

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF SETTLEMENT AND REGIONAL DEVELOPMENT  
THE REPUBLIC OF INDONESIA

**THE DETAILED DESIGN  
OF  
FLOOD CONTROL, URBAN DRAINAGE AND  
WATER RESOURCES DEVELOPMENT IN  
SEMARANG IN THE REPUBLIC OF INDONESIA**

**FINAL REPORT**

COMPREHENSIVE  
URBAN DRAINAGE AND FLOOD CONTROL IMPROVEMENT  
PROGRAM IN SEMARANG

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AUGUST 2000

CTI ENGINEERING INTERNATIONAL CO., LTD.

IN ASSOCIATION WITH

PACIFIC CONSULTANTS INTERNATIONAL

AND

PASCO INTERNATIONAL INC.

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**COMPONENT C:  
URBAN DRAINAGE SYSTEM IMPROVEMENT**

**VOLUME I MAIN REPORT**

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## CONSTITUTION OF THE REPORT

1. SUMMARY
2. COMPONENT A : WEST FLOODWAY/GARANG RIVER IMPROVEMENT

VOLUME I	MAIN REPORT
VOLUME II	DESIGN CRITERIA
VOLUME III	DESIGN NOTES
VOLUME IV	WORK QUANTITY CALCULATION
VOLUME V	CONSTRUCTION PLANNING
VOLUME VI	COST ESTIMATE
VOLUME VII	DATA BOOK

3. COMPONENT B : JATIBARANG MULTIPURPOSE DAM CONSTRUCTION

VOLUME I	MAIN REPORT
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VOLUME IV	WORK QUANTITY CALCULATION
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VOLUME VI	COST ESTIMATE
VOLUME VII	DATA BOOK
VOLUME VIII	ANNEX

4. COMPONENT C : URBAN DRAINAGE SYSTEM IMPROVEMENT

VOLUME I	MAIN REPORT
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VOLUME IV	CONSTRUCTION PLANNING
VOLUME V	COST ESTIMATE
VOLUME VI	DATA BOOK

## PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Detailed Design of Flood Control, Urban Drainage and Water Resources Development in Semarang and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. TOMIOKA Yoshiyuki of CTI Engineering International Co., Ltd. and constituted of members of CTI Engineering International Co., Ltd., Pacific Consultants International and Pasco International Inc., six times between August 1997 and June 2000. In addition, JICA set up an advisory committee, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Indonesia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Indonesia for their close cooperation extended to the Team.

August 2000



Kimio Fujita  
President

Japan International Cooperation Agency

August, 2000

Mr. FUJITA Kimio  
President  
Japan International Cooperation Agency  
Tokyo, Japan

LETTER OF TRANSMITTAL

Sir:

We are pleased to submit herewith the Final Report on the Detailed Design of Flood Control, Urban Drainage and Water Resources Development in Semarang in the Republic of Indonesia.

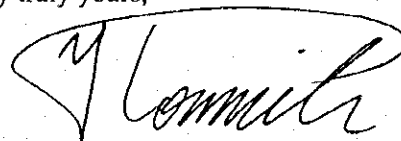
Under a contract with the Japan International Cooperation Agency, the Study was conducted by CTI Engineering International Co., Ltd., in association with Pacific Consultants International and PASCO International, Inc., during the period from August 1997 to August 2000.

This Final Report presents the results of the detailed design of the following three (3) components, which consist of (1) West Floodway/Garang River Improvement including reconstruction of Simongan Weir, (2) Construction of Jatibarang Multipurpose Dam, and (3) Urban Drainage System Improvement. It also presents the pre-qualification and contract documents, and general and technical specifications necessary for the construction stage. In the course of the Study, much attention was given to the particular issues on the present situation in Semarang, and reflected them in the proposed facilities.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Construction. We would also like to extend our deep appreciation to the officials concerned of the Government of the Republic of Indonesia, Jratunseluna Project Office in Semarang, the JICA Indonesia Office, the Embassy of Japan in Indonesia for their cooperation and assistance throughout our field survey.

Finally, we hope that this Report will contribute to the improvement of the flood control and urban drainage facilities, and water resources development in Semarang.

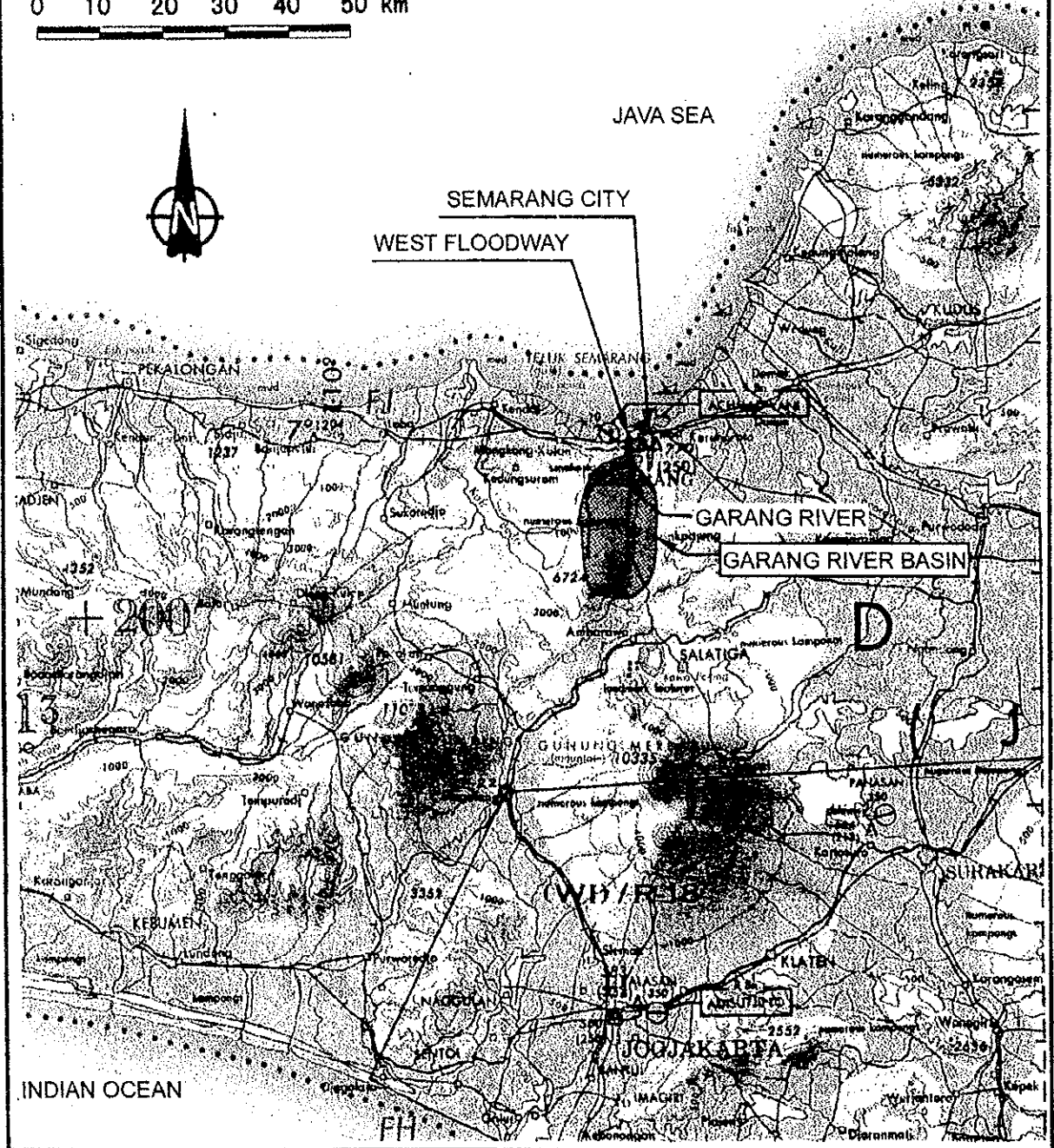
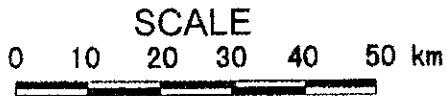
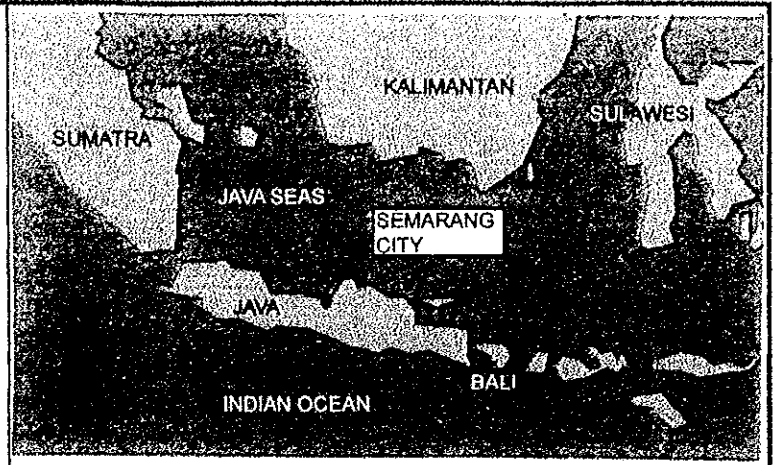
Very truly yours,



TOMIOKA Yosiyuki  
Team Leader

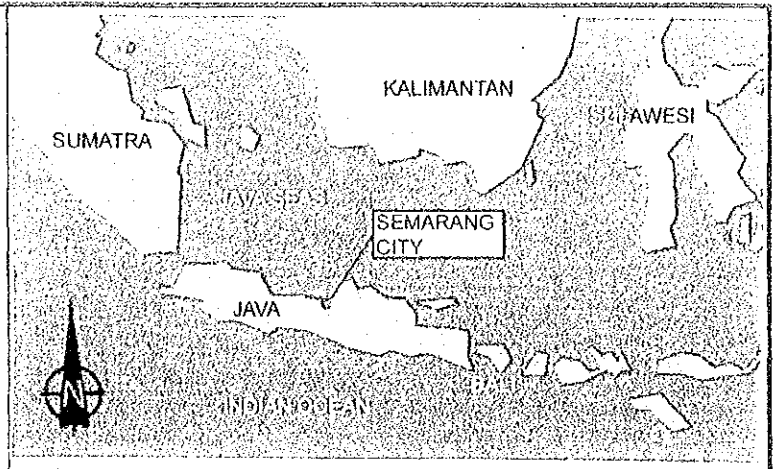
Detailed Design of Flood Control, Urban Drainage  
and Water Resources Development in Semarang  
in the Republic of Indonesia

# GENERAL MAP

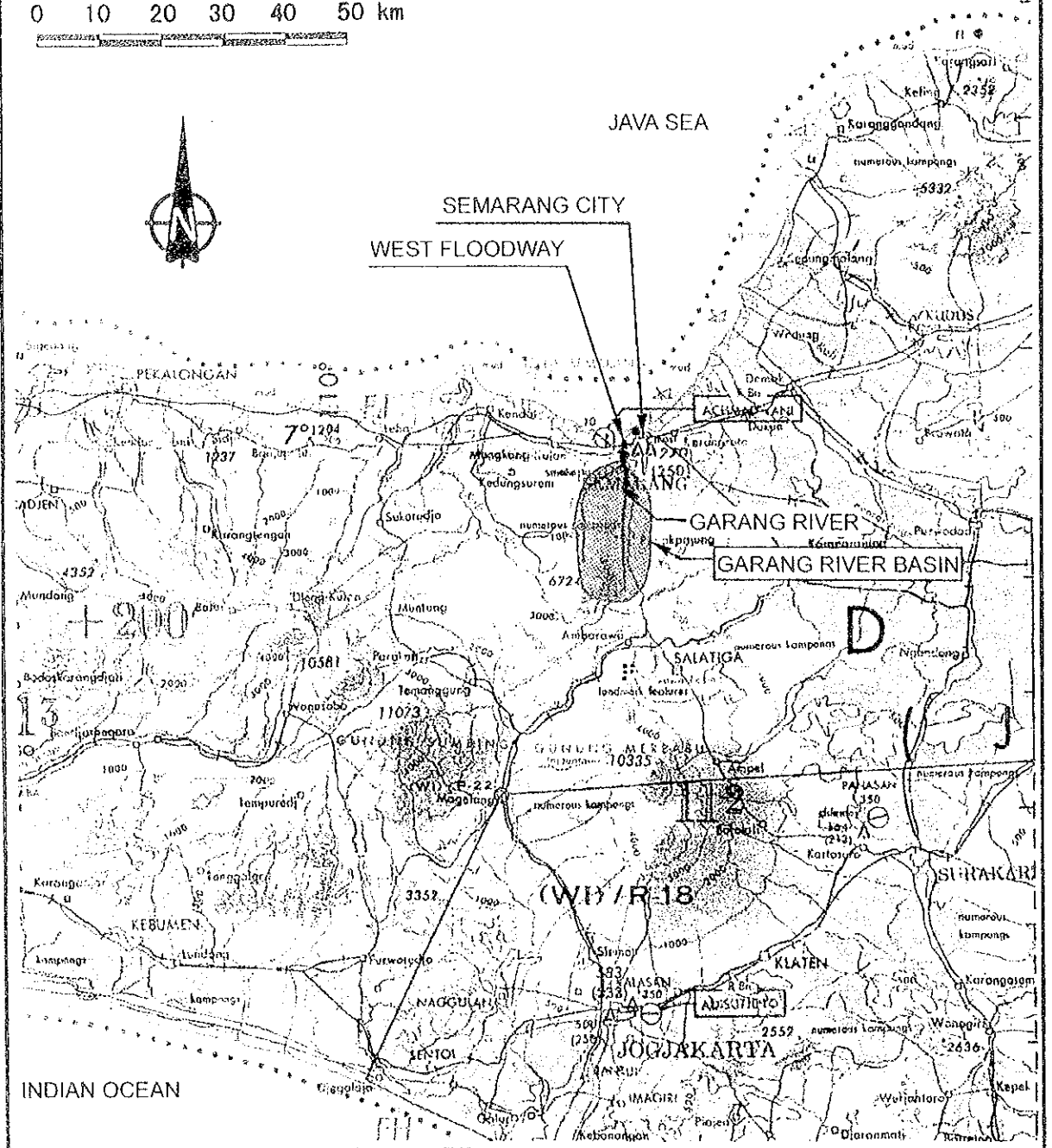


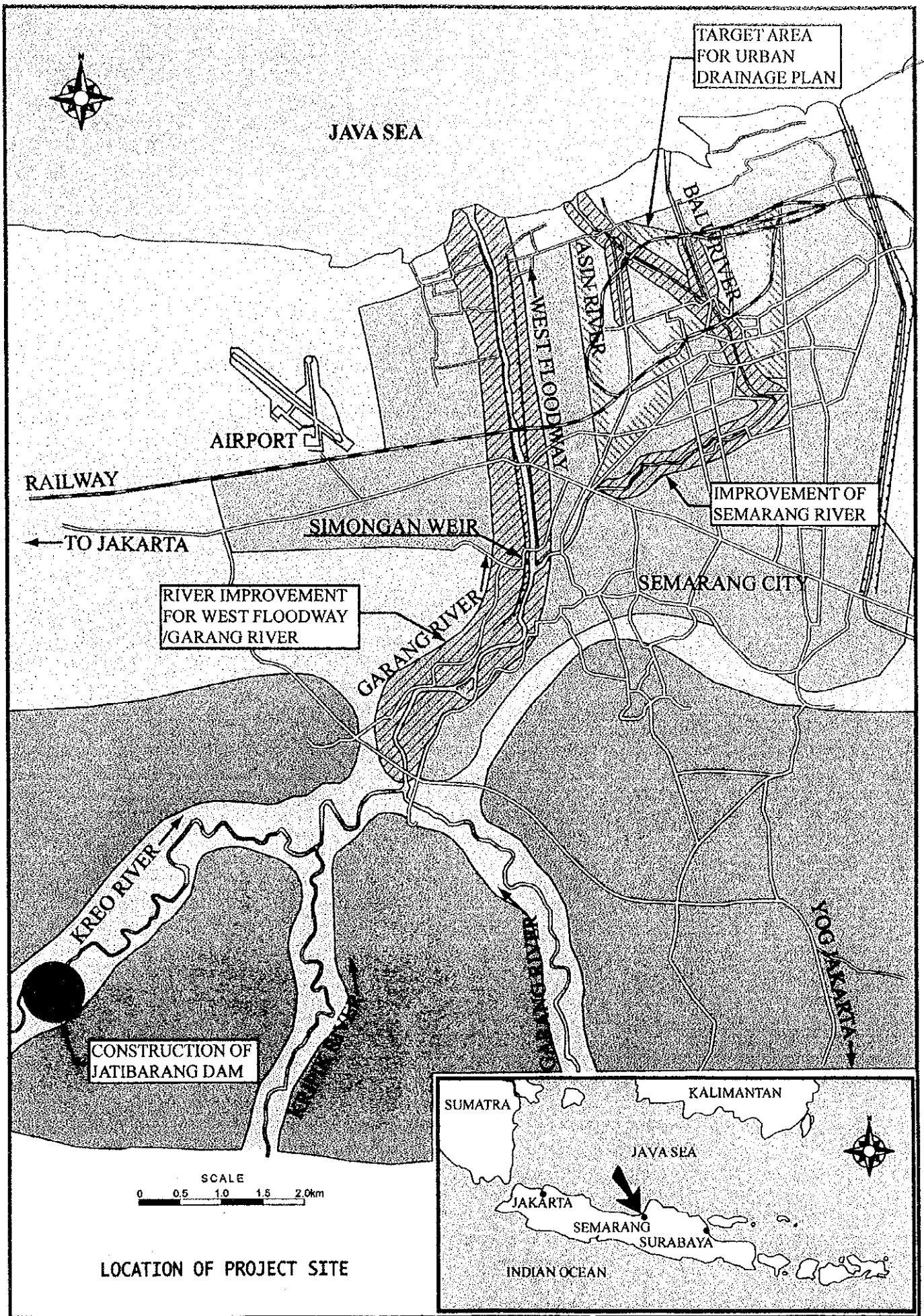


# GENERAL MAP



SCALE  
0 10 20 30 40 50 km





TARGET AREA FOR URBAN DRAINAGE PLAN

JAVA SEA

AIRPORT

RAILWAY

← TO JAKARTA

SIMONGAN WEIR

RIVER IMPROVEMENT FOR WEST FLOODWAY / GARANG RIVER

IMPROVEMENT OF SEMARANG RIVER

SEMARANG CITY

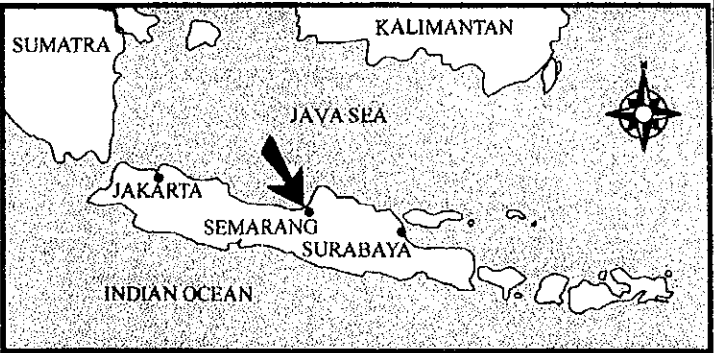
GARANG RIVER

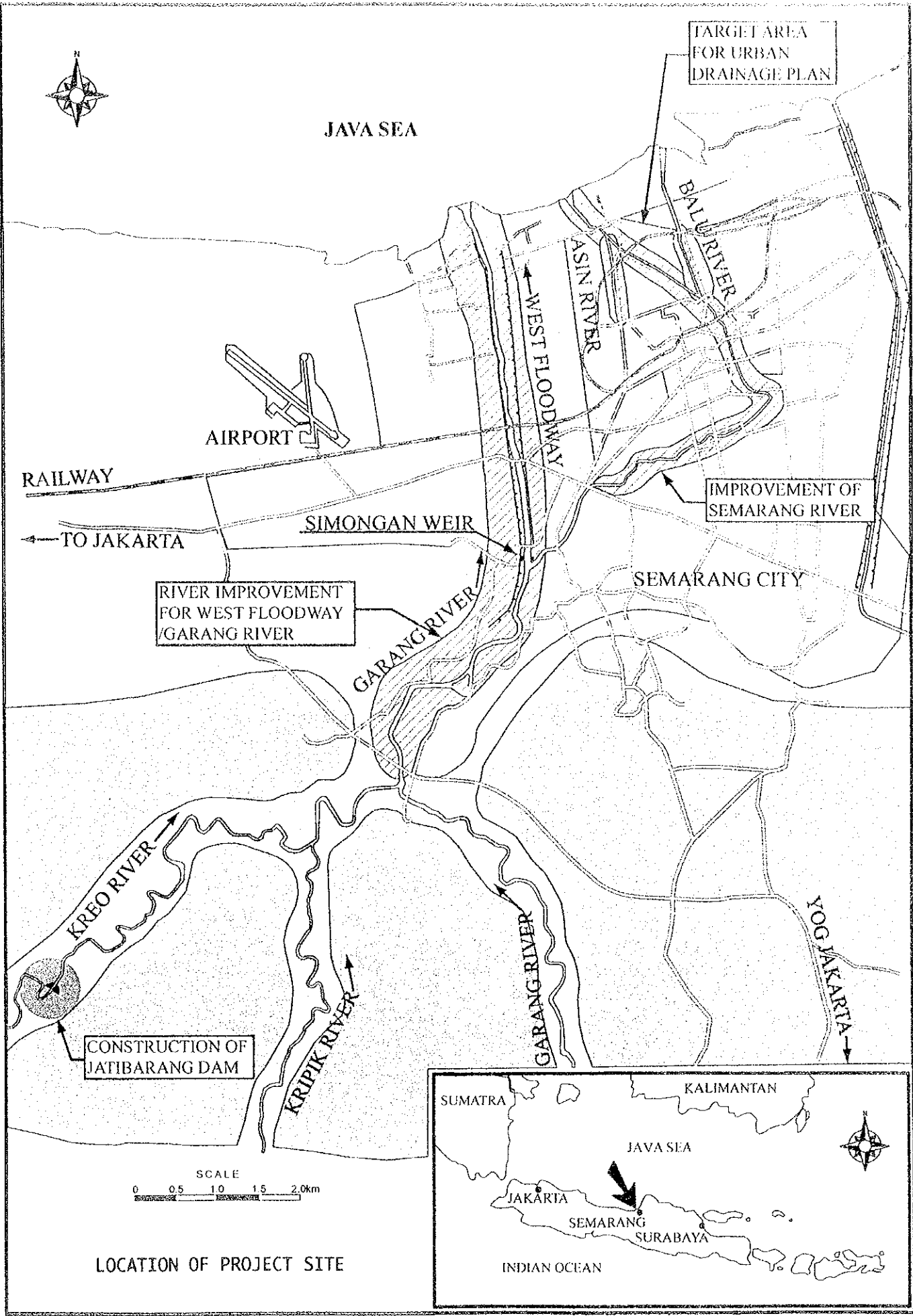
KREO RIVER

CONSTRUCTION OF JATIBARANG DAM

SCALE  
0 0.5 1.0 1.5 2.0km

LOCATION OF PROJECT SITE





JAVA SEA

TARGET AREA FOR URBAN DRAINAGE PLAN

AIRPORT

RAILWAY

← TO JAKARTA

SIMONGAN WEIR

RIVER IMPROVEMENT FOR WEST FLOODWAY / GARANG RIVER

IMPROVEMENT OF SEMARANG RIVER

SEMARANG CITY

GARANG RIVER

KREO RIVER

CONSTRUCTION OF JATIBARANG DAM

KRIPIH RIVER

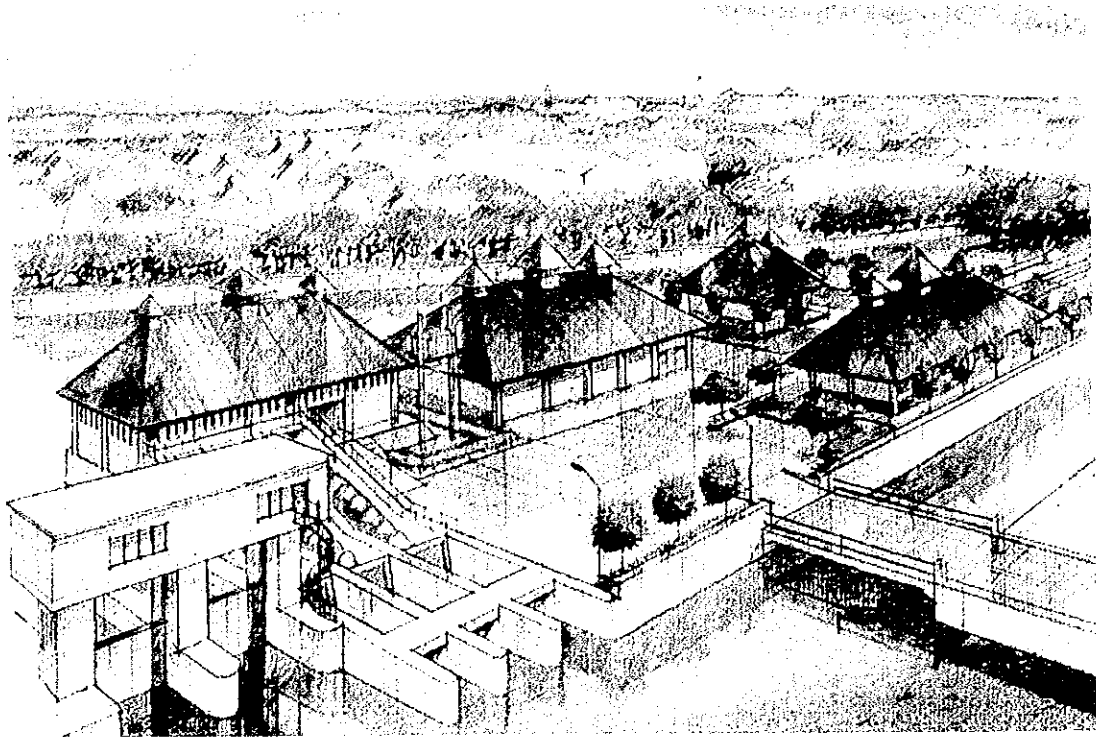
GARANG RIVER

YOG. JAKARTA

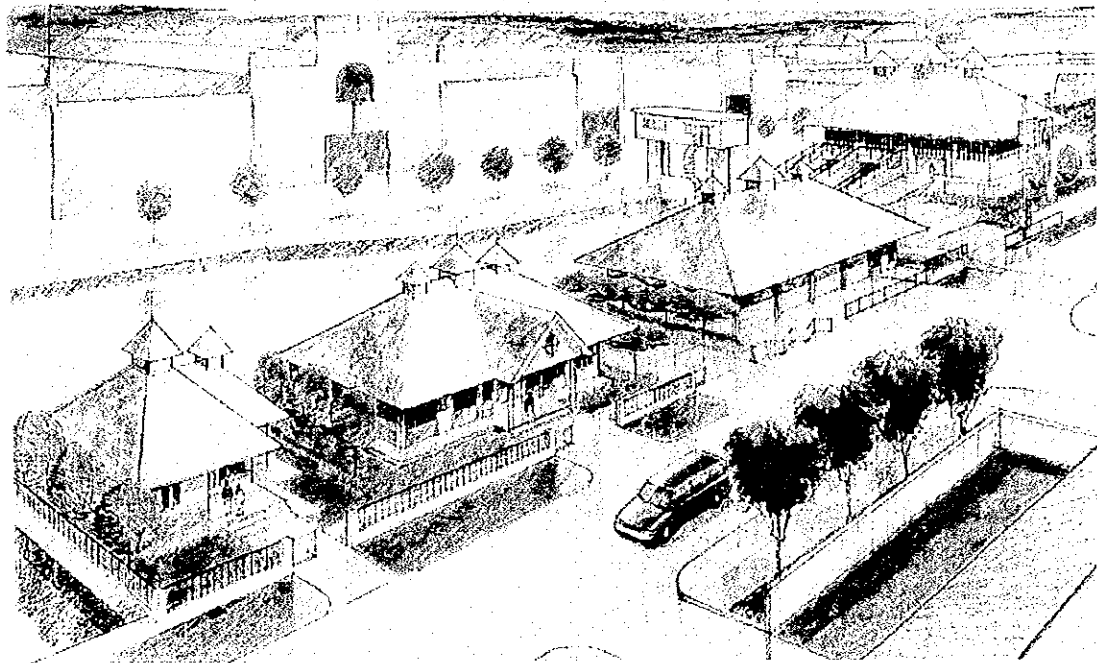
SCALE  
0 0.5 1.0 1.5 2.0km

LOCATION OF PROJECT SITE





ASIN PUMPING STATION



BARU PUMPING STATION

# VOLUME I MAIN REPORT

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## TERMS AND ABBREVIATIONS

### 1. **INDONESIAN GOVERNMENT AGENCIES AND ORGANIZATIONS**

GOI	:	Government of Indonesia
BAPPENAS	:	Badan Perencanaan Pembangunan Nasional (National Development Planning Board)
BAPPEDA	:	Badan Perencanaan Pembangunan Daerah (Provincial Development Planning Board)
BINAMARGA	:	Directorate General of Road and Bridge, Ministry of Public Works
BAPEDAL	:	Badan Pengendalian Dampak Lingkungan (Environmental Impact Assessment Board)
BPN	:	Badan Pertanahan Nasional (National Land Agency)
BPP	:	Balai Penyuluhan Pertanian (Agricultural Extension Center)
DPU	:	Departemen Pekerjaan Umum (Ministry of Public Works)
DGWRD	:	Directorate General of Water Resources Development, Ministry of Public Works
DGCK	:	Directorate General of Cipta Karya (Housing, Building and Urban Development, Ministry of Public Works)
DGRD	:	Directorate General of Research and Development, Ministry of Public Works)
DOR	:	Directorate of Rivers
DPUP	:	Dinas Pekerjaan Umum Propinsi (Provincial Public Works Services)
IHE	:	Institute of Hydraulic Engineering (Bandung)
PJKA	:	Perusahaan Jawatan Kereta Api (Railway Company, Old Name)
PERUMKA	:	Perusahaan Umum Kereta Api (Indonesian Railway Public Corporation, New Name)
PDAM	:	Perusahaan Daerah Air Minum (Water Works Company)
PMG	:	Pusat Meteorologi dan Geofisika (Center of Meteorology and Geophysics)
PLN	:	Perusahaan Listrik Negara (State Electricity Corporation)
P3SA	:	Proyek Pengembangan dan Penyelidikan Sumber-Sumber Air (Water Resources Development and Investigation Project)

### 2. **JAPANESE GOVERNMENT / INTERNATIONAL ORGANIZATIONS**

GOJ	:	Government of Japan
JICA	:	Japan International Cooperation Agency
MOC	:	Ministry of Construction, Japan
JEM	:	Japan Electric Machine Industry

ADB	:	Asian Development Bank
IBRD	:	International Bank for Reconstruction and Development (World Bank)
UNDP	:	United Nations Development Program
WMO	:	World Meteorological Organization
ASTM	:	American Society for Testing and Materials
ASME	:	American Society of Mechanical Engineer
USASI	:	United States of America Standards
IEC	:	International Electrotechnical Committee
NEMA	:	National Electrical Manufacturers Association

### 3. MEASUREMENT UNITS

#### (Length)

mm	:	millimeter(s)
cm	:	centimeter(s)
m	:	meter(s)
km	:	kilometer(s)

#### (Weight)

g, gr	:	gram(s)
kg	:	kilogram(s)
t, ton	:	tonnage (s)

#### (Area)

mm <sup>2</sup>	:	square millimeter(s)
cm <sup>2</sup>	:	square centimeter(s)
m <sup>2</sup>	:	square meter(s)
km <sup>2</sup>	:	square kilometer(s)
ha(has)	:	hectare(s)

#### (Time)

sec., s	:	second(s)
min	:	minute(s)
h (hrs)	:	hour(s)
d (dys)	:	day(s)
y, yr(yrs)	:	year(s)

#### (Volume)

cm <sup>3</sup>	:	cubic centimeter(s)
m <sup>3</sup>	:	cubic meter(s)

#### (Discharge)

l, ltr	:	liter(s)
EL., El.	:	Elevation

#### (Combined Units)

##### Speed/Velocity

cm/sec, cm/s	:	centimeter per second
m/sec, m/s	:	meter per second
km/hr, km/h	:	kilometer per hour

##### Stress

kgf/cm <sup>2</sup>	:	kilogram per square centimeter
tf/m <sup>2</sup>	:	ton per square meter
N/mm <sup>2</sup>	:	newton per square millimeter
Mpa	:	mega pascal

### Discharge

ltr/sec, l/s	:	liter per second
m <sup>3</sup> /sec, m <sup>3</sup> /s	:	cubic meter per second
m <sup>3</sup> /yr, m <sup>3</sup> /y	:	cubic meter per year

(Note : Other combined units may be constructed similarly as above)

### Electricity

MW	:	megawatt	GW	:	gigawatt
MWh	:	megawatt hour	GWh	:	gigawatt hour
kV	:	kilovolt			

## 4. MONETARY TERMS

¥	:	Japanese Yen
US\$	:	United States Dollar
Rp.	:	Indonesian Rupiah

## 5. INDONESIAN TERMS

JKT	:	Jakarta
Jawa	:	Java
Propinsi	:	Province
Kabupaten, Kab.	:	District (Regency)
Kotamadya, Kodya	:	Municipality
Kecamatan, Kec.	:	Sub-District
Desa	:	Village (Rural Area)
Kampung, Kp.	:	Village (Rural Area)
Kelurahan	:	Village (Urban Area)
Kali, Sungai	:	River
Gunung	:	Mountain
Rawa	:	Swamp
Danau	:	Lake
Laut	:	Sea
PT.	:	Incorporated or Limited
PPT	:	Panitia Pembebasan Tanah (Land Acquisition Committee)
KOMPUS	:	Komisi Pusat (Central Committee for Environmental Impact Assessment)
KA-ANDAL	:	Terms of Reference of Environmental Impact Statement
ANDAL	:	Environmental Impact Statement
RKL	:	Environmental Management Plan



RPL	:	Environmental Monitoring Plan
AMDAL	:	Environmental Impact Assessment
BPPM2	:	Semarang Port Bench Mark
SPB	:	Semarang Peil Baru (New Semarang Level)
TTG	:	Tanda Tinggi Geodesi (National Bench Mark)

## 6. OTHERS

JRATUNSELUNA PROJECT : Water Resources Development Projects for Jragung, Tuntang, Serang, Lusi and Juwana Rivers

SSUDP	:	Semarang and Surakarta Urban Development Program
IUIDP	:	Integrated Urban Infrastructures Development Program
SWL	:	Surcharge Water Level
DFWL	:	Design Flood Water Level
PMP	:	Probable Maximum Precipitation
PMF	:	Probable Maximum Flood
EIRR	:	Economic Internal Rate of Return
JIS	:	Japanese Industrial Standard
USASI	:	United States of America Standards
SWR	:	Shadow Wage Rate
CIF	:	Cost, Insurance and Freight
VAT	:	Value Added Tax.

CHAPTER 1  
INTRODUCTION

## CHAPTER 1. INTRODUCTION

### 1.1 Background

Semarang City, the capital of Central Java Province, had the population of 1,250,000 in 1996. The city and its surrounding areas suffer almost every year from floods in rainy seasons and from shortage of water supply in dry seasons. The problem of water shortage will be aggravated further in the future due to the recent trend of population concentration in the urban area.

To mitigate these chronic problems and to enhance the economic development and stabilization of people's livelihood, appropriate measures are indispensable for Semarang City and its surrounding areas. To this end, the Government of Indonesia requested technical assistance from the Government of Japan.

In response to the request of the Government of Indonesia, the Government of Japan dispatched a study team through the Japan International Cooperation Agency (JICA) to formulate a master plan and to carry out a feasibility study on the selected priority projects from 1992 to 1993. The study was named as "The Master Plan on Water Resources Development and Feasibility Study for Urgent Flood Control and Urban Drainage in Semarang City and Suburbs". (refer to Fig. 1.1.1)

In the final report of the above study, three priority projects were proposed from the viewpoint of economic viability and urgent necessity of project realization. The proposed priority projects are:

- (1) West Floodway/Garang River Improvement (including reconstruction of Simongan Weir);
- (2) Construction of Jatibarang Multipurpose Dam on Kreo River; and,
- (3) Urban Drainage System Improvement.

For the urgent realization of the proposed priority projects, the Government of Indonesia requested further technical assistance from the Government of Japan in 1996. JICA then decided to dispatch another study team to carry out the detailed design of the priority projects, and the study is named as "The Detailed Design of Flood Control, Urban Drainage and Water

Resources Development in Semarang in the Republic of Indonesia" (hereinafter referred to as "the Study").

## 1.2 Objectives of the Study

The objectives of the Study are: to carry out the detailed design of the following three (3) components of the Study, which consist of (1) West Floodway/Garang River Improvement, (2) Construction of Jatibarang Multipurpose Dam, and (3) Urban Drainage System Improvement, and to pursue transfer of technical knowledge to the counterpart personnel in the course of the Study.

## 1.3 Study Area

The study area is administratively covered by Semarang City and Semarang Regency (Kabupaten) in Central Java Province, and is topographically included in Garang river basin and the central area of Semarang City. (refer to Fig. 1.3.1)

## 1.4 Description of Project Component : Urban Drainage System Improvement

The urban drainage master plan covering the whole northern coastal plain of approximately 123 km<sup>2</sup> was formulated under the JICA Study mentioned above in 1993. The master plan area is divided into four (4) drainage areas; Eastern Semarang, Central Semarang, Western Semarang and Kec. Tugu. Feasibility Study was conducted for a selected priority project at the Central Semarang Area (12.835 km<sup>2</sup>). There are three packages in the priority project as follows;

- (1) Semarang River Drainage System Improvement
- (2) Asin River Drainage System Improvement
- (3) Bandarharjo Drainage System Improvement

The planning criteria of urban drainage scheme for the priority project are as follows

	Master Plan	Priority Project
Project Works	Improvement of Siringin, Tenggang, Semarang, Banger and Bulu Rivers Drainage Improvement of Western Semarang Area and Kec. Tugu Area Construction of three pumping stations in Semarang Central Area	Semarang River Drainage System Improvement Asin River Drainage System Improvement Bandarharjo Drainage System Improvement
Project Scale	10-year	5-year
Target Year	2015	Target Year for Project Completion ; 2005 Target Year for Social Frame (land use, population, development stage and etc.); 2015

### Necessity of the Project

Semarang City is the largest city and the center of economical and social development of Central Java Province. The Central Semarang area is highly urbanized and densely populated. The area suffers from severe inundation damage three to five times every year because of heavy rainfall, low and flat topography and poor drainage facilities.

Furthermore, recent rapid land subsidence in the area mainly caused by excess groundwater extraction is aggravating the problem. Fig. 1.4.1 shows the habitually inundated area even without any rainfall even in the dry season. The inundation area becomes even larger with rainfall or high tide. The area is spreading further year by year.

Therefore, the urban drainage system improvement of the Central Semarang area, which is composed of Semarang River improvement, Asin River Drainage System improvement and Bandarharjo Drainage System improvement including construction of drainage pumping stations, has been given the highest priority as an urgent project.

### Study Area for the Detailed Design (D/D)

The Study Area for the D/D is the Central Semarang area between Kuala Mas Raya Street and Ronggowarsito Street covering 12.835 km<sup>2</sup>. The study area is divided into two (2) zones, gravity drainage zone and pump drainage zone. The upper reaches area of 6.220 km<sup>2</sup> whose ground elevation is higher than EL. +1.0 m can be drained by gravity, while the lower reaches area of 6.615 km<sup>2</sup> shall be drained by pump, because the ground level is lower than the high tide. To drain storm water discharge from the gravity drainage zone, Semarang River shall be improved for the stretch of 7.240 km. (refer to Fig. 1.4.2)

## 1.5 Scope of the D/D Study

The D/D Study for the three (3) packages mentioned above was commenced in August 1997 and is scheduled to be completed in July 2000 with submission of the final reports for all components. Before the completion of the final reports, the draft final reports are to be prepared and submitted at the end of November 1999.

The D/D Study is divided into two phases, namely Phase 1 in which Definitive Plan was formulated and Phase 2 in which Detailed Design including hydraulic and structural analysis, preparation of drawings, establishment of construction planning, cost estimate and preparation of Prequalification and Tender Documents was conducted.

The flow of work is as illustrated in Fig. 1.5.1, and the details of scope of works are as outlined below.

### Definitive Plan

The main study items of "Definitive Plan" are as follows:

- (1) Data Collection and Compilation,
- (2) Review of Feasibility Study,
- (3) Aerophotograph/Mapping, Topographic and River Survey,
- (4) Geological and Soil Mechanics Survey,
- (5) Environmental/Social Impact Analysis, RKL, RPL and River Basin Management Plan,
- (6) Formulation of Basic Plan,
- (7) Basic Design,
- (8) Preliminary Construction Plan and Cost Estimate,
- (9) Socioeconomic Evaluation, and
- (10) Preparation of Project Implementation Program.

### Detailed Design

The detailed design works include the following items as

- (1) Preparation of Design Criteria,
- (2) Detailed Design Work (Hydraulic and Structural Analysis and Drawings),

- (3) Work Quantity Calculation,
- (4) Establishment of Construction Plan,
- (5) Cost Estimate,
- (6) Establishment of Operation and Maintenance Plan,
- (7) Establishment of Organization and Institution Plan, and
- (8) Preparation of Prequalification, Tender Documents and Tender Drawings.

Prequalification and tender documents are prepared after the preparation of the detailed designs, and the tender documents includes the following:

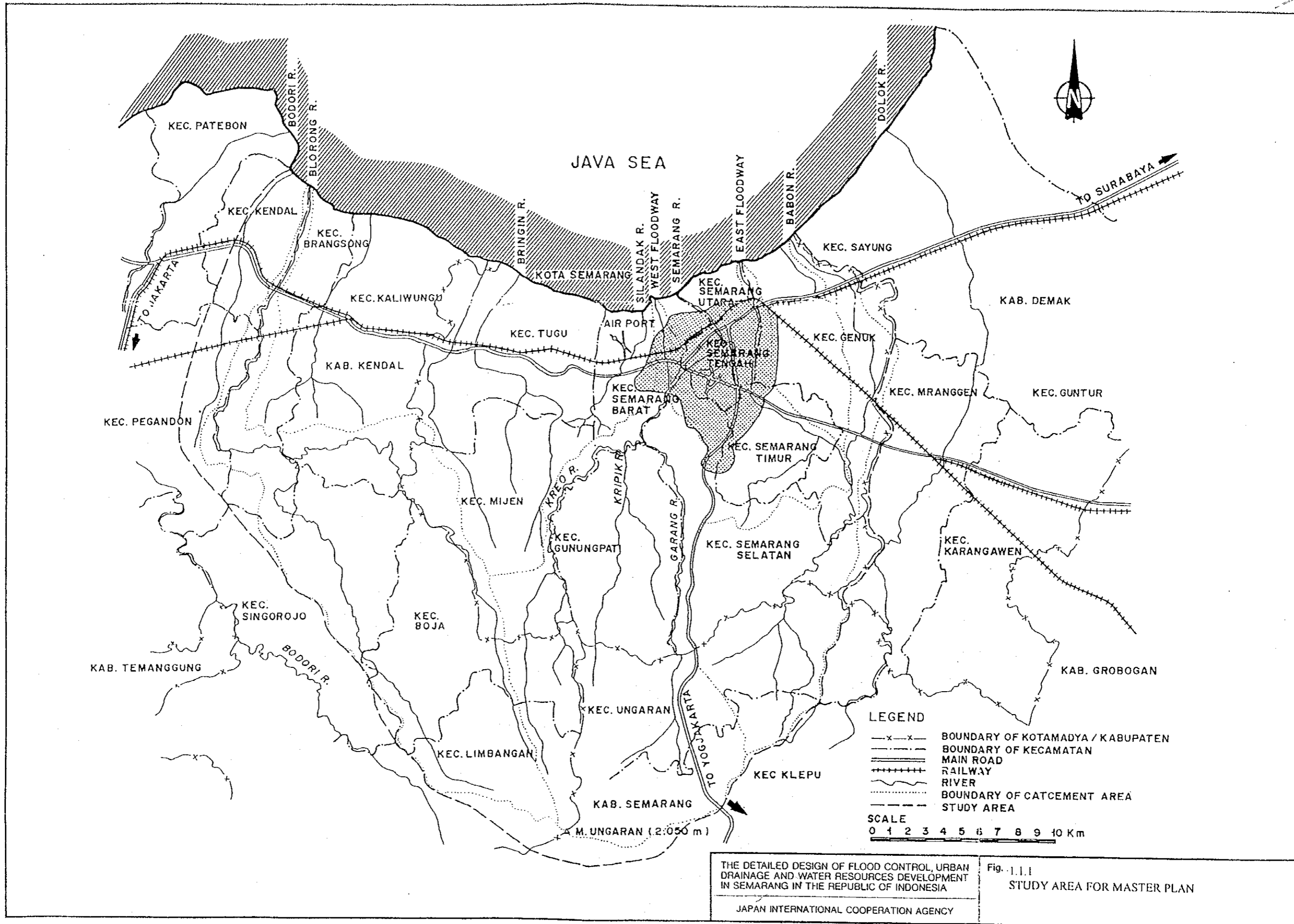
- (1) Prequalification Document
- (2) Invitation to Bids,
- (3) Instructions to Bidders,
- (4) Forms of Bid,
- (5) Form of Contract,
- (6) Specimens of Various Bonds,
- (7) Bill of Quantities,
- (8) General Conditions of Contract,
- (9) Special Conditions of Contract,
- (10) General Specifications,
- (11) Technical Specifications, and
- (12) Tender Drawings.



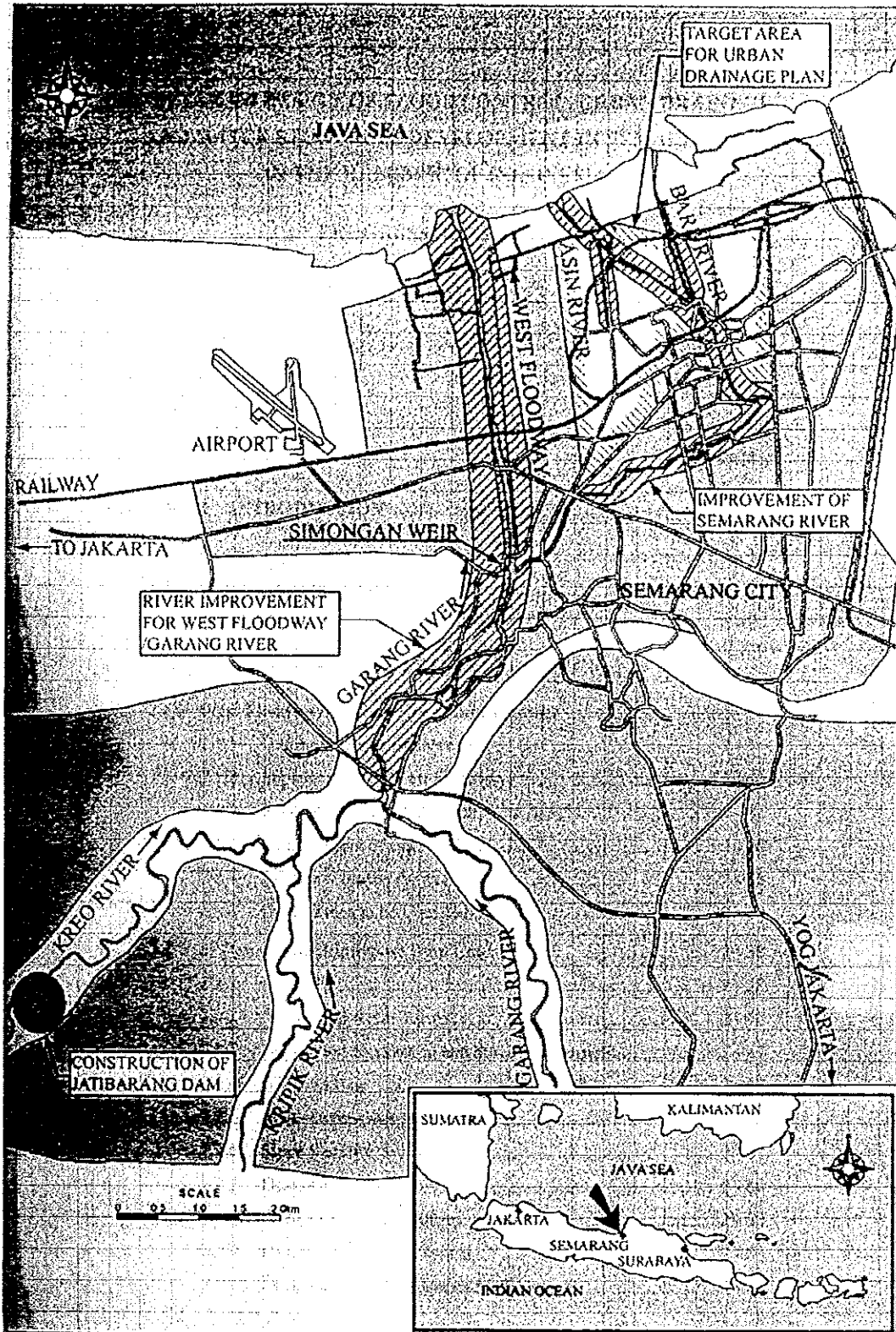


# **FIGURES**

CHAPTER 1  
INTRODUCTION







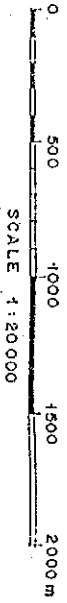
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA




Fig. 1.3.1

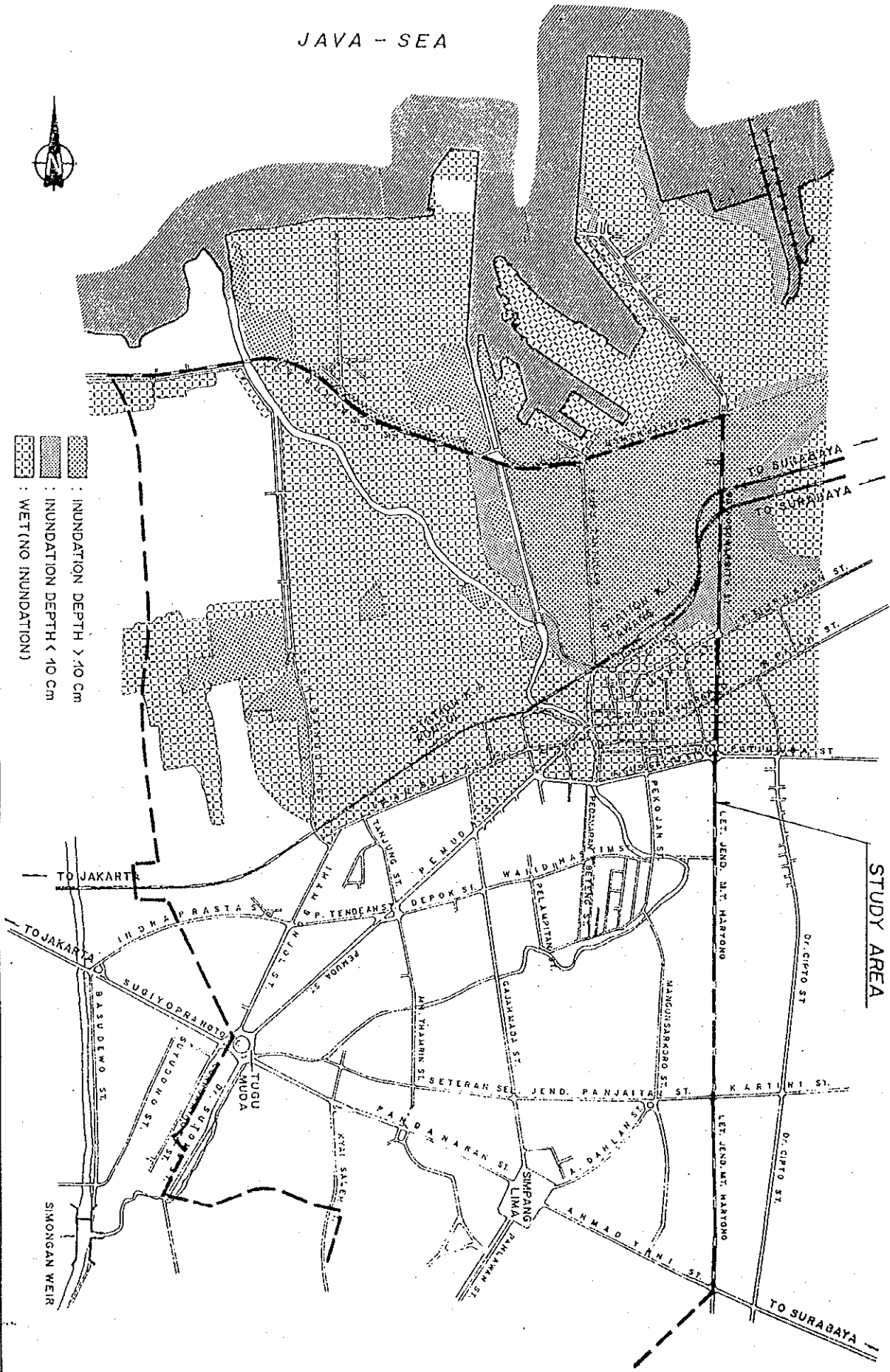
STUDY AREA FOR DETAILED DESIGN

JAPAN INTERNATIONAL COOPERATION AGENCY

JAVA - SEA



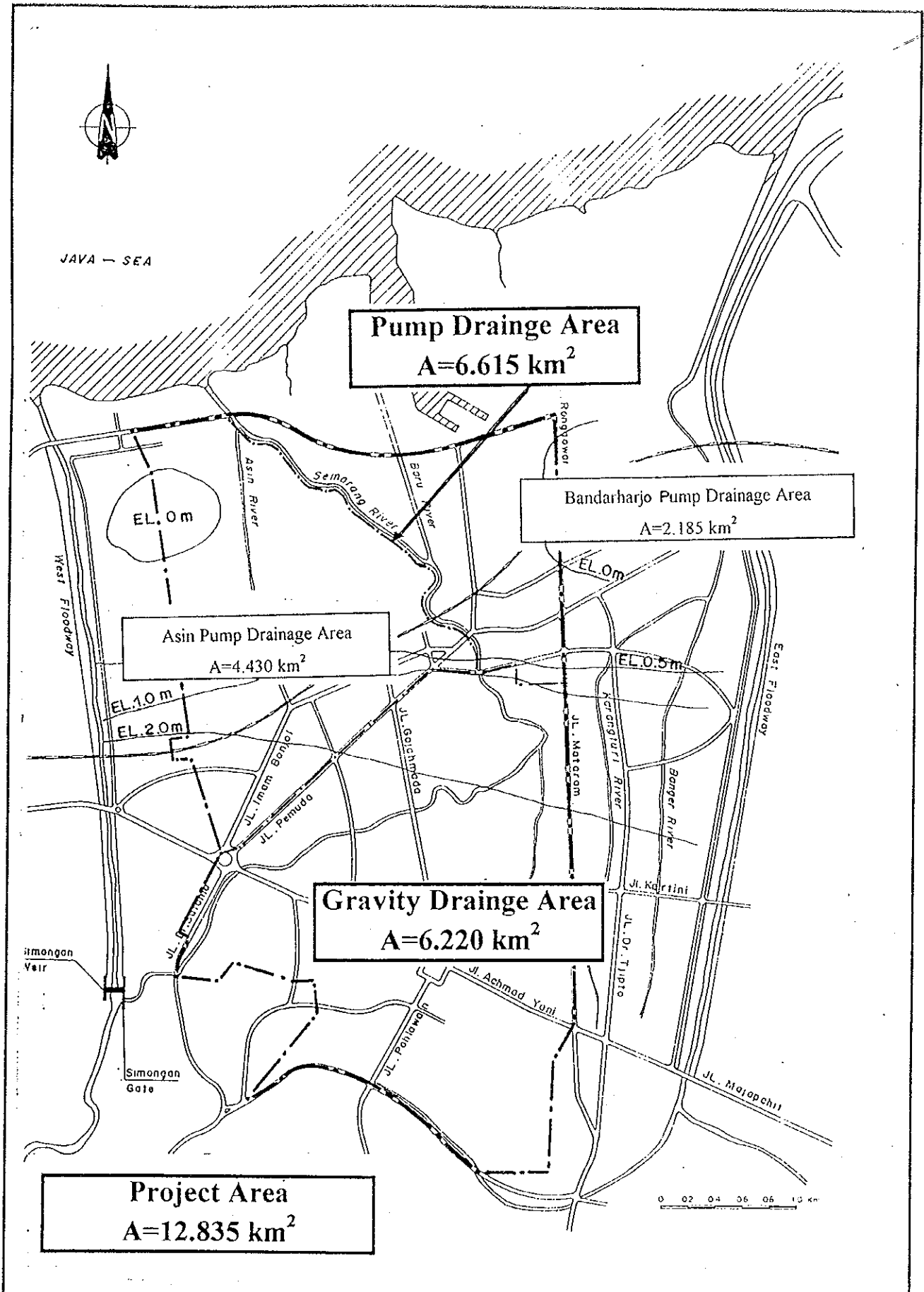
-  : INUNDATION DEPTH > 10 CM
-  : INUNDATION DEPTH < 10 CM
-  : WET (NO INUNDATION)



STUDY AREA

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA  
 JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 4.4.4  
 DAILY INUNDATION AREA DURING DRY SEASON



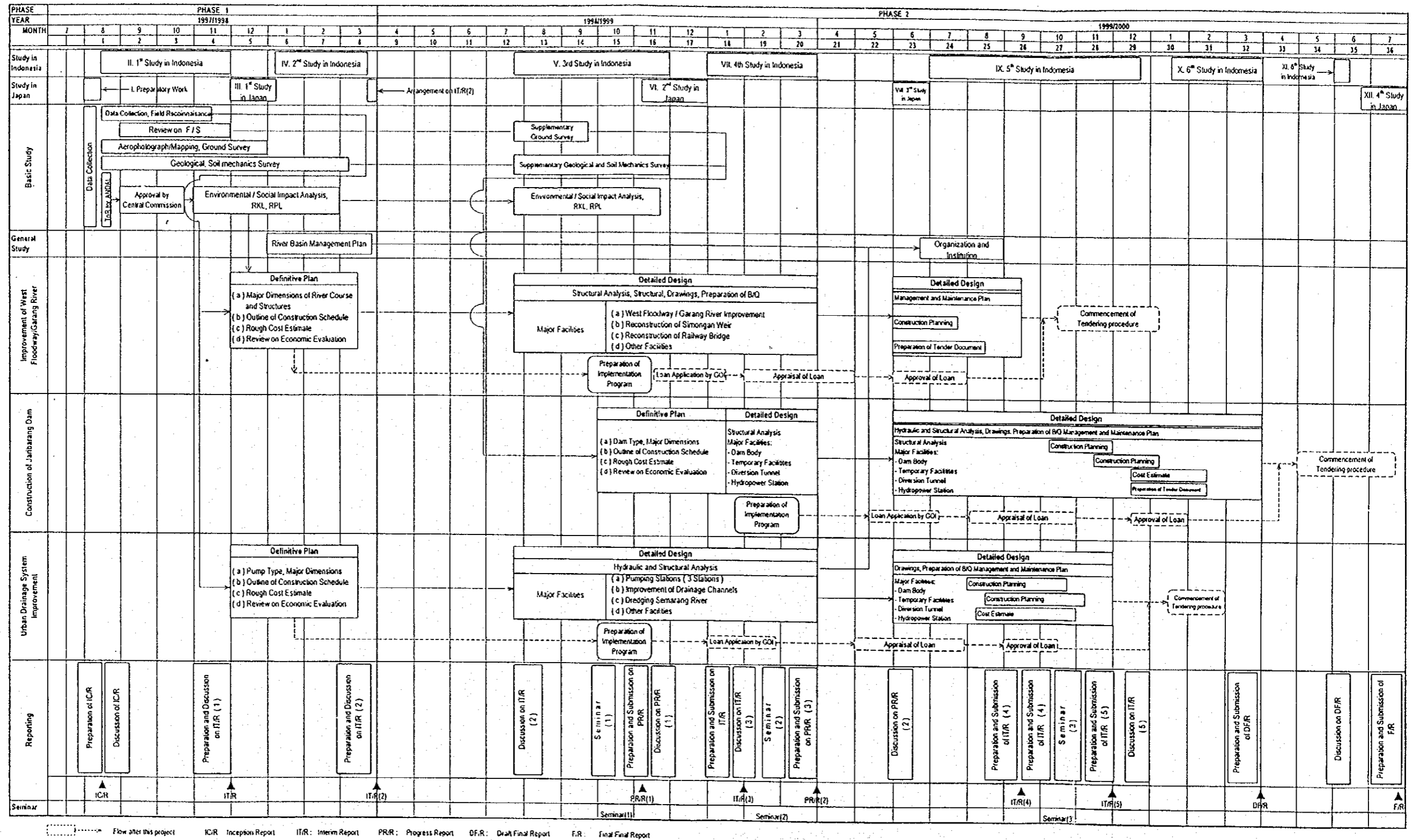
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

Fig. 1.4.2

STUDY AREA FOR URBAN DRAINAGE SYSTEM IMPROVEMENT

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.1.2 STUDY FLOW CHART FOR THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA  
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 1.5.1 STUDY FLOWCHART FOR THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN REPUBLIC OF INDONESIA