>	<b>62,727</b>	<b>72,679</b>	<b>68,760</b>	<b>94,235</b>	<b>104,954</b>	<b>117,141</b>
<b>BALANCE:</b>	<b>806</b>	<b>2,902</b>	<b>4,755</b>	<b>5,852</b>	<b>3,213</b>	<b>1,075</b>	<b>1,923</b>	<b>2,142</b>	<b>2,391</b>

Source : The Phuket Municipality and their Municipality Development Plan (1987 - 1991)

Table 14.2 : Average Monthly Income and Expenditure per Household in 1986  
by Socio-Economic Class in Southern Region & Municipal Area

Unit: Baht

Zonal Average		Municipal Area		Southern Region	
		Distribution (%)		Distribution (%)	
No. of household	(10 <sup>3</sup> )	168	( 12.6)	1,330	(100.0)
Family size	(person/household)	3.6		4.2	
TOTAL MONTHLY INCOME		6,621	128.2 (113.8)	3,657	103.0 ( 93.7)
TOTAL MONTHLY EXPENDITURE		5,817	112.6 (100.0)	3,901	109.9 (100.0)
Consumption Expenditure:		5,164	100.0 ( 88.8)	3,549	100.0 ( 91.0)
Foods		2,058	39.9	1,519	42.8
Apparel		285	5.5	287	8.1
Cloth & clothing		237	4.6	240	6.8
Footwear		48	0.9	47	1.3
Housing		1,369	26.5	804	22.7
Shelter		591	11.4	229	6.5
Rental value of owned home		362	7.0	291	8.2
Fuel & light		246	4.8	160	4.5
Textile housefurnishings		27	0.5	36	1.0
Minor equipment		15	0.3	16	0.5
Major equipment		55	1.1	27	0.8
Cleaning supply		64	1.2	38	1.1
Domestic servants		9	0.2	7	0.2
Medical Care		126	2.4	131	3.7
Drugs & medicines		34	0.7	30	0.8
Medical services		92	1.8	101	2.8
Personal Care		162	3.1	103	2.9
Personal care items		123	2.4	80	2.3
Personal services		39	0.8	23	0.6
Transportation & Communication		621	12.0	402	11.3
Local transportation		102	2.0	60	1.7
Travel out of area		185	3.6	96	2.7
Vehicle operations		205	4.0	131	3.7
Vehicle purchase		95	1.8	101	2.8
Communications		34	0.7	14	0.4
Recreation & Reading		194	3.8	82	2.3
Admissions		16	0.3	9	0.3
Sports equipment		39	0.8	18	0.5
Musical equipment		31	0.6	20	0.6
Reading materials		37	0.7	11	0.3
Religious activities		71	1.4	24	0.7
Education		120	2.3	56	1.6
Miscellaneous		41	0.8	39	1.1
Non-Consumption Expenditure:		653	12.6 ( 11.2)	352	9.9 ( 9.0)
Direct Taxes		62	1.2	15	0.4
Gifts & Contributions		353	6.8	230	6.5
Insurance Premiums		44	0.9	20	0.6
Lottery Tickets		106	2.1	51	1.4
Interest on Debts & Shares		63	1.2	29	0.8
Other Expenses		25	0.5	7	0.2

Source : 1986 Household Socio-Economic Survey Report, Southern Region by National Statistical Office

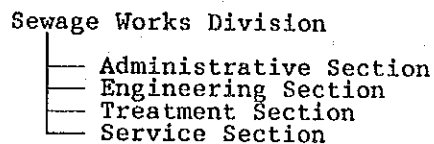
### 14.3 Existing Regulations

Presently there is no regulation directly applied to sewage works except those for sanitary control as stated in Section 5.1.

### 14.4 Recommended Administration

#### 14.4.1 Administrative Regulations

In the initial stage of construction of the sewage treatment plant and trunk sewers, PWD will support and assist the Municipality in the financial and technical aspects. After completion of those facilities, the Municipality shall have to undertake the various works involved in the construction of branch sewers and house connections, and the operation and maintenance of the completed sewerage system. Such works are planning, design, construction supervision, operation and maintenance, sewage fee collection, enlightenment of the people for sewage works, promotion of house connection works by the people themselves, supervision of house connection works, instructions to users, etc. If these works are shared by existing sections, such additional work might affect or be affected adversely by the existing work. To avoid any trouble, it is recommended that a new division who will exclusively implement the sewage works as shown below be established. Such organization will be similar to that of the Waterworks Division.



The duties by section are as follows:

#### (1) Administrative Section

Responsible for the administrative work, general service work, supplies, personnel, public relations, budget, and welfare; conduct the working performance of employees in accordance with rules and orders; inform the public about sewage works; coordinate with the users in maintaining public properties; collect sewage fees and other incomes in accordance with regulations; control and supervise disbursements in accordance with regulations; keep records of accounts.

#### (2) Engineering Section

Responsible for the engineering and architectural work; gather technical information; plan and design the sewerage system both the collection and treatment; improve techniques in treatment to meet regulations; estimate costs of construction.

(3) Treatment Section

Responsible for the pumping and treatment of sewage; operate and maintain equipment, machines, electrical equipment in treatment; control both the quantity and quality of treatment, including the economical use of chemical substances.

(4) Service Section

Responsible for giving the best service to sewerage users; constantly maintain sewers; repair sewers; approve and supervise house connection works; coordinate with the treatment and administrative units in order to speed up the installation of sewers; and perform other kinds of service as assigned.

14.4.2 Recommended Regulations

Since there is no basic law to implement the sewage works in both the central and local level, it is inevitable to enact by-laws for sewage works.

The by-laws must include the following:

- Declaration of service area and time for start of operation

This is to define the area and time that this bylaw is applied to.

- Requirements of persons who will construct or improve their houses in the service area

To promote the use of a sewerage system, the persons who will construct or improve their toilet houses in the declared service area shall be required to connect their toilets to the sewer system.

- Installation method of house connection
- Approval of plans for house connection work
- Inspection of house connection work

House connection works are done by users themselves or by contractors employed by users. Such works must be controlled by the municipality to protect the sewerage facilities and secure the normal operation of the treatment facilities. The municipality has the right to decide how to install the house connection, check the plans and to inspect the works.

- Compulsory improvement to flush toilet

The present pour-flush toilets must be improved to flush toilets for securing the velocity enough to convey excreta to a sewer system without any sedimentation.

- Requirements to users who discharge wastewater exceeding the acceptable level in quantity and/or quality

In consideration of characteristics of sewage treatment process and the durability of sewerage facilities, wastewater which exceeds the allowable levels in quantity and/or quality must be preliminarily treated by such levels by users themselves before flowing into a sewer system.

- Report on start of use of sewer system

The users must report to avail of the sewer system to be able to monitor the population served and for operation and maintenance of the treatment plant.

- Collection of sewage fee

- Calculation method of sewage fee

The municipality must collect the sewage fee from users to cover the expenditures at least spent for operation and maintenance of a sewerage system and specify the basis of sewage fee calculation.

## **CHAPTER 15**

### **BASIC CONCEPT OF PROJECT JUSTI- FICATION FOR FEASIBILITY STUDY**



## CHAPTER 15 : BASIC CONCEPT OF PROJECT JUSTIFICATION FOR FEASIBILITY STUDY

### 15.1 Recognition of Benefits

In the coming feasibility study of this project, the project appraisal will finally be converted to cost/benefit comparisons and consider the propositions "without the project" versus "with the project".

Besides the costs, the benefits to be derived from construction and operation of the sewerage system, the drainage improvement and flood control of Bang Yai river will be grouped into four categories, namely (1) Cost saving benefits, (2) Loss reducing benefits, (3) Inductive benefits and (4) Flood control benefits.

All anticipated benefits will be evaluated on the basis of either quantifiable or unquantifiable benefits. Because of the nature of sewerage project, the benefits are apt to be not wholly quantifiable. Therefore evaluation of unquantifiable benefits will also be stressed in the overall economic justification of this kind of project.

#### (1) Cost saving benefits :

These benefits are derived from saving costs which would otherwise be required if the project is not realized. The benefits represent all the construction, maintenance and operation costs of the respective wastewater treatment and sanitation systems for individual dwellings, apartment housing, service sector buildings and communal facilities.

#### (2) Loss reducing benefits :

These benefits are derived from reducing the loss which would otherwise be incurred if the project is not realized. The benefits include the reduction of possible stagnation of tourism development, which could cause not only environmental destruction in natural features of the area and assumed loss of tourism and supporting industrial sectors. Also involved are the reduction of public health diseases and deterioration and/or additional purchase of sludge suction trucks for sanitation service.

#### (3) Inductive benefits :

Along with the prospective purification of river water and improvement of environment in the community, the impact will reflect the raise of land value, contribute to agriculture production and the reuse of such water resources for living and industrial needs. Other benefits, although mostly unquantifiable, can be expected for reduction of discomfort and distress, reduction of groundwater contamination such sewerage and sanitation measures.

#### (4) Flood control benefits :

The benefits are evaluated as an economic counter-effect involved in flood damages on houses, buildings, household arti-



cles, stock assets, furnitures and equipments, agricultural products, communal infrastructures, business activities and transportations.

## 15.2 Project Justification

Under the 6th national Economic and Social Development Plan (1987-1991), Phuket is definitely nominated as a 2nd generation regional urban growth center for development programs of economic/ social/environmental infrastructure services and tourism promotion. In response, the Phuket Municipality has issued his own Development Plan (1987-1991) provided with due considerations on reconstruction progress of local industrial structure.

Other than this project, JICA Feasibility Study on Water Supply Plan in Phuket Municipality and RCDP Feasibility Study on Phuket Municipality Urban Development Plan are also in parallel under the way as a part of such environmental improvement and regional development.

Recently, an accelerated deterioration and pollution of rivers and canals have occurred and the heavy flood in the fall of 1986 and succeeding floods have attacked major part of the municipal area. The authorities concerned have been urged to take all necessary remedial or protective considerations for those pollution, diseases and damages. The establishment of wastewater treatment facilities has been gradually obligated in their housing and industrial schemes.

Although those countermeasures will partly mitigate the sanitary deterioration and flood damages, overall control and improvement of environmental situations can not be achieved without a comprehensive sewerage system and river improvement.

Under such circumstances, this feasibility study is to justify how and when the project could attain the national and regional objectives.

## **ANNEX : TABLES**



Table 2.1

Flow Capacity of Bang Yai River (1/2)

Sec. no.	Distance from river mouth (m)	Incre- mental distance (m)	Elevation			Flow capacity		River width (m)
			Bottom (El.m)	Right bank (El.m)	Left bank (El.m)	With freeboard (m <sup>3</sup> /sec)	Bankfull (m <sup>3</sup> /sec)	
1	50	120	-1.80	0.20	0.15	0	0	10
2	170	120	-1.63	0.03	0.05	0	0	10
3	290	120	-1.51	0.29	0.25	0	0	10
4	410	120	-1.68	0.80	0.32	0	0	20
5	530	120	-1.99	0.71	1.50	0	0	33
6	650	120	-2.02	0.68	1.50	0	0	33
7	770	120	-2.15	2.00	2.05	34	44	32
8	890	120	-2.15	1.23	1.94	0	0	32
9	1010	120	-1.90	1.89	1.71	24	34	37
10	1130	120	-2.11	1.69	1.72	23	33	32
11	1250	120	-1.93	2.37	2.69	46	56	35
12	1370	120	-2.08	2.19	2.74	40	50	32
13	1490	120	-1.36	2.36	2.22	42	52	30
14	1610	120	-1.73	2.27	2.24	25	35	30
15	1730	120	-1.79	2.30	2.38	42	52	25
16	1850	120	-2.67	1.53	1.32	10	19	25
17	1970	120	-0.90	2.45	1.97	29	38	19
18	2090	120	-2.33	2.06	1.38	5	15	17
19	2210	120	-2.53	1.96	1.39	5	15	17
20	2330	60	-2.17	1.82	1.91	19	28	17
BR1	2390	60	-0.90	2.20	2.20	32	42	17
21	2450	100	-2.85	1.95	1.42	6	15	15
22	2550	100	-2.19	2.90	2.04	24	33	17
23	2650	100	-2.34	2.45	1.85	18	27	15
24	2750	50	-2.04	2.59	1.87	18	27	15
BR2	2800	50	-1.19	2.81	2.81	45	55	12
25	2850	105	-1.17	3.52	1.57	8	17	13
26	2955	105	-2.05	2.54	2.14	23	31	13
27	3060	105	-0.85	2.55	2.13	22	30	15
28	3165	105	-2.28	1.92	1.54	6	14	13
29	3270	50	0.64	2.44	2.56	27	35	12
BR3	3320	50	-0.42	2.88	2.88	38	48	14
30	3370	50	0.59	2.50	2.46	24	32	10
BR4	3420	50	0.36	2.56	2.56	24	31	13
31	3470	50	-0.11	3.19	3.62	38	48	12
BR5	3520	50	0.40	3.00	3.00	33	41	11
32	3570	110	0.50	3.81	3.66	47	56	10
33	3680	110	0.24	3.78	3.80	45	55	13
34	3790	60	0.20	3.80	3.84	43	52	13
BR6	3850	40	0.72	3.02	3.02	24	31	13
35	3890	110	0.54	4.14	4.13	46	55	13
36	4000	110	0.49	4.09	4.22	41	49	14
37	4110	110	1.00	4.70	4.69	55	65	13
38	4220	50	1.24	4.74	4.62	47	55	13
BR7	4270	60	1.41	4.81	4.81	55	63	10
39	4330	100	1.80	4.63	4.61	42	53	10
40	4430	100	1.82	5.62	5.62	70+	70+	10
41	4530	100	1.33	4.96	4.33	26	34	10
42	4630	100	1.66	4.45	3.88	17	28	10

Table 2.1 Flow Capacity of Bang Yai River (2/2)

Sec. no.	Distance from river mouth (m)	Incre- mental distance (m)	Elevation			Flow capacity		River width (m)
			Bottom (El.m)	Right bank (El.m)	Left bank (El.m)	With freeboard (m3/sec)	Bankfull (m3/sec)	
43	4730	100	0.96	4.36	4.38	25	31	10
44	4830	100	1.37	5.44	5.24	45	55	9
45	4930	100	1.98	6.08	6.08	65	70+	9
46	5030	50	3.00	5.53	5.53	50	62	10
BR8	5080	50	3.01	5.53	5.53	41	50	10
47	5130	125	3.54	6.33	6.34	68	70+	10
48	5255	125	3.04	6.24	6.23	30	42	10
49	5380	125	3.38	6.78	6.49	34	45	12
50	5505	125	3.64	7.24	6.28	25	34	11
51	5630	125	3.53	7.33	6.34	23	30	11
52	5755	125	5.25	9.05	8.94	70+	70+	14
53	5880	125	5.04	9.00	7.74	70+	70+	9
54	6005	125	5.52	9.33	8.53	41	52	16
55	6130	140	5.46	9.41	8.41	33	42	16
56	6270	140	5.97	9.27	8.89	45	56	14
57	6410	140	5.72	9.52	9.10	40	49	19
58	6550	140	6.57	10.37	10.49	70+	70+	14
59	6690	140	6.14	9.94	8.60	14	19	14
60	6830	140	4.82	10.13	9.09	21	27	10
61	6970	140	4.57	10.47	10.45	56	67	10
62	7110	140	5.63	10.60	10.60	57	68	10
63	7250	40	5.65	10.09	9.91	33	40	10
BR9	7290	100	5.98	9.88	9.88	38	47	8
64	7390	140	5.48	10.21	9.99	34	41	11
65	7530	140	4.50	9.16	8.98	16	20	11
66	7670	140	4.31	9.79	9.29	20	25	15
67	7810	140	5.09	9.77	9.44	22	27	15
68	7950	140	4.84	10.22	10.47	37	42	15
69	8090	140	5.90	10.52	10.50	42	49	16
70	8230	140	6.73	11.13	12.11	56	63	16
71	8370	140	8.33	11.64	12.07	70+	70+	12
72	8510	140	8.62	11.92	12.54	45	60	12
73	8650	200	8.22	12.22	12.22	39	50	12
74	8850	200	8.06	12.46	12.43	44	56	15
75	9050	200	9.44	12.99	13.03	59	70	12
76	9250	200	9.33	13.81	13.83	60	70+	14
77	9450	200	11.22	14.54	14.72	70+	70+	14
78	9650	200	11.60	14.20	15.70	37	48	14
79	9850		11.71	15.22	15.33	57	69	15

Note : BR1, Poonphol Br.  
 BR2, Taling Chan Br.  
 BR3, Pra-a-ram Br.  
 BR4, Phang-Nga Br.  
 BR5, Tuanpradit Br.

BR6, Thepkrasattri Br.3  
 BR7, Damrong Br.  
 BR8, Thepkrasattri Br.1  
 BR9, Yaovaraj Br.

Table 2.2 Principal feature of Main Bridges and Box Culverts

Bridge

Code No.	Name	River name	Road name	Length (m)	Width (m)	Remarks
BR 1	Poonphol	Bang Yai	Poonphol	16.5 (2)	7.0	
BR 2	Taling Chan	Bang Yai	Taling Chan	12.0 (3)	8.0	
BR 3	Pra-a-ram	Bang Yai	Phuket	12.0 (1)	12.0	
BR 4	Phang-Nga	Bang Yai	Phang-Nga	13.0 (1)	7.5	
BR 5	Tuanpradit	Bang Yai	Thalang	11.0 (1)	7.0	
BR 6	Thepkrasattri 3	Bang Yai	Num Pung	10.5 (3)	8.0	
BR 7	Damrong	Bang Yai	Damrong	10.0 (1)	8.0	with box
BR 8	Thepkrasattri 1	Bang Yai	Thepkrasattri	10.0 (1)	10.8	with box
BR 9	Yaovaraj	Bang Yai	Yaovaraj	8.0 (1)	8.0	
BR10	Thepkrasattri 2	Thepkrasattri	Thepkrasattri	10.0 (3)	8.0	
BR11	Toongkha	Thepkrasattri	Damrong	8.0 (1)	11.0	
BR12	Takuapa	Taling Chan	Takuapa	6.0 (1)	8.0	
BR13	Ratanakosin 200 year	Ta Kraeng	Ratanakosin 200 year	9.0 (1)	8.0	

Note : ( ), Nos. of span

Box culvert

Code No.	Name	River name	Road name	Height (m)	Width (m)	Length (m)
BC 1	-	Saen Suk	Ong Simphai	2.9	2.7 x 2 2.3 x 2	11.3
BC 2	-	Saen Suk	Tilok Utit	2.5	2.0 x 4	9.4
BC 3	-	Saen Suk	Phang-Nga	2.9	2.0 x 4	11.0
BC 4	Phapitaksinpracha	Saen Suk	Suthat	2.5	2.5 x 2	12.0
BC 5	-	Taling Chan	Bangkok	2.5	2.5 x 1	14.0
BC 6	-	Taling Chan	-	1.4	1.5 x 3	7.5
BC 7	-	Taling Chan	Rasda	1.3	2.0 x 1	11.0
BC 8	-	Taling Chan	Ranong	1.2	2.2 x 1	11.0
BC 9	-	Ta Kraeng	Chao Fa	1.2	2.0 x 3	12.5

Table 2.3 : GDP - Thailand, GDP - Southern Region and GDP - Phuket Province for 1975 - 1987  
by industrial origin at current market prices  
(million of Baht)

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
<b>Industrial origin</b>													
<b>Agriculture</b>	94064	104659	110927	120894	147075	173807	187885	186742	204443	193439	189895	180841	198284
Crops	66666	77310	79069	90180	107380	130372	138886	139652	149573	141690	105221	108217	121096
Livestock	1473	12356	14407	13504	16852	21718	24727	23807	28840	26328	14985	18670	22595
Fisheries	8434	9792	12456	13086	13017	11884	13183	14150	14456	12763	13145	11136	14304
Forestry	44770	5002	4953	6325	9125	9734	11090	11132	11164	12274	8962	9048	9037
<b>Agri. services</b>													
Mining & quarrying	4062	5174	8139	10610	12814	14494	13313	14807	16480	21291	40167	21439	24051
Manufacturing	53889	63123	74775	89089	109746	134497	158272	164660	176201	196793	224456	255029	295512
Construction	12873	15784	20250	24845	29241	39666	42006	43040	47129	52172	56824	56564	62955
Elec. & water supply	3290	3745	4384	5168	6075	6584	10743	14454	16319	18864	23590	28689	31859
Transport. & communi	18784	21828	24708	29508	37844	45351	57281	63133	73708	83588	78076	85371	92947
Wholesale & retails	54681	59391	74931	90053	102853	128731	150293	159849	165612	181393	153130	169828	192381
Bank, insu. & estate	14559	16076	19537	24624	31395	41991	52025	61022	71122	80577	35988	37376	48671
Dwellings	4413	4840	5271	5826	6297	7278	8411	9912	11210	12337	41091	44842	48802
Admin. & defence	12321	13571	14810	17943	21623	28263	30643	37349	42531	43182	48545	50612	52712
<b>Service</b>	25878	29545	33326	43953	53240	64432	75229	89170	98680	106704	142637	151129	171665
<b>GDP, Thailand</b>	298995	337738	393126	489353	553240	684812	786136	846136	924255	981359	1014373	1097679	1214030
<b>GDP per capita Baht</b>	7221	7949	9024	10330	12175	14860	16489	17359	18584	19551	19627	20790	23021
<b>Agriculture</b>	13298	16918	20255	23272	28624	31023	33105	32281	39450	37853	37209	37345	37563
Crops	8061	10873	12444	14152	16275	19735	18432	17208	21487	19780	18940	18175	17463
Livestock	1561	1700	1722	1777	2064	2107	3100	3410	4560	3720	3424	3243	3081
Fisheries	2227	3194	4454	4540	4771	4374	4837	5426	5981	5265	4746	4521	4017
Forestry	1448	1152	1636	2802	3514	4807	6735	6237	7422	9088	10099	11406	13002
<b>Agri. services</b>													
Mining & quarrying	1865	2395	4341	6055	6911	7637	5465	1473	3861	4004	3889	3762	3319
Manufacturing	1203	1336	1730	2033	2504	3155	3355	3163	3314	3916	4048	4250	4462
Construction	1242	1593	2024	2214	3173	3565	4236	4242	4807	5384	5626	6326	6952
Elec. & water supply	195	243	284	369	457	463	767	1056	1242	1432	1860	2133	2133
Transport. & communi	2002	2492	2350	2828	3568	4352	5180	5188	6069	6660	7884	8729	10326
Wholesale & retails	5862	6392	8218	9531	11230	13958	16179	16732	18363	19955	20873	22908	26131
Bank, insu. & estate	684	805	1054	1350	1725	3126	2886	3518	4300	4705	5283	5819	6663
Dwellings	448	483	547	666	662	772	862	895	1128	1248	1362	1540	1639
Admin. & defence	1233	1390	1510	1917	2862	3090	3402	4188	5033	4981	5471	6289	7265
<b>Service</b>	2460	2739	3397	4375	4748	5120	5844	6978	7905	8340	9085	9899	10343
<b>GDP, Southern Reg.</b>	30432	36790	45910	54598	63983	77661	81350	82810	92263	96578	102089	108817	119390
<b>GDP per capita Baht</b>	5899	6928	8417	9758	11057	12710	13496	13419	15058	15209	15358	15953	16725
<b>Agriculture</b>	225	311	384	401	194	511	500	466	646	560	513	455	469
Crops	55	126	139	156	183	225	212	207	253	241	234	218	221
Livestock	24	21	36	33	35	44	57	52	118	90	75	63	93
Fisheries	101	153	207	164	244	243	231	184	247	216	191	151	137
Forestry	4	11	1	8	22	0	0	12	28	12	13	13	18
<b>Agri. services</b>													
Mining & quarrying	398	338	522	545	687	753	527	483	495	513	544	551	537
Manufacturing	70	65	104	121	142	170	145	134	122	124	143	140	163
Construction	57	53	110	91	499	217	173	155	202	231	241	326	491
Elec. & water supply	37	37	38	48	53	51	87	117	111	123	133	148	161
Transport. & communi	107	180	143	178	229	328	376	432	440	488	577	681	803
Wholesale & retails	228	289	341	367	565	513	564	583	596	646	670	770	873
Bank, insu. & estate	55	65	80	108	148	212	246	308	352	390	433	434	534
Dwellings	9	10	11	13	15	17	20	24	29	32	35	56	82
Admin. & defence	46	53	58	71	87	111	119	142	163	162	176	189	225
<b>Service</b>	161	180	279	353	341	375	428	482	532	537	579	611	894
<b>GDP, Phuket Prov.</b>	1393	1650	2071	2293	3182	3247	3184	3312	3767	3814	4645	4661	5233
<b>GDP per capita Baht</b>	11901	13000	16701	18456	24232	24296	23071	23373	25291	25596	26139	29555	32613

Table 2.4 : GDP - Thailand, GDP - Southern Region and GDP - Phuket Province for 1975 - 1987  
by industrial origin at constant 1972 prices  
(million of Baht)

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
<b>Industrial origin</b>													
<b>Agriculture</b>	62083	65899	65536	72515	74408	77765	77702	78501	81450	85902	78539	78725	77163
Crops	45639	49013	46794	53563	51804	54179	56528	59904	61920	65317	51820	49662	47011
Livestock	7378	7622	8101	8516	8931	9012	9501	9896	10322	10781	9352	10311	11557
Fisheries	5735	5998	7498	7414	7281	8276	6776	5019	5368	4105	4459	4319	4199
Forestry	3331	3365	3142	3001	3392	3318	2896	2682	2630	2741	2117	2301	2171
<b>Agri. services</b>													
Mining & quarrying	2485	2906	3527	4104	4531	4786	4623	4431	4414	5415	8925	9477	9840
Manufacturing	36832	45580	48122	52522	57841	60639	64490	67318	72251	77083	81463	89305	101414
Construction	8314	10022	11996	13563	14546	16576	15500	15097	15927	17680	16635	16157	17470
Elec. & water supply	3181	3642	4144	4500	5178	5560	6300	6755	7148	8068	9324	11162	12161
Transport. & communi	13446	13366	14474	16205	17664	18811	20208	21715	23290	24605	28171	30191	32701
Wholesale & retails	33774	38821	41213	43638	45497	48227	51103	52789	55076	57430	64162	67050	74730
Bank, insu. & estate	9629	10206	11532	13471	15627	17419	19197	21396	24238	26994	11772	12006	15252
Dwellings	3555	3664	3823	4052	4289	4502	4723	4936	5178	5369	17357	18027	18971
Admin. & defence	8359	8893	9555	10166	11594	12423	13182	13834	14498	14106	21358	22030	22883
Service	19704	21276	23260	26352	28777	31173	34202	37216	39276	41536	54821	57456	63406
<b>GDP, Thailand</b>	203562	221275	237181	261127	276952	292897	311272	324033	342945	364207	394113	411814	448161
<b>GDP per capita Baht</b>	4918	5208	5444	5851	6062	6269	6520	6648	6895	7181	7625	7620	8327
<b>Agriculture</b>	9395	10096	11527	12007	11939	12073	12852	12410	13981	13968	14560	15107	15650
Crops	5436	6289	6790	8722	6641	7097	7187	7485	7738	7485	7670	7900	8137
Livestock	1096	1065	941	1124	1165	820	1167	1255	1516	1431	1471	1442	1413
Fisheries	1529	1953	2780	2773	2903	2579	2398	2642	2983	3088	3262	3425	3590
Forestry	1333	789	1016	1388	1230	1578	1700	1530	1745	1964	2156	2340	2510
<b>Agri. services</b>													
Mining & quarrying	965	1170	1459	1808	1839	1890	1632	1424	1151	1298	1152	1063	1001
Manufacturing	871	997	1156	1204	1376	1512	1302	1281	1357	1467	1510	1583	1741
Construction	821	1012	1199	1210	1580	1482	1567	1481	1604	1797	1842	1931	2026
Elec. & water supply	187	232	267	321	380	402	495	549	603	689	765	846	932
Transport. & communi	1494	1580	1566	1671	1771	2012	1951	1894	1975	2157	2285	2506	2698
Wholesale & retails	3835	4178	4520	4645	4667	4855	5301	5566	6099	6297	6513	6832	7183
Bank, insu. & estate	452	511	622	738	859	968	1065	1233	1453	1576	1730	1893	2160
Dwellings	389	376	392	413	433	452	470	489	509	525	543	576	613
Admin. & defence	827	911	974	1087	1267	1358	1465	1551	1715	1627	1729	1801	1873
Service	1807	1895	2161	2551	2578	2458	2666	2831	3018	3128	3289	3473	3661
<b>GDP, Southern Reg.</b>	21033	22951	23643	27657	28888	29462	30967	30678	33466	35228	37631	39538	
<b>GDP per capita Baht</b>	4072	4324	4736	4843	5056	5015	5144	4971	5290	5324	5400	5517	5652
<b>Agriculture</b>	156	185	218	207	247	235	232	200	252	248	259	266	278
Crops	67	70	72	83	70	72	77	81	84	86	86	89	92
Livestock	16	14	15	19	16	16	17	17	34	31	32	33	34
Fisheries	70	94	130	101	151	147	137	99	126	131	136	142	149
Forestry	4	7	1	4	8	0	0	4	8	3	3	4	3
<b>Agri. services</b>													
Mining & quarrying	215	172	169	147	178	200	147	141	136	130	140	132	119
Manufacturing	61	71	81	87	97	94	75	59	55	57	57	58	64
Construction	38	33	65	50	213	90	64	58	67	77	79	89	102
Elec. & water supply	37	36	38	41	47	46	58	64	58	63	71	79	87
Transport. & communi	80	105	93	104	122	149	153	157	153	182	196	231	273
Wholesale & retails	149	176	186	178	259	192	192	186	188	204	209	235	265
Bank, insu. & estate	36	42	48	59	73	88	91	108	119	131	142	160	180
Dwellings	7	8	6	9	10	16	11	12	13	14	14	19	28
Admin. & defence	32	35	37	40	47	49	51	53	56	53	56	59	63
Service	122	128	176	206	181	203	217	226	231	239	251	284	321
<b>GDP, Phuket Prov.</b>	832	990	1121	1126	1474	1357	1290	1362	1333	1416	1472	1614	1776
<b>GDP per capita Baht</b>	7865	8248	9040	8869	11250	10125	9247	8690	9258	9360	9621	10348	11162



Table 2.5 : Distribution of GDP - Thailand, GDP - Southern Region and GDP - Phuket Province  
for 1975 - 1987 by industrial origin at constant 1972 prices (%)

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Industrial origin													
Agriculture	30.50	29.78	27.63	27.77	25.78	24.85	24.96	24.23	23.75	23.59	19.93	19.12	17.29
Crops	22.42	22.15	19.73	20.52	18.71	18.50	18.80	18.49	18.06	17.96	13.10	11.96	10.53
Livestock	3.62	3.44	3.26	3.26	3.08	3.08	3.05	3.05	3.01	2.96	2.37	2.65	2.59
Fisheries	2.82	2.67	3.16	2.84	2.63	2.14	2.18	1.86	1.92	1.84	1.04	1.08	0.97
Forestry	1.64	1.52	1.32	1.15	1.22	1.13	0.93	0.83	0.77	0.75	0.54	0.56	0.49
Agri. services											0.61	0.56	0.51
Agricultural processing											2.26	2.30	2.20
Manufacturing	1.22	1.31	1.49	1.57	1.84	1.63	1.49	1.37	1.29	1.49	2.51	2.36	2.33
Construction	18.09	19.24	20.29	20.11	20.88	20.70	20.72	20.78	21.07	21.16	20.57	21.59	22.72
Elec. & water supply	4.18	4.53	5.06	5.20	5.25	5.66	4.98	4.66	4.84	4.85	4.22	3.92	3.91
Transport. & communi	1.56	1.63	1.75	1.72	1.87	1.90	2.03	2.08	2.14	2.22	2.52	2.71	2.72
Wholesale & retail	5.61	5.04	6.10	6.21	6.38	6.42	6.47	6.70	6.79	6.76	7.15	7.33	7.33
Bank, insu. & estate	17.57	17.34	17.38	16.72	16.43	16.47	16.42	16.23	15.06	15.77	16.28	16.23	16.74
Dwellings	4.73	4.61	4.86	5.16	5.64	5.95	6.17	6.60	7.07	7.41	2.99	2.92	3.42
Admin. & defence	1.75	1.66	1.61	1.55	1.53	1.54	1.52	1.52	1.51	1.47	4.40	4.38	4.25
Service	4.11	4.02	4.03	3.89	4.19	4.24	4.24	4.27	4.23	3.87	5.42	5.35	5.08
GDP, Thailand	9.68	9.62	9.81	10.09	10.39	10.64	10.99	11.48	11.53	11.40	13.91	13.95	14.21
GDP, Thailand	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Agriculture	44.63	43.97	44.60	43.41	41.19	40.98	41.50	40.45	41.76	40.45	40.56	40.15	39.58
Crops	23.62	23.39	26.27	24.30	22.91	24.09	23.21	22.77	23.12	21.68	21.37	20.99	20.58
Livestock	5.21	4.64	3.64	4.06	4.02	2.78	3.77	4.09	4.53	4.14	4.10	3.83	3.57
Fisheries	7.26	8.51	10.76	10.03	10.01	8.75	9.04	8.61	8.91	8.94	9.09	9.18	9.08
Forestry	6.33	3.44	3.93	5.02	4.24	5.36	5.49	4.99	5.21	5.69	6.01	6.22	6.35
Agri. services													
Agricultural processing													
Manufacturing	4.68	5.10	5.65	6.54	6.34	6.42	5.27	4.64	3.44	3.76	3.21	2.82	2.53
Construction	4.14	4.34	4.47	4.35	4.75	5.13	4.20	4.18	4.05	4.25	4.21	4.21	4.40
Elec. & water supply	3.50	4.41	4.64	4.38	5.45	5.03	5.06	4.83	4.78	5.20	5.13	5.13	5.12
Transport. & communi	0.89	1.01	1.03	1.16	1.31	1.36	1.60	1.79	1.80	2.00	2.13	2.25	2.36
Wholesale & retail	7.10	6.88	6.06	6.04	6.11	6.93	6.30	6.14	5.90	6.25	6.37	6.56	6.82
Bank, insu. & estate	18.22	18.20	17.49	16.80	17.13	16.48	17.76	18.01	18.32	18.24	18.14	18.21	18.17
Dwellings	2.15	2.23	2.41	2.67	2.96	3.29	3.44	4.02	4.34	4.56	4.82	5.03	5.46
Admin. & defence	1.75	1.65	1.52	1.49	1.49	1.53	1.52	1.59	1.52	1.52	1.51	1.53	1.55
Service	3.93	3.97	3.77	3.93	4.37	4.61	4.73	5.06	5.12	4.71	4.82	4.79	4.74
GDP, Southern Reg.	8.58	8.25	8.36	9.22	8.69	8.34	8.61	9.29	9.02	9.06	9.11	9.23	9.26
GDP, Southern Reg.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Agriculture	16.74	18.69	19.45	18.38	16.76	17.32	17.96	15.85	18.76	17.51	17.60	16.60	15.64
Crops	7.19	7.07	6.42	7.37	4.75	5.31	5.97	6.42	6.25	5.86	5.84	5.51	5.17
Livestock	1.72	1.41	1.43	1.69	1.22	1.18	1.32	1.35	2.33	2.19	2.17	2.04	1.91
Fisheries	7.51	9.49	11.60	8.97	10.24	10.83	10.62	7.84	9.38	8.25	9.38	8.80	8.38
Forestry	0.43	0.71	0.09	0.36	0.54	0.00	0.00	0.32	0.60	0.21	0.20	0.23	0.17
Agri. services													
Agricultural processing													
Manufacturing	23.07	17.37	15.08	13.06	12.08	14.74	11.40	11.17	10.28	10.59	9.51	8.18	6.69
Construction	6.55	7.17	7.23	7.73	6.58	6.93	5.81	4.68	4.10	4.03	3.87	3.59	3.60
Elec. & water supply	4.08	3.33	3.80	4.44	14.45	6.63	4.60	4.60	4.98	5.44	5.37	5.51	3.74
Transport. & communi	3.97	3.64	3.39	3.64	3.19	3.39	4.50	5.07	4.45	4.45	4.82	4.89	4.89
Wholesale & retail	8.58	10.81	8.30	9.24	8.28	10.98	11.86	12.44	11.34	12.85	13.32	14.31	15.35
Bank, insu. & estate	15.99	17.78	16.77	15.81	17.57	14.15	14.88	14.74	14.41	14.41	14.20	14.56	14.90
Dwellings	3.86	4.24	4.28	5.24	4.55	6.48	7.03	8.56	6.66	8.25	9.65	9.91	10.12
Admin. & defence	0.75	0.81	0.71	0.80	0.68	0.74	0.83	0.95	0.97	0.99	0.95	1.18	1.46
Service	3.43	3.34	3.30	3.55	3.19	3.61	3.95	4.20	4.17	3.74	3.80	3.66	3.54
GDP, Phuket Prov.	13.09	12.93	15.70	18.29	12.28	14.96	16.82	17.91	17.20	16.88	17.05	17.60	18.05
GDP, Phuket Prov.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 2.6 : Growth Rate of GDP - Thailand, GDP - Southern Region and GDP - Phuket Province for 1975 - 1987 by industrial origin at constant 1972 prices

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1981/84 1984/87 (Annual aver.)
Industrial origin													
Agriculture	106.15	99.45	110.85	98.47	101.93	105.76	101.03	103.76	105.47	91.43	100.24	98.02	3.40
Crops	107.39	95.47	114.51	96.68	104.58	108.03	102.35	103.37	105.81	98.79	105.43	98.43	3.83
Livestock	103.31	106.28	105.12	104.87	100.91	105.43	104.16	104.41	104.35	86.75	105.73	105.73	4.30
Fisheries	102.84	107.14	98.87	98.21	86.20	108.00	88.80	109.12	104.45	59.81	98.82	98.82	0.42
Forestry	101.02	93.37	95.51	113.63	97.62	87.28	95.61	98.05	104.22	77.33	108.30	108.30	-1.82
Agri. services													
Agri. processing	116.94	121.37	116.36	110.40	105.40	96.72	95.85	99.52	122.88	182.84	167.88	167.88	5.41
Mining & quarrying	115.61	113.02	109.74	110.23	104.54	93.35	194.39	107.33	106.58	105.68	109.03	109.03	6.13
Manufacturing	117.71	119.70	113.24	107.09	113.96	93.51	194.39	107.33	106.58	105.68	109.03	109.03	4.48
Construction	114.49	113.78	108.59	115.37	107.38	112.83	107.71	108.78	109.80	123.12	108.13	108.13	8.42
Elec. & water supply	109.41	108.29	111.36	109.00	106.49	107.43	107.43	107.25	108.63	114.49	107.17	107.17	6.78
Transport. & communi	108.52	106.16	103.93	104.21	106.00	105.86	103.30	104.33	104.37	111.72	104.50	104.50	9.95
Wholesale & retails	105.59	112.99	116.81	116.30	111.47	110.21	111.45	113.28	111.37	43.61	101.99	121.45	12.03
Bank, insu. & estate	103.07	104.34	105.99	105.65	104.97	104.91	104.51	104.90	103.88	33.28	103.88	103.88	17.33
Dwellings	106.39	107.44	106.39	114.85	107.15	106.19	104.97	104.90	97.30	131.11	103.66	103.66	4.37
Admin. & defence	107.98	109.33	113.29	109.20	108.33	109.72	108.81	105.54	103.75	131.56	104.99	104.99	5.26
Service	107.98	109.33	113.29	109.20	108.33	109.72	108.81	105.54	103.75	131.56	104.99	104.99	6.59
GDP, Thailand	108.70	107.19	110.10	106.06	106.27	104.10	103.84	106.20	108.20	108.20	104.99	104.99	1.11
GDP, per capita	105.90	104.53	107.48	103.61	103.41	104.00	111.96	103.42	104.15	106.20	102.54	102.54	5.06
Agri. processing	107.46	115.17	104.16	99.33	101.12	106.45	98.66	112.86	99.71	104.74	103.78	103.78	2.81
Mining & quarrying	115.69	107.97	109.00	98.80	106.87	101.27	97.18	100.80	96.73	102.47	103.00	103.00	3.86
Manufacturing	127.17	88.36	119.45	103.65	107.39	142.32	107.54	120.80	94.39	102.60	98.03	97.99	2.82
Livestock	127.73	142.35	99.75	104.69	88.84	108.49	94.42	112.31	103.52	103.52	103.00	104.82	7.03
Fisheries	59.19	128.77	136.61	88.62	128.29	107.73	90.00	114.05	112.55	109.78	108.53	107.26	3.34
Forestry													5.15
Agri. services													8.52
Agri. processing	118.78	124.70	123.92	101.71	102.77	86.33	87.25	80.33	118.77	88.75	92.27	94.17	7.35
Mining & quarrying	114.47	115.95	114.15	114.29	109.88	86.11	96.39	106.11	118.11	120.53	104.82	104.82	4.06
Manufacturing	123.26	118.48	100.92	100.58	92.90	105.74	94.51	106.31	112.03	102.53	104.82	104.82	4.87
Construction	124.06	115.08	120.22	108.28	105.79	123.13	106.31	104.63	109.22	105.98	109.59	109.59	1.65
Elec. & water supply	105.76	98.11	105.70	102.38	102.38	97.75	98.57	104.63	109.22	105.98	109.59	109.59	7.75
Transport. & communi	108.93	108.19	102.71	108.53	113.61	113.31	100.45	110.77	103.25	103.43	105.20	104.83	4.49
Wholesale & retails	113.05	121.72	118.65	118.40	112.69	110.02	115.77	117.04	108.47	103.43	105.20	104.83	13.96
Bank, insu. & estate	102.44	103.70	105.36	104.84	104.39	103.88	104.04	104.09	103.14	103.43	106.08	106.42	1.08
Dwellings	102.44	103.70	105.36	104.84	104.39	103.88	104.04	104.09	103.14	103.43	106.08	106.42	5.30
Admin. & defence	104.87	114.04	118.05	101.96	95.35	108.46	106.94	105.66	103.64	104.51	106.24	106.24	4.61
Service	104.87	114.04	118.05	101.96	95.35	108.46	106.94	105.66	103.64	104.51	106.24	106.24	3.56
GDP, Southern Reg.	109.66	112.55	107.02	104.81	101.64	105.11	99.07	109.09	103.77	103.57	102.62	102.62	5.47
GDP, per capita	106.19	109.57	104.33	102.29	99.19	102.57	95.64	106.42	100.64	101.43	102.17	102.17	3.99
Agri. processing													2.01
Mining & quarrying	118.59	117.84	94.95	119.32	95.14	88.72	86.21	126.00	98.41	104.44	102.47	102.47	3.88
Crops	104.48	102.86	115.28	84.74	102.86	105.94	105.19	103.70	98.81	103.61	103.49	103.49	2.33
Livestock	87.50	114.29	118.75	94.74	88.89	105.25	100.00	200.00	91.18	103.22	103.13	103.03	22.17
Fisheries	124.29	108.30	77.69	149.50	97.35	93.20	72.26	177.27	103.97	103.34	102.90	104.93	1.48
Forestry	175.00	14.29	400.60	200.60				200.00	37.50				
Agri. services													
Agri. processing	80.00	98.26	86.98	121.89	112.36	73.50	95.92	91.97	108.70	92.33	94.29	90.15	0.58
Mining & quarrying	116.39	114.08	107.41	111.49	96.91	78.79	78.67	97.82	103.64	100.00	101.75	101.75	8.74
Manufacturing	86.84	196.97	76.92	42.25	97.87	121.00	100.63	115.23	102.60	102.60	102.60	102.60	9.56
Construction	97.30	105.56	107.89	114.63	97.87	126.09	102.68	98.73	108.32	102.60	102.60	102.60	9.56
Elec. & water supply	131.25	88.57	111.83	117.31	124.13	102.68	102.68	98.73	108.32	102.60	102.60	102.60	14.36
Transport. & communi	118.12	106.82	94.68	145.31	124.13	102.68	102.68	98.73	108.32	102.60	102.60	102.60	14.36
Wholesale & retails	116.67	114.29	122.92	123.73	120.55	103.41	106.68	106.45	103.03	102.45	102.45	102.45	9.11
Bank, insu. & estate	114.28	100.00	122.92	123.73	120.55	103.41	106.68	106.45	103.03	102.45	102.45	102.45	14.36
Dwellings	109.28	105.71	108.11	117.11	100.00	110.00	109.92	108.33	107.69	105.66	105.66	105.66	1.99
Admin. & defence	104.92	107.50	117.05	87.86	124.26	104.08	104.08	104.66	94.64	105.66	105.66	105.66	3.33
Service	104.92	107.50	117.05	87.86	124.26	104.08	104.08	104.66	94.64	105.66	105.66	105.66	3.33
GDP, Phuket Prov.	106.22	113.23	100.45	139.91	92.06	95.06	97.83	102.21	103.46	103.95	103.03	103.03	3.76
GDP, per capita	103.55	109.60	98.11	126.65	89.98	92.33	95.11	104.15	102.60	101.27	107.54	108.08	0.54

Table 2.7 : Estimated GDP - Phuket Municipality out of GDP - Phuket Province for 1975 - 1987  
by industrial origin at current prices (million of Baht) and their  
Sectoral Distribution (%) & Annual Growth Rate (%)

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
<b>Industrial origin</b>													
Agriculture	225	311	384	401	494	511	500	465	645	560	513	455	469
Crops	95	126	139	196	193	225	212	207	253	241	234	216	221
Livestock	24	21	36	36	35	44	57	53	118	60	75	63	93
Fisheries	101	153	207	164	244	243	231	194	247	216	191	161	137
Forestry	4	11	1	8	22	0	0	12	28	13	13	13	18
Mining & quarrying	398	338	522	545	687	753	527	485	495	513	544	551	537
Manufacturing	70	65	104	121	142	170	145	134	122	134	143	150	163
Construction	57	53	110	91	429	217	173	165	202	231	241	326	491
Elec. & water supply	37	37	38	48	55	51	87	117	111	123	133	148	161
Transport. & communi	107	160	143	178	229	328	376	432	440	498	577	681	803
Wholesale & retail	228	269	341	367	586	513	564	563	596	646	670	770	873
Bank, insur. & estate	55	65	80	108	146	212	246	308	352	390	433	494	534
Dwellings	9	10	11	13	13	17	20	24	29	32	35	56	82
Admin. & defence	46	53	58	71	87	111	119	142	163	162	176	189	226
Service	181	180	279	353	324	375	428	482	512	537	579	611	594
GDP, Phuket Prov.	1393	1650	2071	2293	3193	3257	3184	3319	3687	3814	4045	4561	5233
GDP per capita Baht	11901	13000	16701	18056	24373	24309	23071	23373	25391	25596	26439	28595	32913
<b>Distribution by sector</b>													
Manufacturing	21	20	31	36	43	51	44	40	37	40	43	45	49
Construction	17	16	33	27	129	65	52	50	61	69	72	98	147
Elec. & water supply	11	11	11	11	17	15	26	35	33	37	40	44	48
Transport. & communi	32	48	43	53	69	98	113	130	132	146	173	204	241
Wholesale & retail	114	135	171	184	293	257	282	282	298	323	335	385	437
Bank, insur. & estate	28	33	40	54	73	106	123	154	176	195	217	247	267
Dwellings	5	5	6	7	8	9	10	12	15	16	18	28	41
Admin. & defence	23	27	29	36	44	56	60	71	82	81	88	95	113
Service	81	90	140	137	162	188	214	241	255	269	290	306	347
GDP, Phuket Municip.	331	383	503	587	836	844	923	1014	1085	1178	1275	1452	1790
GDP per capita Baht	10000	11000	14000	16000	21000	21000	22000	23000	24000	25000	26000	28000	33000
<b>Distribution by sector</b>													
Manufacturing	5.09	6.20	6.18	5.10	5.10	6.04	4.71	3.96	3.35	3.42	3.37	3.10	2.73
Construction	5.17	4.15	8.56	4.65	15.40	7.72	5.62	4.88	5.57	5.89	5.67	8.74	8.23
Elec. & water supply	3.36	2.90	2.27	2.45	1.97	1.81	2.83	3.46	3.06	3.14	3.13	3.06	2.70
Transport. & communi	9.70	12.53	8.53	9.09	8.22	11.66	12.22	12.78	12.13	12.45	13.58	14.08	13.48
Wholesale & retail	34.46	35.12	33.89	31.24	35.07	30.40	30.56	27.76	27.38	27.46	28.28	26.52	24.39
Bank, insur. & estate	8.31	8.49	7.93	9.19	8.74	12.38	13.33	15.19	16.17	16.58	18.98	17.02	14.92
Dwellings	1.36	1.31	1.09	1.11	0.90	1.01	1.08	1.18	1.33	1.36	1.37	1.93	2.29
Admin. & defence	6.95	6.92	5.77	6.04	5.21	6.58	6.45	7.00	7.43	6.89	6.90	6.51	6.31
Service	24.33	23.50	27.73	30.05	19.39	22.22	23.19	23.77	23.52	23.83	22.71	21.05	24.97
GDP, Phuket Municip.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
<b>Annual growth</b>													
Manufacturing	32.86	160.00	116.35	117.46	119.72	83.39	92.41	91.04	109.84	106.72	104.90	108.67	1981.84 1984.87
Construction	92.86	207.53	82.73	471.43	50.58	79.72	95.38	122.42	114.36	104.33	135.27	150.61	(Annual aver.)
Elec. & water supply	100.00	102.70	126.32	114.58	92.73	170.59	134.48	94.87	110.81	105.13	111.28	108.78	-2.60 6.75
Transport. & communi	19.53	89.36	124.48	128.63	143.23	114.83	114.89	94.87	110.81	105.13	111.28	108.78	10.12 28.57
Wholesale & retail	117.8	125.77	101.52	159.77	157.54	109.54	93.82	105.85	108.36	103.77	115.62	117.91	12.24 28.57
Bank, insur. & estate	118.18	125.08	135.09	135.19	157.51	116.04	122.20	114.28	110.80	103.77	115.62	117.91	18.06 18.06
Dwellings	111.11	110.09	121.18	125.58	117.77	117.55	122.00	120.63	110.34	103.77	115.62	117.91	16.60 11.04
Admin. & defence	115.22	109.43	122.44	122.58	127.59	107.43	118.33	114.79	99.39	106.84	107.38	119.58	16.86 38.94
Service	111.80	115.00	125.32	122.44	127.59	107.43	118.33	114.79	99.39	106.84	107.38	119.58	11.74 15.02
GDP, Phuket Municip.	115.78	131.33	116.78	142.24	100.99	109.51	108.39	107.65	106.35	107.37	113.87	123.31	7.46 14.10

**Table 2.8 : Estimated GMP - Phuket Municipality out of GDP - Phuket Province for 1975 - 1987**  
By industrial origin at constant 1972 prices (million of Baht) and their  
Sectoral Distribution (%) & Annual Growth Rate (%)

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
<b>Industrial origin</b>													
<b>Agriculture</b>	156	185	218	207	247	235	232	200	252	243	259	268	278
Crops	87	70	72	83	70	72	77	81	84	83	86	89	92
Livestock	16	14	16	19	18	16	17	17	34	31	32	33	34
Fisheries	70	94	130	101	151	147	137	99	126	131	138	142	149
Forestry	4	7	1	4	4	0	0	4	8	3	3	4	3
<b>Mining &amp; quarrying</b>	215	172	169	147	178	200	147	141	138	150	140	132	119
Manufacturing	61	71	81	87	97	94	75	59	55	57	57	58	64
Construction	38	33	65	50	213	90	64	58	67	77	79	89	102
Elec. & water supply	37	36	38	41	47	46	56	64	57	63	71	79	87
Transport. & communi	80	105	93	104	122	149	153	157	155	182	196	231	273
Wholesale & retails	149	176	188	178	259	192	192	186	198	204	209	235	265
Bank, insu. & estate	36	42	48	59	73	88	91	108	119	131	142	160	180
Dwellings	7	8	8	9	10	10	11	12	13	14	14	19	26
Admin. & defence	32	35	37	40	47	49	51	53	56	53	56	59	63
Service	122	128	176	206	181	203	217	226	231	239	251	284	321
GDP, Phuket Prov.	932	980	1121	1126	1474	1357	1290	1262	1343	1416	1472	1614	1778
GDP per capita Baht	7965	8248	9040	8869	11250	10123	9347	8390	9259	9500	9621	10346	11182
<b>Manufacturing</b>	18	21	24	26	29	28	23	18	17	17	17	17	19
Construction	11	10	20	15	64	27	19	17	20	23	24	27	31
Elec. & water supply	11	11	11	12	14	14	17	19	17	19	21	24	26
Transport. & communi	24	32	28	31	37	45	46	47	47	55	59	69	82
Wholesale & retails	75	88	94	89	130	96	96	93	99	102	105	118	133
Bank, insu. & estate	18	21	24	30	37	44	46	54	60	66	71	80	90
Dwellings	4	4	4	4	5	5	6	6	7	7	7	10	13
Admin. & defence	16	18	19	20	24	25	26	27	28	27	28	30	32
Service	61	64	88	103	91	102	109	113	116	120	126	142	161
GDP, Phuket Municipality	238	268	312	331	429	385	386	394	409	434	457	516	585
GDP per capita Baht	238	268	312	331	429	385	386	394	409	434	457	516	585
<b>Distribution by sector:</b>													
Manufacturing	7.70	7.95	7.80	7.89	6.79	7.33	5.83	4.49	4.03	3.94	3.74	3.37	3.28
Construction	4.79	3.89	6.26	4.54	14.91	7.32	4.97	4.42	4.91	5.32	5.19	5.18	5.23
Elec. & water supply	4.67	4.03	3.66	3.72	3.29	3.29	4.51	4.87	4.23	4.35	4.68	4.60	4.46
Transport. & communi	10.09	11.75	8.95	9.44	8.54	11.89	11.96	11.96	12.57	12.87	12.44	13.99	13.99
Wholesale & retails	31.33	32.84	30.17	26.92	30.21	24.95	24.87	23.61	24.21	23.49	22.87	22.79	22.64
Bank, insu. & estate	7.57	7.84	7.70	8.92	8.51	11.44	11.79	13.71	14.53	15.09	15.54	15.52	15.38
Dwellings	1.47	1.49	1.28	1.36	1.17	1.00	1.42	1.52	1.59	1.61	1.53	1.64	2.22
Admin. & defence	6.73	6.53	5.94	6.05	5.48	6.37	6.61	6.73	6.85	6.16	6.13	5.72	5.38
Service	25.65	23.88	28.24	31.16	21.11	26.38	28.11	28.69	28.21	27.52	27.17	27.54	27.42
GDP, Phuket Municipality	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
<b>Annual growth:</b>													
Manufacturing	116.39	14.09	107.41	111.49	96.91	79.79	78.67	93.22	103.64	100.00	101.75	110.34	110.34
Construction	68.84	186.97	76.92	426.00	42.25	71.11	90.63	115.52	114.33	102.63	112.86	114.61	9.83
Elec. & water supply	97.30	105.36	107.89	114.63	97.87	126.09	110.74	98.63	108.62	112.70	111.77	112.13	6.36
Transport. & communi	131.25	88.57	111.83	117.31	122.13	102.66	102.61	98.73	111.42	107.59	117.56	118.18	2.79
Wholesale & retails	118.12	106.82	94.68	145.51	74.13	100.00	96.88	101.15	103.03	102.53	112.47	112.77	5.99
Bank, insu. & estate	114.29	114.29	122.92	123.71	120.55	131.41	118.68	111.19	110.08	116.40	112.50	112.50	2.94
Dwellings	114.29	100.00	112.50	111.11	100.00	100.00	109.09	109.09	109.09	109.09	109.09	109.09	1.91
Admin. & defence	109.38	105.71	108.11	117.50	104.26	104.08	104.08	104.08	104.08	104.08	104.08	104.08	1.29
Service	104.92	137.50	117.05	87.86	112.15	106.90	104.08	104.08	104.08	104.08	104.08	104.08	104.08
GDP, Phuket Municipality	112.70	116.27	106.10	123.67	89.74	90.34	102.53	102.53	102.53	102.53	102.53	102.53	102.53
GDP per capita Baht	112.70	116.27	106.10	123.67	89.74	90.34	102.53	102.53	102.53	102.53	102.53	102.53	102.53

Table 2.9 Schools in Study Area

Reference No.	Name of School	Level of Education	No. of Pupils/ Students	No. of Teachers	Dormitories	Students from Other Provinces
1	Tesaban Boon Banya School	nursery & primary	1,282	43	no	0
2	Tesaban Ban Samkong School	nursery & primary	294	15	no	0
3	Tesaban Muang Phuket School	primary	916	40	no	0
4	Tesaban Watkajornrung School	primary	958	44	no	0
5	Tasaban Banbangnaeng School	primary	1,071	38	no	0
6	Anuban Phuket School	nursery & primary	1,500	87	no	0
7	Bantaladnuaa School	nursery & primary	675	44	no	0
8	Piboon Sawasdi School	nursery & primary	766	60	no	0
9	Koku School	nursery & primary	132	19	no	23
10	Vichit Songkram School	primary	208	23	no	0
11	Anuban Kongkuan School	nursery	220	8	no	0
12	Anuban Phuket Kultida School	nursery	170	9	no	0
13	Darasmut Phuket School	nursery & Primary	1,089	37	yes	16
14	Tapamruaywittaya School	nursery & primary	275	15	yes	33
15	Phuket Taihua School	primary	389	24	no	0
16	Kanjanawatwittaya School	primary	596	21	no	0
17	Prateepwittaya School	primary	175	8	no	0
18	Kajornkaatsua School	primary	222	10	no	0
19	Naravit School	primary	217	7	no	0
20	Tamsupapagdee School	primary	343	14	no	0
21	Dauwrungrwittaya School	nursery to secondary	494	26	yes	7
22	Puttamongkonninit School	nursery to secondary	773	35	yes	40
23	Prasanvittaya School	primary	285	11	no	8
24	Stri Phuket School	secondary	2,674	167	no	235
25	Vittaya Phuket School	secondary	2,654	173	no	361
26	Taknoloyee Phuket School	post-secondary level	704	29	yes	202
27	Phuket Vocational College	post-secondary level	1,574	74	no	398
28	Phuket Technical College	post-secondary level	1,747	109	no	406
29	Phuket Teachers College	post-secondary level	952	137	yes(approx. 400 students)	-
30	Phuket Community College	post-secondary level	294	26	no	-
Total			23,631	1,353		1,729

Source : DTCP Analysis Report 1988

Table 2.10 Hotels in Study Area

Reference No.	Name of Hotel	No. of Rooms	Remarks
1.	Damrong Hotel	79	Approx. 28 employees
2.	999 Hotel	29	
3.	Imperial Hotel	39	Approx. 24 employees
4.	Kittikorn Hotel	25	being expanded
5.	Kohsawan Hotel	16	
6.	Lamethong Hotel	29	
7.	Montri Hotel	72	
8.	On On Hotel	53	
9.	Pearl Hotel	200	Approx. 300 employees
10.	Phoonplo Hotel	14	
11.	Phuket Merlin Hotel	180	Approx. 260 employees
12.	Phuket Motel	29	
13.	P.S. Inn Hotel	86	
14.	Siri Hotel	30	
15.	Jaroensook Hotel	25	
16.	Rasada Hotel	15	
17.	Siam Hotel	20	
18.	Sintawee Hotel	108	being expanded approx 23 employees
19.	Sukasbye Hotel	53	
20.	June Hotel	28	
21.	Thara Hotel	16	
22.	T. Songsaeng Hotel	32	
23.	Thavorn Hotel	200	Approx. 78 employees including restaurant staff
24.	Down Town Inn	24	Approx. 21 employees
25.	City Hotel	165	Approx. 161 employees
26.	Phuket Garden Hotel	127	Approx. 124 employees
27.	Imperial Hotel 2	50	
28.	Roongrawee Mansion	29	
29.	Wasama Guesthouse	28	
30.	Daeng Plaza Hotel	80	
Total		1,881	

Source : List of Hotels and Bungalows in Phuket  
TAT 1989

Table 2.11 Food and Water borne Disease in Phuket and Thailand

Year	Rate/1,000											
	Diarrhoea		Food poisoning		Dysentery		Enteric fever		Typhoid		Hepatitis	
	PKT	Nation- wide	PKT	Nation- wide	PKT	Nation- wide	PKT	Nation- wide	PKT	Nation- wide	PKT	Nation- wide
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
2525-1982	11.	6.76	0.68	0.57	0.42	1.10	0.97	0.29	0.04	0.11	0.39	0.19
2526-1983	14.02	8.53	0.78	0.70	0.61	1.31	0.73	0.30	0.08	0.12	0.36	0.23
2527-1984	10.43	8.22	0.80	0.73	0.12	1.13	1.18	0.33	0.06	0.14	0.29	0.29
2528-1985	12.38	8.58	0.81	0.77	0.75	1.26	1.31	0.36	0.14	0.14	0.62	0.35
2529-1986	13.95	10.27	1.32	0.86	0.87	1.56	0.82	0.33	0.17	0.13	0.47	0.41
2530-1987	26.03	12.50	1.26	0.97	2.41	2.48	1.39	0.50	0	0.21	0.21	0.41
2531-1988	24.24		1.34		3.07		0.58		0.25		0.49	
2532-1989	18.08	6.68	0.56	0.53	2.08	0.91	0.26	0.11	0.12	0.05	0.20	0.12

Source: (1) Phuket Municipality (Year 1982-1989 June)

(2) Ministry of Public Health "Annual Epidemiologic Surveillance Report" 1987 &amp; 1989 prompt report

Table 3.1 Estimated Population Distribution in 2006

Zone	Total	LU1	LU2	LU3	LU4	LU5
A1	1530	0	0	1530	0	0
A2	970	0	25	945	0	0
A3	1383	0	0	1383	0	0
A4	1640	0	0	1640	0	0
A5	1351	0	0	1351	0	0
A total	6874	0	25	6849	0	0
B1	1710	0	0	1710	0	0
B2	3661	0	0	3661	0	0
B3	2222	0	0	2222	0	0
B4	1772	0	0	1772	0	0
B5	1221	12	1209	0	0	0
B6	2171	1099	1072	0	0	0
B total	12757	1111	2281	9365	0	0
C1	1223	0	1223	0	0	0
C2	1841	920	921	0	0	0
C3	1888	1888	0	0	0	0
C4	1023	850	0	173	0	0
C5	1643	1643	0	0	0	0
C6	1766	1766	0	0	0	0
C7	2869	0	2869	0	0	0
C total	12252	7066	5013	173	0	0
D1	1846	0	1846	0	0	0
D2	1235	0	1235	0	0	0
D3	1339	1339	0	0	0	0
D4	1558	1558	0	0	0	0
D5	4120	120	770	3230	0	0
D6	3730	425	2183	1122	0	0
D total	13828	3442	6034	4352	0	0
E1	5155	89	5066	0	0	0
E2	1805	1805	0	0	0	0
E3	2783	1991	0	792	0	0
E4	1236	1236	0	0	0	0
E total	10979	5121	5066	792	0	0
In-Munici.	56689	16739	18419	21531	0	0
T.Rasada	12886	7454	1889	0	2479	1063
T.Vichit	4623	4623	0	0	0	0
F zone	100	100	0	0	0	0
Out-Munici	17609	12177	1889	0	2479	1063
DTCP Area	74298	28917	20309	21531	2479	1063
S zone	3045					
Bang Ping	860					
Study Area	78203					

LU1 : Low density residential zone

LU2 : Medium density residential zone

LU3 : Commercial and high density residential zone

LU4 : Industrial zone

LU5 : Agricultural and rural zone

Source : Analysis Report for Phuket Town Plan, DTCP 1989  
 Analysis and Estimation by the Study Team



Table 3.2 Estimated Population Distribution in 2001

Zone	Total	LU1	LU2	LU3	LU4	LU5
A1	1530	0	0	1530	0	0
A2	970	0	25	945	0	0
A3	1383	0	0	1383	0	0
A4	1640	0	0	1640	0	0
A5	1351	0	0	1351	0	0
A total	5874	0	25	6849	0	0
B1	1710	0	0	1710	0	0
B2	2926	0	0	2926	0	0
B3	2116	0	0	2116	0	0
B4	1772	0	0	1772	0	0
B5	1221	12	1209	0	0	0
B6	2171	1099	1072	0	0	0
B total	11916	1111	2281	8524	0	0
C1	1120	0	1120	0	0	0
C2	1841	920	921	0	0	0
C3	1888	1888	0	0	0	0
C4	1023	850	0	173	0	0
C5	1643	1643	0	0	0	0
C6	1754	1754	0	0	0	0
C7	2293	0	2293	0	0	0
C total	11562	7055	4334	173	0	0
D1	1846	0	1846	0	0	0
D2	1235	0	1235	0	0	0
D3	1339	1339	0	0	0	0
D4	1558	1558	0	0	0	0
D5	3293	96	615	2581	0	0
D6	2981	340	1745	897	0	0
D total	12252	3333	5441	3478	0	0
E1	5155	89	5066	0	0	0
E2	1442	1442	0	0	0	0
E3	2224	1591	0	633	0	0
E4	1235	1235	0	0	0	0
E total	19058	4359	5066	633	0	0
In-Munici.	52661	15856	17148	19657	0	0
T. Rasada	12886	7454	1889	0	2479	1963
T. Vichit	3695	3695	0	0	0	0
F zone	80	80	0	0	0	0
Out-Munici	16661	11229	1889	0	2479	1063
DTCP Area	69322	27085	19037	19657	2479	1963
S zone	3045					
Bang Ping	859					
Study Area	73227					

LU1 : Low density residential zone

LU4 : Industrial zone

LU2 : Medium density residential zone

LU5 : Agricultural and rural zone

LU3 : Commercial and high density residential zone

Source : Analysis Report for Phuket Town Plan, DTCP 1989

Analysis and Estimation by the Study Team

Table 3.3 Water Distribution and Consumption

Year	Distrib. (cu m/mo) (A)	Consump. (cu m/mo) (B)	Conn. (nos.) (C)	Unaccount. (I) (D)	Per Conn. (cu m/d) (E)	Per House (pers.) (F)	Per Capita (lpcd) (G)	Fluctu. (%) (H)
Month					$=(B)/(C)$	$=(E)/(F)$	$=(B)/(H)$	
1984								
Jan	237.550	207.110	4.408	0.872	1.516	4.58	331	0.081
Feb	222.290	203.176	4.418	0.814	1.586	4.58	346	0.080
Mar	237.550	228.634	4.422	0.962	1.668	4.58	364	0.090
Apr	229.920	204.325	4.475	0.889	1.522	4.58	332	0.080
May	264.890	240.721	4.485	0.909	1.731	4.58	378	0.095
Jun	250.860	226.025	4.500	0.901	1.674	4.58	366	0.089
Jul	258.820	222.270	4.515	0.859	1.588	4.58	347	0.087
Aug	259.480	210.584	4.531	0.812	1.499	4.58	327	0.083
Sep	250.080	181.913	4.543	0.727	1.335	4.58	291	0.072
Oct	258.000	212.523	4.558	0.824	1.504	4.58	328	0.084
Nov	246.620	185.270	4.583	0.751	1.348	4.58	294	0.073
Dec	259.920	218.736	4.631	0.842	1.524	4.58	333	0.086
Total	2,975.980	2,531.287	4.506	0.854	1.541	4.58	336	1.000
1985								
Jan	259.870	223.782	4.653	0.881	1.551	4.55	341	0.077
Feb	275.090	238.016	4.672	0.865	1.819	4.55	400	0.082
Mar	289.550	246.102	4.695	0.850	1.691	4.55	372	0.085
Apr	294.400	252.135	4.714	0.856	1.783	4.55	392	0.087
May	281.970	241.459	4.728	0.856	1.647	4.55	362	0.083
Jun	287.390	249.385	4.797	0.868	1.733	4.55	381	0.086
Jul	282.210	236.744	4.818	0.839	1.585	4.55	348	0.082
Aug	297.120	248.756	4.822	0.837	1.684	4.55	366	0.086
Sep	294.720	254.362	4.830	0.863	1.755	4.55	386	0.089
Oct	280.340	234.460	4.838	0.836	1.563	4.55	344	0.081
Nov	273.120	229.482	4.848	0.840	1.578	4.55	347	0.079
Dec	278.400	244.563	4.869	0.878	1.620	4.55	356	0.084
Total	3,394.180	2,899.247	4.774	0.854	1.664	4.55	366	1.000
1986								
Jan	334.270	279.930	4.888	0.837	1.847	4.50	410	0.085
Feb	295.170	271.014	4.908	0.918	1.972	4.50	438	0.083
Mar	334.030	290.737	4.926	0.870	1.904	4.50	423	0.089
Apr	305.140	258.589	4.943	0.847	1.744	4.50	388	0.079
May	356.530	301.410	4.973	0.845	1.955	4.50	434	0.092
Jun	352.240	303.448	4.981	0.861	2.027	4.50	450	0.093
Jul	334.240	253.036	5.021	0.757	1.626	4.50	361	0.077
Aug	319.440	267.811	5.061	0.838	1.707	4.50	379	0.082
Sep	316.240	266.879	5.081	0.843	1.750	4.50	389	0.081
Oct	310.160	261.644	5.091	0.844	1.658	4.50	368	0.080
Nov	319.615	232.833	5.120	0.728	1.515	4.50	337	0.071
Dec	334.000	289.813	5.158	0.868	1.812	4.50	403	0.088
Total	3,911.075	3,276.722	5.014	0.838	1.780	4.50	398	1.000

Table 3.3 Water Distribution and Consumption (Cont'd)

Year	Month	Distrib. (cu m/mo) (A)	Consump. (cu m/mo) (B)	Conn. (nos.) (C)	Unaccount. (Z) (D)	Per Conn. (cu m/d) (E)	Per House (pers.) (F)	Per Capita (l/pd) (G)	Fluctu. (%) (H)
						$=(C)/(A)$	$=(E)/(F)$	$=(G)/(B)$	
1987	Jan	356,640	305,287	5,202	0,856	1,893	4.42	428	0.081
	Feb	322,080	293,367	5,245	0,911	1,988	4.42	452	0.078
	Mar	356,480	297,137	5,282	0,834	1,815	4.42	411	0.079
	Apr	344,400	303,033	5,320	0,880	1,898	4.42	430	0.081
	May	386,160	374,008	5,354	0,969	2,253	4.42	510	0.099
	Jun	372,373	349,126	5,390	0,938	2,159	4.42	488	0.093
	Jul	371,440	316,102	5,420	0,851	1,881	4.42	426	0.084
	Aug	371,360	300,944	5,455	0,810	1,780	4.42	403	0.080
	Sep	359,520	309,534	5,494	0,861	1,878	4.42	425	0.082
	Oct	329,320	281,956	5,530	0,856	1,645	4.42	372	0.075
	Nov	359,520	297,724	5,556	0,828	1,786	4.42	404	0.079
	Dec	386,370	331,667	5,593	0,858	1,913	4.42	433	0.088
	Total	4,315,663	3,759,885	5,404	0,871	1,906	4.42	431	0.099
1988	Jan	386,320	319,598	5,637	0,827	1,829	4.30	425	0.076
	Feb	361,280	342,236	5,683	0,947	2,077	4.30	483	0.081
	Mar	386,160	325,808	5,733	0,844	1,833	4.30	426	0.077
	Apr	373,600	353,024	5,780	0,945	2,036	4.30	473	0.084
	May	386,000	380,799	5,817	0,987	2,112	4.30	491	0.090
	Jun	373,920	360,331	5,852	0,964	2,052	4.30	477	0.086
	Jul	386,240	361,669	5,887	0,936	1,982	4.30	461	0.086
	Aug	386,400	357,946	5,943	0,926	1,943	4.30	452	0.085
	Sep	373,920	324,831	5,969	0,869	1,814	4.30	422	0.077
	Oct	407,880	360,083	6,006	0,883	1,934	4.30	450	0.086
	Nov	416,790	347,914	6,039	0,835	1,920	4.30	447	0.083
	Dec	425,000	373,511	6,055	0,879	1,990	4.30	463	0.089
	Total	4,663,520	4,207,750	5,867	0,902	1,960	4.30	456	1.000
1989	Jan	430,800	369,096	6,086	0,857	1,956			
	Feb	387,510	386,397	6,112	0,997	2,257			
	Mar	425,970	397,794	6,160	0,934	2,083			
	Apr	416,700	365,303	6,191	0,877	1,867			
	May	408,300	387,610	6,219	0,949	2,011			
	Jun	362,070	364,469	6,226	1,007	1,951			
	Jul								
	Aug								
	Sep								
	Oct								
	Nov								
	Dec								
	Total	2,431,350	2,270,609		0,934				

Table 3.4 Number of Connections by Water Use

Category	1985		1986		1987		1988	
	No.	Share (%)	No.	Share (%)	No.	Share (%)	No.	Share (%)
Residential								
Inside Mun.	3,451	69.73	3,631	69.43	3,826	67.44	3,985	64.96
Outside Mun.	77	1.56	142	2.72	356	6.28	592	9.65
Sub-total	3,528	71.29	3,773	72.14	4,182	73.72	4,577	74.60
Commercial								
Inside Mun.	1,281	25.88	1,310	25.05	1,341	23.64	1,397	22.77
Outside Mun.								
Sub-total	1,281	25.88	1,310	25.05	1,341	23.64	1,397	22.77
Institutional								
Inside Mun.	78	1.58	82	1.57	83	1.46	88	1.43
Outside Mun.								
Sub-total	78	1.58	82	1.57	83	1.46	88	1.43
Industrial								
Inside Mun.	53	1.07	55	1.05	57	1.00	63	1.03
Outside Mun.	9	0.18	10	0.19	10	0.18	10	0.16
Sub-total	62	1.25	65	1.24	67	1.18	73	1.19
Agricultural								
Inside Mun.								
Outside Mun.								
Sub-total								
Recreational								
Inside Mun.								
Outside Mun.								
Sub-total								
Total								
Inside Mun.	4,863	98.26	5,078	97.09	5,307	93.55	5,533	90.19
Outside Mun.	86	1.74	152	2.91	366	6.45	602	9.81
Sub-total	4,949	100.00	5,230	100.00	5,673	100.00	6,135	100.00

Source : Phuket Municipal Waterworks

Table 3.5 Result of Interview on Water Usage

Zone No. (Block)	No. of House-hold	No. of (1) Water Supply User	No. of (2) H.H. having Meter	No. of Family	No. of Person	Water Charge/ Mt	l/cd (3)	Pes/ Family	Fami./ Connec.	H.H./ Connec.
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
								F/E	E/D	C/D
01 (I)	20	4	4	4	16	390	406	4.0	1.0	1.0
02 E.D.H. I.M.	39	22	19	28	129	1,503	194	4.6	1.63	
03 H.K. Q.R.	43	29	29	41	198	2,018	170	4.8	1.4	1.0
04 (L.M.)	20	17	17	18	72	1,530	354	4.0	1.1	1.0
05 B.C.G.F. I.J.K.Q.	60	44	42	53	239	3,503	244	4.5	1.3	1.0
06 (A.F.I.)	50	37	37	53	234	3,362	239	4.4	1.4	1.4
7	232	153	148	197	888	12,306	231	4.5	1.3	1.0
08 (all K)	27	21	16	41	170	2,842	279	4.1	2.6	1.3
Municipal Official	120	73	71	98	420	4,850	192	4.3	1.4	1.0
Total	389	247	235	336	1,478	19,998	226	4.4	1.4	1.1

Note: (1) Number of water supply user, except small and large water consumer, less than 100 cu m/year (14 H.H.) and not less than 3,000 cu m/year (23 H.H.), and private shallow well user (105 H.H.) from interviewers.

(2) Number of households having water meter.

(3) Water charge is Baht 2 per 1 m, according

(H) =  $\frac{G}{6}$

B2/mx30 /Mt x1F) 60 (F)

Table 4.1 Result of Survey on Type of Toilet

	No. Infor- mation	Cesspool	Septic Tank	Thai Standard	Total
Random sampling	28	45	155	9	232
	68 (29%)		(67%)	(4%)	(100%)
Specified Area	7	13	7	0	27
	20 (74%)		(26%)		(100%)
Municipal Official	8	75	32	15	130
	83 (64%)		(25%)	(11%)	(100%)
Total	38	133	194	24	389
	171 (44%)		(50%)	(6%)	(100%)

Table 4.2 Result of Interview on Discharge of Domestic Wastewater

Outlet of Domestic Wastewater				
	Gutter	Ground	River	Total
Random Sampling	195	24	16	234
Specified Area	15	2	8	25
Municipal Official	80	42	8	130
Total	289 (74%)	68 (18%)	32 (8%)	389 (100%)

Table 4.3 Sludge removal volume in Phuket Province  
Year 1988

Month	Residential		Hotel	
	Service	Volume	Service	Volume
		m3		m3
January	132	505	8	87
February	103	392	7	30
March	134	510	13	61
April	155	596	10	69
May	178	675	7	28
June	146	548	5	37
July	129	626	2	9
August	170	657	11	38
September	145	555	8	45
October	171	665	12	52
November	170	658	9	52
December	157	601	10	49
Total	1,790	6,988	102	557

Source: Phuket city

Table 4.4 Total Income of the Sludge Disposal Service  
Unit Baht

	Inside of City	Outside of City	Total
1986 - 1987	264,800	287,600	552,400
1987 - 1988	272,000	521,000	523,000

Table 4.1.5 Expense of the Sludge Disposal Service

	Unit Baht				
	Repair	Fuel	Staff Salary	Others	Total
1986 - 1987	38,783	44,936	138,180	17,340	239,239
1987 - 1988	26,739	49,610	196,155	12,970	285,474

Source: Phuket city

Table 4.5 TYPICAL SURFACE AREA OF RBC

Diameter	Stages	Surface area for indicated length, m <sup>2</sup>			
		3.0 m	4.5 m	6.0 m	7.5 m
3.2 m $\phi$	1	3220	4630	5920	7450
	2	2820	4240	5530	7080
	4	2050	3590	4890	6430
3.6 m $\phi$	1	4160	5990	7650	9660
	2	3650	5500	7150	9150
	4	2670	4640	6330	8310

Source; \*



Table 5.1 DOMESTIC EFFLUENT STANDARDS (DRAFT)

Parameters	Units	Domestic Effluent Standards for Community			
		group-(persons)			
		A (<101)	B (101-500)	C (501-2500)	D (> 2500)
1. BOD <sub>5</sub> 20	mg/dm <sup>3</sup>	30	60	30	20*
2. Solids					
2.1 SS	"	60	50	40	30
2.2 Settleable S.	"	0.5	0.5	0.5	0.5
2.3 TDS	"	+500	+500	+500	+500**
3. Sulfide	"	4.0	3.0	1.0	1.0
4. Free Residual Chlorine	"	-	-	0.3	0.3***
5. Nitrogen					
5.1 TKN	"	40	40	-	-
5.2 ORG-N	"	15	15	10	10
5.3 NH <sub>3</sub> -N	"	25	25	-	-
5.4 NO <sub>3</sub> -N	"	-	-	-	-
6. pH	"	5-9	5-9	5-9	5-9
7. Oil & Grease	"	20	20	20	20

\* Settled BOD (30 min).

\*\* More than TDS of used water

\*\*\* Maximum allowance under epidemic condition only.

Table 5.2 SURFACE WATER QUALITY STANDARDS

Parameters	Unit	**** Max. Allowance by Class				
		1	2	3	4	5
1. Temperature	°C	n	n'	n'	n'	-
2. pH value	-	n	5-9	5-9	5-9	-
3. Dissolved oxygen	mg/l	n	6	4	2	-
4. BOD(5 days, 20 °C)	mg/l	-	1.5	2.0	4.0	-
5. Coliform Bacteria						
- Total Coliform	MPN/100 ml	-	5,000	20,000	-	-
- Fecal coliform	"	-	1,000	4,000	-	-
6. NO <sub>3</sub> -N	mg/l	n	-	5.0	-	-
7. NH <sub>3</sub> -N	"	n	-	0.5	-	-
8. Phenols	"	n	-	0.005	-	-
9. Cu	"	n	-	0.1	-	-
10. Ni	"	n	-	0.1	-	-
11. Mn	"	n	-	1.0	-	-
12. Zn	"	n	-	1.0	-	-
13. Cd	"	n	0.005*	0.05**	-	-
14. Cr (Hexavalent)	"	n	-	0.05	-	-
15. Pb	"	n	-	0.05	-	-
16. Hg (total)	"	n	-	0.002	-	-
17. As	"	n	-	0.01	-	-
18. CN	"	n	-	0.005	-	-
19. Radioactivity						
- Gross x	Becquerel/l	n	-	0.1	-	-
- Gross B	"	n	-	1.0	-	-
20. Pesticides (Total)	mg/l	n	-	0.05	-	-
- DDT	ug/l	n	-	1.0	-	-
- BHC	"	n	-	0.02	-	-
- Dieldrin	"	n	-	0.1	-	-
- Aldrin	"	n	-	0.1	-	-
- Heptachlor & Heptachlor epoxide	"	n	-	0.1	-	-
- Endrin	"	n	-	0.2	-	-
				none		

Note n = Natural.

n' = Natural but changing not more than 3° C.

\* = When water hardness is not more than 100 mg/l as CaCO<sub>3</sub>.

\*\* = When water hardness is more than 100 mg/l as CaCO<sub>3</sub>.

## Water Classification

### Classifications

### Condition and Beneficial usages

Class 1	Extra clean fresh surface water resources using for: (1) conservation, not necessary pass through water treatment processes require only ordinary process for pathogenic destruction (2) ecosystem conservation which basic living organisms can spread breeding naturally
Class 2	Very clean fresh surface water resources using for: (1) consumption which requires the ordinary water treatment process before uses (2) aquatic organism conservation for (3) living and assisting for fishery (3) fishery (4) recreation
Class 3	Medium clean fresh surface water resources using for: (1) consumption but have to pass through an ordinary treatment process before uses (2) agriculture
Class 4	Fairly clean fresh surface water resources using for; (1) consumption but require special water treatment process before uses. (2) industry (3) other activities
Class 5	The resources which are not classified in class 1-4 and using for: (1) navigation

Source : Setting by the Sub-Committee of Chao Praya River Management under the Committee on Water (August 25, B.E.2524 (1981)  
Revise: February 21, B.E.2526 (1983) approved by the National Environment Board (January 31, B.E.2528 (1985).

Table 5.3 COASTAL WATER QUALITY STANDARDS FOR KAON BAY, PHUKET

Parameters	Units	Standard values of Coastal water use for	
		Swimming	Coral Reef Conservation
1. pH	-	6.5-8.3	7.5-8.9
2. Temperature	°C	23-33	23-33
3. DO	mg/l	Not less than 4.0	Not less than 5.0
4. Coliform bacteria	MPN/100ml	Not more than 1,000	-
5. Salinity	ppt.	-	29-35
6. Oil & Grease	mg/l	Not detectable	Not detectable
7. S.S.	mg/l	Not more than 20	Not more than 10
8. Transparency	m.of Secchi Depth	Not less than 10	Not less than 15
Control Areas (500 m from lowest sea water line)		II.Karon bay	I.Lam Mai Ngang III.Koh Joo

Source : Notification of the Ministry of Science, Technology and Energy  
B.E.2526 printed in the Royal Government Gazette, Vol.100 Part 101  
dated December 27, B.E.2526 (1983)

Table 5.4 Results of Analysis

Station	Date	Time	pH	EC ( $\mu$ S/cm)	Cl (mg/l)	SS* (mg/l)
St.1	8/19	12:07	6.7	94.2	15	4
		17:23	6.8	94.2	15	4
St.2	8/19	12:15	6.8	98.1	20	4
		18:00	6.8	97.2	20	4
St.3	8/19	11:42	6.8	100.0	20	4
		17:35	6.9	105.7	20	5
St.4	8/19	11:38	6.8	105.4	20	5
		17:45	6.8	105.0	20	5
St.5	8/19	11:32	6.8	2110	538	10
		17:50	6.9	265	53	10
St.6	8/19	11:55	6.9	382	30	32
		17:26	6.9	383	31	31
St.7	8/19	12:00	6.9	365	32	35
		17:30	7.0	383	30	44
St.8	8/19	11:52	6.9	347	32	30
		17:35	7.0	380	30	32
St.9	8/24	16:00	7.1	214	20	19
St.10	8/24	16:05	7.0	505	100	28
St.11	8/24	16:15	7.0	8770	4300	40
St.12	8/24	16:30	7.1	10200	4200	36
St.13	8/24	16:40	8.0	43160	18100	34

\* SS : Simplified method by HACH

8/19 12:00 high tide

8/19 18:00 low tide

8/24 16:30 high tide

Table 5.5 Results of Analysis on Water Quality

Station	Date	Time	pH	EC ( $\mu$ S/cm)	Cl (mg/l)	SS (mg/l)
R-1	8/23	9:35	7.1	89.3	13	15
R-2	8/23	10:05	7.1	112.7	18	5
R-3	8/23	10:30	7.0	266.0	44	22
R-4	8/23	11:45	7.0	3440	898	22
B-1	8/23	9:55	7.0	356	30	111
B-2	8/23	10:20	6.8	1560	20	68
B-3	8/23	10:45	6.9	1557	385	57
B-4	8/23	11:15	7.0	16250	6400	20
B-5	8/23	11:30	7.7	57920	9900	14
D-1	8/23	9:45	7.6	515	36	46
D-2	8/23	10:00	7.1	581	54	100
D-3	8/23	10:15	7.2	327	28	34
C-1	8/23	8:15	8.2	1038	-	-
C-2	8/23	8:45	6.9	3240	-	-

SS ; Simplified method by HACH

Analyzed by Study Team

8/23 weather; fine

Table 5.6 Results of Bacteriological Analysis

Station	Date	Time	Coliform Group (MPN/100 ml)	Bacteria (CFU/ml)
R-1	08/23/1989	9:35	5,400	5,050
	01/25/1990	10:13	5,400	2,360,000
R-2	08/23/1989	10:05	24,000	206,000
	01/25/1990	10:45	6,300,000	25,000,000
R-3	08/23/1989	10:30	24,000	222,600
	01/25/1990	11:15	11,000,000	37,400,000
R-4	08/23/1989	11:45	24,000	893,000
	01/25/1990	11:22	22,000,000	58,600,000
B-1	08/23/1989	9:55	2,400,000	8,590,000
	01/25/1990	10:30	220,000,000	2,395,000,000
B-2	08/23/1989	10:20	350,000	7,800,000
B-3	08/23/1989	10:45	2,400,000	4,660,000
B-4	08/23/1989	11:15	2,400,000	4,030,000
	01/25/1990	11:30	9,200,000,000	5,880,000,000
B-5	08/23/1989	11:30	11,000	1,730

Analyzed by Wachira Hospital

Table 5.7 Results of Analysis ( Rainy season and Dry season )

Station	Data	Time	pH	EC ( $\mu$ S/cm )	CL (mg/l)	SS (mg/l)	BOD (mg/l)	COD (mg/l)	SS (mg/l)	T-P (mg/l)	T-N (mg/l)		
											NH-N	Org.	Total
R-1	1989 8/24	8:40	7.0	88.1	13	16	1.20	22.56	62.00	0.10	0.45	0.87	1.11
	1990 1/25	10:13	6.9	75.8	-	0	0.95	7.60	5.00	0.05	-	-	2.94
R-2	1989 8/24	9:05	6.8	115.4	17	11	0.65	10.24	19.50	0.16	5.52	3.90	9.42
	1990 1/25	10:45	6.9	131	-	2	3.10	15.20	8.50	0.04	-	-	4.34
R-3	1989 8/24	9:30	6.9	216	40	22	2.70	50.70	51.00	0.45	6.30	4.96	11.28
	1990 1/24	15:00	7.2	620	-	43	13.25	79.80	52.00	0.84	-	-	7.77
R-4	1989 8/24	9:50	7.0	2630	980	27	2.20	24.44	23.00	0.20	4.68	6.18	10.87
	1990 1/24	14:55	9.2	13000	-	50	12.40	273.60	80.00	0.49	-	-	7.84
B-1	1989 8/24	8:56	7.0	165	17	121	5.20	45.12	91.00	0.37	6.13	3.84	9.97
	1990 1/25	10:30	7.2	700	-	102	50.0	186.20	118.00	0.87	-	-	17.36
B-2	1989 8/24	9:20	6.8	518	73	72	6.00	54.52	48.50	1.60	10.09	6.24	16.33
	1990 1/25	10:05	7.0	717	-	27	6.80	32.30	25.50	0.35	-	-	5.11
B-3	1989 8/24	9:35	6.8	5270	1870	65	1.20	56.40	38.00	0.11	2.51	5.18	7.69
	1990 1/24	14:45	9.2	12600	-	45	13.00	136.80	61.50	0.38	-	-	3.92
B-4	1989 8/24	10:00	8.9	1947	1200	37	3.76	41.36	26.50	0.26	6.46	5.07	11.53
	1990 1/24	15:09	7.1	17270	-	45	20.00	182.40	56.00	1.04	-	-	12.74
B-5	1989 8/24	10:10	7.6	11540	16400	19	1.90	165.44	51.00	0.13	1.00	0.96	1.96
	1990 1/24	15:15	8.2	52750	-	26	7.80	965.50	197.50	0.18	-	-	0.84
D-1	1989 8/24	8:50	7.5	553	40	50	11.00	120.32	60.00	1.64	21.29	14.49	35.77
	1990 1/25	10:20	7.6	720	-	99	220.00	444.60	239.00	4.66	-	-	6.72
D-2	1989 8/24	8:59	7.2	548	49	117	15.00	139.12	75.50	1.40	18.94	16.16	35.10
	1990 1/25	10:35	7.0	470	-	90	150.00	228.00	51.00	2.85	-	-	21.14
D-3	1989 8/24	9:10	7.2	270	24	36	7.00	26.32	70.00	0.54	6.46	1.00	7.47
	1990 1/25	11:40	7.5	534	-	51	29.50	144.40	30.50	2.31	-	-	28.98
C-1	1989 8/24	7:48	8.2	1050	-	-	185.00	308.32	128.25	8.67	60.46	36.22	96.67
	1990 1/25	7:58	8.3	1000	-	-	275.00	418.00	103.00	4.88	-	-	62.72
C-2	1989 8/24	7:55	6.9	3240	-	-	670.00	2068.00	563.00	10.10	222.88	130.94	353.82
	1990 1/25	8:04	6.8	3300	-	-	975.00	1612.30	367.00	12.65	-	-	222.32

SS : Simplified method by HACH

pH, EC, CL, SS : Analyzed by Study Team

BOD, COD, SS, T-P, T-N : Analyzed by Songkhla University

weather : 1989 8/22 - 8/23 fine

8/24 - 8/25 rain ( 78 mm )

1990 1/22 - 1/23 fine

1/24 fine.

Table 5.8 Industrial Wastewater

Kind of Factory	Amount of Wastewater (cu m/d)	BOD		No. of Factories	BOD Loadig (kg/d)
		(mg/l)	(kg/d)		
Canned Goods (Fish)	100	3200	320	1	32
Rubber Goods (Smoked Sheet)	26	270	7	1	7
Cold-Storage	10	110	1	1	1
Feed Product (Fine Fish)	20	3750	75	3	225
Chinese Noodle	7	3000	2	12	24
Laundry	100	122	12	1	12

Source: Provincial Authority

Table 5.9 Worst 10 Industries Discharging High BOD

Order	Name	pH	BOD (mg/l)	SS (mg/l)	T-N (mg/l)	T-P (mg/l)
1	Cold-Storage Factory	7.0	3750	7740	1618	5400
2	Canning Factory	6.8	3200	560	165	900
3	Slaughter House	6.4	3100	280	374	190
4	Nimit Market	6.2	780	220	173	248
5	Canning Factory	6.2	580	153	378	920
6	Laundry	11.5	122	37	7.2	272
7	Cold-Storage Storehouse	8.7	110	40	33	23
8		7.1	80	29	43	115
9	Wet Market I, II	5.9	75	80	13	25
10		7.7	16	70	7	11



Table 6.1 Summary of Interview Survey Result  
for Flood Damage (1/5)

Area code	District code	Sheet No.	Inundation depth (m)	Inundation duration		Sediment (cm)	Flood mark
				above floor (hrs)	above ground (hrs)		
01	C	1		42	42	15	YES
01	I	2	1.00	12	17	3	YES
01	A	3					
01	I	6		10	15	3	YES
01	B	8	0.50	36	36	3	YES
01	C	76	0.50	48	48	1	YES
01	C	77	0.20	96	96	3	YES
01	C	78	1.50	144	144	3	YES
01	O	87	0.30	22	28	1	YES
01	N	88	1.00	168	168	5	YES
01	J	89	0.50	72	168	3	NO
01	Q	90	0.50		72		NO
01	N	91	1.00	168	192	1	YES
01	O	94	0.50	48	48	5	YES
01	S	95	0.60	60	96	2	YES
01	S	103	1.00	72	72	1	YES
01	S	110	0.30	72	72	1	YES
02	D	4	3.00	72	264	2	YES
02	D	5	4.00	72	264	2	YES
02	E	41	1.50	48	96	1	NO
02	H	42	0.30	72	120	2	YES
02	H	43	2.00	72	120	2	NO
02	E	47	2.00	48			
02	O	83	2.00	72	120	2	NO
02	O	84	2.00	72	120	2	YES
02	N	85	0.30	72	120	2	YES
02	N	86	1.00	48	168	1	NO
02	D	129	0.50	120	168	2	YES
02	D	130	0.35	72	120	1	YES
02	D	131	0.90	168	216	1	YES
02	E	132	0.05	24			
02	E	133	0.05	24			
02	D	155	0.50	20	25	1	NO
02	E	156	0.30	18	22	2	NO
02	E	157	0.60	120	168	2	YES
02	E	158	0.60	120	168	2	YES
02	A	159	0.20	24	32	1	YES
02	G	168	0.30	72	72	1	YES
02	O	169	0.45	48	72	2	YES
02	O	188	0.80	72	120	1	YES
02	O	189	1.00		168	2	YES
02	O	190	0.60	72	120	1	YES
02	O	191	0.60	72	120	1	YES
02	A	209	0.50	60	96	2	NO
02	A	210	0.50	11	16	1	NO
02	A	212	0.50	72	72	1	YES
02	A	211	0.30	48	48	1	NO
03	D	7	1.50	48	48	2	YES
03	G	10	0.30	48	48		NO

Table 6.1 Summary of Interview Survey Result  
for Flood Damage (2/5)

Area code	District code	Sheet No.	Inundation depth (m)	Inundation duration		Sediment (cm)	Flood mark
				above floor (hrs)	above ground (hrs)		
03	K	11	0.50	48	48		NO
03	G	45	0.50	48		1	YES
03	K	46	0.30	48	48		YES
03	G	48	0.50	192	192	1	YES
03	O	65	0.50	2	2	1	YES
03	J	68	0.30	96	96	1	YES
03	J	69	0.50	672	336	3	YES
03	J	72	0.50	96	96	1	YES
03	Q	181	0.08	24			
03	Q	182	0.05	24			
04	L	20					
04	H	29	2.60	48	48		NO
04	I	30	0.90	48	48	1	NO
04	H	31	0.60	48	48		NO
04	H	32	0.80	48	48		NO
04	L	49	1.30	48	48		NO
04	M	50	0.80	48	48	1	YES
04	M	51	1.00	48	48		YES
04	I	52	1.20	48	48		NO
04	K	113	1.60	48	48		NO
04	K	114	1.00	48	48		NO
04	J	115	0.30	48	48		NO
04	R	118	0.60	48	48		NO
04	V	119	0.80	48	48		NO
04	V	128	0.70	48	48		NO
04	R	143	0.60	20	20		NO
04	J	153	0.50	48	48		NO
04	E	151	0.50	48	48	5	YES
04	E	152	0.50	48	48	5	YES
04	E	153	1.00	24	24	10	YES
04	E	171	0.10	120	72	1	YES
04	L	180	0.10	48			
04	E	187	0.90	48	48		NO
05	G	9	1.00	144	144	2	YES
05	G	12	1.00	144	120	1	YES
05	G	13	2.00	144	144	2	YES
05	G	14	1.00	144	120	2	YES
05	C	15	2.00	168	168	2	YES
05	R	25	0.15	13	16	2	NO
05	Q	26	1.00	16	9	3	NO
05	K	28	2.30	75	75	1	NO
05	L	53	0.30	96	96	1	YES
05	L	54	1.00	96	144	1	YES
05	Q	55	1.00	144	72	2	YES
05	Q	56	0.30	144	72	1	YES
05	N	104	1.00	6	72	3	YES
05	M	105	0.50	2	4	2	YES
05	M	106	1.00	72	72	2	YES
05	S	124	0.30	4	4		YES
05	U	125	0.20	4	4	1	YES

Table 6.1 Summary of Interview Survey Result  
for Flood Damage (3/5)

Area code	District code	Sheet No.	Inundation depth (m)	Inundation duration		Sediment (cm)	Flood mark
				above floor (hrs)	above ground (hrs)		
05	S	126	0.50	48	48	2	YES
05	T	127	0.30	4	72	2	YES
05	Q	149	1.00	24			YES
05	Q	167					
05	Q	170	1.00				
05	Q	150	1.50	18	18	7	YES
05	Q	154	0.50	72	72	2	YES
05	K	172	0.20	144	72	1	NO
05	Q	173	0.20	168	144	2	YES
05	Q	174	0.50	48	72	2	NO
05	Q	175	0.50	72	72	1	NO
05	Q	176	0.50	48	72	1	NO
05	Q	183	1.00	48	48	1	YES
05	K	184	0.70	48	48		NO
05	K	185	0.80	48	48		NO
05	K	186	0.70	48	48		NO
05	Q	192	0.30	96	96	1	YES
05	Q	193	0.40	96	96	1	YES
05	Q	194	0.42	96	96	1	YES
05	Q	195	0.50	144	96	2	YES
05	K	196	1.00	96	96	1	YES
05	Q	197	0.50	24	24	6	YES
05	Q	198	0.20	24	24	1	YES
05	Q	199	0.75	48	48	1	YES
05	K	204	0.50	48	72	2	NO
05	K	205	0.25	16	16	1	NO
06	H	16	0.50	12	12	0	NO
06	D	17					
06	H	37	0.50	96	96	10	YES
06	H	38	0.50	10	10	8	YES
06	Q	39	0.25	12	12	5	YES
06	R	40	1.00	8	8	12	YES
06	V	57	0.50	24	24	1	NO
06	V	58	0.50	24	24	5	YES
06	P	59	0.10	48	48	1	YES
06	V	60	1.00	24	24	1	YES
06	V	61	0.30	20	480	50	YES
06	V	62	0.50	24	24	50	YES
06	W	79	0.50	1	1	10	YES
06	U	80	0.07	24	24	5	YES
06	W	81	0.10	24	24		NO
06	W	82	30.00	72	72	10	YES
06	T	95	0.15	1	1	3	YES
06	P	97	0.10	2	2	1	YES
06	P	98	1.00	1	1	1	YES
06	M	99	0.50	24	24	3	YES
06	Q	120	2.00	24	24	7	YES
06	Q	121	1.00	24	24	10	YES
06	Q	122	1.00	24	24	10	YES
06	V	123	2.00	72	72	20	YES

Table 6.1 Summary of Interview Survey Result  
for Flood Damage (4/5)

Area code	District code	Sheet No.	Inundation depth (m)	Inundation duration		Sediment (cm)	Flood mark
				above floor (hrs)	above ground (hrs)		
07	H	18	0.50	20	72	1	NO
07	E	19	0.50	48	72	2	NO
07	D	102	1.50	84	86	2	NO
08	J	17	0.80	34	24		
08	E	20	0.50	34	27	1	NO
08	E	22		36	36	1	NO
08	E	23	0.50	36	36	1	NO
08	E	24	0.20	36	36	1	NO
08	F	33			4	1	NO
08	F	34		3	6	1	NO
08	F	35					
08	F	63	0.50	55	58	1	NO
08	F	64	2.50	72	72	2	YES
08	A	66	0.50	96	96	1	NO
08	A	67	0.50	3	48	1	NO
08	F	63	0.50	55	48	2	NO
08	F	100	2.00	48	48	1	NO
08	A	101	2.00	13	61	1	NO
08	F	115	0.80	51	70		NO
08	J	116	0.90	58	60	1	NO
09	B	27	0.05	7	6	2	NO
09	C	70	0.15	9	7	2	NO
09	H	71	0.45	30	54	2	NO
09	B	111	0.21	36	42	1	NO
09	A	112	0.28	10	11	2	NO
09	D	107	1.00	96	120	3	NO
09	D	108	0.40	8	14	2	NO
09	D	109	0.70	11	10	2	NO
09	E	134		5	8	3	NO
09	E	135	0.30	4	7	3	YES
09	E	136	0.30	4	7	3	YES
09	E	137		3	6	3	NO
09	E	138	0.50	13	22	3	YES
09	J	144			22	1	NO
09	J	145			16	2	NO
09	J	146			16	2	NO
09	J	147		13	12	1	NO
09	J	148		13	12	1	NO
09	H	160	0.20	60	64	2	NO
09	I	161	0.20	60	64	2	NO
09	N	162	0.60	64	64	3	NO
09	N	163	0.25			1	NO
09	U	164	0.80	6	7.5		YES
09	U	165	1.50	5	6		YES
09	U	166	0.10	5	8.5	3	YES
09	C	177	0.80	34	58	1	YES
09	C	178	0.80	34	48	1	YES
09	C	179	0.80	33	34	1	YES
09	Q	200	0.50	34	72	1	YES
09	A	201	0.30		36		YES

Table 6.1 Summary of Interview Survey Result  
for Flood Damage (5/5)

Area code	District code	Sheet No.	Inundation depth (m)	Inundation duration		Sediment (cm)	Flood mark
				above floor (hrs)	above ground (hrs)		
09	I	213	0.50	23	10	1	NO
09	I	214	0.20	15	13	1	NO
09	I	215	0.70		12	1	NO
09	I	216	0.30	27	26	1	NO
09	E	208	0.50	12	14	2	NO
09	E	217	0.50	9	12	3	NO
10	C	36	1.00	16	15	1	NO
10	C	73	0.50	13	15	1	NO
10	G	74	0.50	34	25	1	NO
10	G	75	1.00	72	120	2	YES
10	F	92	0.50	13	14	1	NO
10	K	93	0.50	11	10	1	NO
10	A	139	1.00	96		1	NO
10	A	140	0.50	240		1	NO
10	J	141	0.50	240	312	2	YES
10	J	142	0.50	242		2	NO

Table 7.1 Gross Provincial Product and Growth Rate for 1981-1988  
at 1972 Price by Industrial Origin, by Changwat:

Unit : Million of Baht

Industrial Origin	1981		1982		1983		1984		1985	
	Value	Growth rate	Value	Growth rate	Value	Growth rate	Value	Growth rate	Value	Growth rate
Gross Provincial Product (G.P.P)	1,290	-4.90	1,262.4	-21.4	1,342.6	6.35	1,415.5	5.43	1,472.1	4.00
Manufacturing	74.5	-20.41	58.6	-21.34	55.2	-5.80	56.5	7.36	57.3	1.42
Growth of Manufacturing	Based on 100%		78.7%		74.1%		75.8%		76.9%	

Source ; Office of the National Economic and Social Development Board

Table 10.1 Design Population Density Distribution in Planning 16 Blocks

(in 2006 Year)

Block	Item	Zone					Total	Pop.Dens.
								(cap/ha)
Block 1	:Zone	: E1	E2	E3	E4	T.RASADA:	:	:
	:Area(ha)	: 4	72.2	55.6	31.7	188.2	: 351.7	: 33.3
	:Pop.	: 196	1,805	1,511	763	4,454	: 11,729	:
	:Area-Share(%)	: 3.8	100	54.3	61.8	(LU1)100	:	:
Block 2	:Zone	: B 1					:	:
	:Area(ha)	: 67.7					: 67.7	: 73.2
	:Pop.	: 4,959					: 4,959	:
	:Area-Share(%)	: 96.2					:	:
Block 3	:Zone	: A1	A2	A3	A4	A5	:	:
	:Area(ha)	: 14.1	5.6	8.2	6.7	11.8	:	:
	:Pop.	: 1,530	970	1,383	1,640	1,351	:	:
	:Area-Share(%)	: 100	100	100	100	100	:	:
	:Zone	: B1	B2	B3	B4	C1	:	:
	:Area(ha)	: 16.4	33.3	20.5	10.2	23.6	:	:
	:Pop.	: 1,710	3,657	2,222	1,772	1,223	:	:
	:Area-Share(%)	: 100	100	100	100	100	:	:
	:Zone	: C2	D1	D2	D5	D6	:	:
	:Area(ha)	: 13	20.5	28.1	28.4	12.8	:	:
	:Pop.	: 921	1,846	1,235	3,230	862	:	:
	:Area-Share(%)	: (LU2)100	100	100	(LU3)100	(LU3)76.9	:	:
Block 4	:Zone	: S					:	:
	:Area(ha)	: 4.7					: 258.4	: 100.9
	:Pop.	: 516					: 26068	:
	:Area-Share(%)	: 4.9					:	:
Block 4	:Zone	: C5	C6	T.VICHIT			:	:
	:Area(ha)	: 5.3	11.5	186			: 202.8	:
	:Pop.	: 303	413	4,623			: 5,339	: 26.3
	:Area-Share(%)	: 18.5	23.4	100			:	:
Block 5	:Zone	: C2	C3	C4	C5	C7	:	:
	:Area(ha)	: 22.8	35.8	15.4	25.7	4.5	:	:
	:Pop.	: 920	1,888	1,023	1,340	198	:	:
	:Area-Share(%)	: (LU1)100	100	100	81.5	6.9	:	:
	:Zone	: E3					:	:
	:Area(ha)	: 46.8					: 151	: 44
	:Pop.	: 1,272					: 6,641	:
	:Area-Share(%)	: 45.7					:	:

Table 10.1

( continued)

Block	Item	Zone				Total	Pop. Dens. (cap/ha)
Block 6	:Zone	C6	C7	BANG PING			
	:Area(ha)	59.1	2.9	1		63	
	:Pop.	1,353	379	23		1,755	27.9
	:Area-Share(%)	76.6	13.2	2.7			
Block 7	:Zone	C7	S				
	:Area(ha)	10.6	6			16.6	59.5
	:Pop.	447	540			987	
	:Area-Share(%)	15.6	5.7				
Block 8	:Zone	T.RASADA					
	:Area(ha)	152.9				152.9	
	:Pop.	1,063				1,063	7
	:Area-Share(%)	30.6					
Block 9	:Zone	D3	D4	D5	E4 T.RASADA		
	:Area(ha)	41	48.9	8.6	15.6 15.2	129.3	
	:Pop.	1,339	1,300	120	473 725	3,957	30.6
	:Area-Share(%)	100	83.5 (LU1)	100	38.2 (LU2)38.4		
Block 10	:Zone	B5	B6	D5	D6		
	:Area(ha)	3.8	5	2.9	6.4	18.1	
	:Pop.	488	595	192	346	1,621	89.6
	:Area-Share(%)	40 (LU2)54.3	(LU2)25.0	(LU2)10.5			
			(LU3)10.4				
Block 11	:Zone	C7	S				
	:Area(ha)	47.3	63.6			110.9	
	:Pop.	1,845	1,276			3,121	28.1
	:Area-Share(%)	64.3	66.6				
Block 12	:Zone	F	BANG PING				
	:Area(ha)	29.3	105.9			135.2	
	:Pop.	0	46			46	0.3
	:Area-Share(%)	32.2	83.3				
Bloc 13	:Zone	T.RASADA					
	:Area(ha)	75.5				75.5	
	:Pop.	1,443				1,443	19.1
	:Area-Share(%)	14.6					
Block 14	:Zone	D4	D5	D6	T.RASADA	F	
	:Area(ha)	4.9	8.7	85.2	68.3	20.9	188
	:Pop.	258	578	2,219	2,200	0	5,255
	:Area-Share(%)	16.5 (LU2)62.1	(LU1)30.0	(LU2)61.6		23	
			(LU2)77.6	(LU4)41.8			
			(LU3)12.7				



Table 10.1

( continued)

Block	Zone	Zone				Total	Pop. Dens.
							(cap/ha)
Block 15	Zone	B5	B6	D6	S		
	:Area(ha)	6.4	26.7	34.9	21.2	892	
	:Pop.	733	1,576	303	713	3,325	37.3
	:Area-Share(%)	60 (LU1)	100 (LU1)	100 (LU1)	22.2		
			(LU2)45.7	(LU2)11.9			
Block 16	Zone	F BANG PING					
	:Area(ha)	40.8	13.1			53.9	
	:Pop.	100	791			891	16.5
	:Area-Share(%)	44.8	10.9				
Total							
	:Area(ha)					2,064.2	
	:Pop.					78,200	37.9

Table 11.1 One-day Heavy Rainfall (1/2)

Unit: mm

Date	Station Name		
	Phuket (1)	Bang Wad (2)	Basin (3)
1968 (2511)			
2 May	143	-	-
24 June	85	-	-
31 Aug	90	-	-
15 Sept	82	-	-
1969 (2512)			
20 June	129	-	-
27 June	125	-	-
1970 (2513)			
12 May	78	-	-
1971 (2514)			
15 June	95	-	-
3 July	83	-	-
20 Aug	96	-	-
13 Sept	110	-	-
1972 (2515)			
17 Sept	57	-	-
1973 (2516)			
5 June	99	-	-
24 July	85	-	-
29 Aug	81	-	-
7 Sept	100	-	-
1974 (2517)			
22 July	123	-	-
31 Oct	135	-	-
1975 (2518)			
25 Sept	130	-	-
17 Oct	82	-	-
18 Oct	83	-	-
1976 (2519)			
2 May	87	-	-
10 June	106	-	-
28 July	104	-	-
23 Aug	86	-	-
18 Sept	102	-	-
1977 (2520)			
2 Sept	87	-	-
14 Oct	84	-	-
26 Oct	81	-	-
1978 (2521)			
26 July	87	-	-
1979 (2522)			
21 July	80	-	-
1980 (2523)			
8 July	85	-	-
29 Aug	110	-	-
1981 (2524)			
1 Nov	124		

Table 11.1 One-day Heavy Rainfall (2/2)

Unit: mm

Date	Station Name		
	Phuket (1)	Bang Wad (2)	Basin (3)
1982 (2525)			
3 July	135		
4 July	83		
6 July	100		
1983 (2526)			
13 Aug	81	90	87
14 Aug	118	101	106
8 Sept	88	66	73
15 Oct	82	96	92
1984 (2527)			
25 Apr	90	65	72
6 June	90	72	77
24 July	62	107	93
17 Dec	22	90	69
1985 (2528)			
8 Aug	82	95	91
11 Sept	133	96	107
1986 (2529)			
18 Apr	128	67	86
7 May	103	72	81
8 May	127	146	140
3 Aug	81	99	94
24 Aug	70	167	138
10 Sept	76	111	100
14 Sept	101	100	100
26 Sept	173	155	160
4 Oct	7	100	72
11 Nov	89	219	180
14 Nov	90	92	91
1987 (2530)			
3 May	80	62	67
8 Aug	87	105	100
15 Aug	95	137	124
26 Sept	60	142	117
8 Nov	126	133	131
9 Nov	62	81	75
1988 (2531)			
23 Nov	141	105	116
1989 (2532)			
29 Mar	112	8	40
24 Aug	78	115	104

Source: (1) JICA  
 (2) RID, 1989  
 (3) Study Team

Table 11.2 Yearly Maximum One-day Rainfall

Date	Station Name		
	Phuket (1)	Bang Wad (2)	Basin (3)
1968 (2511)			
2 May	143	-	-
1969 (2512)			
20 June	129	-	-
1970 (2513)			
12 May	78	-	-
1971 (2514)			
13 Sept	110	-	-
1972 (2515)			
17 Sept	57	-	-
1973 (2516)			
7 Sept	100	-	-
1974 (2517)			
31 Oct	135	-	-
1975 (2518)			
25 Sept	130	-	-
1976 (2519)			
10 June	106	-	-
1977 (2520)			
2 Sept	87		
1978 (2521)			
26 July	87		
1979 (2522)			
21 July	80		
1980 (2523)			
29 Aug	110		
1981 (2524)			
1 Nov	124		
1982 (2525)			
3 July	135		
1983 (2526)			
14 Aug	118	101	106
1984 (2527)			
24 July	62	107	93
1985 (2528)			
11 Sept	133	96	107
1986 (2529)			
11 Nov	89	219	180
1987 (2530)			
8 Nov	126	133	131
1988 (2531)			
23 Nov	141	105	116

Note: Rainfall at Phuket up to 1982 and basin rainfall after 1983 are used for probable rainfall analysis.

Source: (1) JICA  
 (2) RID (1989)  
 (3) Study Team

Table 11.3 Flood Peak Discharge from Upstream Sub Basins

Case 1

		Unit : m3/sec				
Return period	Sub basin					Point 1
	1	2	3	4	5	
2	12	4	4	3	4	26
5	23	7	9	6	7	51
10	37	12	14	10	12	81
20	45	14	16	12	14	98
30	49	15	18	13	16	107
50	53	17	19	14	17	116

Case 2

		Unit : m3/sec				
Return period	Sub basin					Point 1
	1	2	3	4	5	
2	16	7	8	7	7	37
5	33	13	17	15	15	75
10	53	21	27	23	23	120
20	65	26	32	29	29	146
30	71	29	36	31	31	160
50	78	32	39	35	35	176

Note : Case 1, Assumed that present land use condition will be consistent in future.  
Case 2, Assumed that retarding effect of pond is not expected due to filling for land reclamation or full storage on flood time in future.

Table 11.4 Ground Elevation along Ring Road (Katu)

Elevation (m)			Elevation (m)			Elevation (m)		
Station	-----		Station	-----		Station	-----	
No.	A	B	No.	A	B	No.	A	B
St.4+225	56.05	18.00	St.8+600	-	-	St.13+000	59.50	21.45
4+300	56.36	18.31	8+700	-	-	13+100	59.33	21.28
4+400	57.42	19.37	8+800	-	-	13+200	59.90	21.85
4+500	58.75	20.70	8+900	-	-	13+300	60.74	22.69
4+600	60.10	22.05	9+000	-	-	13+400	58.60	20.55
4+700	58.78	20.73	9+100	-	-	13+500	58.20	20.15
4+800	56.96	18.91	9+200	-	-	13+600	57.68	19.63
4+900	56.86	18.81	9+300	-	-	13+700	58.22	20.17
5+000	57.43	19.38	9+400	-	-	13+800	58.08	20.03
5+100	57.85	19.80	9+500	-	-	13+900	58.41	20.36
5+200	58.03	19.98	9+600	-	-	14+000	57.96	19.91
5+300	60.83	22.78	9+700	-	-	14+100	58.19	20.14
5+400	63.26	25.21	9+800	-	-	14+200	58.23	20.18
5+500	63.38	25.33	9+900	-	-	14+300	59.21	21.16
5+600	61.71	23.66	10+000	-	-	14+400	58.63	20.58
5+700	60.77	22.72	10+100	-	-	14+500	58.65	20.60
5+800	60.55	22.50	10+200	-	-	14+600	57.64	19.59
5+900	61.08	23.03	10+300	-	-	14+700	56.12	18.07
6+000	61.57	23.52	10+400	-	-	14+800	56.31	18.26
6+100	57.50	19.45	10+500	-	-	14+896	55.85	17.80
6+200	55.28	17.23	10+600	-	-			
6+300	55.35	17.30	10+700	-	-			
6+400	55.79	17.74	10+800	-	-			
6+500	55.77	17.72	10+900	-	-			
6+600	55.84	17.79	11+000	-	-			
6+700	55.62	17.57	11+100	-	-			
6+800	55.92	17.87	11+200	67.36	29.31			
6+900	55.90	17.85	11+300	66.26	28.21			
7+000	56.04	17.99	11+400	64.87	26.82			
7+100	55.34	17.29	11+500	64.46	26.41			
7+200	55.88	17.83	11+600	64.29	26.24			
7+300	-	-	11+700	63.50	25.45			
7+400	-	-	11+800	63.97	25.92			
7+500	-	-	11+900	66.28	28.23			
7+600	-	-	12+000	65.73	27.68			
7+700	-	-	12+100	66.43	28.38			
7+800	-	-	12+200	67.34	29.29			
7+900	-	-	12+300	66.38	28.33			
8+000	-	-	12+400	64.48	26.43			
8+100	-	-	12+500	62.52	24.47			
8+200	-	-	12+600	61.06	23.01			
8+300	-	-	12+700	60.70	22.65			
8+400	-	-	12+800	59.73	21.68			
8+500	-	-	12+900	60.40	22.35			

Remarks : A, Relative elevation used by Highway Dept.  
 B, Elevation above mean sea water level  
 The difference between "A" and "B" is judged 38.054 m  
 based on the both values at Provincial highway No.4020.  
 Source : Phuket branch office of Highway Department

Table 12.1 Principal Feature of Proposed Master Plan

I. River improvement

- Channel dredging : 33,800 m<sup>3</sup> ( =1,300 m)
- Embankment : 74,400 m<sup>3</sup> ( =1,700 m)
- Revetments (wet masonry) : 600 m
- Heightening of existing retaining wall : 200 m (h=1.0 m)
- Reconstruction of bridge : 6 bridges  
 Poonphol br. Phang-Nga br.  
 Tuanpradit br. Thepkrasattri 3 br.  
 Damrong br. Thepkrasattri 1 br.
- Reconstruction of Saen Suk intake

III. Floodway

East floodway

- From just upstream Yaovaraj Bridge (Sam Kong Village) to Sapam bay
- Length : 4,325 m
- Width of channel : 28.0 m at bottom
- Slope : 1:2.0 with revetment
- Excavation volume : 1,500,000 m<sup>3</sup>

Table 12.2 Design High Water Level of Bang Yai River (1/2)

Sec. no.	Distance from river mouth (m)	Incre- mental distance (m)	Existing bottom (El.m)	River width (m)	Design bottom (El.m)	Design HWL (El.m)	Design bed slope
1	50	120	-1.80	10	-1.68	1.03	1/2800
2	170	120	-1.63	10	-1.64	1.08	
3	290	120	-1.51	10	-1.60	1.13	
4	410	120	-1.68	20	-1.55	1.18	
5	530	120	-1.99	33	-1.51	1.20	
6	650	120	-2.02	33	-1.47	1.20	
7	770	120	-2.15	32	-1.43	1.20	
8	890	120	-2.15	32	-1.38	1.20	
9	1010	120	-1.90	37	-1.34	1.21	
10	1130	120	-2.11	32	-1.30	1.21	
11	1250	120	-1.93	35	-1.25	1.21	
12	1370	120	-2.08	32	-1.21	1.22	
13	1490	120	-1.36	30	-1.17	1.22	
14	1610	120	-1.73	30	-1.13	1.23	
15	1730	120	-1.79	25	-1.08	1.23	
16	1850	120	-2.67	25	-1.04	1.23	
17	1970	120	-0.90	19	-1.00	1.24	
18	2090	120	-2.33	17	-0.95	1.35	
19	2210	120	-2.53	17	-0.91	1.36	
20	2330	60	-2.17	17	-0.87	1.38	
BR1	2390	60	-0.90	17	-0.85	1.37	
21	2450	100	-2.85	15	-0.83	1.40	1/2800, 1/600
22	2550	100	-2.19	17	-0.79	1.41	
23	2650	100	-2.34	15	-0.75	1.43	
24	2750	50	-2.04	15	-0.72	1.46	
BR2	2800	50	-1.19	12	-0.70	1.46	
25	2850	105	-1.17	13	-0.62	1.47	
26	2955	105	-2.05	13	-0.44	1.52	
27	3060	105	-0.85	15	-0.27	1.56	
28	3165	105	-2.28	13	-0.09	1.60	
29	3270	50	0.64	12	0.08	1.64	
BR3	3320	50	-0.42	14	0.17	1.66	
30	3370	50	0.59	10	0.25	1.68	
BR4	3420	50	0.36	13	0.33	1.72	
31	3470	50	-0.11	12	0.42	1.75	
BR5	3520	50	0.40	11	0.50	1.99	
32	3570	110	0.50	10	0.58	2.80	
33	3680	110	0.24	13	0.77	2.96	
34	3790	60	0.20	13	0.95	3.21	
BR6	3850	40	0.72		1.05	3.20	
35	3890	110	0.54	13	1.12	3.45	
36	4000	110	0.49	14	1.30	3.61	
37	4110	110	1.00	13	1.48	3.74	
38	4220	50	1.24	13	1.67	3.97	
BR7	4270	60	1.41	10	1.75	3.93	
39	4330	100	1.80	10	1.85	4.06	
40	4430	100	1.82	10	2.02	4.17	
41	4530	100	1.33	10	2.18	4.43	
42	4630	100	1.66	10	2.35	4.56	
43	4730	100	0.96	10	2.52	4.69	



Table 12.2 Design High Water Level of Bang Yai River (2/2)

Sec. no.	Distance from river mouth (m)	Incre- mental distance (m)	Existing bottom (El.m)	River width (m)	Design bottom (El.m)	Design HWL (El.m)	Design slope
44	4830	100	1.37	9	2.68	4.81	1/600
45	4930	100	1.98	9	2.85	5.03	
46	5030	50	3.00	10	3.02	5.26	
BR8	5080	50	3.01	10	3.10	5.35	
47	5130	125	3.54	10	3.18	5.33	
48	5255	125	3.04	10	3.39	5.66	
49	5380	125	3.38	12	3.60	5.89	
50	5505	125	3.64	11	3.81	6.01	
51	5630	125	3.53	11	4.02	6.28	
52	5755	125	5.25	14	4.23	6.44	
53	5880	125	5.04	9	4.43	6.94	
54	6005	125	5.52	16	4.64	7.19	
55	6130	140	5.46	16	4.85	7.42	
56	6270	140	5.97	14	5.08	7.45	
57	6410	140	5.72	19	5.32	7.55	
58	6550	140	6.57	14	5.55	7.66	
59	6690	140	6.14	14	5.78	7.83	
60	6830	140	4.82	10	6.02	7.97	
61	6970	140	4.57	10	6.25	8.07	
62	7110	140	5.63	10	6.48	8.19	
63	7250	40	5.65	10	6.72	8.34	
BR9	7290	100	5.98	8	6.78	8.31	1/600, 1/400
64	7390	140	5.48	11	6.95	8.66	
65	7530	140	4.50	11	7.18	8.79	
66	7670	140	4.31	15	7.42	8.94	
67	7810	140	5.09	15	7.65	9.01	
68	7950	140	4.84	15	7.88	9.13	
69	8090	140	5.90	16	8.12	9.28	
70	8230	140	6.73	16	8.35	9.47	
71	8370	140	8.33	12	8.58	9.78	
72	8510	140	8.62	12	8.93	10.57	
73	8650	200	8.22	12	9.28	10.94	
74	8850	200	8.06	15	9.78	11.07	
75	9050	200	9.44	12	10.28	11.50	
76	9250	200	9.33	14	10.78	12.26	
77	9450	200	11.22	14	11.28	12.59	
78	9650	200	11.60	14	11.78	13.13	
79	9850		11.71	15	12.28	13.60	1/400

Note : BR1, Poonphol Br.  
 BR2, Taling Chan Br.  
 BR3, Pra-a-ram Br.  
 BR4, Phang-Nga Br.  
 BR5, Tuanpradit Br.

BR6, Thepkrasattri Br.3  
 BR7, Damrong Br.  
 BR8, Thepkrasattri Br.1  
 BR9, Yaovaraj Br.

Table 12.3      Hydraulic Condition at Major Bridges  
(after implementation of proposed Master Plan)

Bridge code No.	Bridge/Road name	Lower edge of girder (El.m)	Surface of road (El.m)	Design HWL (El.m)	Clearance h (m)
BR 1	Poonphol	1.70	2.20	1.37	0.33 *
BR 2	Taling Chan	2.21	2.81	1.46	0.75
BR 3	Pra-a-ram	2.28	2.88	1.66	0.62
BR 4	Phang-Nga	1.86	2.56	1.72	0.14 *
BR 5	Tuanpradit	2.30	3.00	1.99	0.31 *
BR 6	Thepkrasattri 3	2.42	3.02	3.20	-0.78 *
BR 7	Damrong	4.21	4.81	3.93	0.28 *
BR 8	Thepkrasattri 1	5.03	5.53	5.35	-0.32 *
BR 9	Yaovara j	9.38	9.88	8.31	1.07

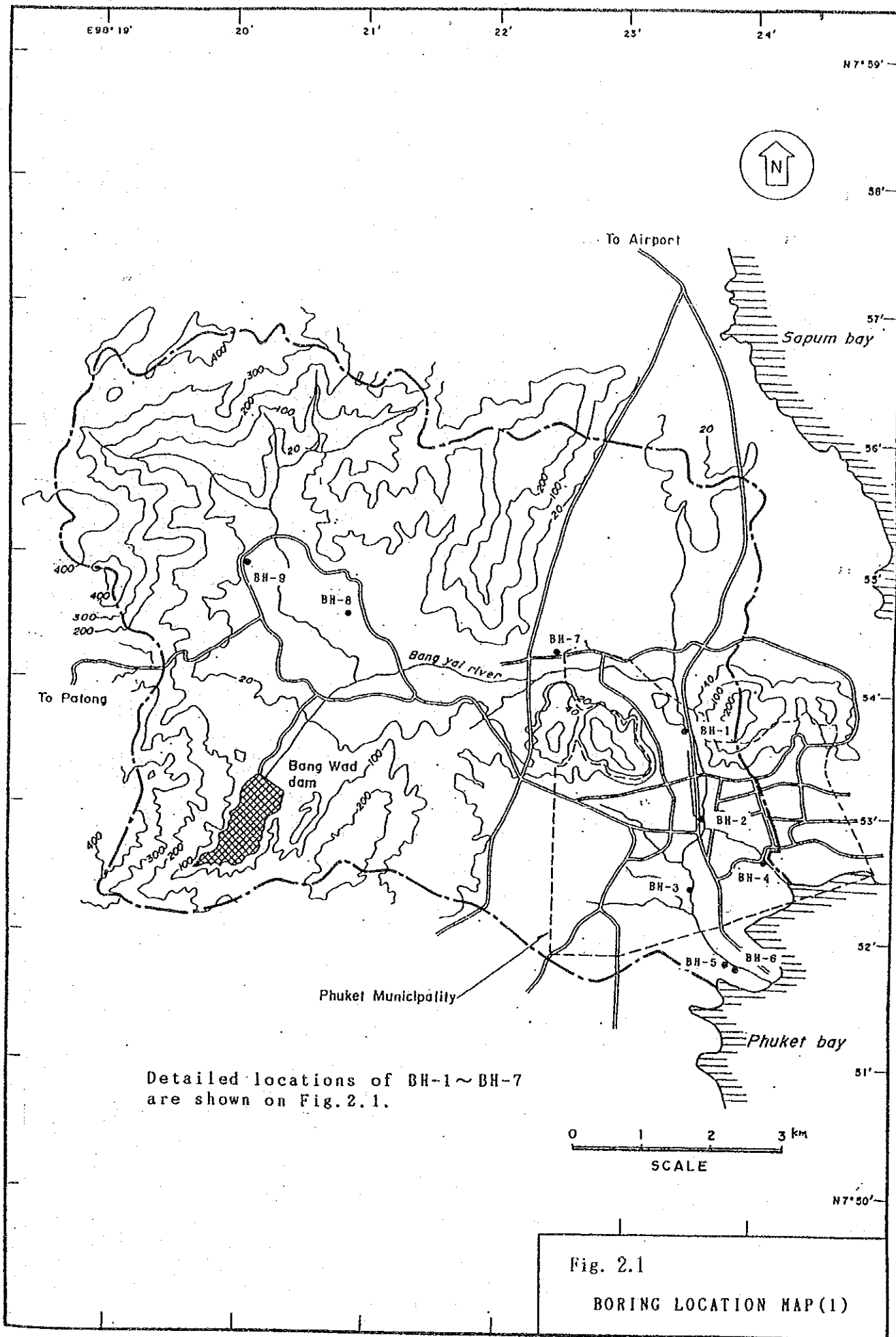
Remarks : \*, Bridge to be reconstructed

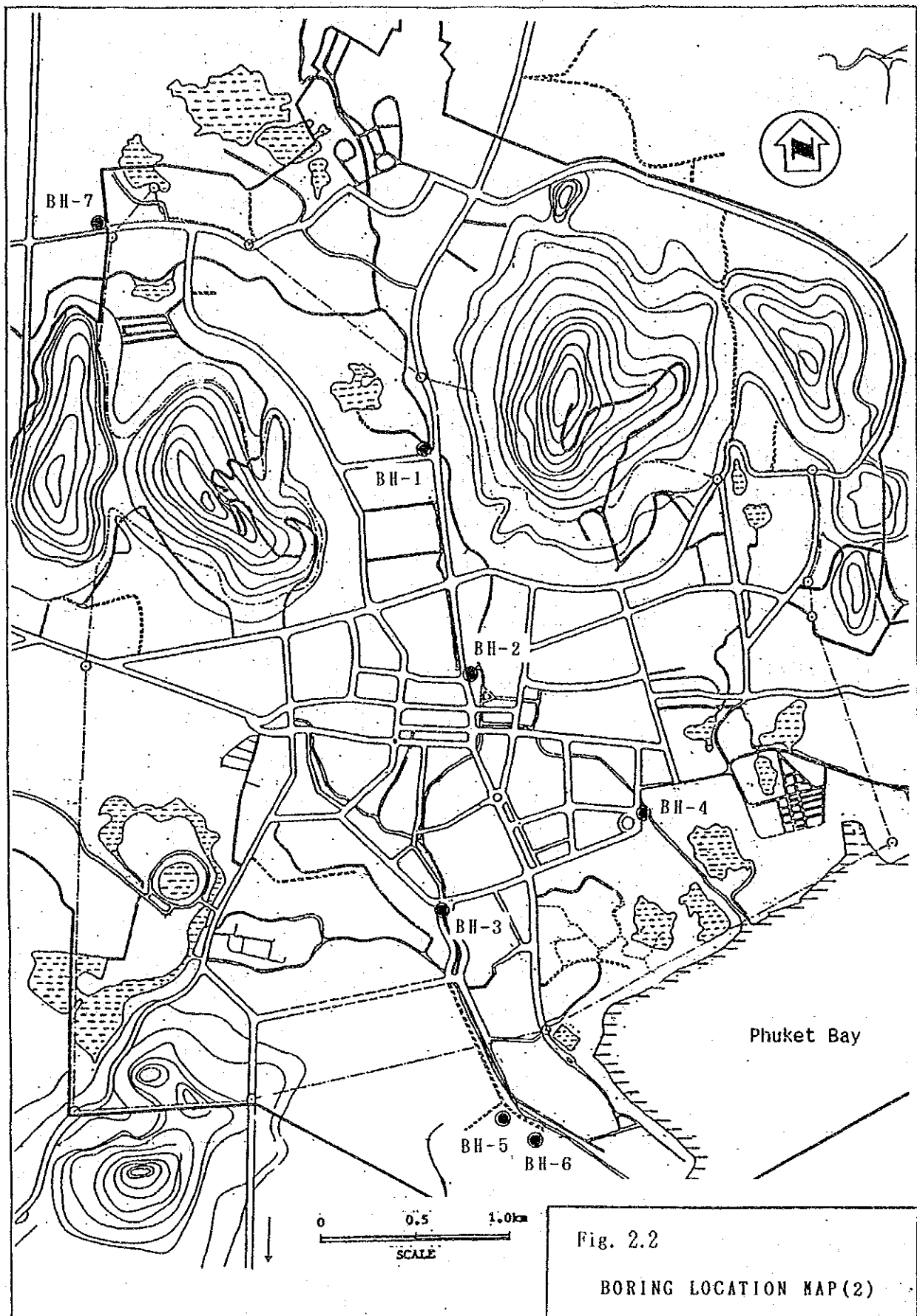
Note : 60 cm of freeboard shall be considered.



## **ANNEX : FIGURES**







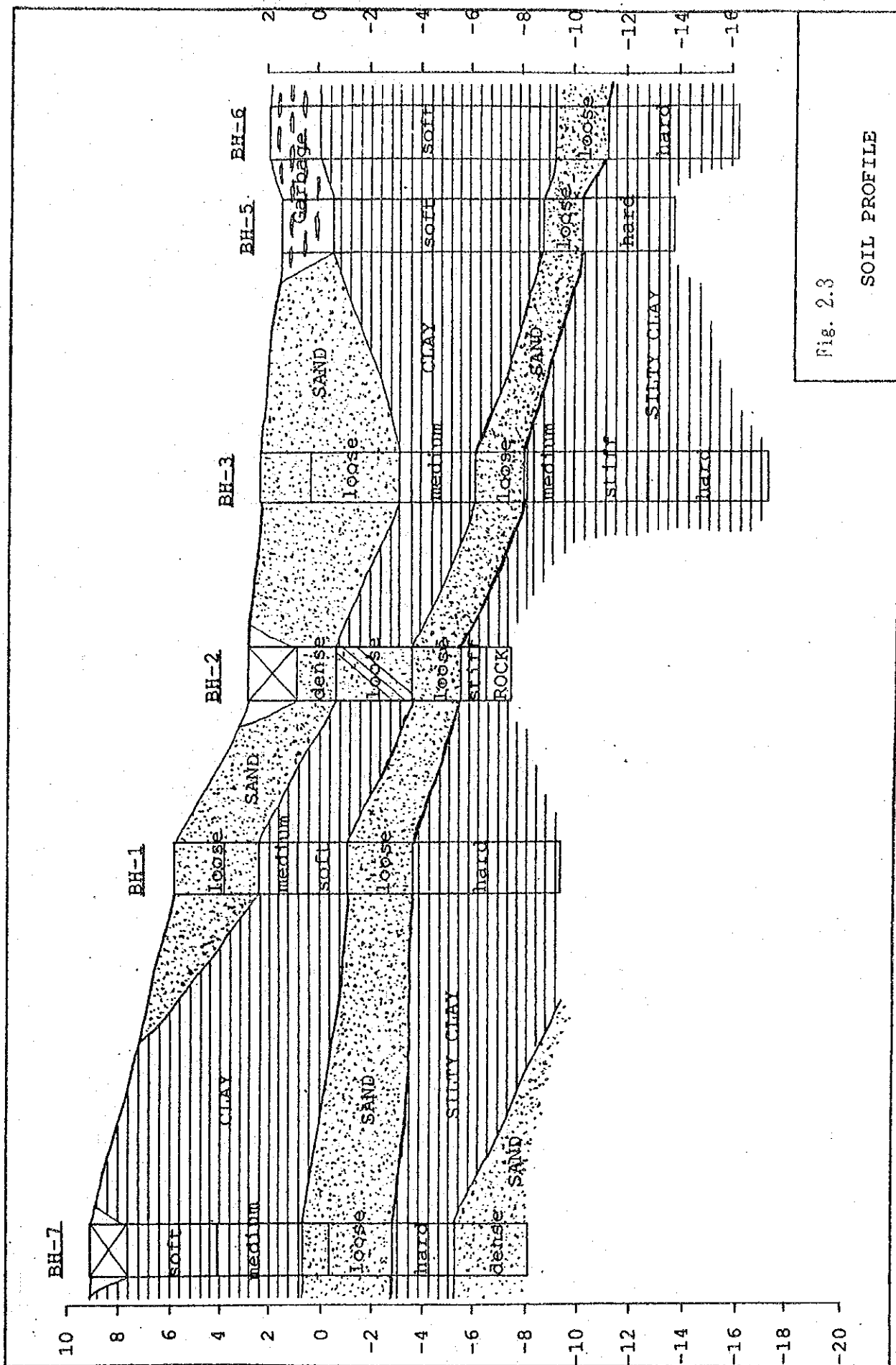
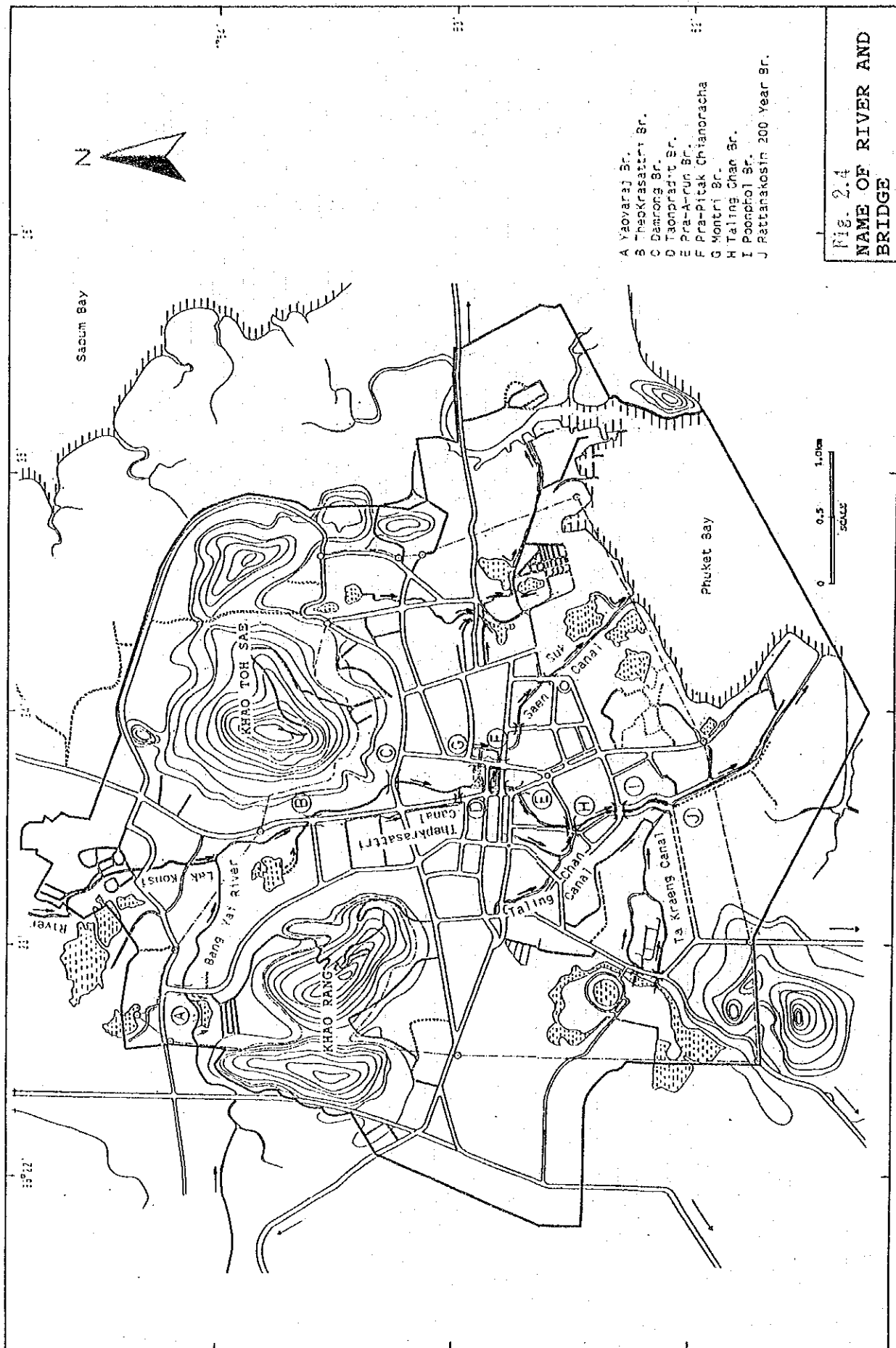


Fig. 2.3

SOIL PROFILE





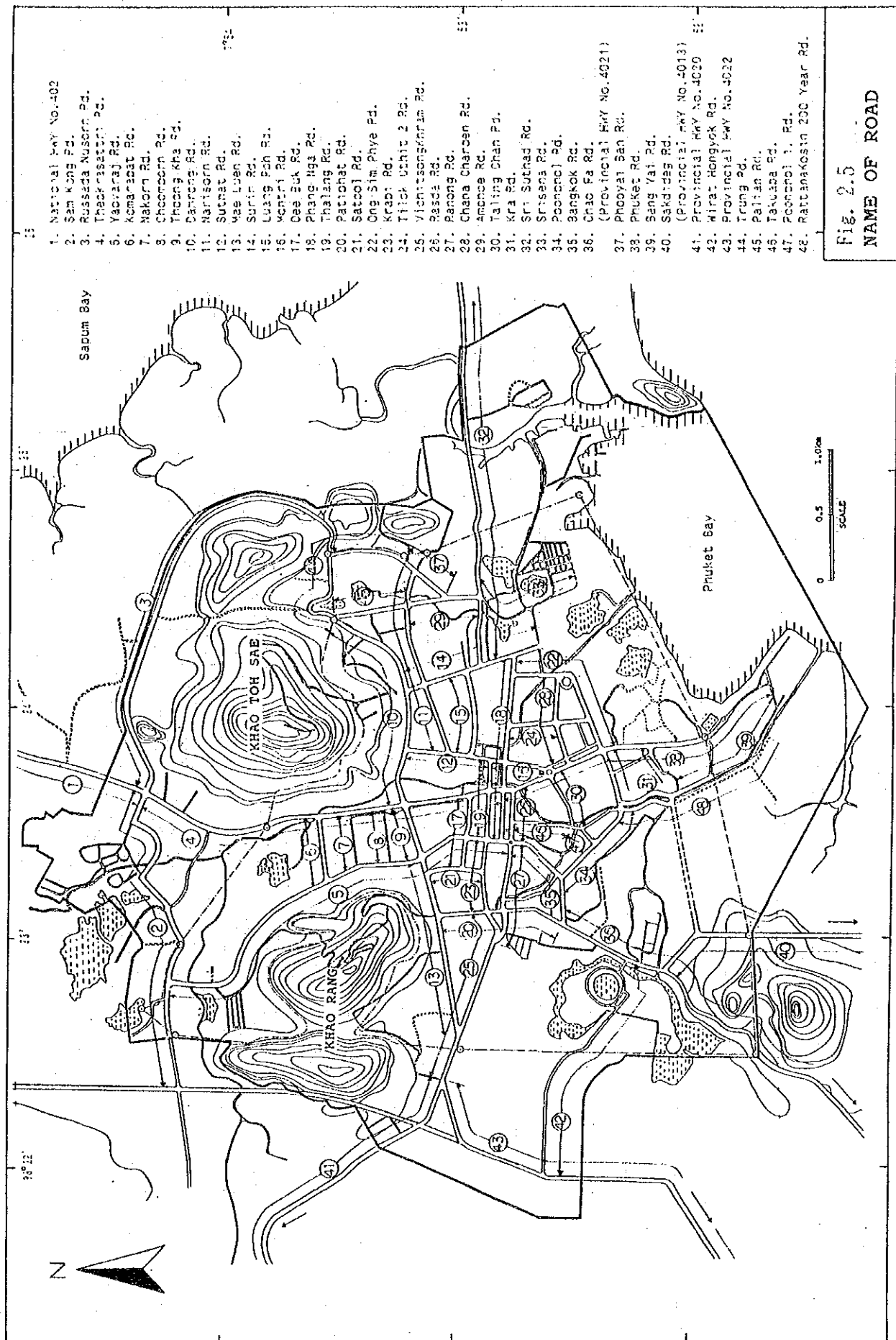
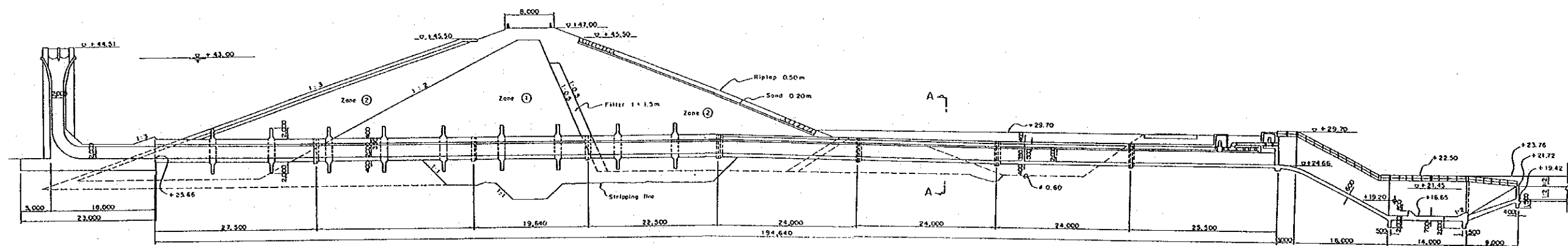


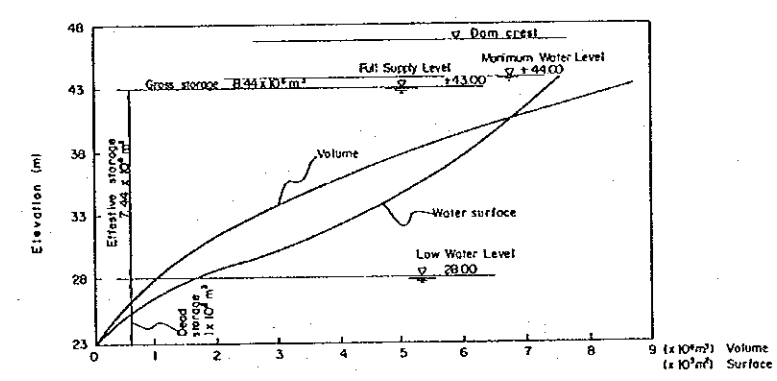
Fig. 2.5  
NAME OF ROAD



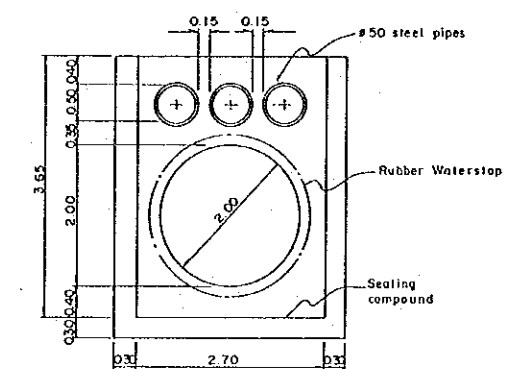




PROFILE



RESERVOIR STORAGE CURVE  
OF BANG WAD DAM



SECTION A - A

Fig. 2.6 PRINCIPAL FEATURE  
OF BANG WAD DAM



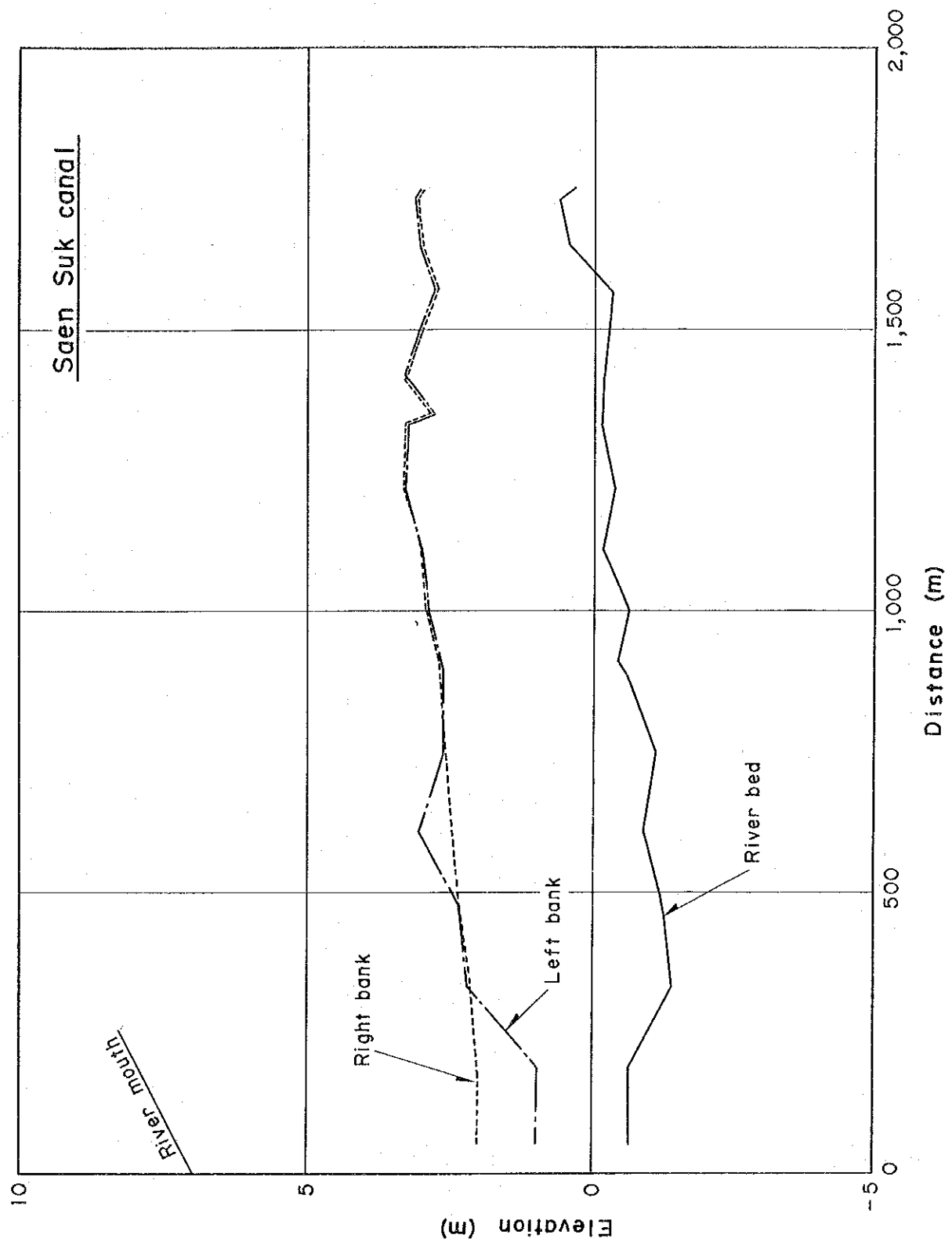


Fig. 2.7  
LONGITUDINAL PROFILE  
OF TRIBUTARIES AND  
CANALS (1/5)

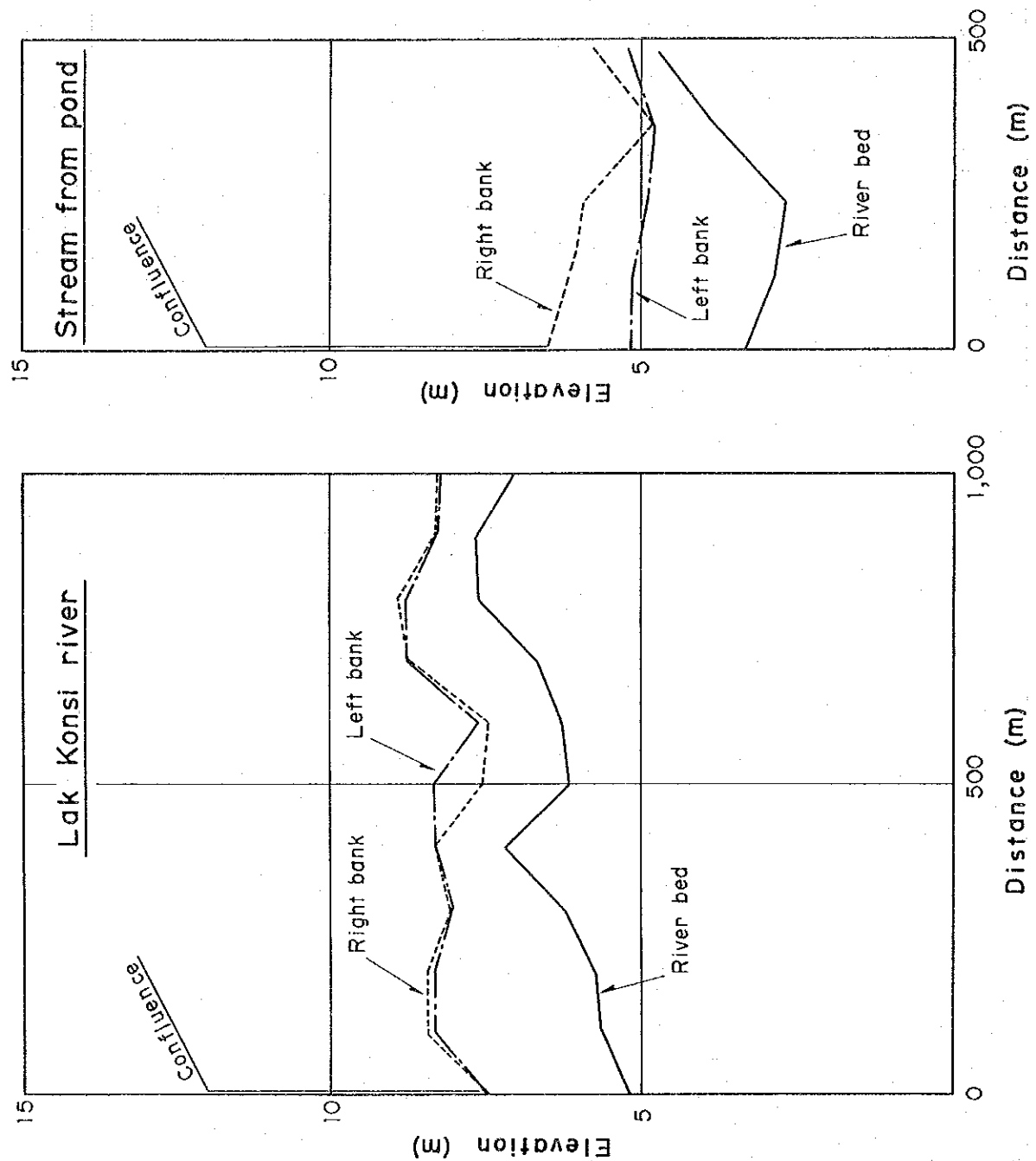


Fig. 2.7  
LONGITUDINAL PROFILE  
OF TRIBUTARIES AND  
CANALS (2/5)



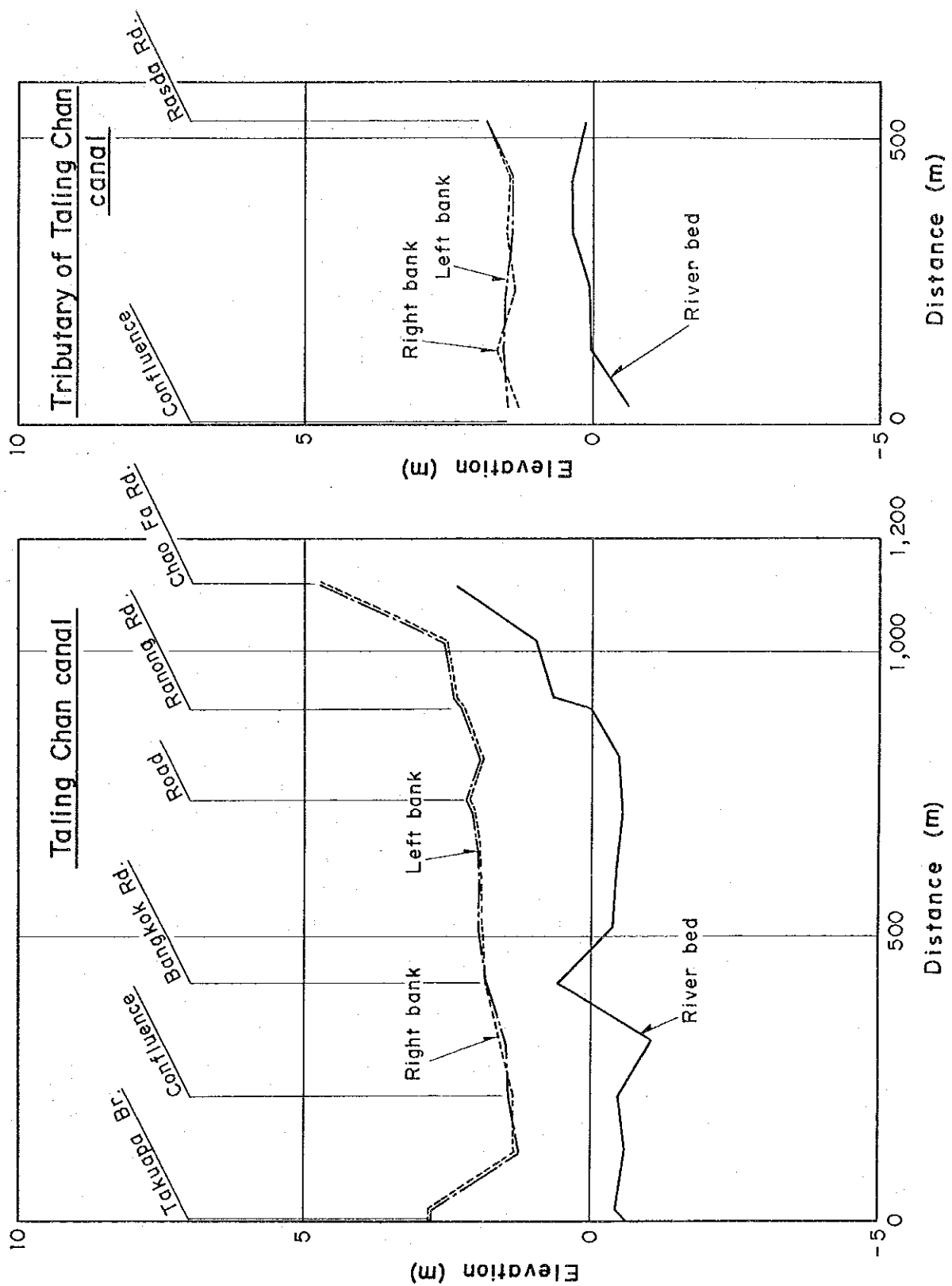


Fig. 2.7  
LONGITUDINAL PROFILE  
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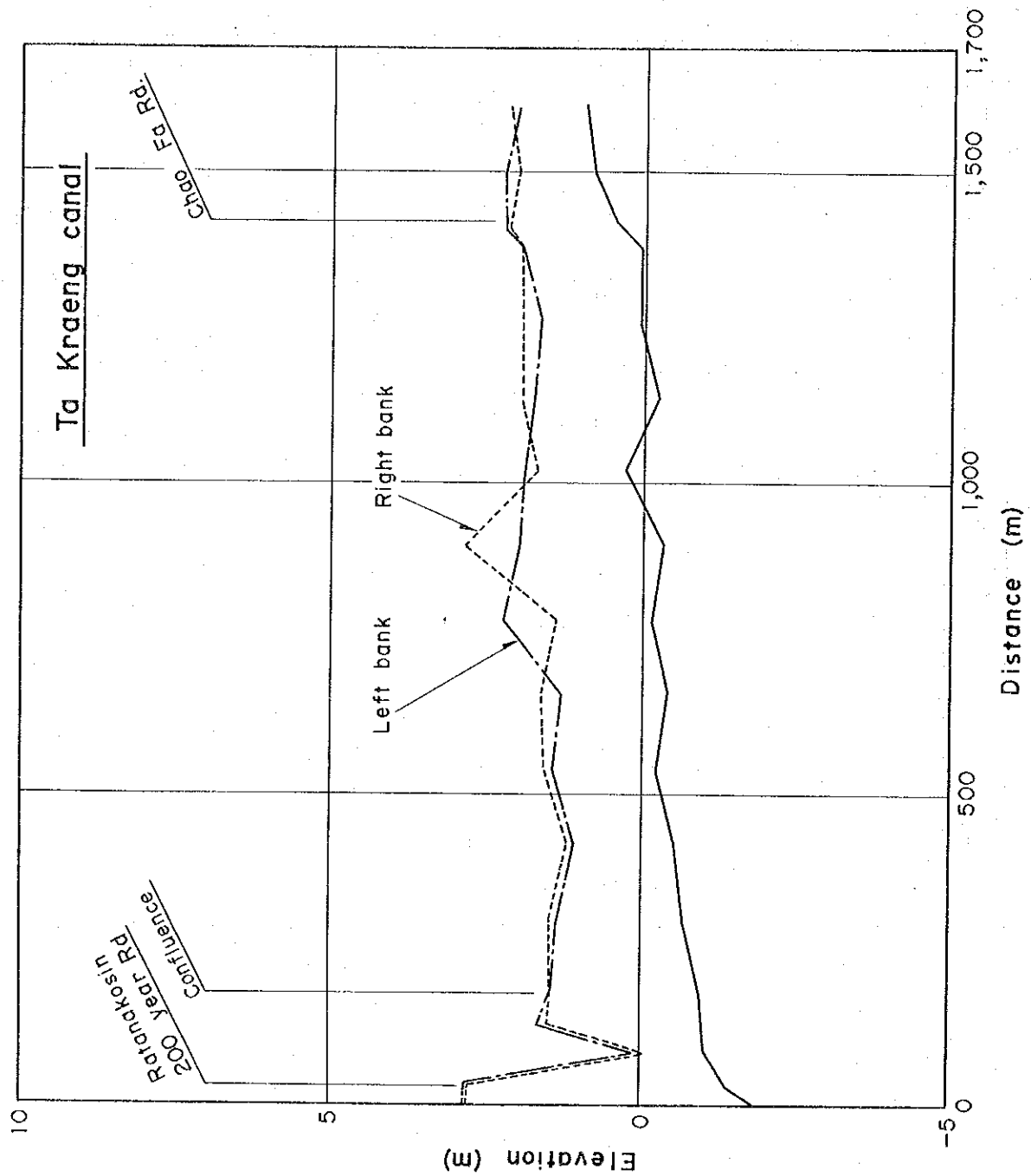


Fig. 2.7  
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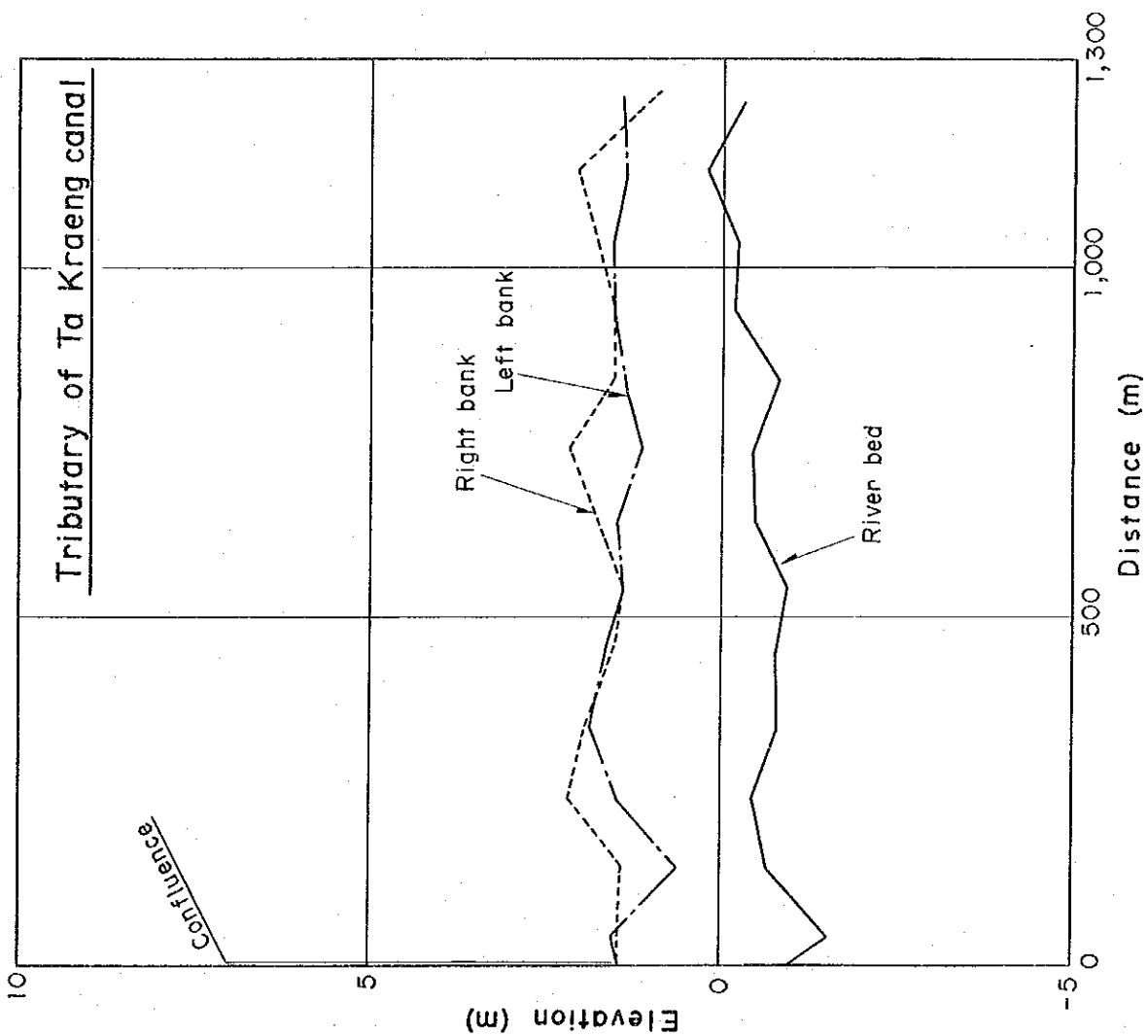
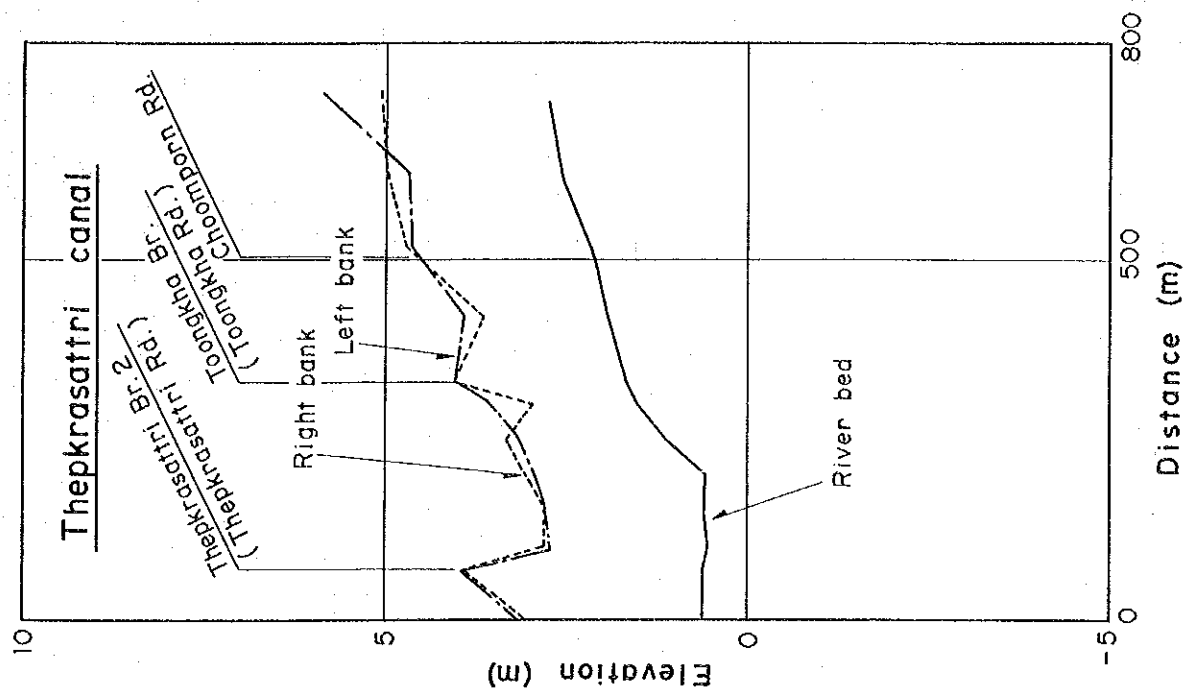
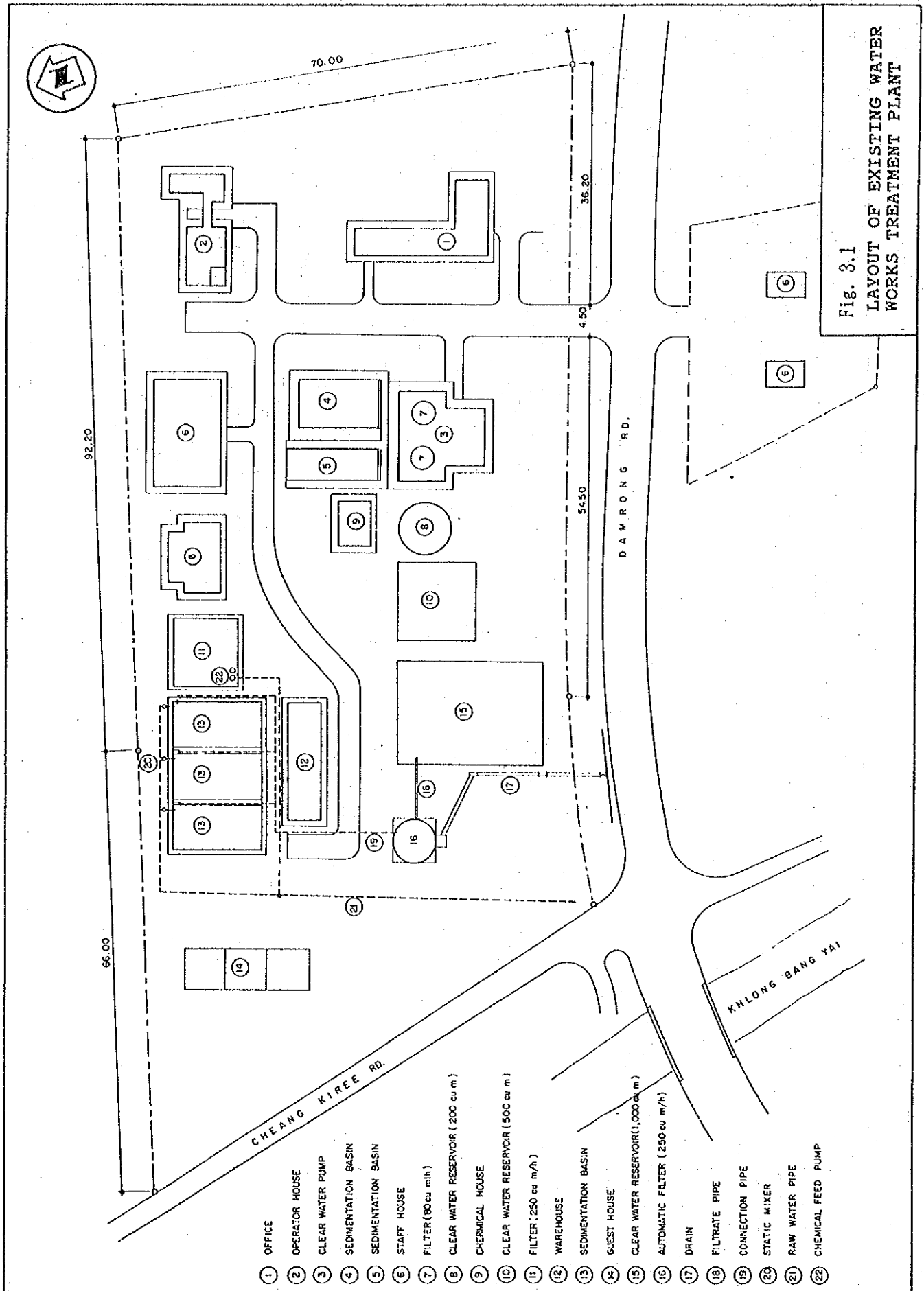
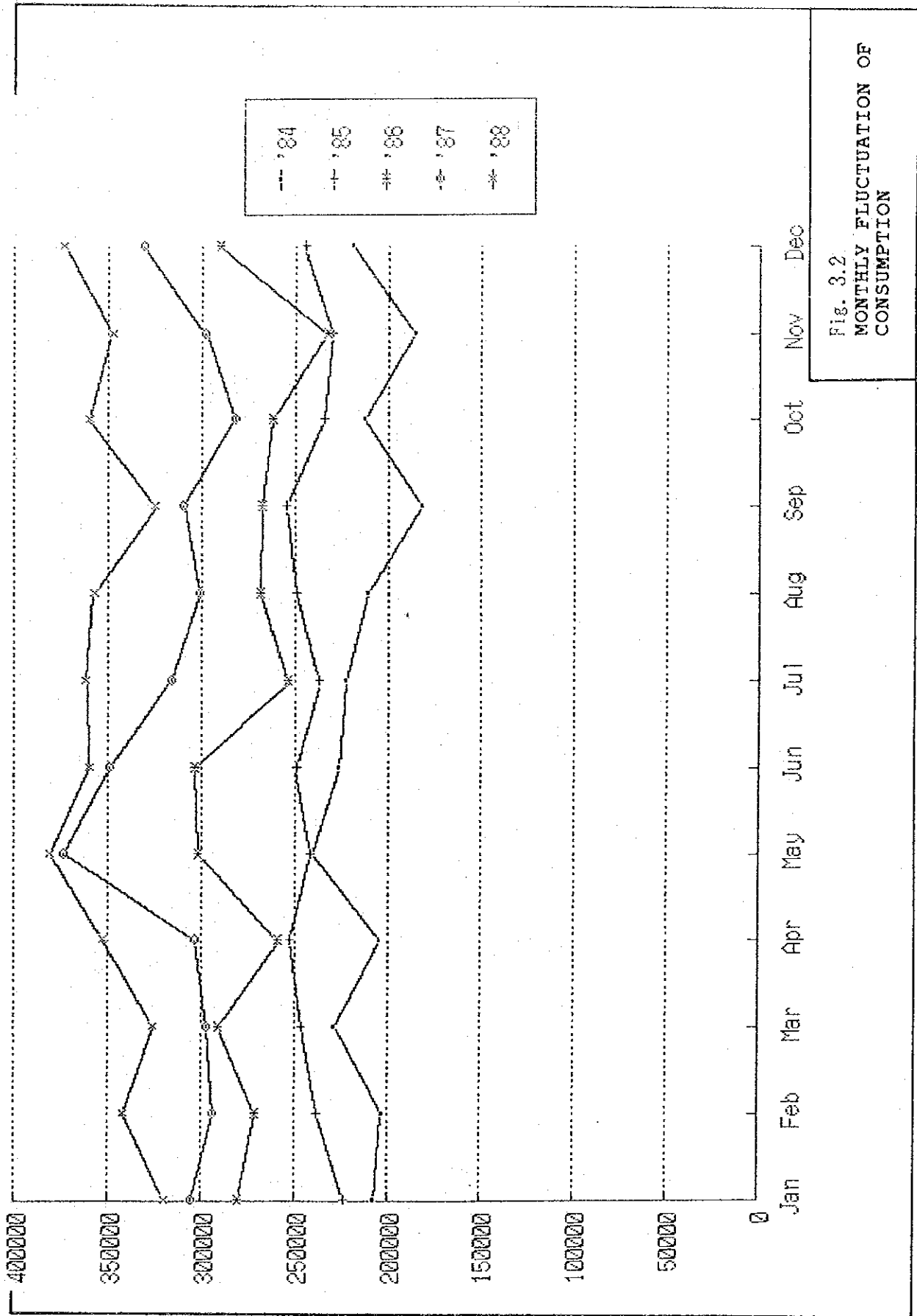
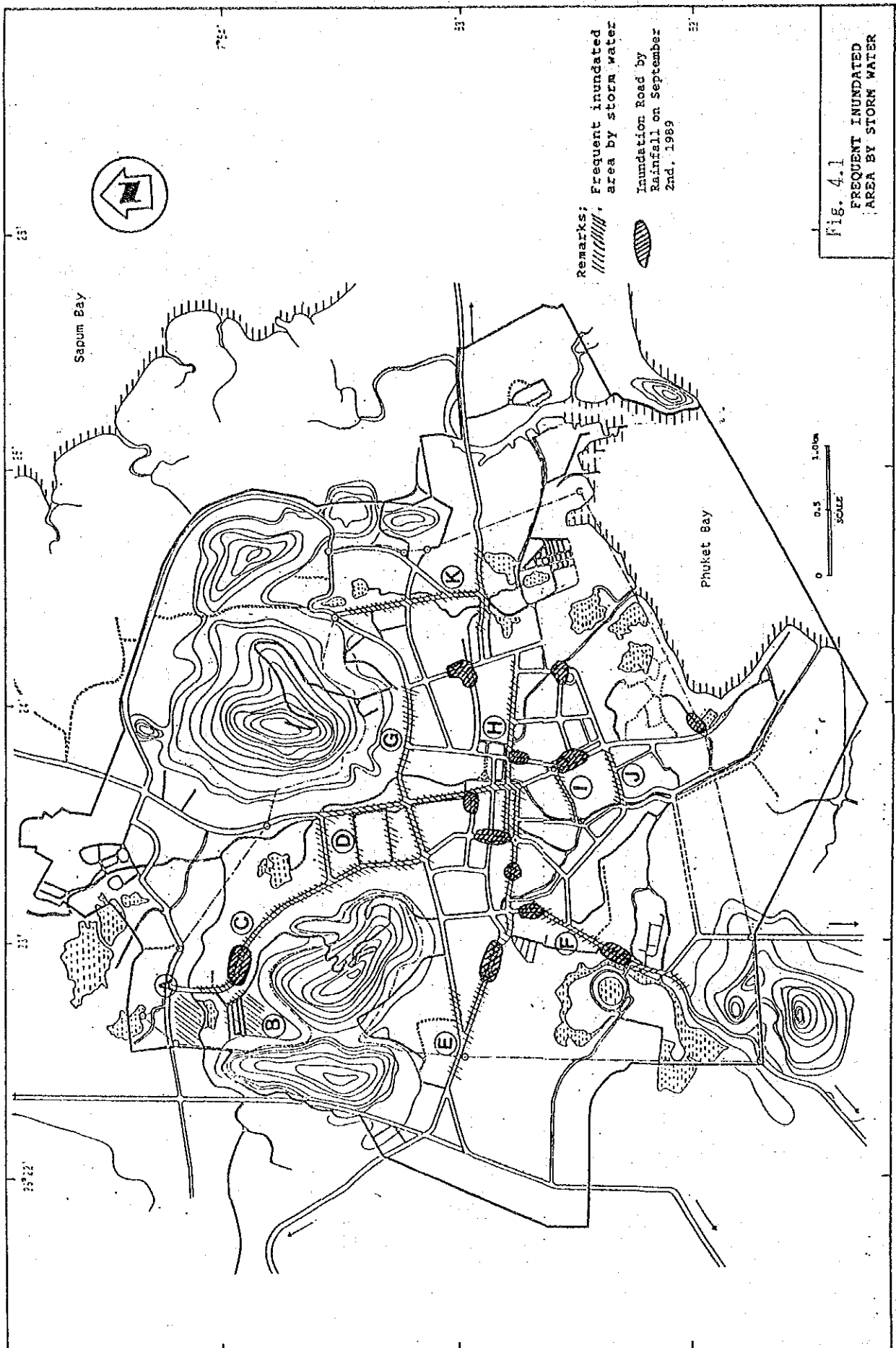
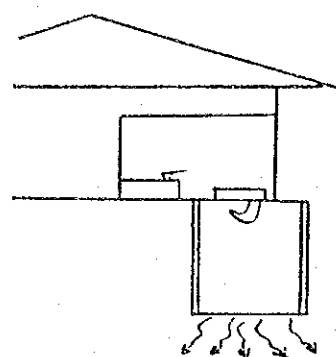


Fig. 2.7  
LONGITUDINAL PROFILE  
OF TRIBUTARIES AND  
CANALS ( 5 / 5 )

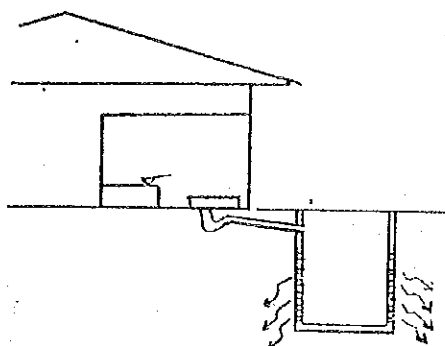




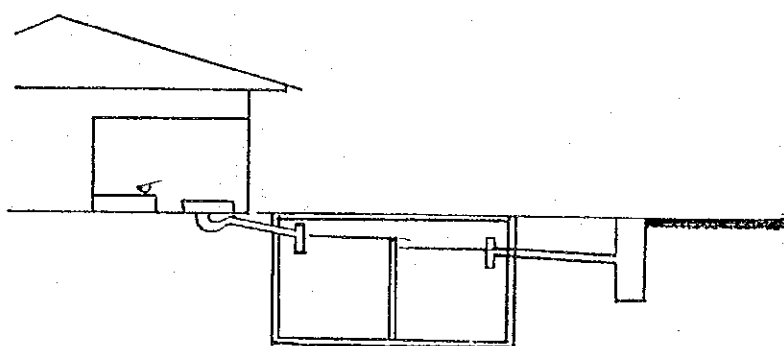




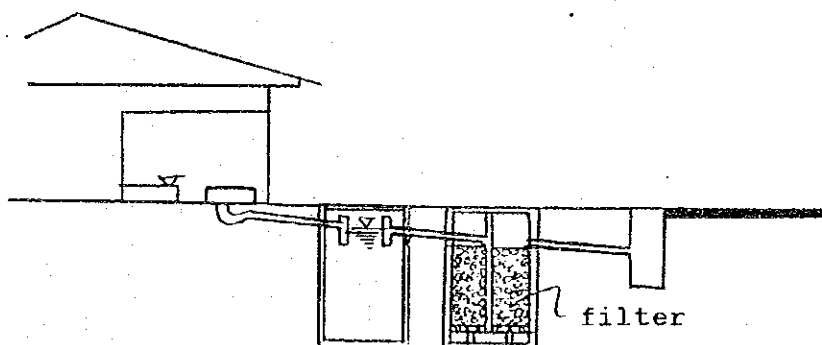
A, Pit Type



B, Leaching Pit Type



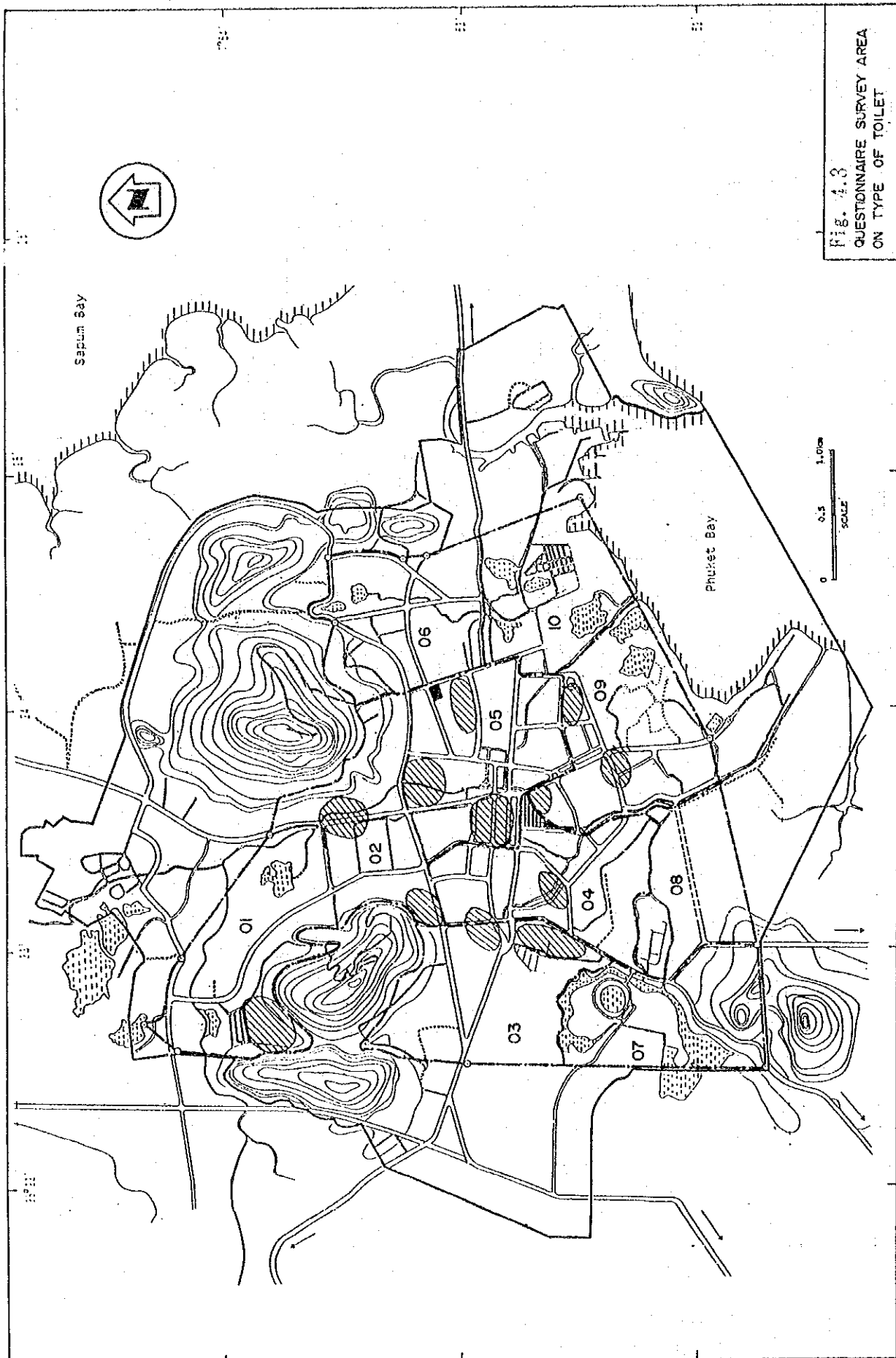
C, Septick Tank Type



D, Thai Standard Type

Fig. 4.2

TYPE OF TOILET





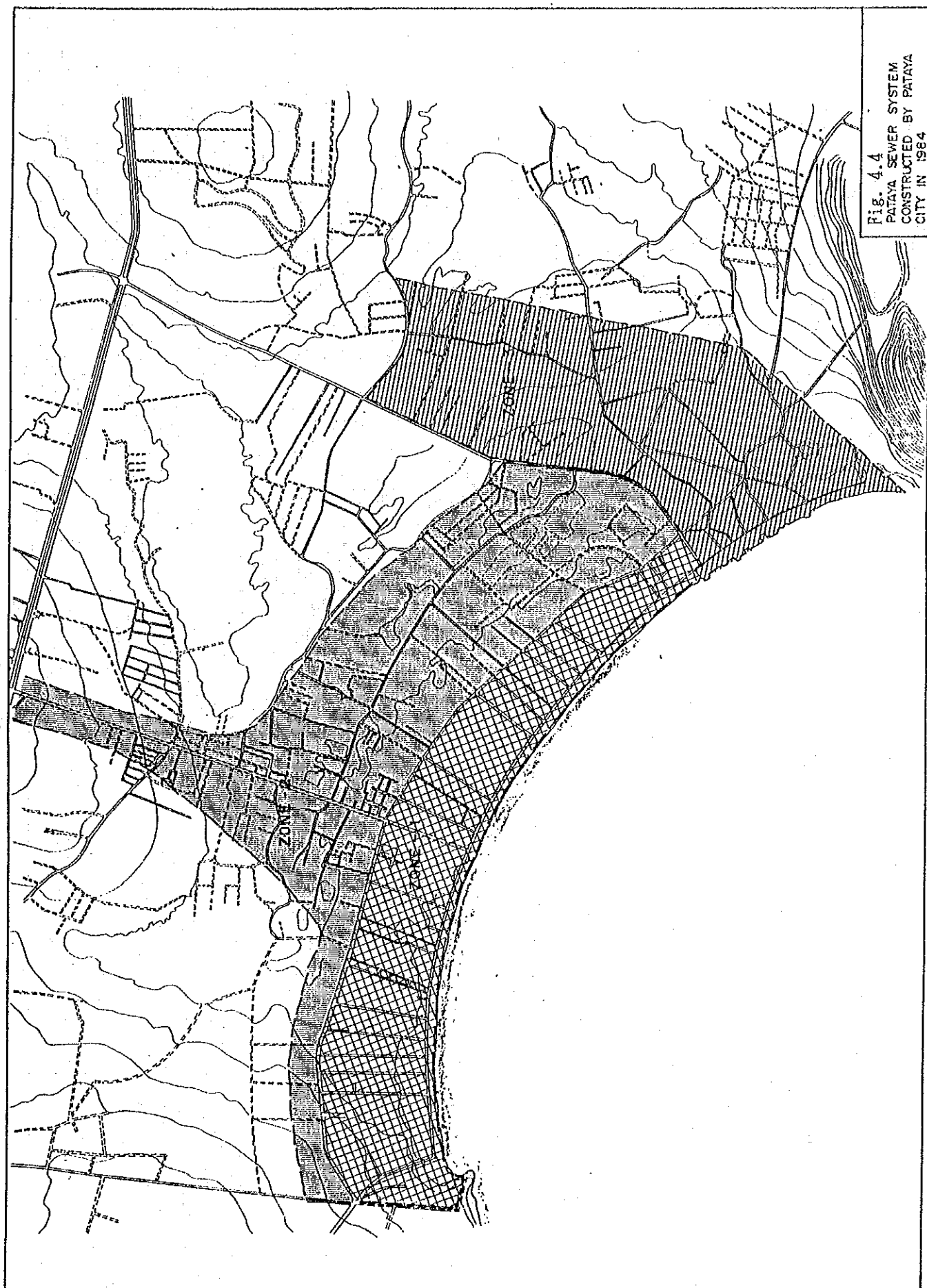
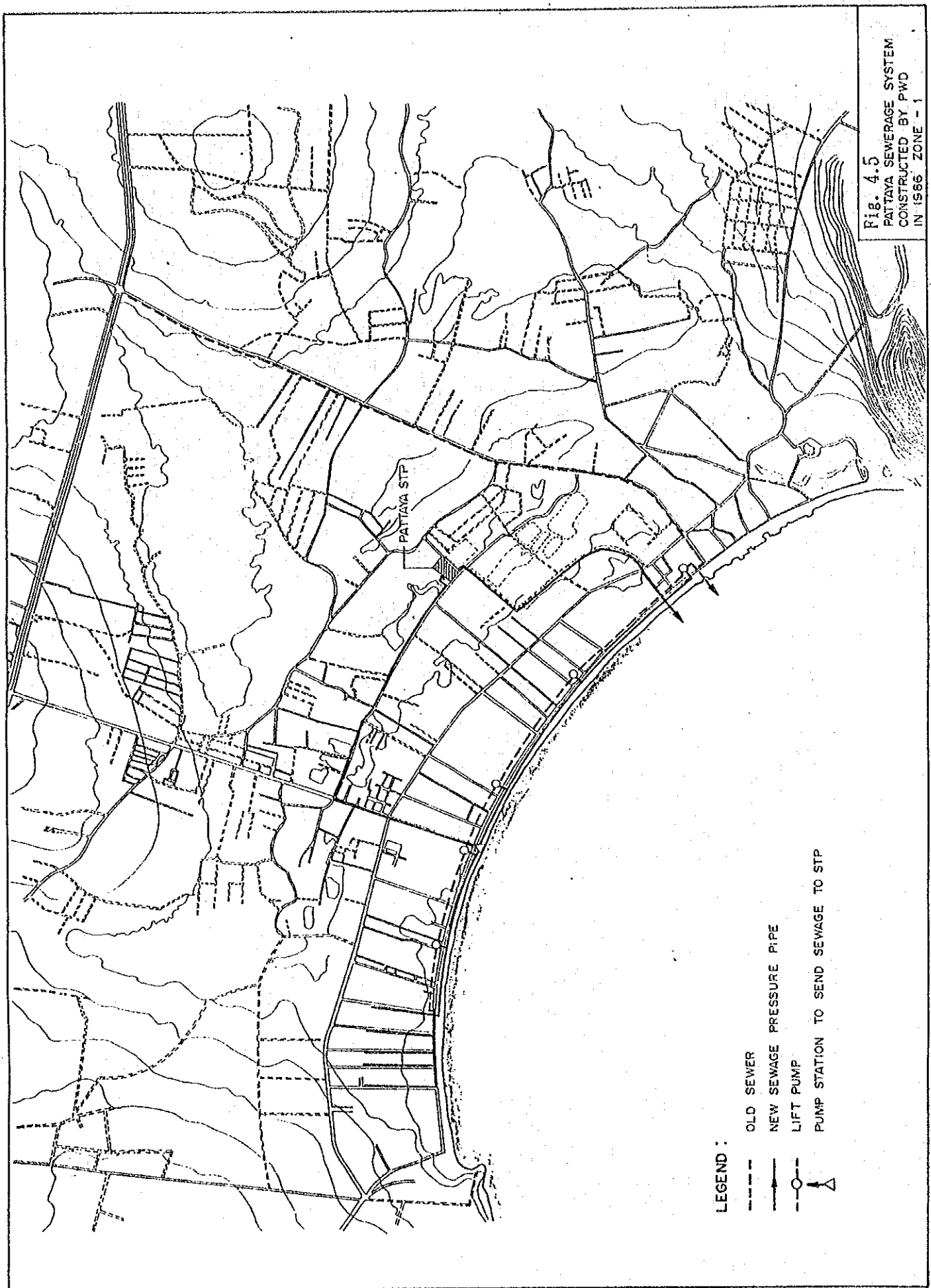
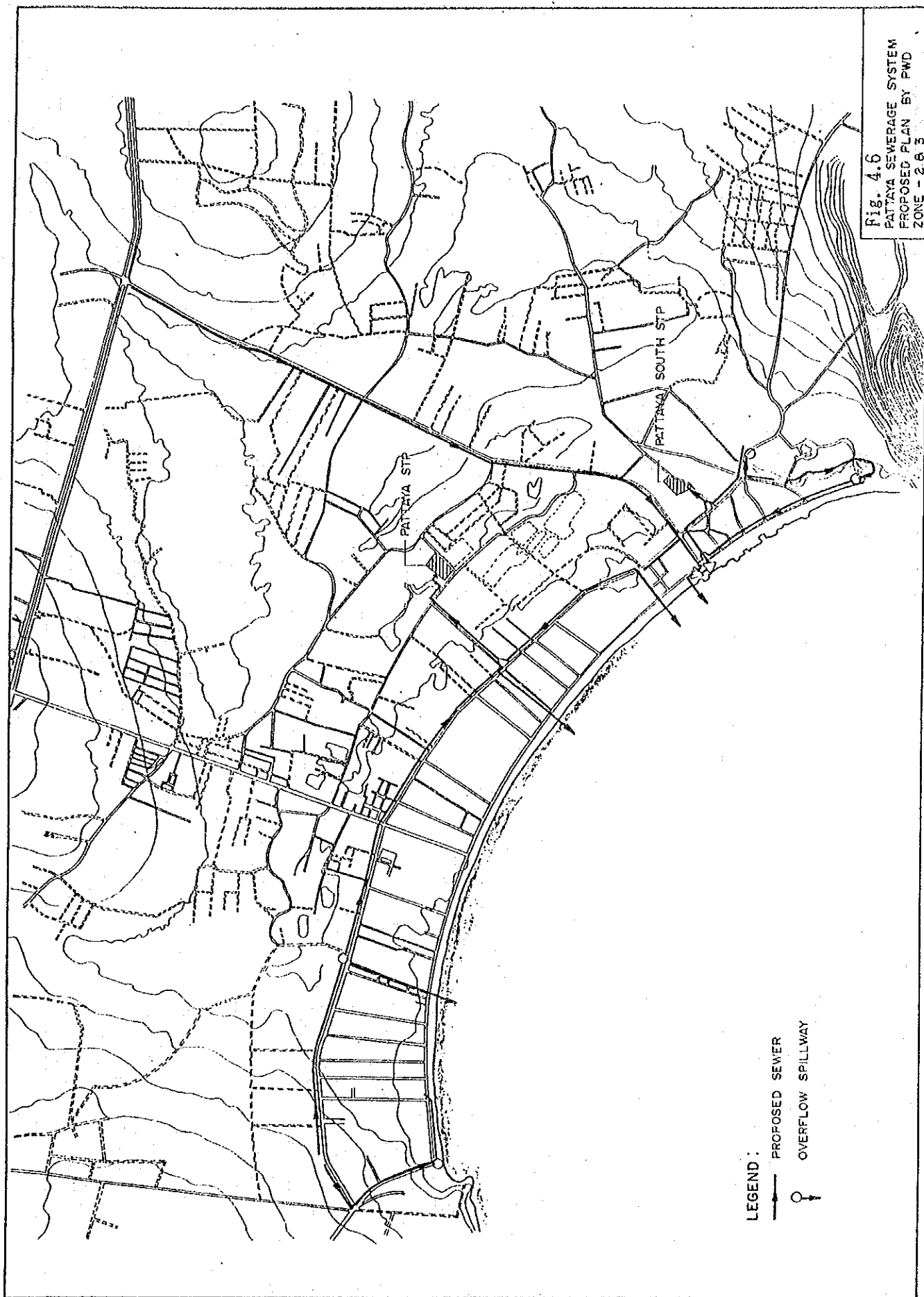
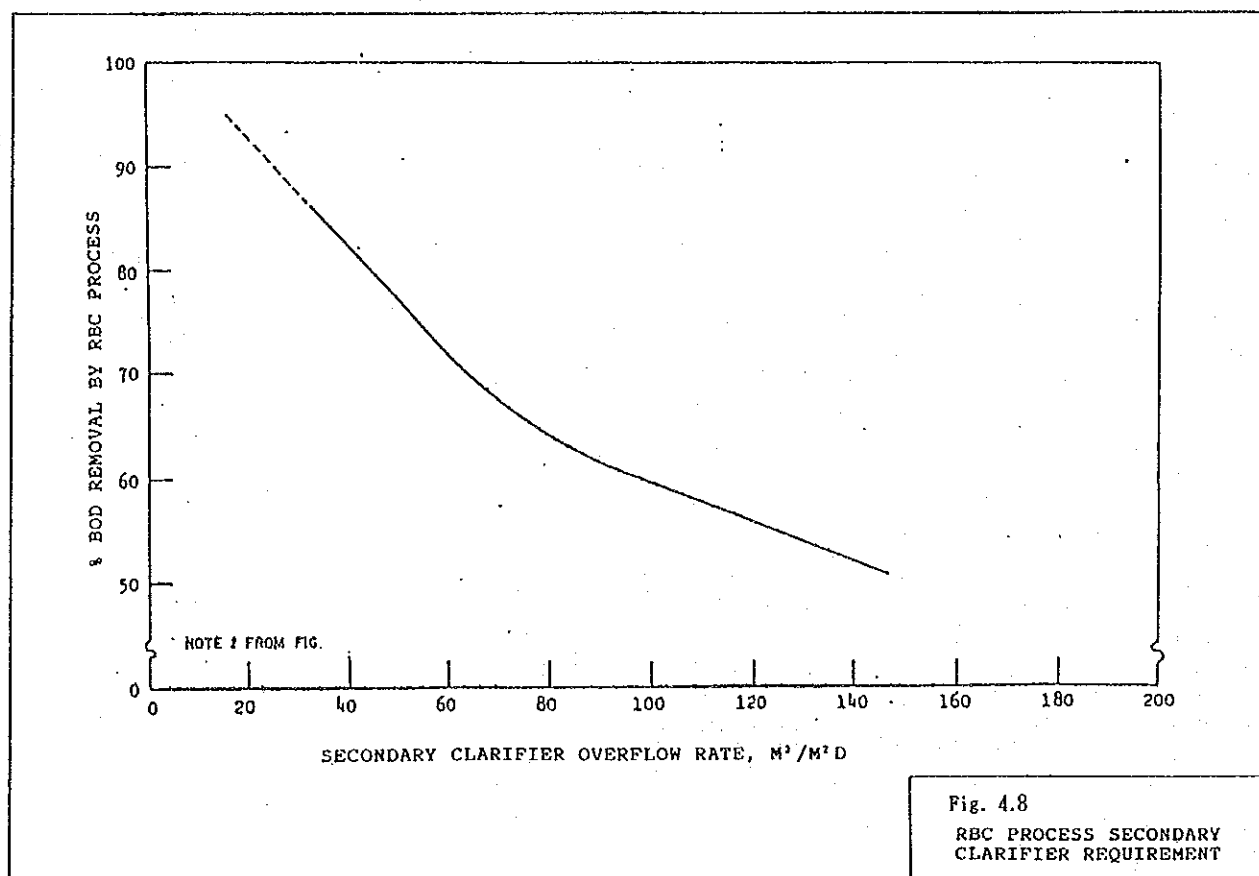
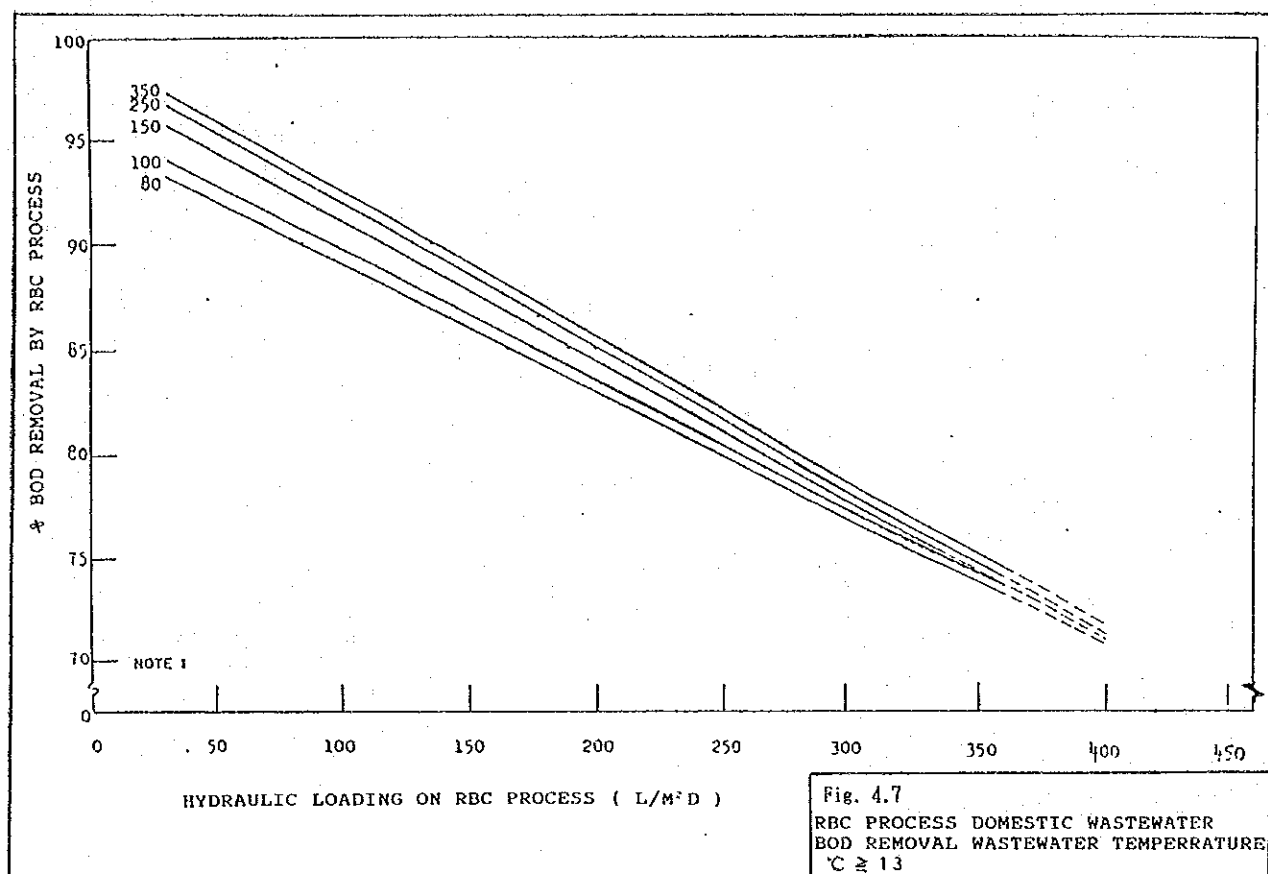
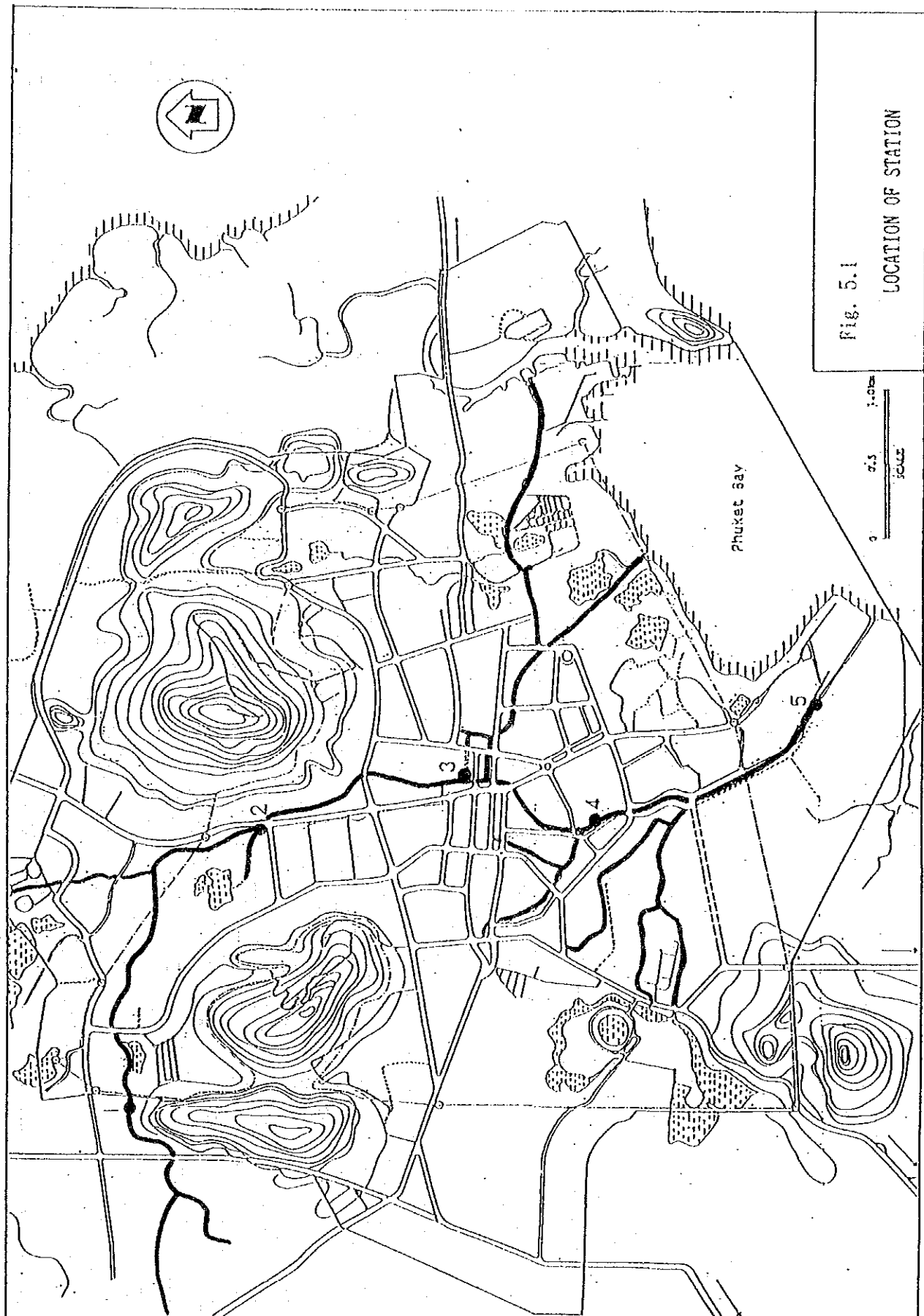


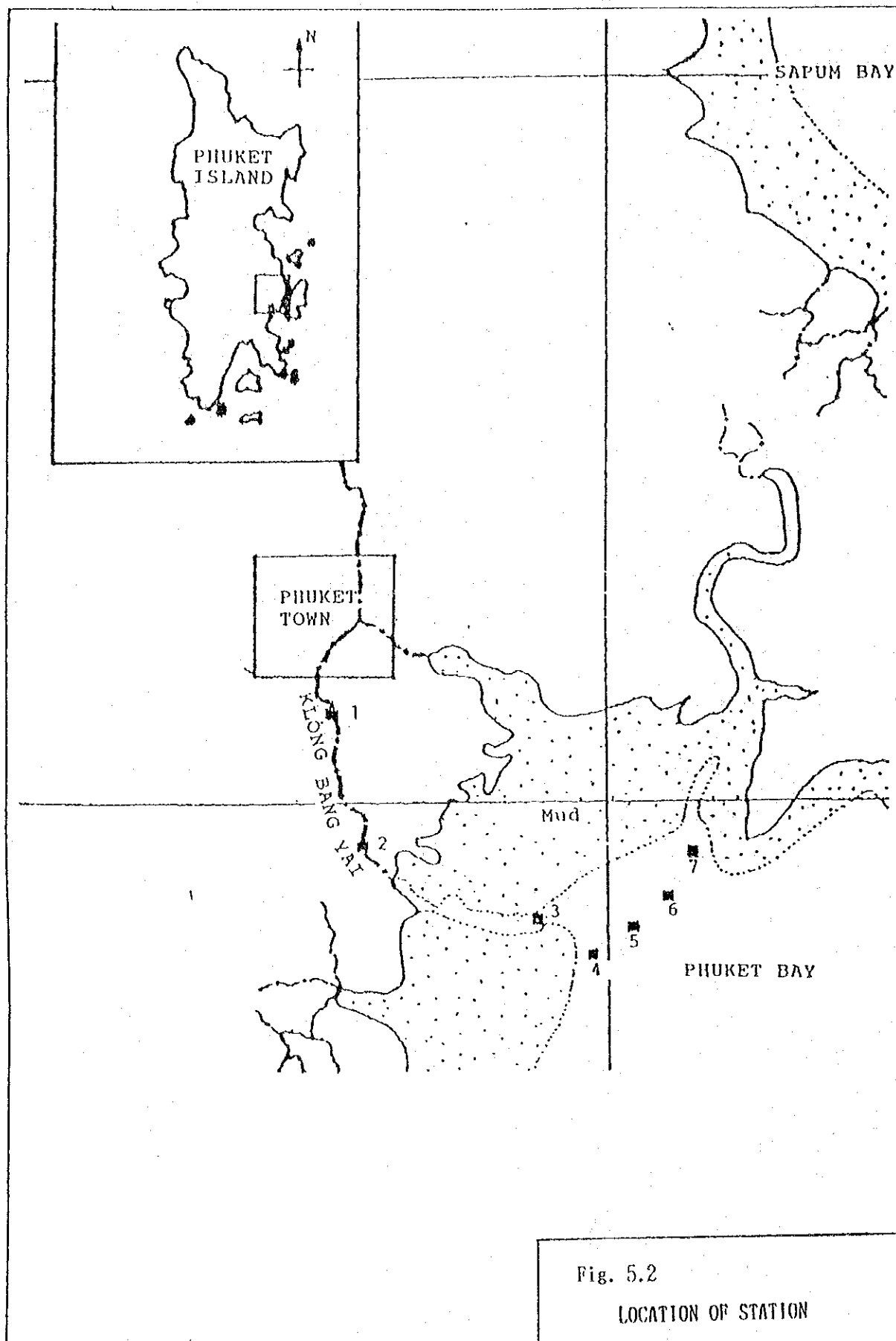
Fig. 4.4  
PATAYA SEWER SYSTEM  
CONSTRUCTED BY PATAYA  
CITY IN 1984











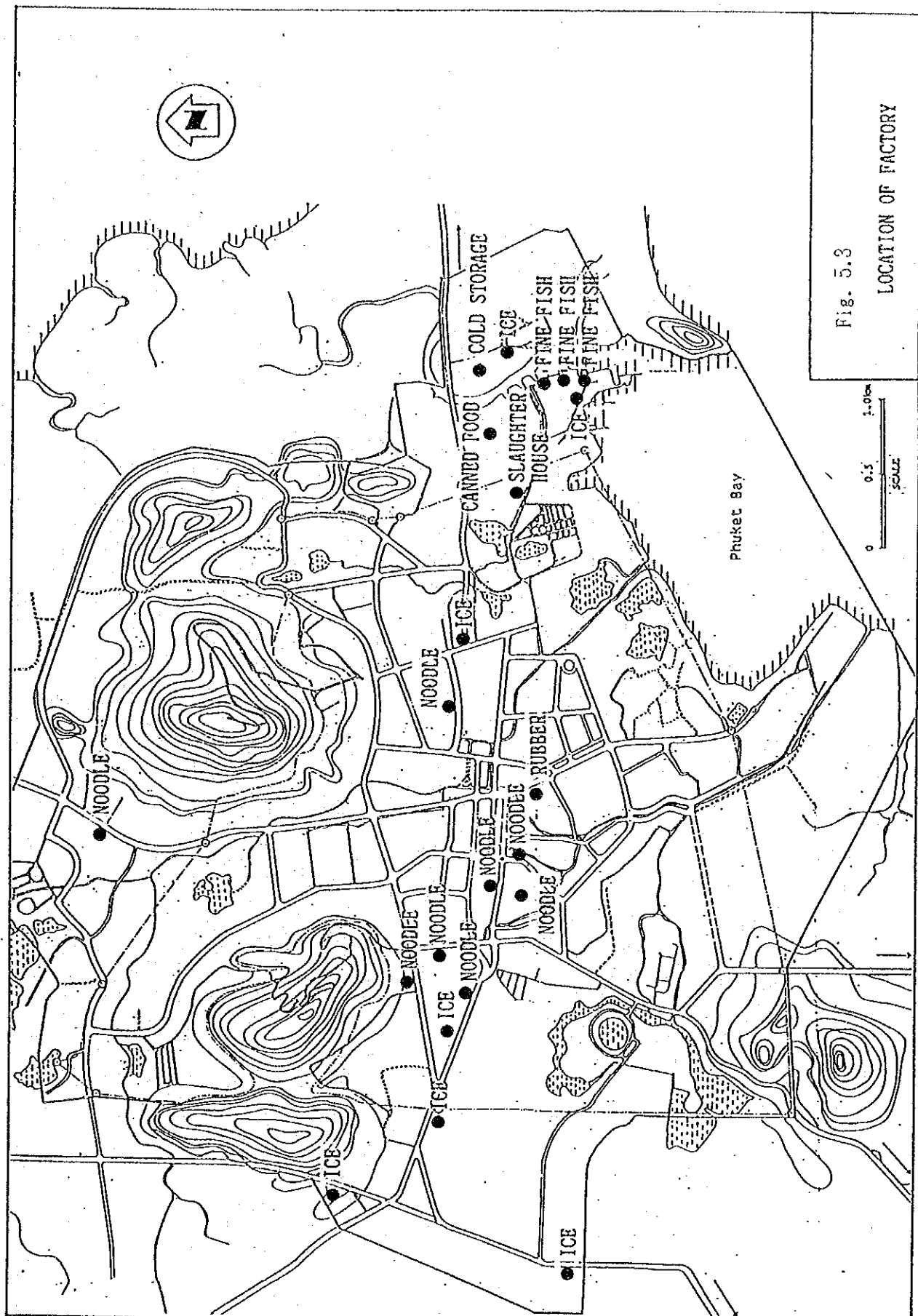


Fig. 5.3

LOCATION OF FACTORY

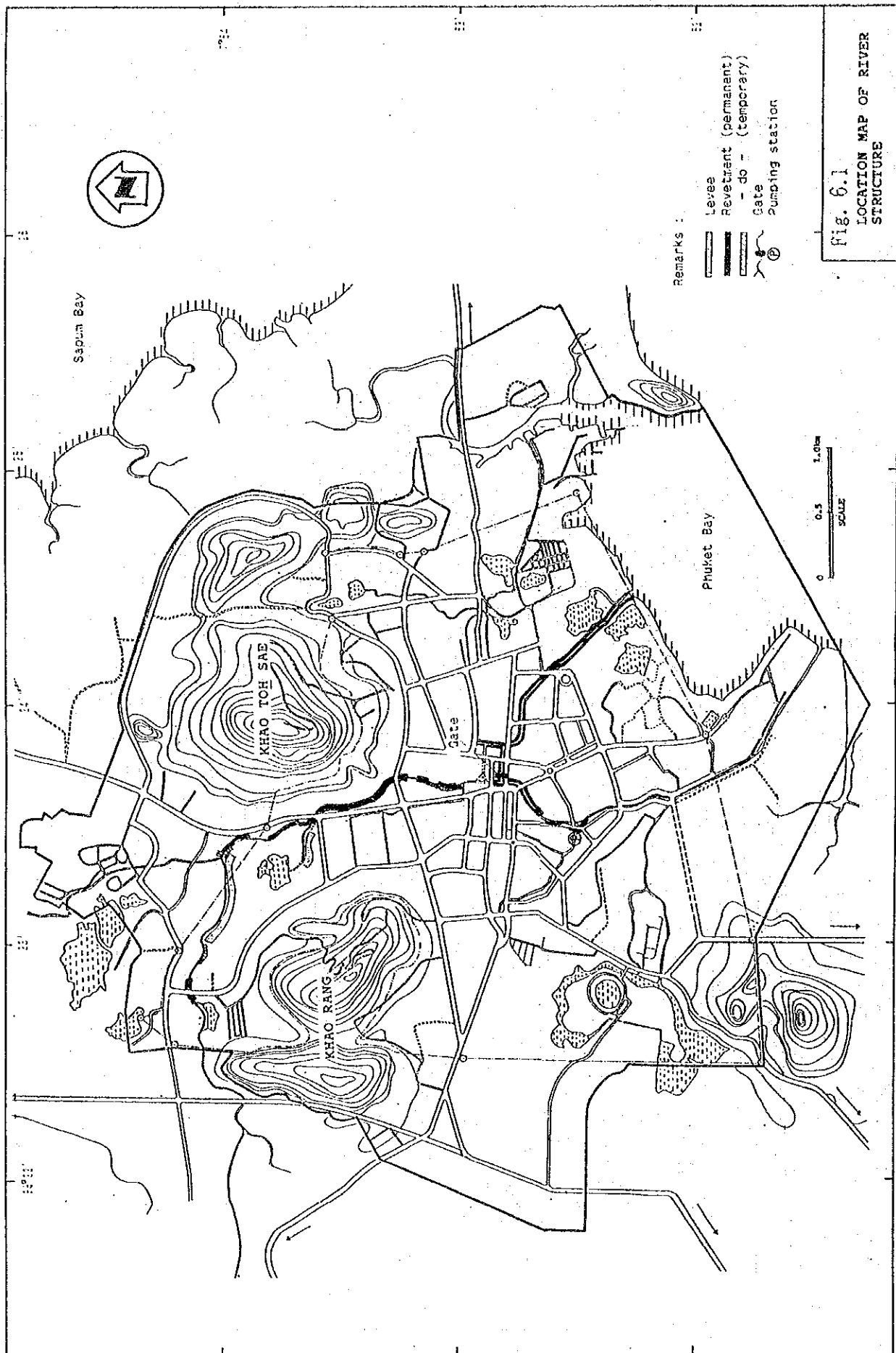


Fig. 6.1  
LOCATION MAP OF RIVER  
STRUCTURE



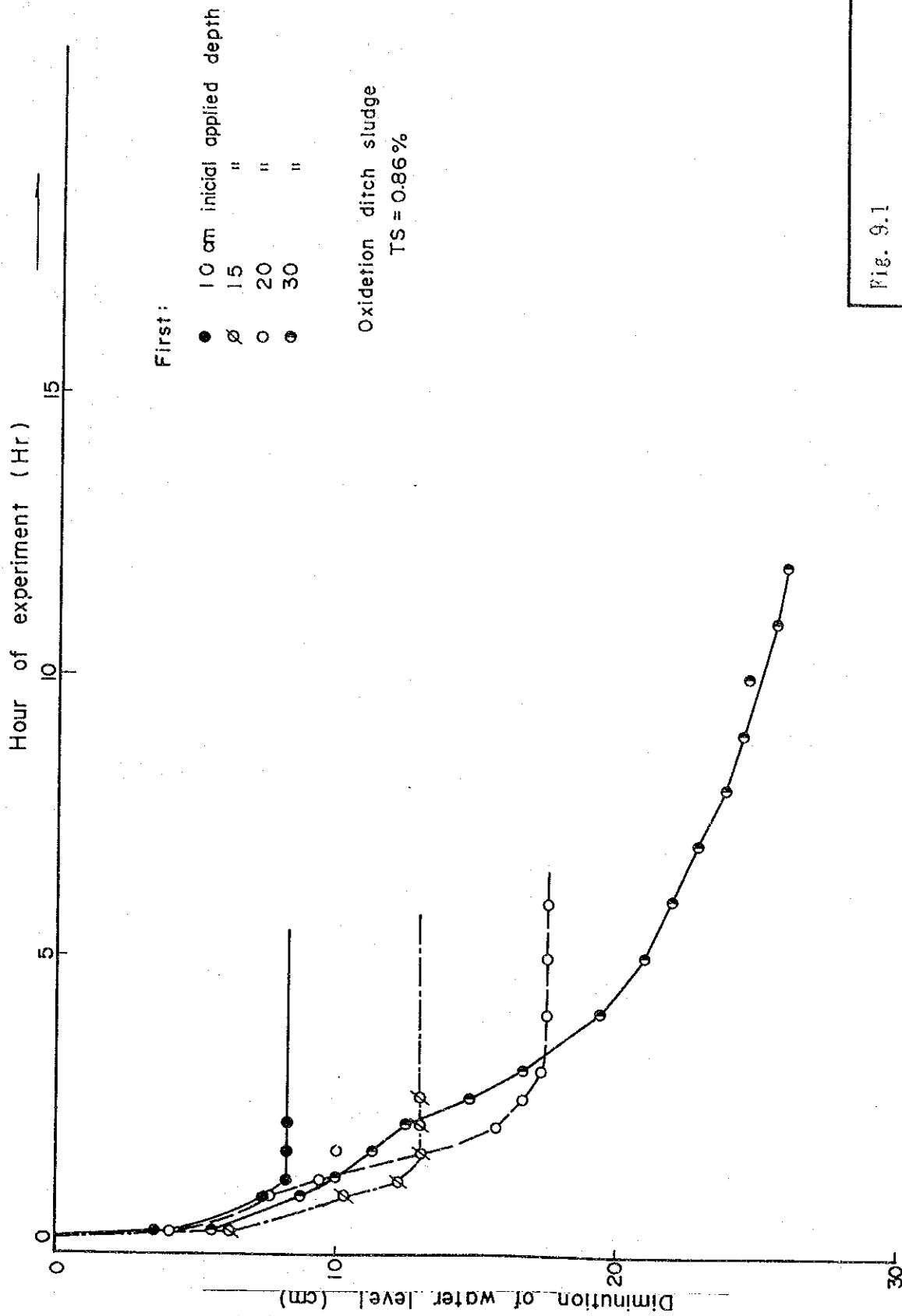


Fig. 9.1  
EFFECT OF APPLIED SLUDGE DEPTH  
IN FILTRATION PROCESS

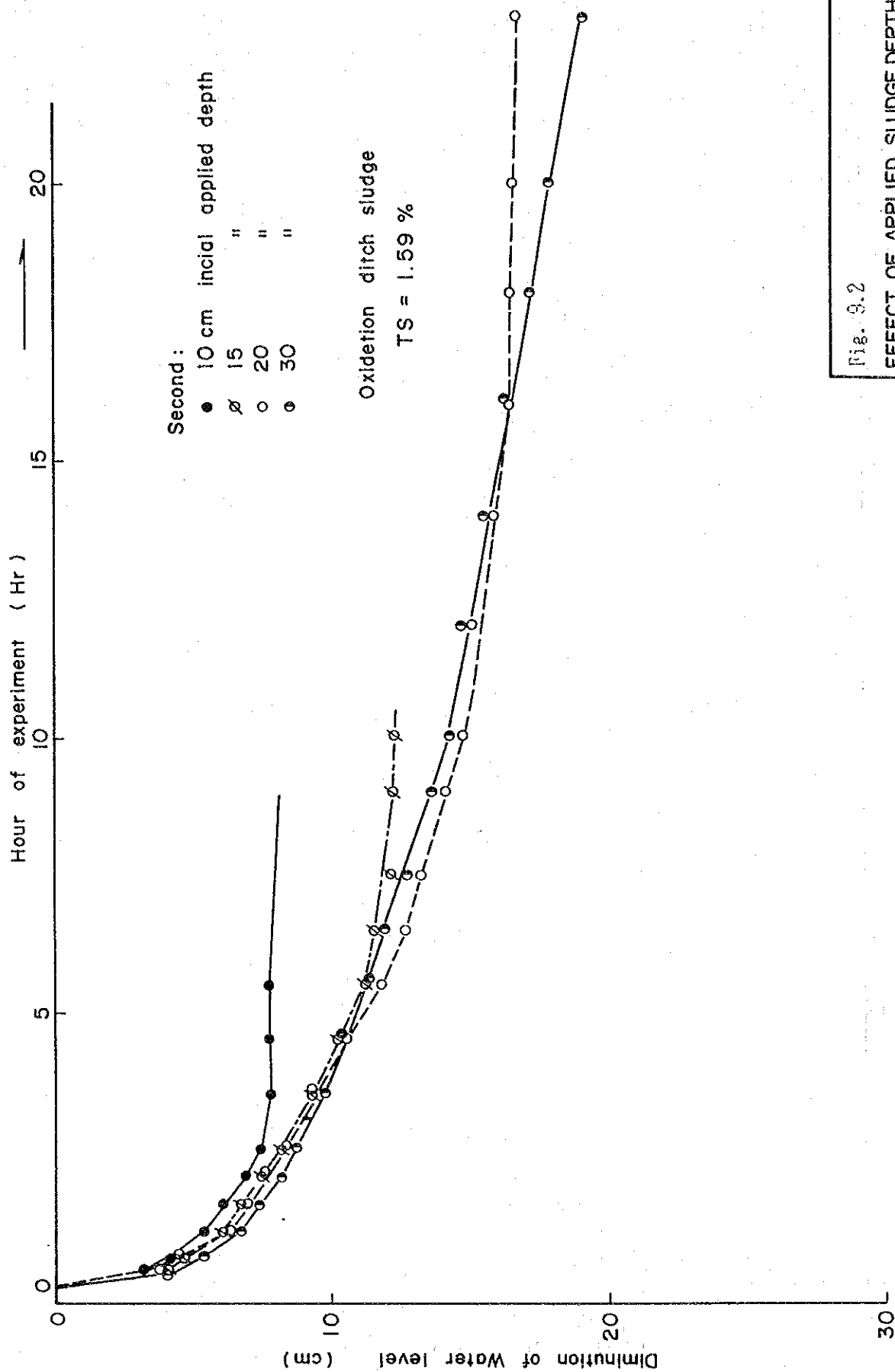


Fig. 9.2  
EFFECT OF APPLIED SLUDGE DEPTH  
IN FILTRATION PROCESS

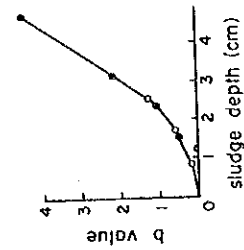
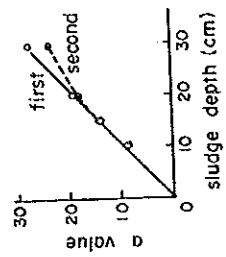
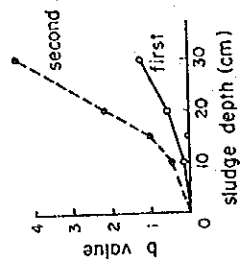


Fig. 9.3  
RELATIONSHIP BETWEEN SOLID  
LOADING AND NATURE OF SLUDGE

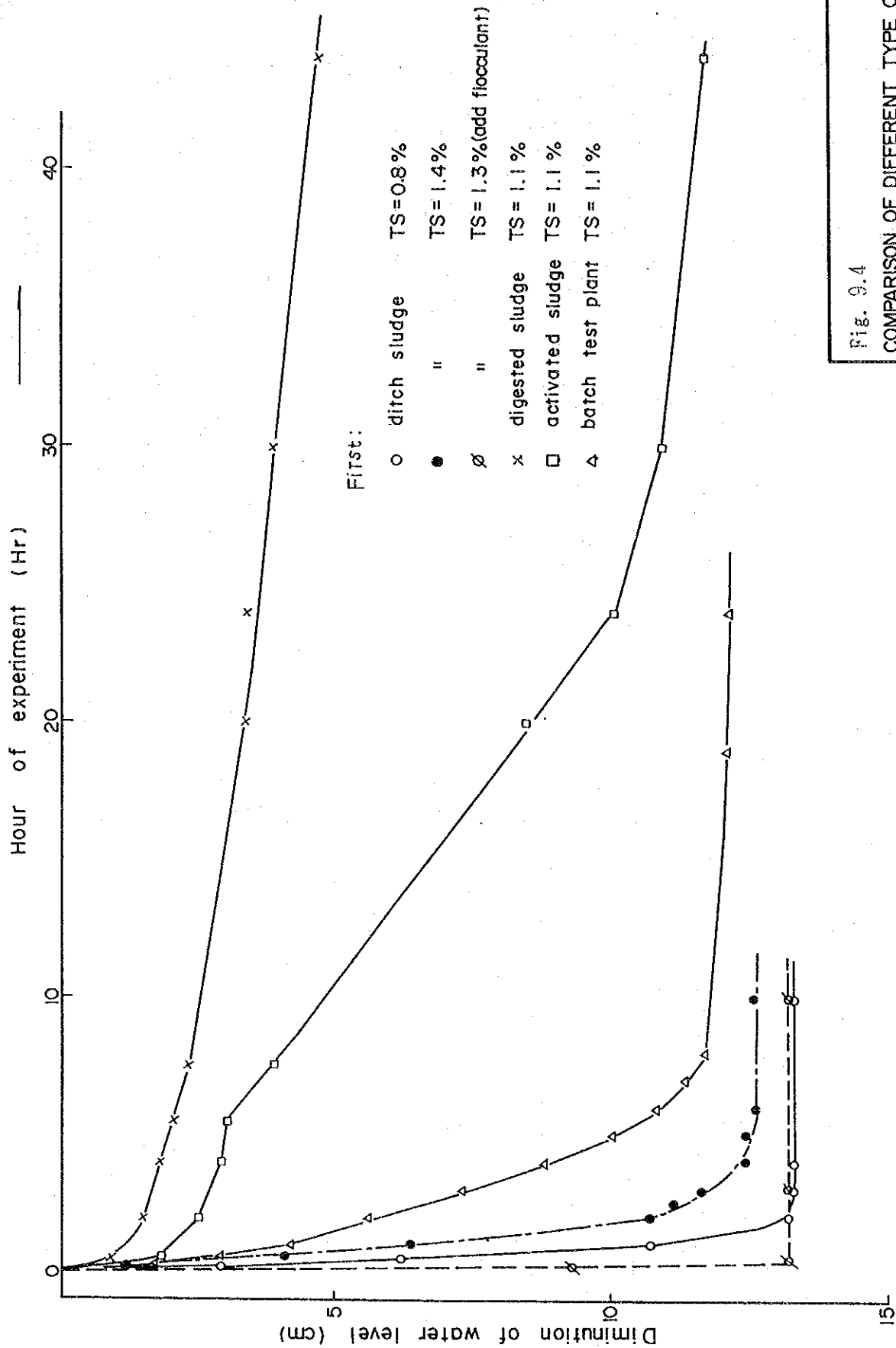


Fig. 9.4  
COMPARISON OF DIFFERENT TYPE OF  
SLUDGES IN FILTRATION PROCESS

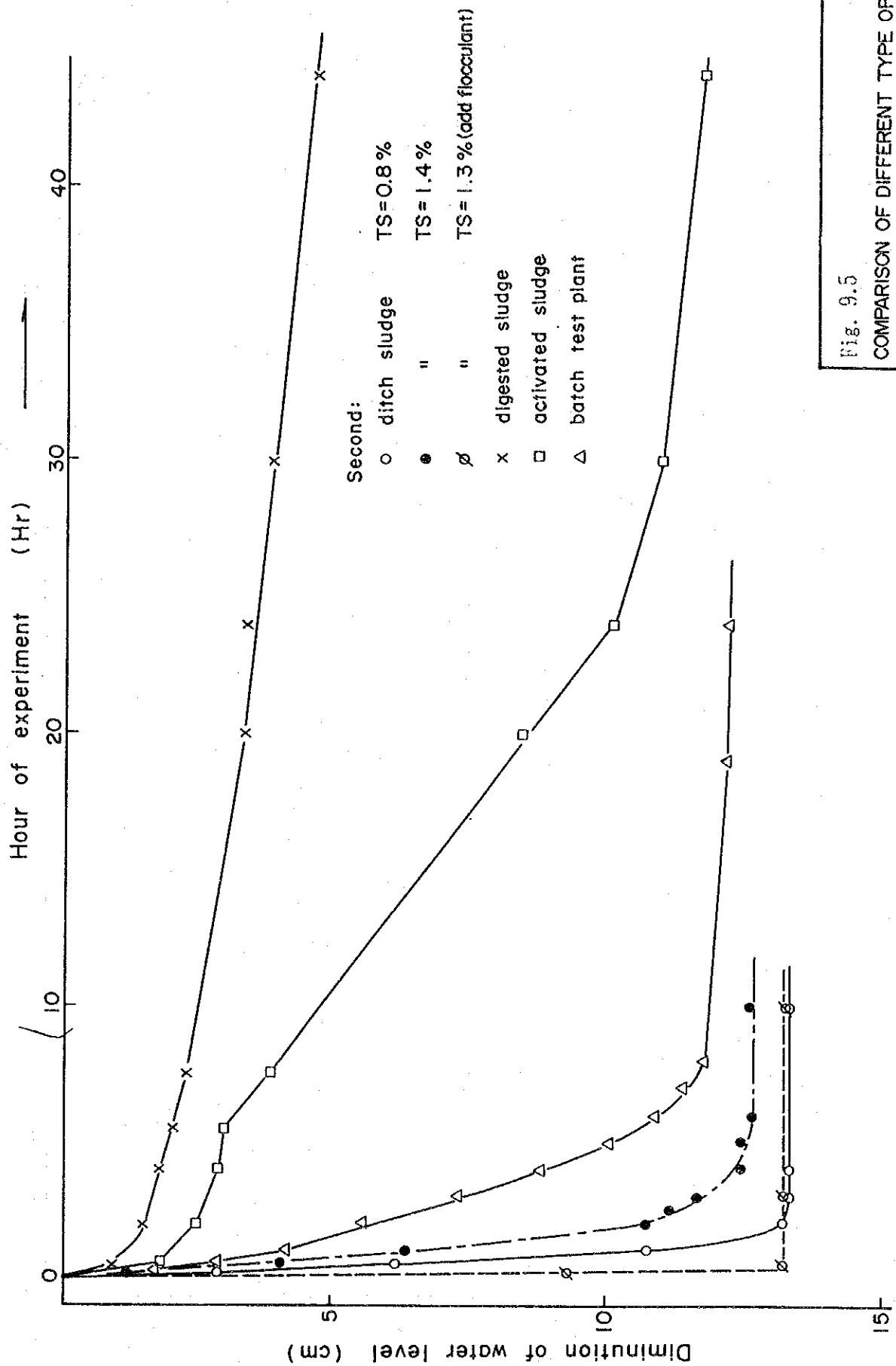


Fig. 9.5  
COMPARISON OF DIFFERENT TYPE OF  
SLUDGES IN FILTRATION PROCESS

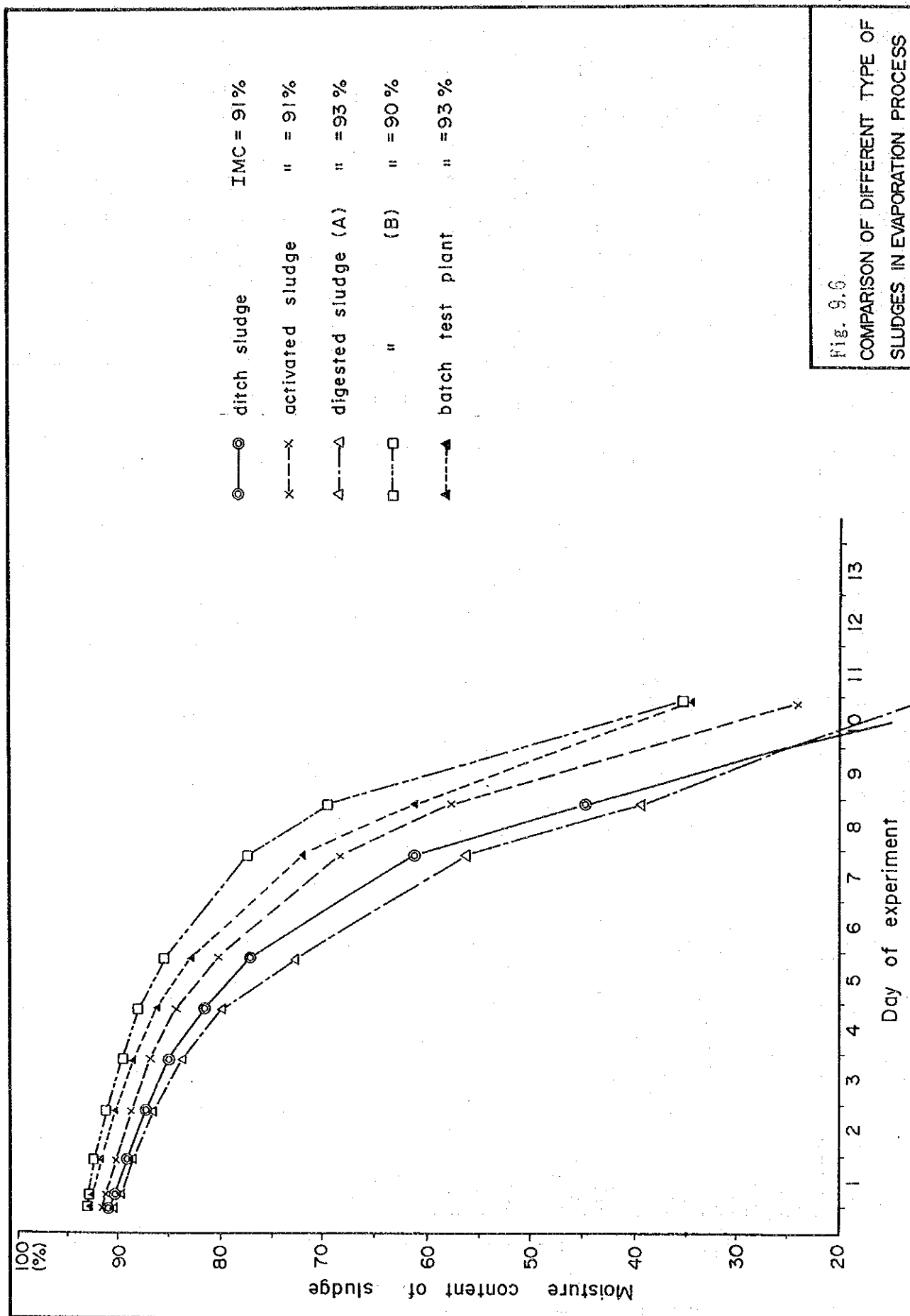


Fig. 9.6  
COMPARISON OF DIFFERENT TYPE OF  
SLUDGES IN EVAPORATION PROCESS

- First:
- low humidity (24.5°C, 40%)
  - △ mid. humidity (24.5°C, 80%)
  - high humidity (24.5°C, 92%)
- Second:
- low humidity (25.0°C, 40%)
  - ▲ mid. humidity (25.0°C, 80%)
  - high humidity (25.0°C, 92%)

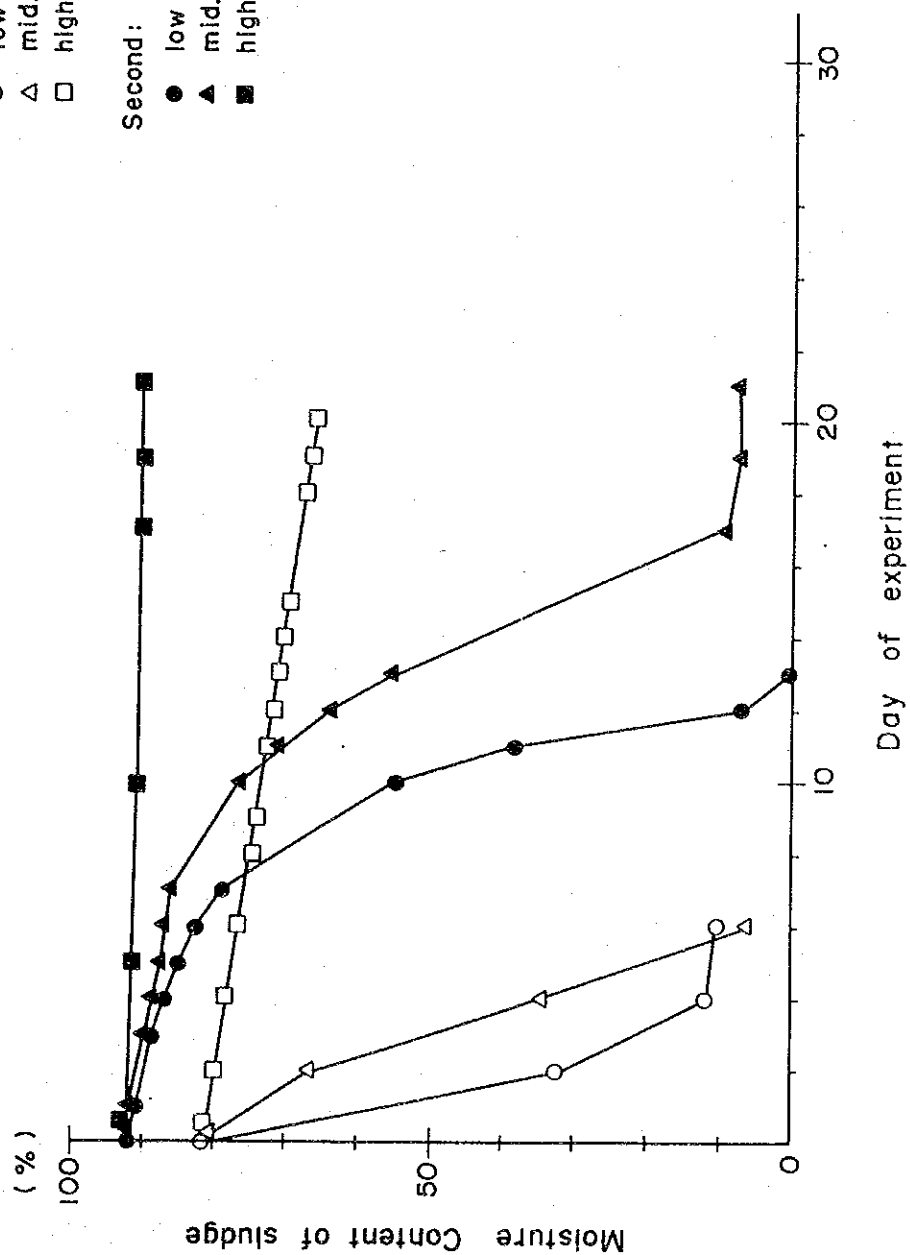


Fig. 9.7  
EFFECT OF HUMIDITY

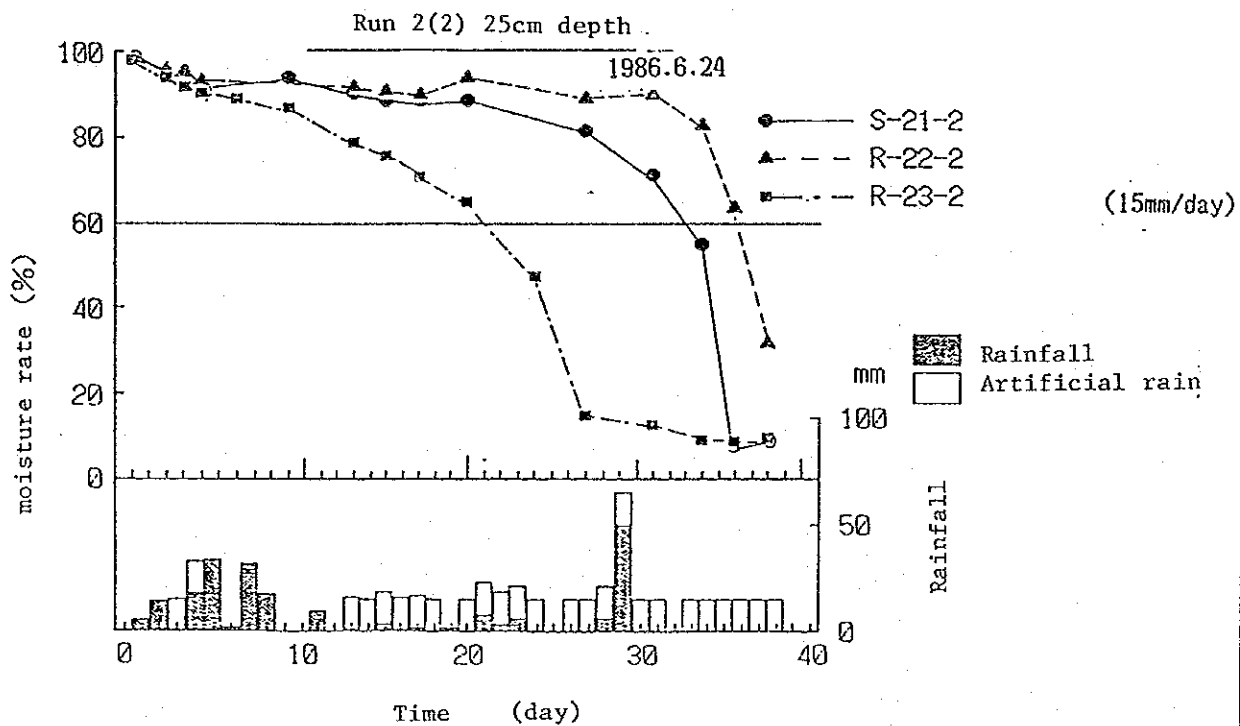
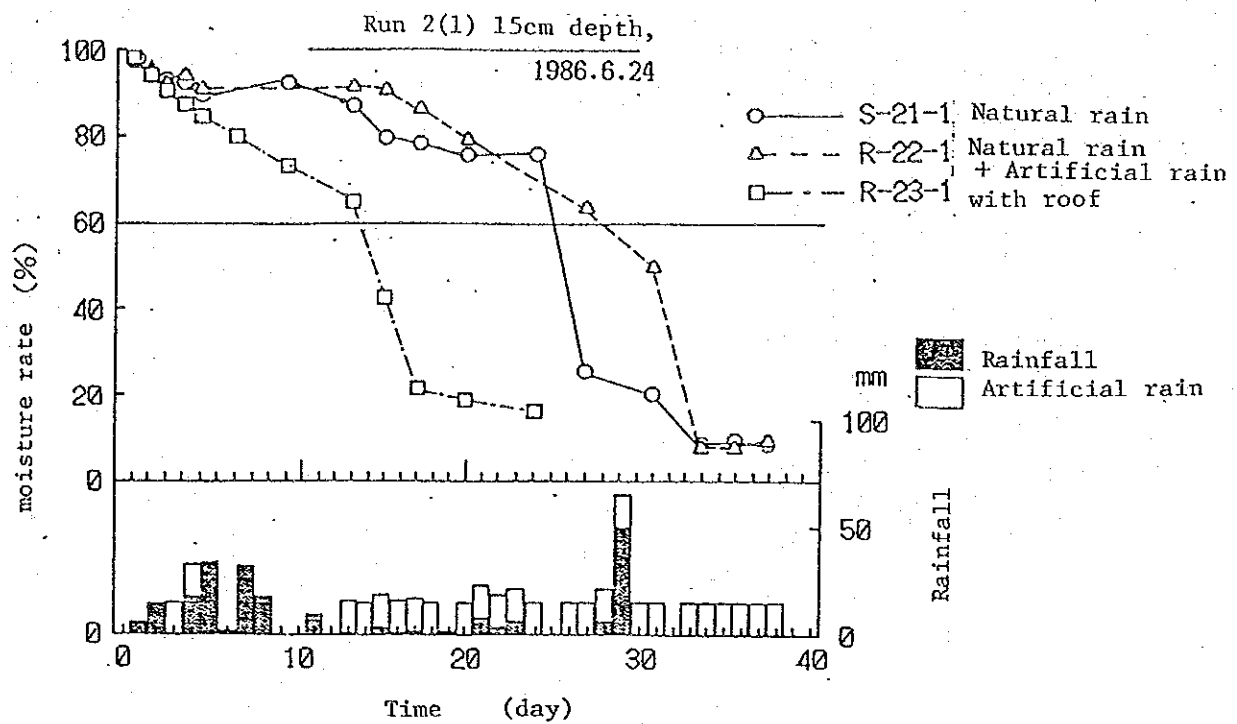


Fig. 9.8

EFFECT OF RAINFALL



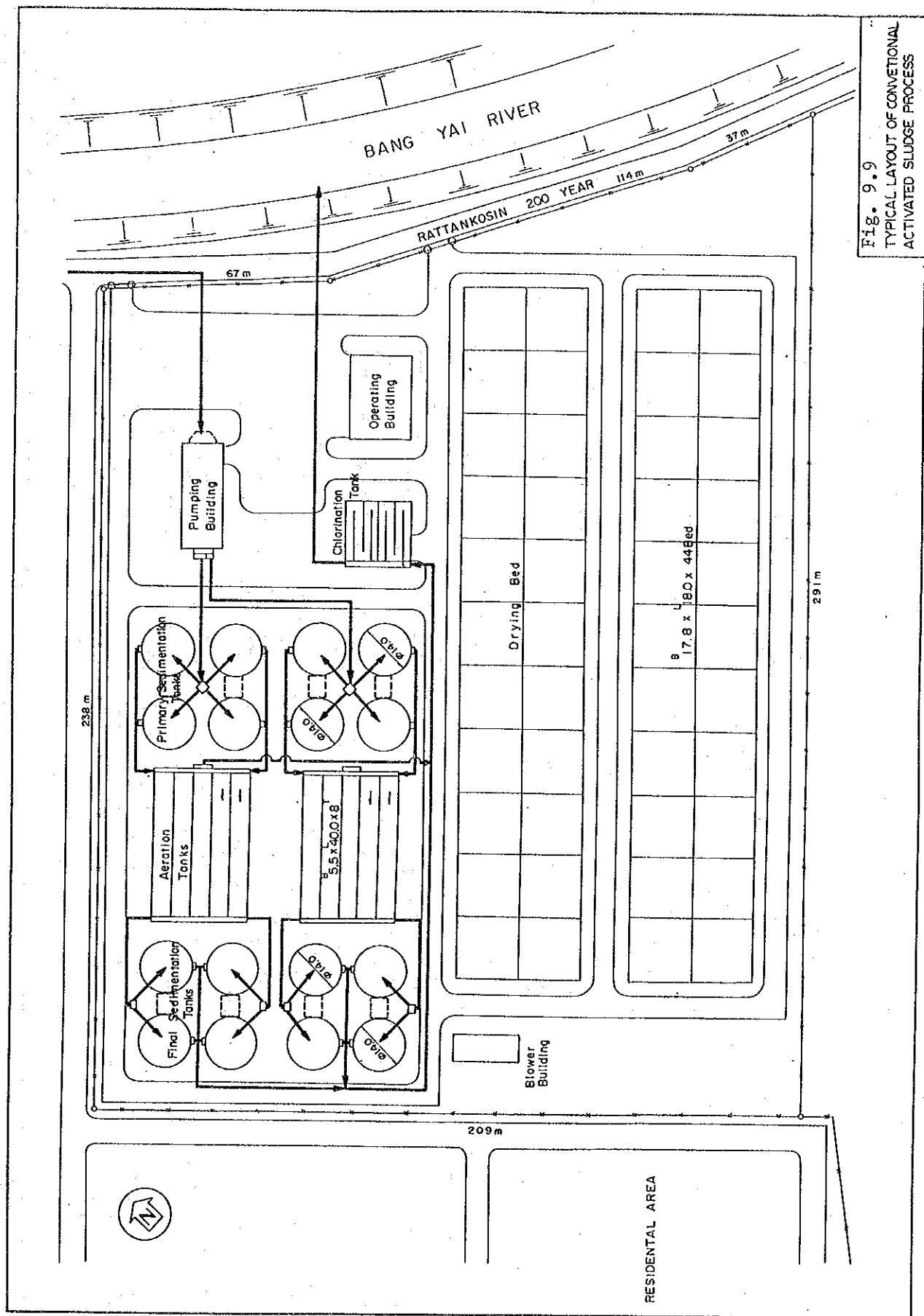


Fig. 9.9  
TYPICAL LAYOUT OF CONVENTIONAL  
ACTIVATED SLUDGE PROCESS

