

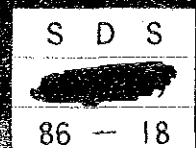
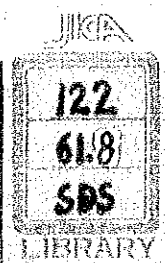
THE KINGDOM OF THAILAND  
BANGKOK METROPOLITAN ADMINISTRATION

**FEASIBILITY STUDY  
ON FLOOD PROTECTION/DRAINAGE PROJECT  
IN EASTERN SUBURBAN-BANGKOK**

**SUMMARY**

**FEBRUARY, 1986**

**JAPAN INTERNATIONAL COOPERATION AGENCY**





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国際協力事業団	
受入 月日 '86. 8. 4日	122
登録No. 15053	61.8
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## PREFACE

In response to the request of the Government of the Kingdom of Thailand, the Japanese Government decided to conduct a feasibility Study on the Flood Protection/Drainage Project in Eastern Suburban-Bangkok. The study was entrusted to the Japan International Cooperation Agency (JICA).

Based on the Master Plan Study completed in early 1985, the Feasibility Study was carried out by a study team headed by Mr. Fukagawa, Director of Pacific Consultants International, which was sent to Thailand from June 1985 to February 1986. The team exchanged views on the Project with the officials concerned of the Government of Thailand and conducted a field survey in the eastern suburbs of Bangkok. After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

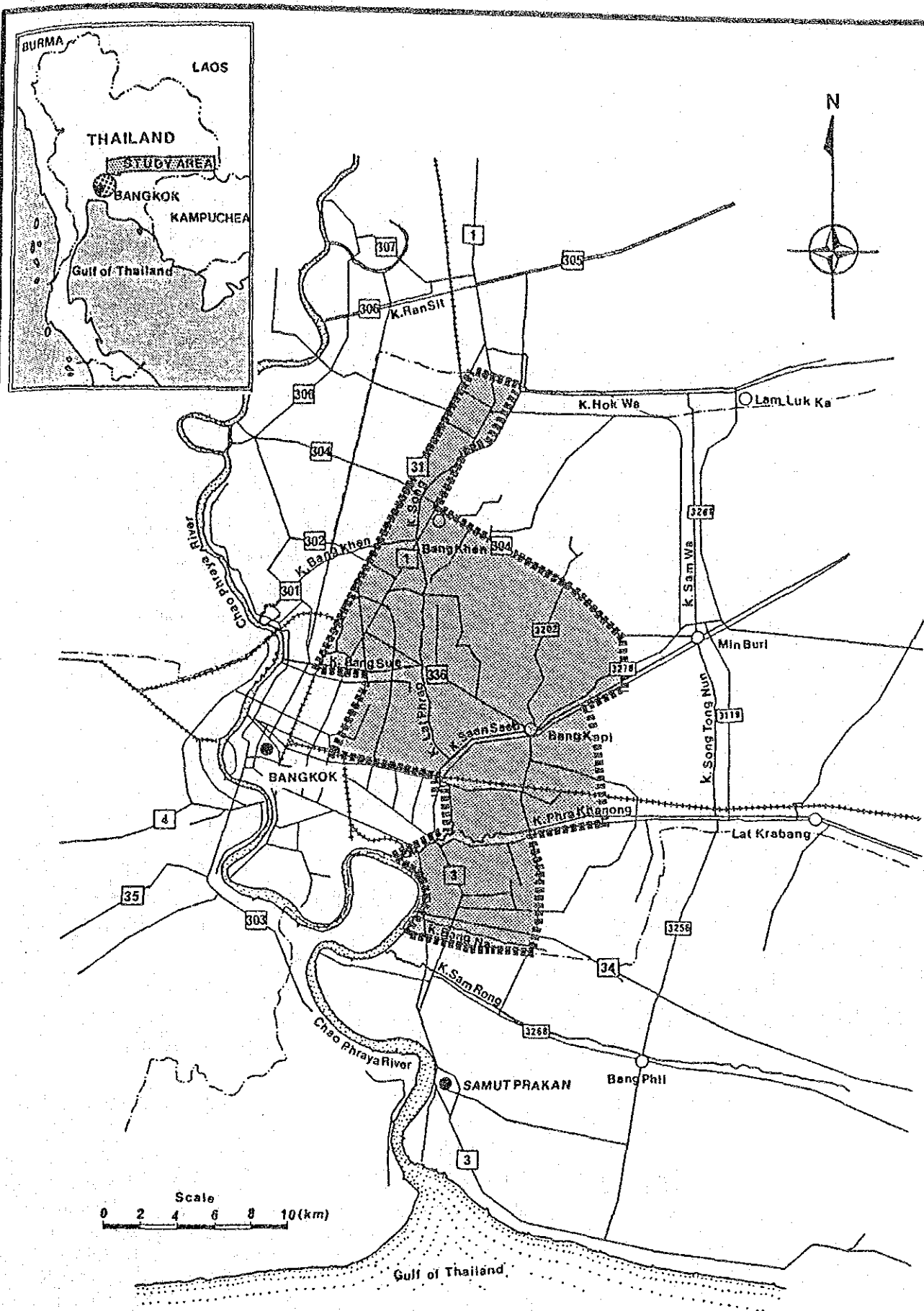
February, 1986

A handwritten signature in dark ink, reading "Keisuke Arita", is written over a horizontal line.

Keisuke Arita  
President

Japan International Cooperation Agency







## SUMMARY

### 1. Introduction

In response to the request, Japan International Cooperation Agency (JICA) undertook the preliminary and master plan studies for the flood protection/drainage project in eastern suburban Bangkok (1983 – 1985). In the preliminary study, the general concept for a comprehensive flood damage mitigation plan for an area of 501 km<sup>2</sup> in eastern suburban Bangkok was studied. In the master plan, structural and non-structural measures were established as the comprehensive permanent measures, targeting the year 2000, for the western half of the area (260 km<sup>2</sup>).

Following the master plan study, a feasibility study has been carried out since June, 1985 on the first stage programme, as defined in the Master Plan, which has high priority in mitigating the effects of serious flooding. This study also presents the action plan for non-structural measures (Flood Plain Management).

### 2. Outline of Comprehensive Flood Damage Mitigation Plan

Past flood damage in Bangkok has been caused by natural physical conditions (heavy rainfall, tide, low flat plain) and also by the progress of urbanization and land subsidence.

Flood damage in an urbanizing area can not be mitigated only by structural measures which have very high construction costs. The introduction of flood plain management will reduce construction costs and the resulting financial burden. Thus, a comprehensive flood loss mitigation plan including non-structural measures is needed (See Fig. S.1).

On the occasion of the 1983 floods, urgent structural measures complying with the general concept recommended by the JICA preliminary study were carried out. Nevertheless, residual flooding problems will still remain for a large segment of the community. The progress of urbanization and land subsidence is aggravating the flooding situation. It is estimated that almost the same damage as the 1983 flood will occur in 2000 if no measures are undertaken. Therefore, the execution of a comprehensive flood damage mitigation plan is needed.

#### 2.1 Structural Measures

The basic idea of the structural measures is to establish a polder system. The area is to be protected by polder dykes and gates against water inflow from outside and from the Chao Phraya River. Rainfall collected in the polder is to be discharged by drainage facilities installed inside the polder (See Fig. S.2).

The Eastern Suburbs covered by the Preliminary Study has been protected since 1984 by the Green Belt dyke. The western half of the study area is to be surrounded also by polder dykes and gates. Installation of pumping stations discharging storm water into the Chao Phraya River and the improvement of the main klongs leading to the pumping stations is necessary to alleviate overall flooding. On the other hand, heavy local flooding will be relieved by improvements to a large number of sub-klongs and main drains, and the installation of inner area pumps.

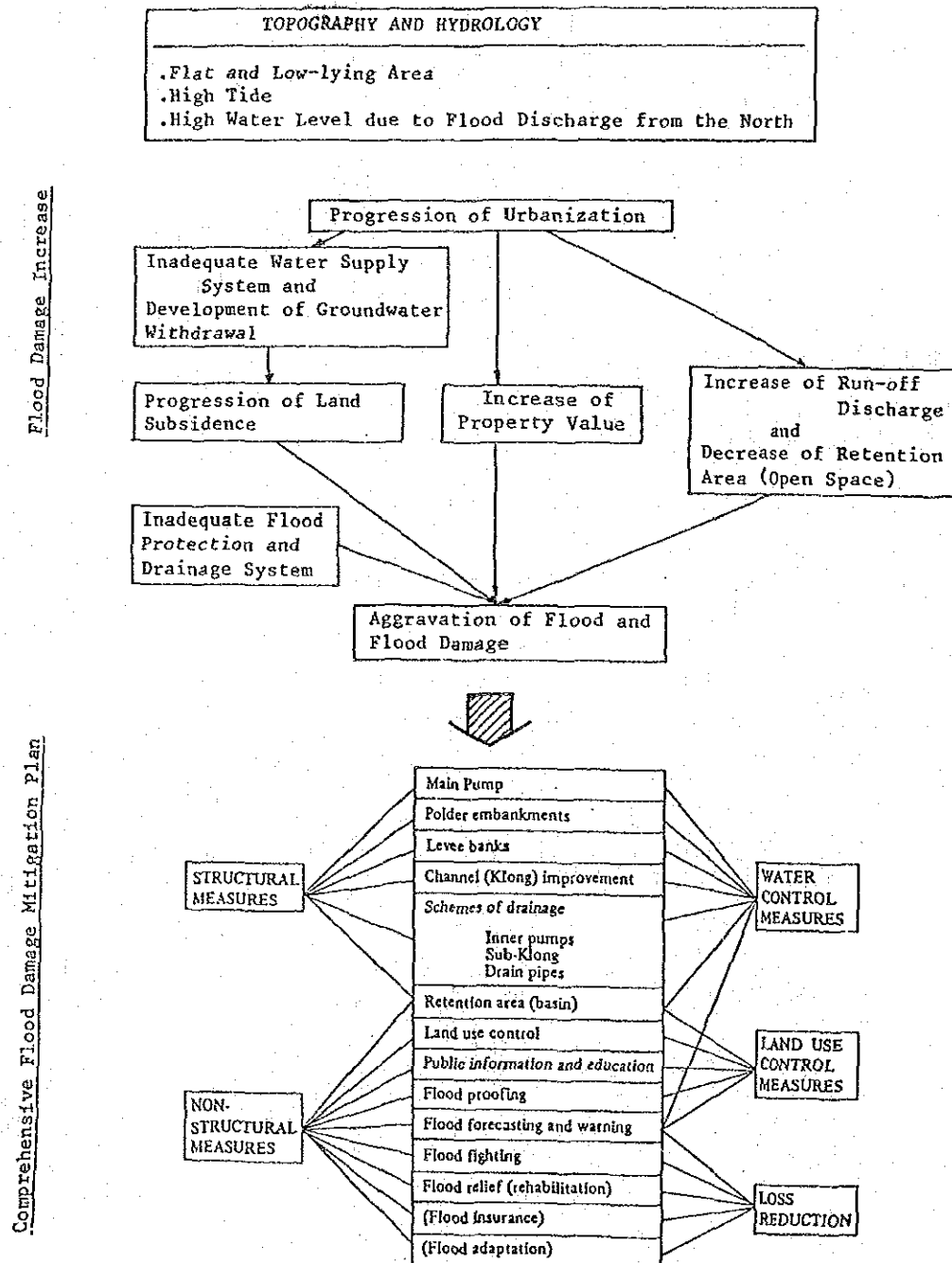


Fig. S.1 Comprehensive Flood Damage Mitigation Plan (1)



## **2.2 Non-Structural Measures**

The basic idea of non-structural measures is to modify the susceptibility of damage to property and activity in the flood-prone area and to maintain the natural rainwater storage function in the area in order to lessen peak discharge into the klongs.

The Green Belt Area has already been designated as an agricultural conservation area in order not to increase future flood damage. Similarly, the eastern half of the preliminary study area enclosed by the Green Belt and some parts of the master plan areas are also designated as rainwater retarding areas.

The master plan area is in principle designated as a flood protection area. However, the increasing urbanized area ( $82 \text{ km}^2$ ) between 1980 and 2000 should be allocated to low risk flood-prone areas. Then, the remaining non-urbanized areas ( $44 \text{ km}^2$ ) in the year 2000 can be utilized as the natural storm-water retention areas, reducing the investment in structural measures.

## **2.3 Hydraulic and Environmental Impact**

Flood damage is reduced to a great extent by the proposed structural measures. However, it will raise the flood level in neighboring areas and the Chao Phraya River, and will deteriorate water quality in the Project Area. Control of the discharge to the Chao Phraya River and introduction of fresh water from the outer areas will improve the flooding condition in the outer areas to some extent. The proper operation of facilities is a prerequisite condition for maintaining environmental conditions.

## **3. Results of the Feasibility Study**

Examination is made of the feasibility of the selected facilities to alleviate overall flooding in the entire Study Area and also local flooding in high priority areas. An action plan for the implementation of the non-structural measures is also proposed.

### **3.1 Facilities, Project Cost and Implementation Schedule**

Based on the first stage program of the Master Plan, field investigations and comparative studies on alternatives were made and final plan is formulated as shown in Fig. S.3.

The proposed facilities, costing Baht 2,655 million at 1985 prices are shown in Table S.1.

Table S.1 Proposed Facilities

Facility	Quantity
Dyke (Barrier)	5.1 km
Gate	4 places
Pumping Station with Gate	5 stations (36 m <sup>3</sup> /s)
Klong Improvement	93 km
Main Drain Improvement	4 km
Flood Control Operation Centre	1 set

The project is to be scheduled for execution during the 6th five-year national plan period (1987–1991). The facilities to alleviate overall flooding such as dykes, gates, pumping stations, main klongs and flood control operation centre are to be constructed in 1988 and 1989 following detailed design in 1987. Sub-klongs and drains are improved in 1990 and 1991.

### 3.2 Flood Plain Management

The effective measures are to establish a zoning system (see Fig. S.4) according to flood risk of each area through city planning. Considering the difficulty in enforcing city planning now under preparation and the increasing flood damage each year during the preparation, the necessary measures to be initiated are shown in Table S.2. These measures are classified into three stages; short-term, intermediate-term and long-term action plans. To begin with, the sub-committee for non-structural measures is to be mobilized, because flood plain management needs strong leadership and public support. Then, the publication of observed flooding, construction of retention ponds etc. are to be made.

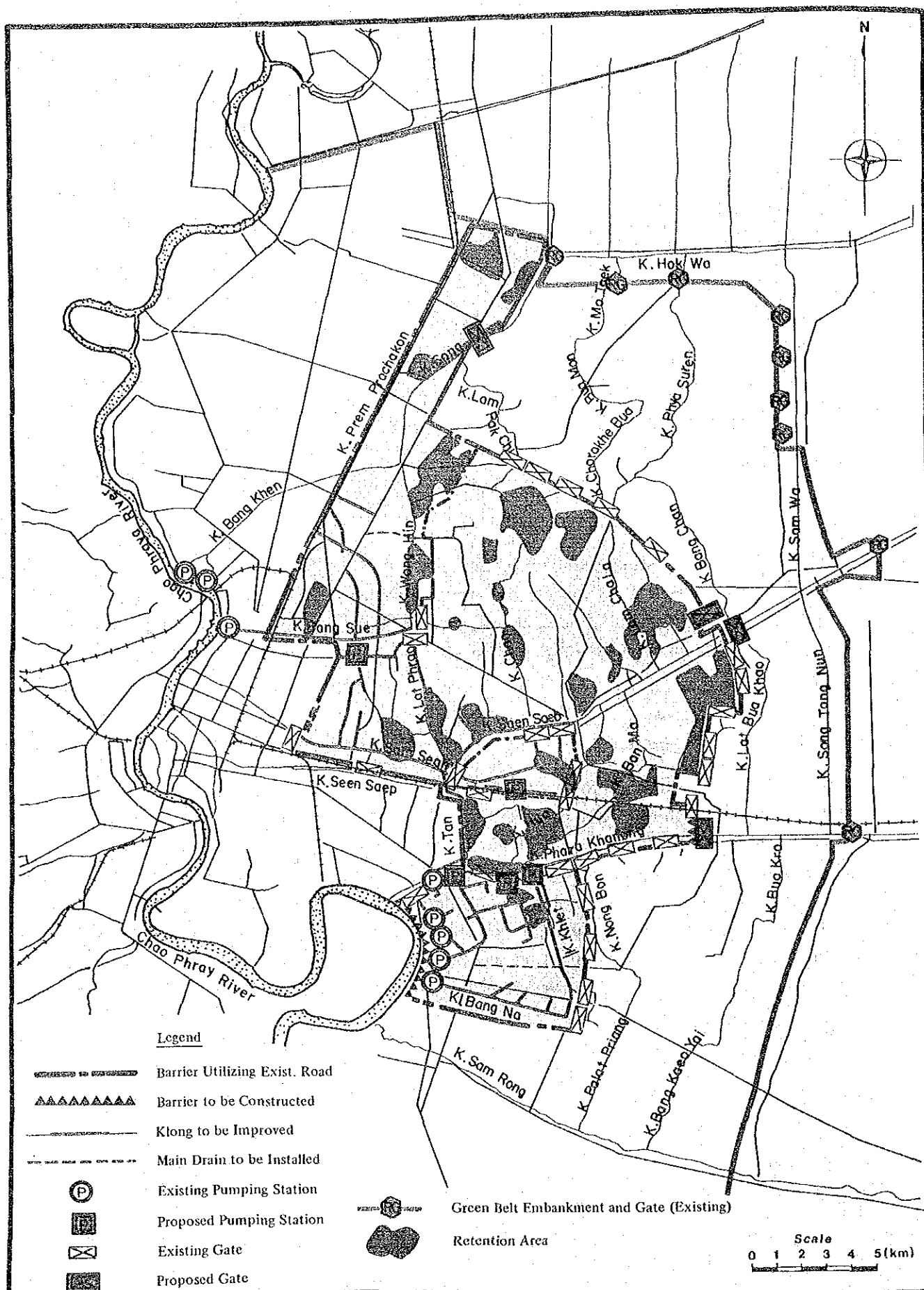


Fig. s.3 .

PROPOSED FACILITIES IN THE FEASIBILITY STUDY

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



Table S.2 Action Plan for Non-Structural Measures

Authority in Charge	Flood Protection Committee (Overall Flood Control)	Flood Control & Operation Authorities	Regional City Planning Authorities
Current Situation	* Sub-Committee	* Construction of Green Belt Dyke	* Green Belt area as open space (retarding area)
Short Term Action Plan	<ul style="list-style-type: none"> <li>* Mobilization of sub-committee</li> <li>* Recognition of importance of flood plain management between relating agencies</li> <li>* Public education of flood plain management</li> </ul>	<ul style="list-style-type: none"> <li>* Publicizing observed flood area</li> <li>* Establishment of flood control operation system</li> </ul>	* Projection of population and urbanized area
Inter-mediate Term Action Plan	<ul style="list-style-type: none"> <li>* Inter-governmental recognition of zoning system in accordance with flood risk</li> <li>* Publicizing flood risk map</li> </ul>	<ul style="list-style-type: none"> <li>* Collection of flood data</li> <li>* Preparation of flood risk map</li> <li>* Improvement of flood control operation system</li> </ul>	<ul style="list-style-type: none"> <li>* Approval or dis-approval of development applications based on building codes</li> <li>* Construction of roads and water supply, compatible with zoning system</li> <li>* Guidance for prohibition of land reclamation in retarding area</li> <li>* Multi-purpose retention pond in the park</li> </ul>
Long Term Action Plan	<ul style="list-style-type: none"> <li>* Zoning regulation</li> <li>* Property tax adjustment, reflecting zoning</li> <li>* Surcharge to developers</li> </ul>		* Approval or dis-approval of development applications based on zoning regulation

### 3.3 Flood Control Operation Centre

The proposed facilities rely on rainwater storage in the klongs and retention areas. Further, the proposed facilities contribute not only to flood alleviation in the eastern paddy and Green Belt areas but will also raise the water level of the Chao Phraya river if facilities are operated. Besides, klong flushing will become necessary for improvement of klong water quality. For these operations, a flood control operation centre which supervises the hydrological conditions in the entire study areas and neighboring areas, are proposed.

Fifteen monitoring stations are proposed as a first step of the control centre organization.

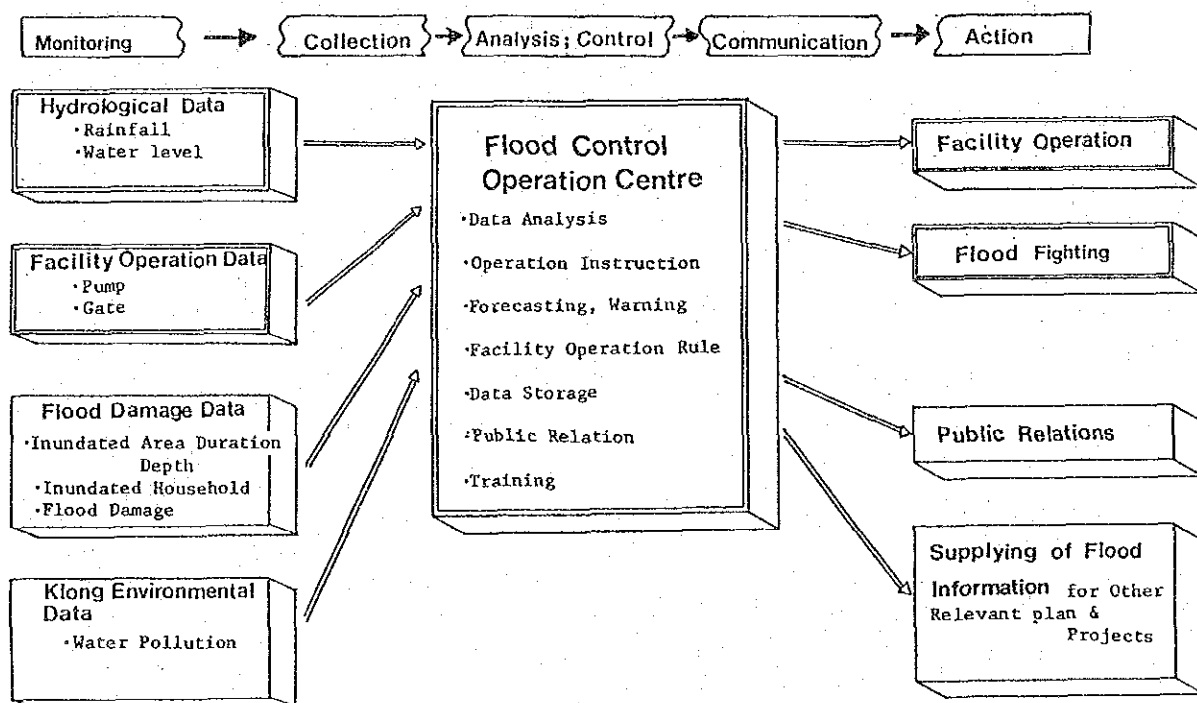


Fig. S.5 Concept of Flood Control Operation System

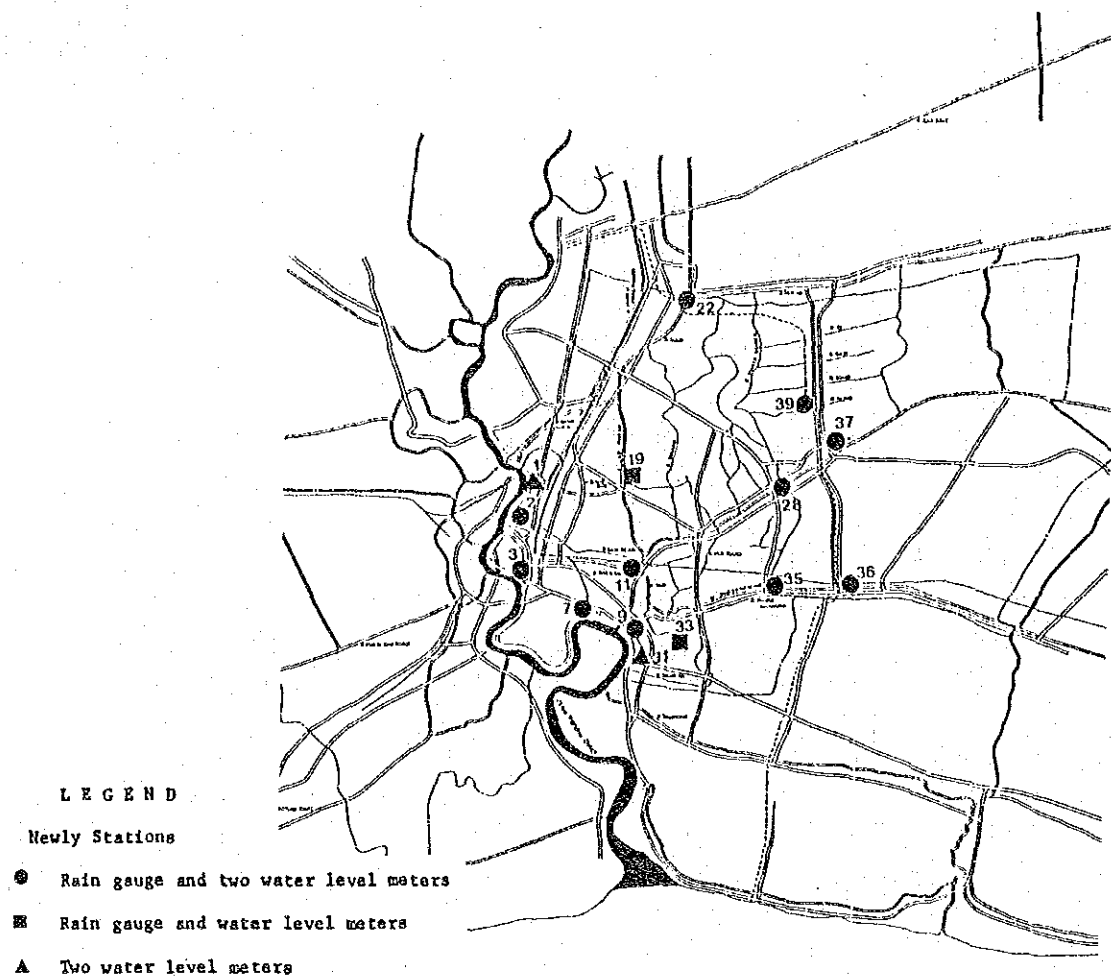


Fig. S.6 Proposed 15 Monitoring Stations

### 3.4 Organization

The organization is examined within the current framework where the present Flood Protection Committee is the co-ordinating body and the DDS is the executing body. For the execution of the project, three items must be set up/strengthened (Fig. S.7),

- (1) Strengthening of the DDS for the construction, supervision, and operation/maintenance of the facilities;
- (2) The mobilization of a "sub-committee on supporting activities" for flood plain management;
- (3) The establishment of a flood control operation centre.

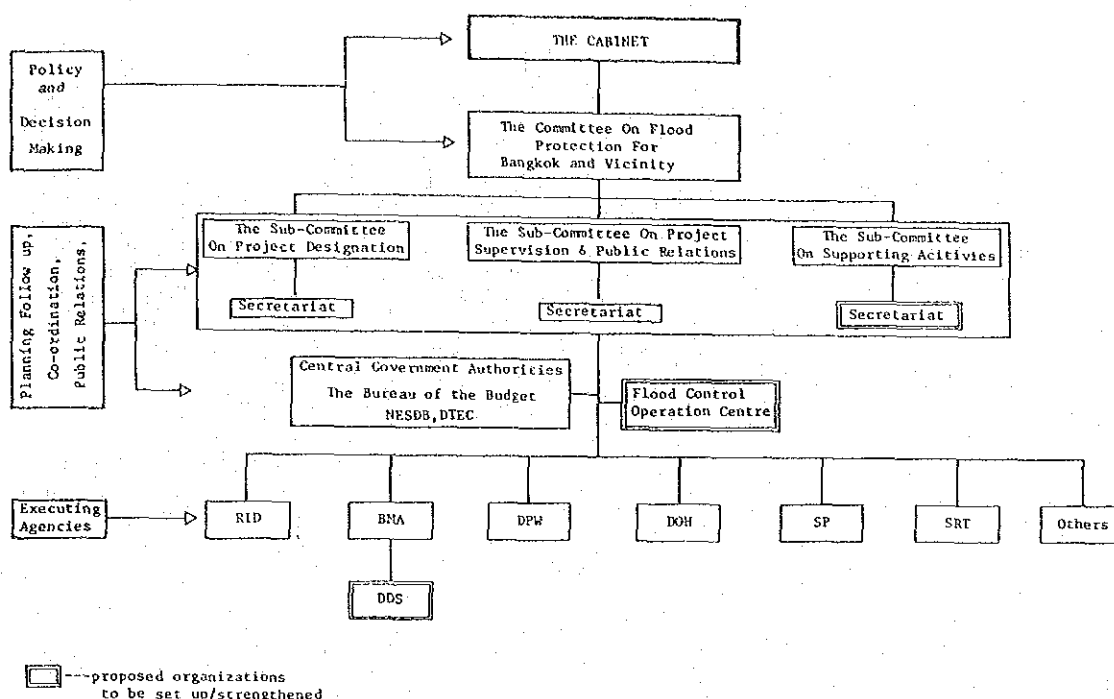


Fig. S.7 Proposed Organizations

### 3.5 Financial Aspect

The project cost is estimated at Baht 2,655 million at 1985 prices. Out of it, the foreign currency component of Baht 1,261 million (47.5%) is to be financed by foreign loans and the local currency component of Baht 1,394 million is proposed to be equally split between the BMA and the Central Government, while the debt service of the loan and the operation and maintenance cost is covered by the BMA.

BMA's financial requirement of about Baht 200 million per year during 1988 – 1991, will be covered by one fourth of the revenues to be generated by the natural increase in tax base and the appropriation of existing local taxes.

To recover repayment and O/M and replacement costs from 1992 onwards, between one sixth and one ninth of the revenue of existing local taxes will be allotted to the Project. These are shown graphically in Figure S.8.

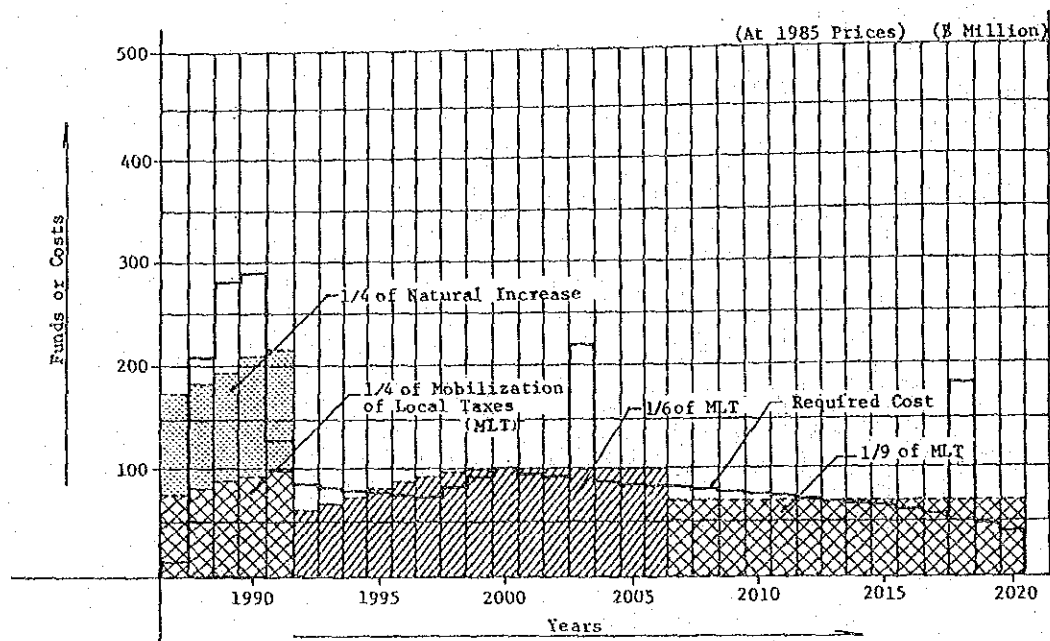


Fig. S.8 Project Cost and Financial Source

Annual damage and loss per capita are estimated at Baht 495 and project cost per capita is calculated at Baht 54.5 at the 1985 price.

### 3.6 Economic Evaluation

From the result of the economic analysis, economic internal rate of return, net present worth, benefit cost ratio are:

Economic rate of return	20.2%
Net present worth	Baht 425 million
Benefit cost ratio	1.24

Annual benefit and economic cost per capita are calculated at Baht 24 and 19 respectively. (discounted at the rate of 16%).

## 4. Conclusion and Recommendations

There are various standpoints from which to judge the feasibility of the Project.

It is proved that the Project is economically feasible; the Project, from the standpoint of national economy is estimated to generate a benefit greater than the cost of the project implementation and operation/maintenance during the project life of 40 years.

Technically speaking, there is no problem or difficulty in implementing the Project.

Financially, it has been made clear that the project cost is to be self-financed. This is possible under the condition that half of the local currency portion is subsidized by the central government and about half of the project cost is financed by an external soft loan.

In conclusion, the implementation of the Project is fully justified and therefore, strongly recommended.

For the project implementation, particular attention must be paid to:

- (i) DDS (executing agency) should be strengthened for Project implementation work and the "sub-committee on supporting activities" be mobilized for flood plain management.
- (ii) The terrain in the Study Area is very flat and, therefore, klongs and drains are of gentle slope, resulting in poor drainage. Hence the drainage facilities are only effective provided that the facilities are operated efficiently and the a large amount of water is retained in the Area. The flood control operation centre has to be established and flood plain management conducted.
- (iii) Preparatory works such as financial procurement and detailed design be started as soon as possible to start Project construction in 1988.





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