

Process to Flood Damage	Purpose of Measures	Facility Measures	Institutional Measures/Emergency Activities
(1) Runoff	- Retention of Rainfall	- Rainfall Storage Facilities - Infiltration Facilities	- Land Use Regulation (Conservation of Watershed)
(2) Flood Flow	- Prevention of Flood - Alleviation of Flood Condition	- Retarding Pond/Basin	
(3) Flooding	- Mitigation of Flood Damage		- Land Use Regulation - Flood-Proofing - Flood Forecasting/Warning - Flood Fighting
(4) Flood Damage	- Relief of Flood Damage		- Evacuation/Rescue

As presented in the above, non-structural measures act as important roles in mitigating the flood damage in every stage of process to the flood.

#### 4. PREVALENT NON-STRUCTURAL MEASURES IN METRO MANILA

In Metro Manila, three non-structural measures are being carried out to mitigate flood damage. These are the Tropical Cyclone Warning Service and the Evacuation/Relief Service. Moreover, a Warning Service is planned to commence after the completion of the EFCOS Project.

##### Tropical Cyclone Warning Service

Flood forecasting and warning is not conducted at present in rivers in Metro Manila. However, tropical cyclone warning service is undertaken by PAGASA to give ample time to concerned authorities and the general public to take preventive, protective and evasive actions necessary in mitigating the destructive effects of strong winds and flood-producing rains relative to tropical cyclone passages.

The PAGASA issues Domestic Bulletin four times a day, on or before 5:00 A.M., 11:00 A.M., 5:00 P.M. and 11:00 P.M., when a tropical cyclone exists in the Philippine Area of Responsibility.

Domestic Bulletin contains the following information on a particular tropical cyclone; name, date and time of fix (4:00 A.M., 10:00 A.M., 4:00 P.M., 10:00 P.M.), relative distance from a prominent place, coordinates, maximum wind, movement (direction and speed), 10-hour forecast position, appropriate storm signals to be hoisted (see Table 11-4-1), expected weather and coastal water conditions including storm surges.

Domestic Bulletins are disseminated to the Governors, the Mayors and the National Disaster Coordinating Council. The general public obtain warning through the routes mentioned above, as well as the mass media and a broadcasting station owned by the PAGASA.

#### Evacuation/Relief Service

Based on the Calamities and Disaster Preparedness Plan formulated in 1976 by the OCD of the then MND, the Disaster Coordinating Councils at National, Regional, Provincial, City/Municipal and Barangay Levels have been established in order to save lives, to prevent needless suffering, to protect property and to minimize damages during disasters and calamities. For Metro Manila, the MMDCC has been constituted in accordance with the Presidential Decree No. 1566 in 1978.

The National Disaster Coordinating Council (NDCC) is composed of the Secretary of the DND as Chairman, Secretaries of all Departments including DPWH, Administrator of the OCD and the Heads of other agencies concerned. The NDCC exercises direction and control, through the OCD, overall emergency operations from the regional to the barangay levels.

Regarding the evacuation and relief services on the emergency phase of floods, City/Municipal Mayors and Barangay Captains are responsible for organizing evacuation teams and for carrying out actual evacuation. The Department of Local Governments oversees the organizing and training of evacuation teams of the cities, municipalities and barangays. Chief of Evacuation Service determines ideal evacuation centers before the

occurrence of any disaster in coordination with the next higher authorities and maintains a chart of routes from populated area to the evacuation centers and a list of persons for possible evacuation.

In connection with evacuation activities, it is found that difficulties have been encountered by some agencies due to the limited information in the Domestic Bulletin, particularly included in the storm signals which are warnings on wind speed, but not intensity of rainfall.

#### Warning Service

For the effective flood control operation and warning along the Pasig-Marikina River, EFCOS Project (An Effective Flood Control Operation System including Telemetry and Warning System in Pasig-Marikina-Laguna Lake Complex) is scheduled to commence its construction work from 1989, of which the telemetry system comprises from five (5) water stage telemetry stations, two (2) rain gauge telemetry stations and nine (9) warning posts as shown in Fig. 12-3-1. Expansion or modification of this system can easily be attained for the respective river basins without any difficulty, and enormous effects to decrease the damages that can be expected with its early and exact provision of the flood information.

#### 5. APPLICABLE NON-STRUCTURAL MEASURES

Comprehensive Zoning Ordinance for the National Capital Region (Zoning Ordinance) was prepared jointly by Local Zoning Review Committee, Office of the Commission for Planning of the MMC and Human Settlements Regulatory Commission (now, Housing and Land Use Regulatory Board). The Zoning Ordinance was approved by the Governor and enacted in 1981.

Fig. 11-5-1 shows the urban areas designated in the zoning ordinance which may be transferred from lower intensity land use such as fishponds, paddy fields, open spaces and agricultural lands, as well as the areas to be conserved as lower intensity land use. In view of the existence of the zoning ordinance, the new land use regulation is not considered.

Flood insurance is deemed too early to apply. This is because the application of this method requires the fundamental data on flood frequency and damage amount in the subject area to be precise, and the inhabitants in the highly flood-prone area which is usually the low land area, are not inclined to spend for insurance.

The rainfall retention facilities to compensate for the increase of flood flow are also difficult to apply, considering the present practice of the Philippines and the difficulty of its maintenance.

In view of the foregoing, the following measures are recommended.

- Publication of Flood Risk Map
- Introduction of Flood-Proofing
- Flood Forecasting/Warning
- Flood Fighting
- Evacuation/Rescue

## 6. PROPOSED NON-STRUCTURAL MEASURES

### Publication of Flood Risk Map and Introduction of Flood-Proofing

The flood risk map is proposed to demarcate the present probable inundation areas caused either by the river channel overflow or by the local storm rainfall. River channel overflow will have a long recurrence period, but once it occurs, it will bring about severe damage in a wide area and may cause heavy casualties. In this connection, the flood risk map for the overflow of all related rivers was estimated, as shown in Fig. 11-6-1, assuming a 100-year return period flood which corresponds to the proposed design flood level for the river channel improvement. As for the other rivers, however, except for the Pasig-Marikina River, the inundation phenomena is not so clear for the ground level information. Therefore, the flood risk map of Buli-Baho-Mahaba River, Malabon-Tullahan River and South Parañaque-Las Piñas River could not be prepared in this study.

On the other hand, the local storm rainfall will have a small inundation area with a shorter recurrence period. The estimation of the flood risk map for the local storm rainfall will also require the subtle

ground level information and could not be made during this study stage due to the insufficient available information on ground level.

The flood risk map should be published for the information of people dwelling within the probable inundation area, and flood-proofing measures such as raising the floor elevation of houses/buildings should be introduced. Through these non-structural measures, the flood damage potential will be substantially reduced.

#### Establishment of Flood Warning System and Enforcement of Emergency Activity

The flood warning system is proposed for the Pasig-Marikina River where flood forecasting will be available subject to the flood lag time of about two hours as shown in Fig. 11-6-2. The NCR head office will carry out the flood forecasting through the telemetry facilities of the EFCOS Project, and instruct the six NCR engineering district offices to take the necessary operation of the existing ten pumping stations and four flood gates. Moreover, the related engineering district offices instruct the patrol cars to disseminate the flood warning to the people along the Pasig-Marikina River.

The results of the flood forecasting will also be forwarded to MMDCC, CDCC/MDCC and BDCC so as to disseminate the flood warning and enforce the proper emergency activities including evacuation services.

## TABLES



Table 11-4-1 STORM WARNING SIGNALS BY PAGASA

Classification	Warning
Signal No. 1	Disturbance is existing. Winds of up to 60 km/hr may be expected in the locality within the next 24 to 36 hours. Tune in any of the radio stations for further information.
Signal No. 2	Disturbance is approaching or affecting the locality. Winds of 60 to 100 km/hr may be expected within the next 24 hours. Strengthen houses of light materials. Children are advised to stay indoors. Suspension of classes is optional and upon the advice of higher authorities.
Signal No. 3	Disturbance is dangerous to the locality. Winds in excess of 100 km/hr would be expected in the locality within the next 12 to 24 hours. Everybody is advised to stay indoors. Classes are automatically suspended.





## FIGURES

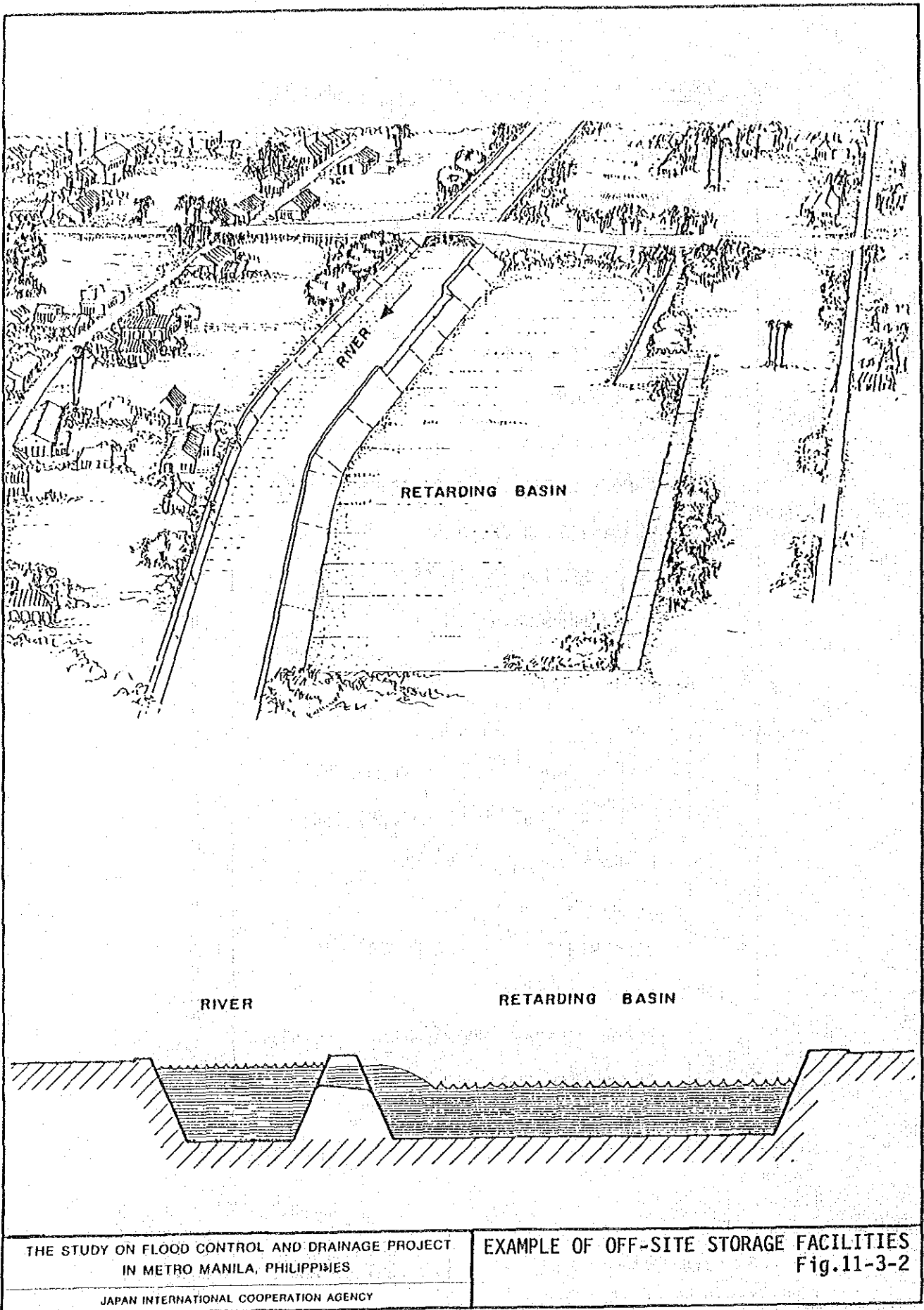


**COMPREHENSIVE FLOOD LOSS PREVENTION AND MANAGEMENT**

- RIVER IMPROVEMENT
  - DIKES AND FLOOD WALLS
  - CHANNEL IMPROVEMENTS
  - FLOODWAY
  
- RETARDATION OF RUNOFF
  - RESERVOIRS
  - RETARDING BASIN
  - RUNOFF RETARDING FACILITIES
  - CONSERVATION OF AREAS
    - REGULATION OF DEVELOPMENT
    - AFFORESTATION
  
- FLOOD PLAIN MANAGEMENT
  - LAND USE REGULATION
    - REGULATION OF DEVELOPMENT
    - REGULATION OF RECLAMATION
  - FLOOD PROOFING OF BUILDINGS
  - FLOOD INSURANCE
  - DISSEMINATION OF FLOOD RISK MAP
  
- EMERGENCY ACTIVITIES
  - FLOOD FORECASTING/WARNING
  - FLOOD FIGHTING
  - EVACUATION/RESCUE

STRUCTURAL MEASURES

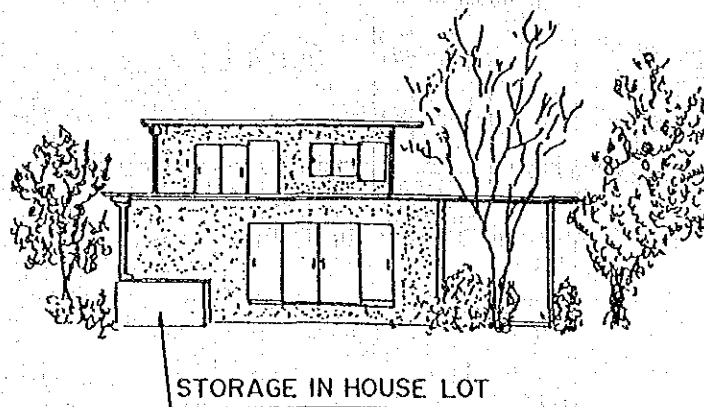
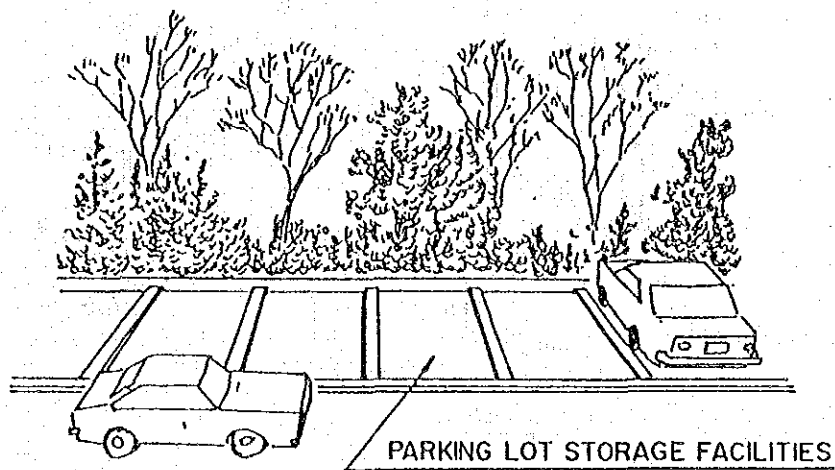
NON-STRUCTURAL MEASURES



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

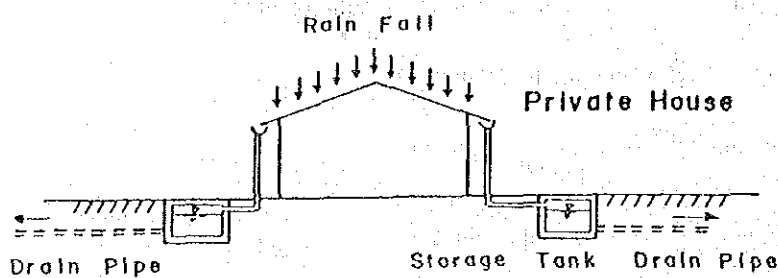
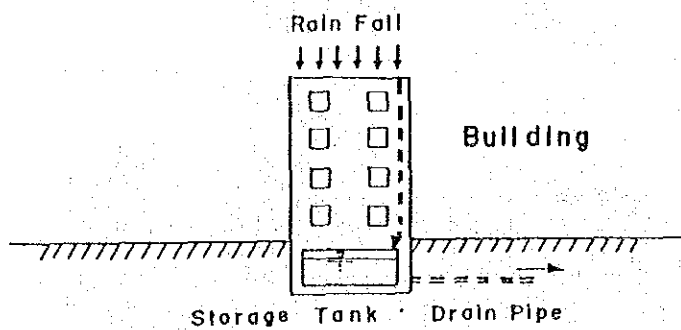
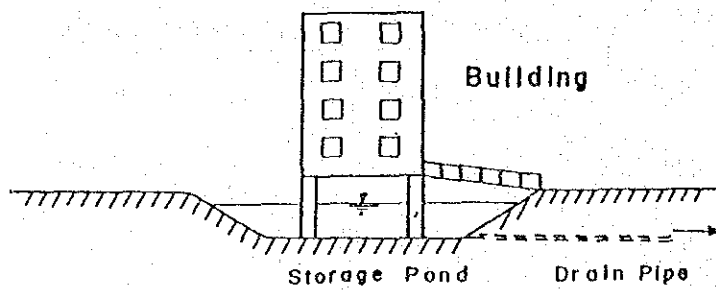
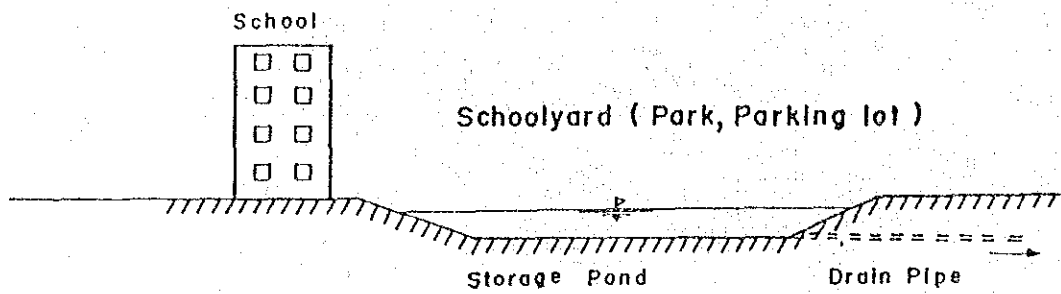
EXAMPLE OF OFF-SITE STORAGE FACILITIES  
Fig.11-3-2



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

TYPICAL ON-SITE STORAGE FACILITIES  
Fig.11-3-3(1/2)



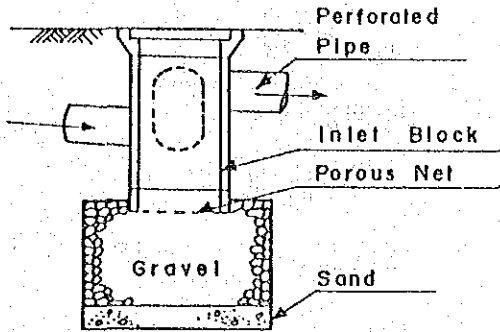
THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

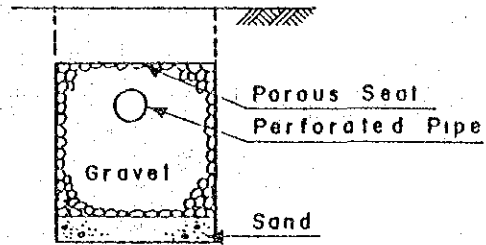
TYPICAL ON-SITE STORAGE FACILITIES  
Fig.11-3-3(2/2)

# INFILTRATION INLET AND TRENCH

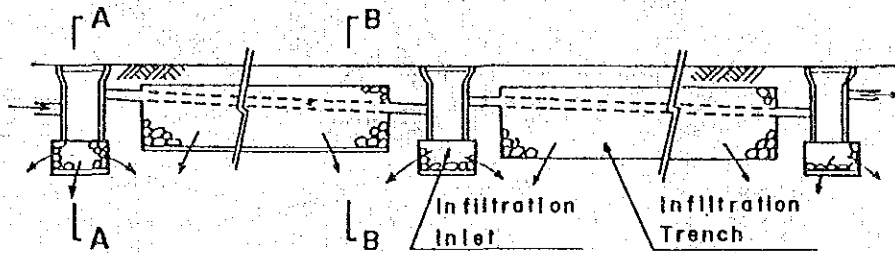
SECTION A-A



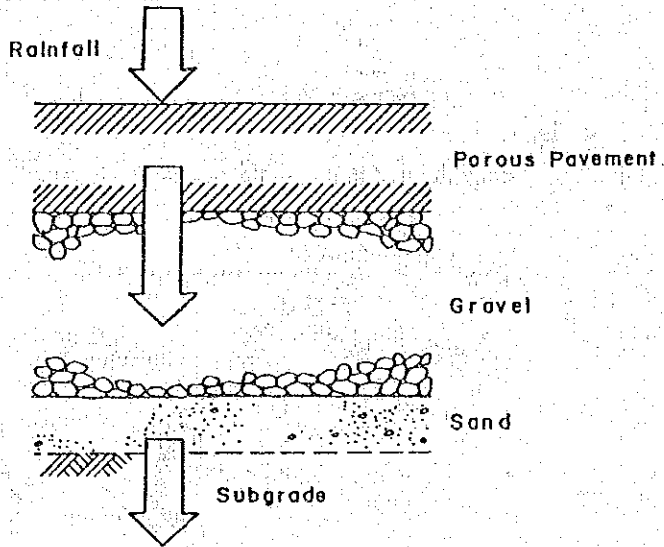
SECTION B-B



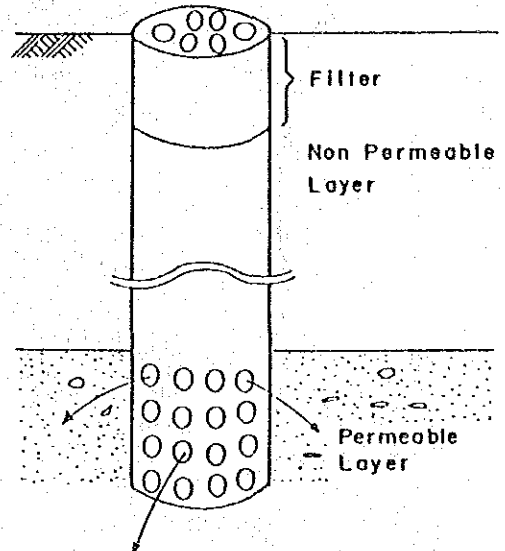
PROFILE



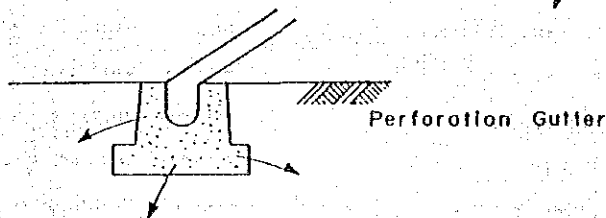
PERMEABLE PAVEMENT



INFILTRATION WELL



INFILTRATION GUTTER

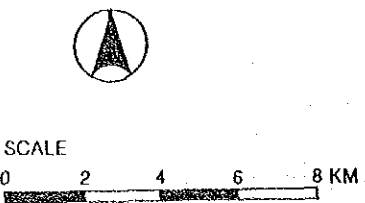
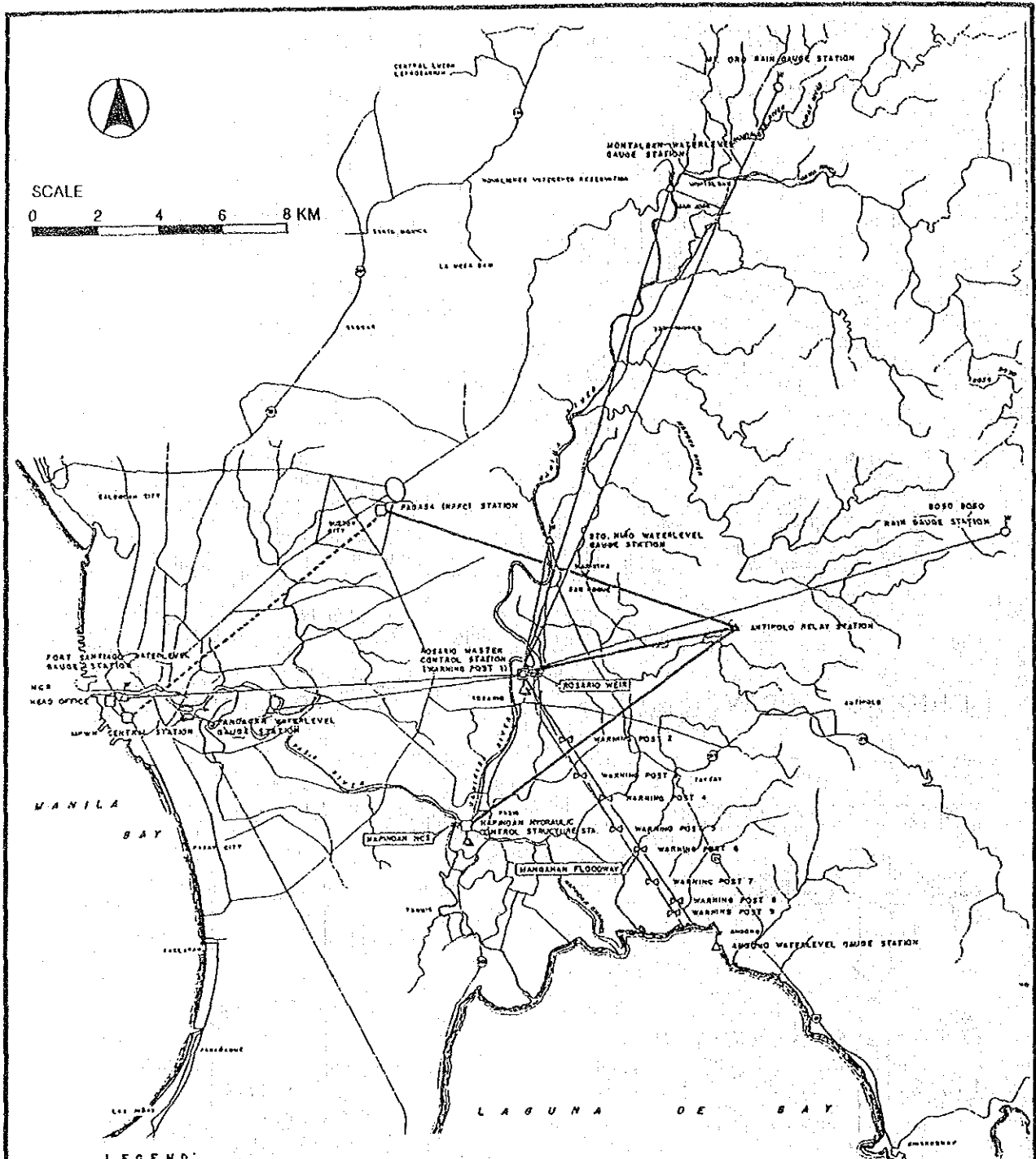


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

TYPICAL INFILTRATION TYPE FACILITIES  
Fig.11-3-4





LEGEND:

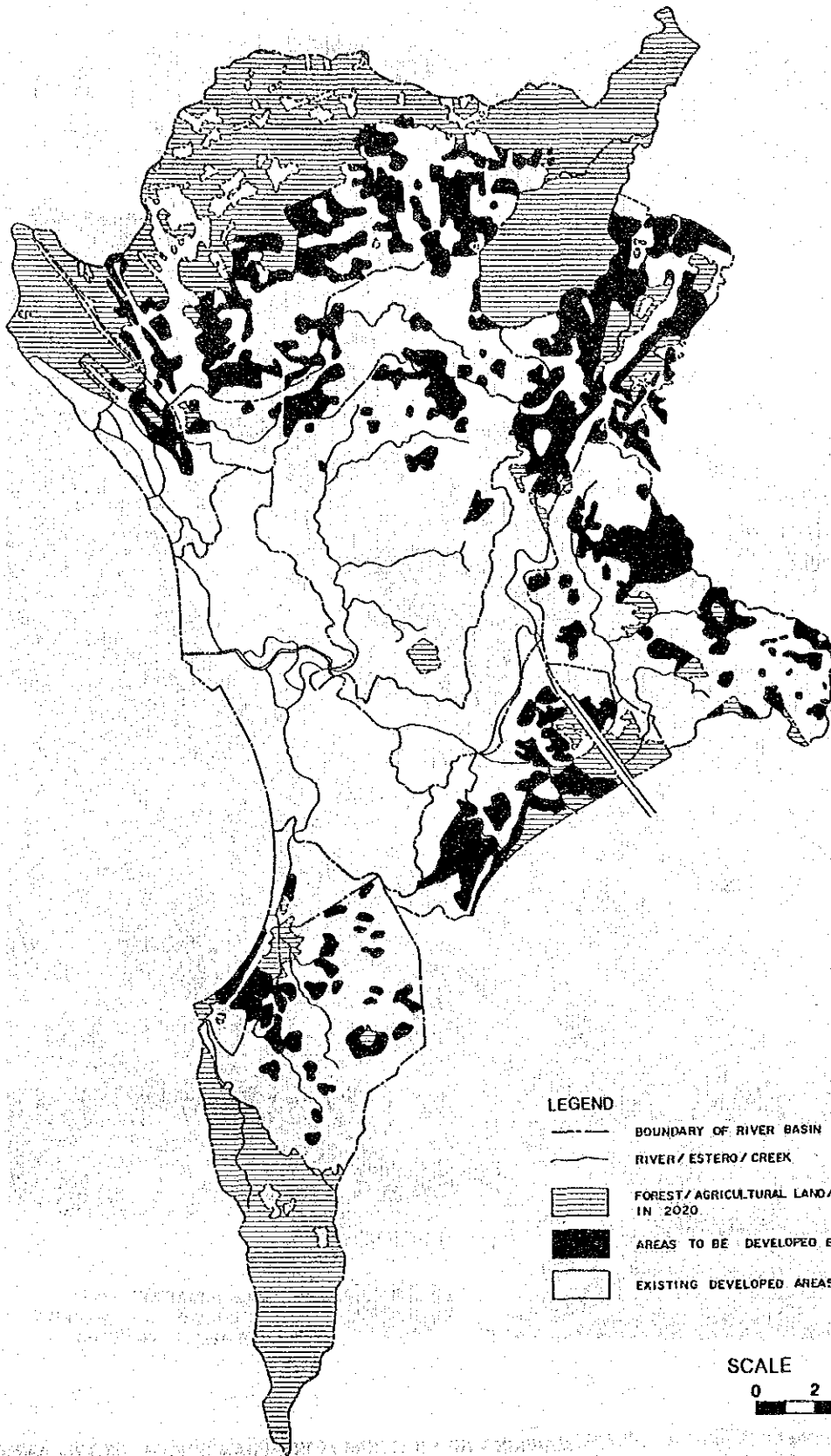
- |   |                           |       |                         |
|---|---------------------------|-------|-------------------------|
| ○ | RAIN GAUGE STATION        | △     | RELAY STATION           |
| △ | WATERLEVEL GAUGE STATION  | ⊗     | WARNING POST            |
| △ | WATERLEVEL GAUGE          | —     | VHF LINK                |
| ▲ | EXISTING WATERLEVEL GAUGE | ====  | MULTIPLEX LINK          |
| □ | MONITOR STATION           | ===== | EXISTING MULTIPLEX LINK |
| ⊠ | MASTER CONTROL STATION    | ----- | CABLE LINK              |

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES






TELECOMMUNICATION NETWORK OF  
EFCOS PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.11-4-1



**LEGEND**

-  BOUNDARY OF RIVER BASIN
-  RIVER/ ESTERO/ CREEK
-  FOREST/ AGRICULTURAL LAND/ PADDYFIELD/ FISH POND IN 2020
-  AREAS TO BE DEVELOPED BY 2020
-  EXISTING DEVELOPED AREAS

**SCALE**

0 2 4 6 (km)

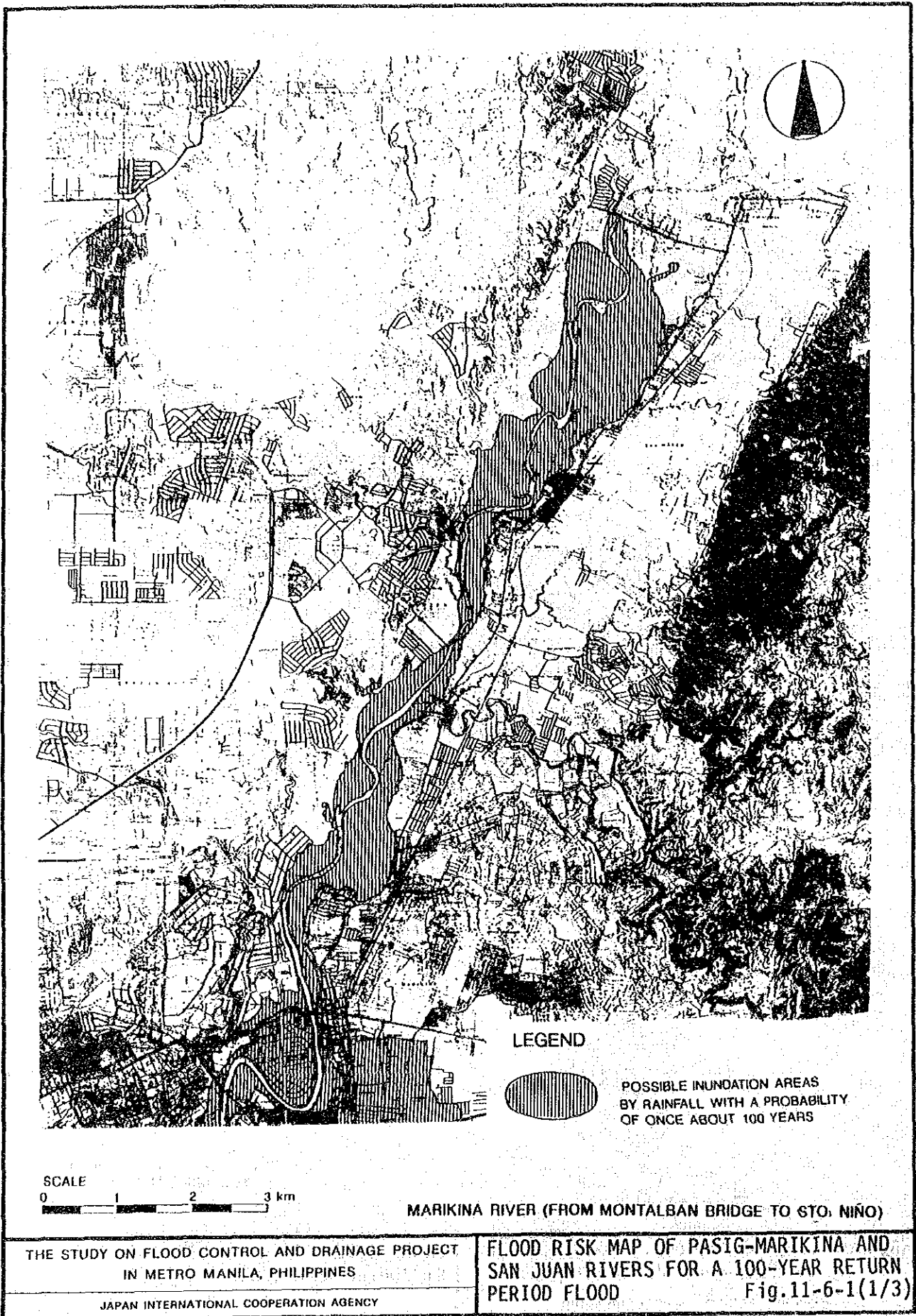


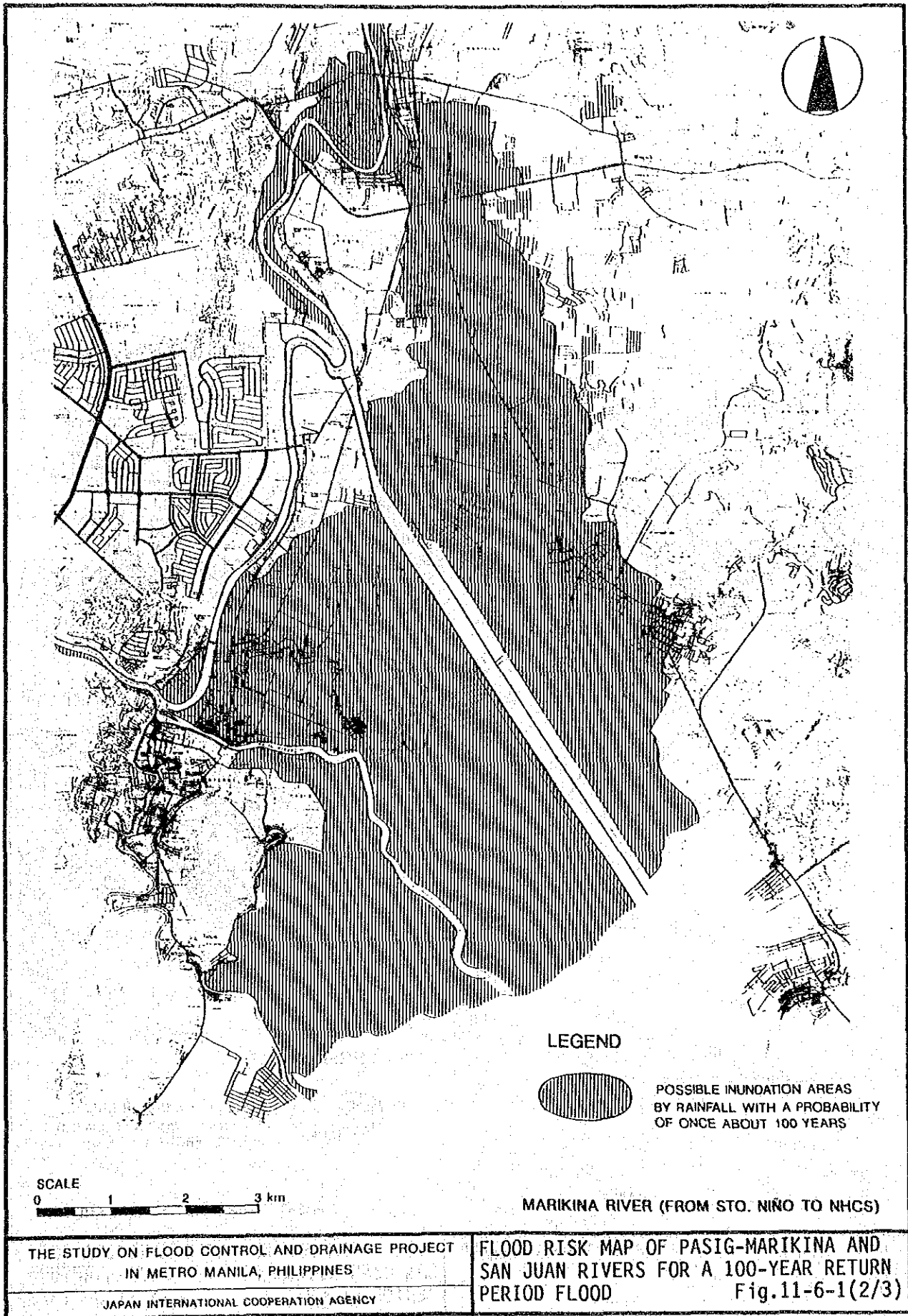
THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

URBAN DEVELOPMENT IN METRO MANILA  
BY ZONING ORDINANCE

Fig.11-5-1





LEGEND



POSSIBLE INUNDATION AREAS  
BY RAINFALL WITH A PROBABILITY  
OF ONCE ABOUT 100 YEARS

SCALE

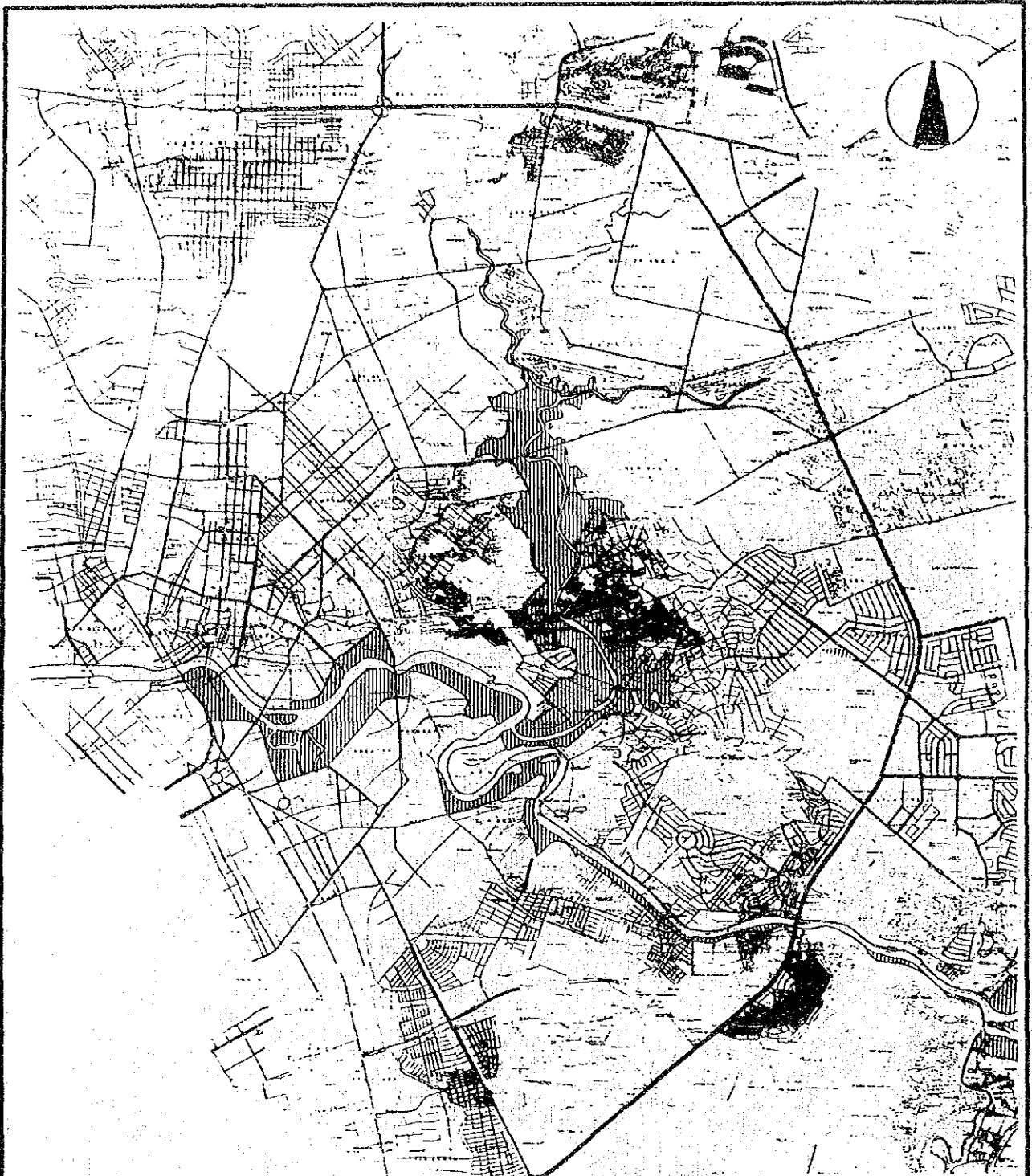


MARIKINA RIVER (FROM STO. NIÑO TO NHCS)

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

FLOOD RISK MAP OF PASIG-MARIKINA AND  
SAN JUAN RIVERS FOR A 100-YEAR RETURN  
PERIOD FLOOD  
Fig.11-6-1(2/3)

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND



POSSIBLE INUNDATION AREAS  
BY RAINFALL WITH A PROBABILITY  
OF ONCE ABOUT 100 YEARS

SCALE



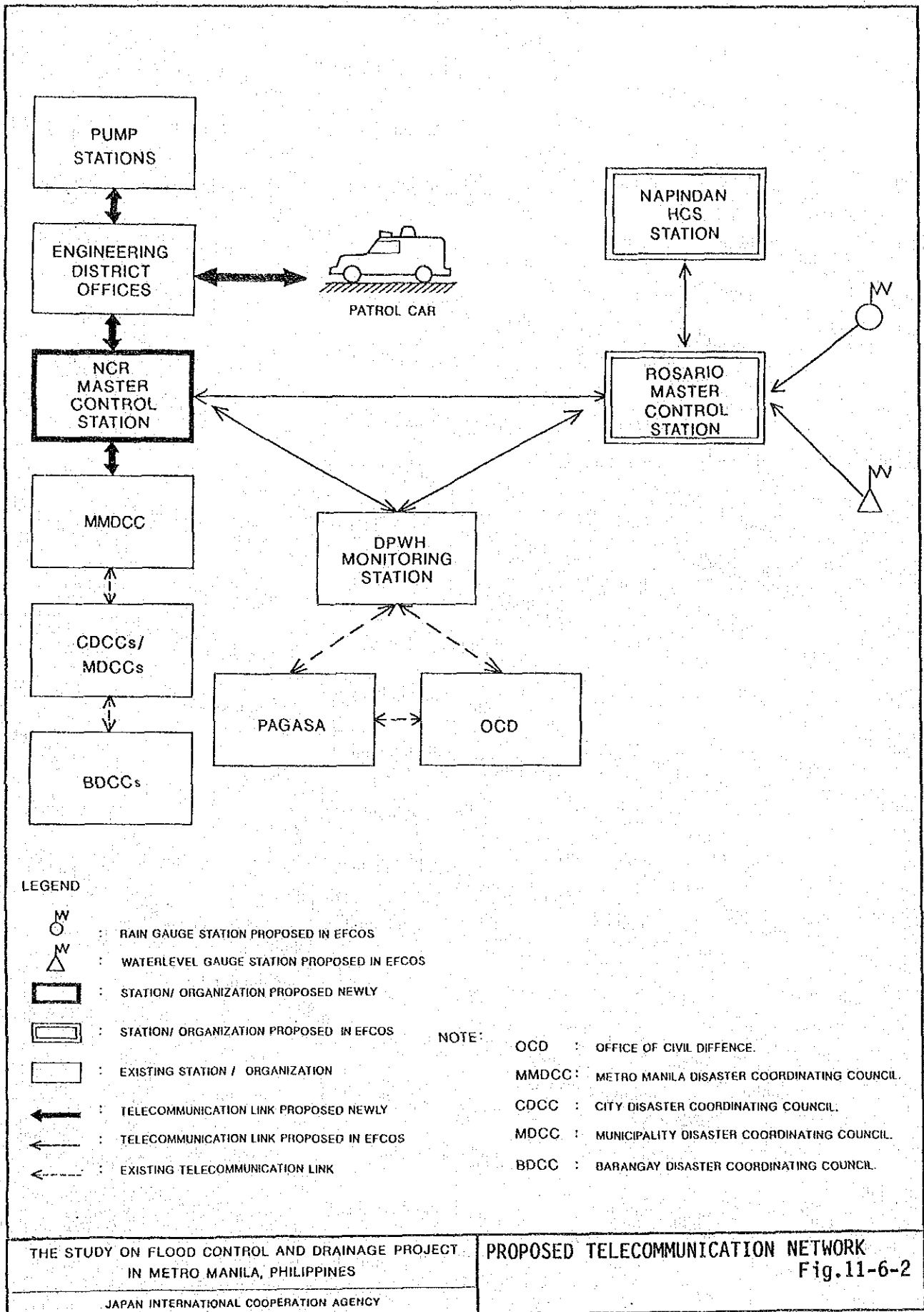
PASIG RIVER AND SAN JUAN RIVER

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

FLOOD RISK MAP OF PASIG-MARIKINA AND  
SAN JUAN RIVERS FOR A 100-YEAR RETURN  
PERIOD FLOOD

Fig.11-6-1(3/3)





## **XII. TOPOGRAPHIC SURVEY**





SUPPORTING REPORT  
XII. TOPOGRAPHIC SURVEY

TABLE OF CONTENTS

	<u>Page</u>
1. GENERAL .....	XII-1
2. WORK QUANTITY .....	XII-2
2.1 Framework Plan and Master Plan Stage .....	XII-2
2.2 Feasibility Study Stage .....	XII-3
3. EXECUTION OF WORK .....	XII-4
3.1 Framework Plan and Master Plan Stage .....	XII-4
3.2 Feasibility Study Stage .....	XII-5
4. RESULTS .....	XII-5

## LIST OF FIGURES

<u>Fig. No.</u>	<u>Title</u>
12-2-1	Bench Mark Network and Elevation
12-2-2	Location of Survey Work (Framework Plan and Master Plan Stage I)
12-2-3	Location of Survey Work (Framework Plan and Master Plan Stage II)
12-2-4	Location of Survey Work (Feasibility Study Stage)

## 1. GENERAL

To conduct the Master Plan Study on Flood Control and Drainage in Metro Manila and the Feasibility Study on priority projects, the topographic information such as the longitudinal profile and cross sections of the main rivers, esteros and other channels are needed as the fundamental data.

To attain the above, survey was done in the following three stages:

### (1) Framework Plan and Master Plan Stage I

Longitudinal and cross sectional survey of the main rivers, esteros and other channels in Metro Manila, under the finance of the Philippine Government.

### (2) Framework Plan and Master Plan Stage II

Supplemental longitudinal and cross sectional survey of Baho, Buli and Mahaba rivers in the East of Mangahan Floodway, which were not included in the above survey, under the finance of the Japan International Cooperation Agency (JICA).

### (3) Feasibility Study

To conduct the feasibility study on the priority projects recommended in the Master Plan Study, a more detailed topographic information such as longitudinal profile and cross sectional features of rivers and creeks, and also the ground elevations under the finances of the Japan International Cooperation Agency (JICA).

## 2. WORK QUANTITY

### 2.1 Framework Plan and Master Plan Stage

#### (1) Framework Plan and Master Plan Stage I

The work quantity done in the Framework Plan and Master Plan Stage I is summarized as follows:

<u>Rivers/Esteros</u>	<u>Longitudinal Profile</u>	<u>Cross Section</u>
a-1 Pasig River	17.3 km	97 sections
a-2 Marikina River	29.1	91
a-3 San Juan River	7.2	41
a-4 Mangahan Floodway	8.87	47
a-5 Napindan Channel	8.25	47
a-6 Malabon-Navotas-Marala Rivers	7.44	48
a-7 Tullahan River	19.7	110
a-8 Parañaque River	4.0	24
a-9 South Parañaque River	3.6	20
a-10 San Dionisio River	5.0	30
a-11 Dongalo River	2.5	13
a-12 Las Piñas River	4.5	25
a-13 Zapote River	3.8	21
a-14 Pateros-Taguig River	14.1	83
a-15 Estero de Vitas	1.8	13
a-16 Estero de Paco	9.0	49
a-17 Buendia Outfall	5.0	6
a-18 Rivera Outfall	5.0	6
a-19 Estero de Sta. Clara	1.0	9
a-20 Estero de Pandacan	4.2	13
a-21 Estero de San Miguel	3.5	14
a-22 Estero dela Reina	4.1	30
a-23 Meycauayan	5.0	6

The locations of bench mark and the above survey are shown in Figs. 12-2-1 and 12-2-2.

## (2) Framework Plan and Master Plan Stage II

The work quantity done in the Framework Plan and Master Plan Stage II is summarized as follows:

<u>Rivers/Esteros</u>	<u>Longitudinal Profile</u>	<u>Cross Section</u>
b-1 Bull River	2 km	4 sections
b-2 Baho River	14	24
b-3 Tributary A (Baho River)	2	3
b-4 Tributary B (Baho River)	4	8
b-5 Tributary C (Baho River)	3.6	5
b-6 Mahaba River	5.0	7
b-7 Marcos Highway	3.0	4

The locations of the above survey are shown in Fig. 12-2-3.

## 2.2 Feasibility Study Stage

The work quantity done in the Feasibility Study Stage is summarized as follows:

<u>Rivers/Esteros</u>	<u>Longitudinal Profile</u>	<u>Cross Section</u>
c-1 Tipas Labasan River	1.8 km	13 sections
c-2 Antipolo River	3.3	30
c-3 Sapang Baho Creek	1.4	10
c-4 Sapang Bull Creek	2.1	15
c-5 Sapang Mahaba Creek	1.5	7
c-6 Ususan Creek	1.2	6
c-7 Tributary I (Sapang Babo Cr.)	0.5	3
c-8 Dampalit River	2.8	32
c-9 Pinagkabalian River	2.4	26
c-10 Tributary I (Pinagkabalian R.)	1.2	16
c-11 Tributary II (Pinagkabalian R.)	0.8	15
c-12 Tributary III (Pinagkabalina R.)	1.0	17
c-13 Panghulo River	0.6	9
c-14 Santolan River	1.2	15
c-15 Catmon Creek	1.2	13

c-16 Longos Creek	0.8	10
c-17 Estero North Sunog Apog	1.2	13

In addition to the above, the ground elevation was surveyed at 60 points in East and West of the Mangahan Floodway and 40 points in Malabon-Navotas area.

The locations of the above survey are shown in Fig. 12-2-4.

### 3. EXECUTION OF WORK

#### 3.1 Framework Plan and Master Plan Stage

##### Preliminary Survey

Prior to the longitudinal profile survey, the geodetic control data such as tide station and bench marks were checked, and the datum was set as follows:

Primary Bench Mark (BM4B)	:	13.247 m
Mean Higher High Water (MHHW)	:	10.980 m
Mean High Water (MHW)	:	10.838 m
Mean Sea Level (MSL)	:	10.101 m
Mean Lower Low Water (MLLW)	:	10.000 m
Datum Line (DL)	:	0.000 m

Location of the bench marks and the elevations are shown in Fig. 12-2-1.

##### Longitudinal and Cross Sectional Survey

The longitudinal profile was surveyed through the combination of leveling and distance measurement, on the basis of the leveling on the bench marks shown in Fig. 12-2-1, of which the survey was made by the double trip measurement.

The cross sectional survey was carried out in the same way as the longitudinal survey. The cross section intervals was fundamentally set at approx. 200 m. In the cross sectional survey attention was paid to the variation points of elevation in the section, especially for the variation from the channel to the bank.

### 3.2 Feasibility Study Stage

The same datum as described in Section 3.1 was adopted in the Feasibility Study Stage.

The longitudinal and cross sectional features were surveyed in the same manner as the Master Plan stage, setting the cross section interval as follows:

- 400 m interval for the rivers/channels with more than 50 m of channel width.
- 200 m interval for the rivers/channels with 50-25 m of channel width.
- 100 m interval for the rivers/channels with less than 25 m of channel width.

The ground elevation survey points were pinpointed from the topographic map, of which these points correspond to approximately the crossing points of a 1 km by 1 km mesh. The leveling was conducted by the double-trip measurement.

## 4. RESULTS

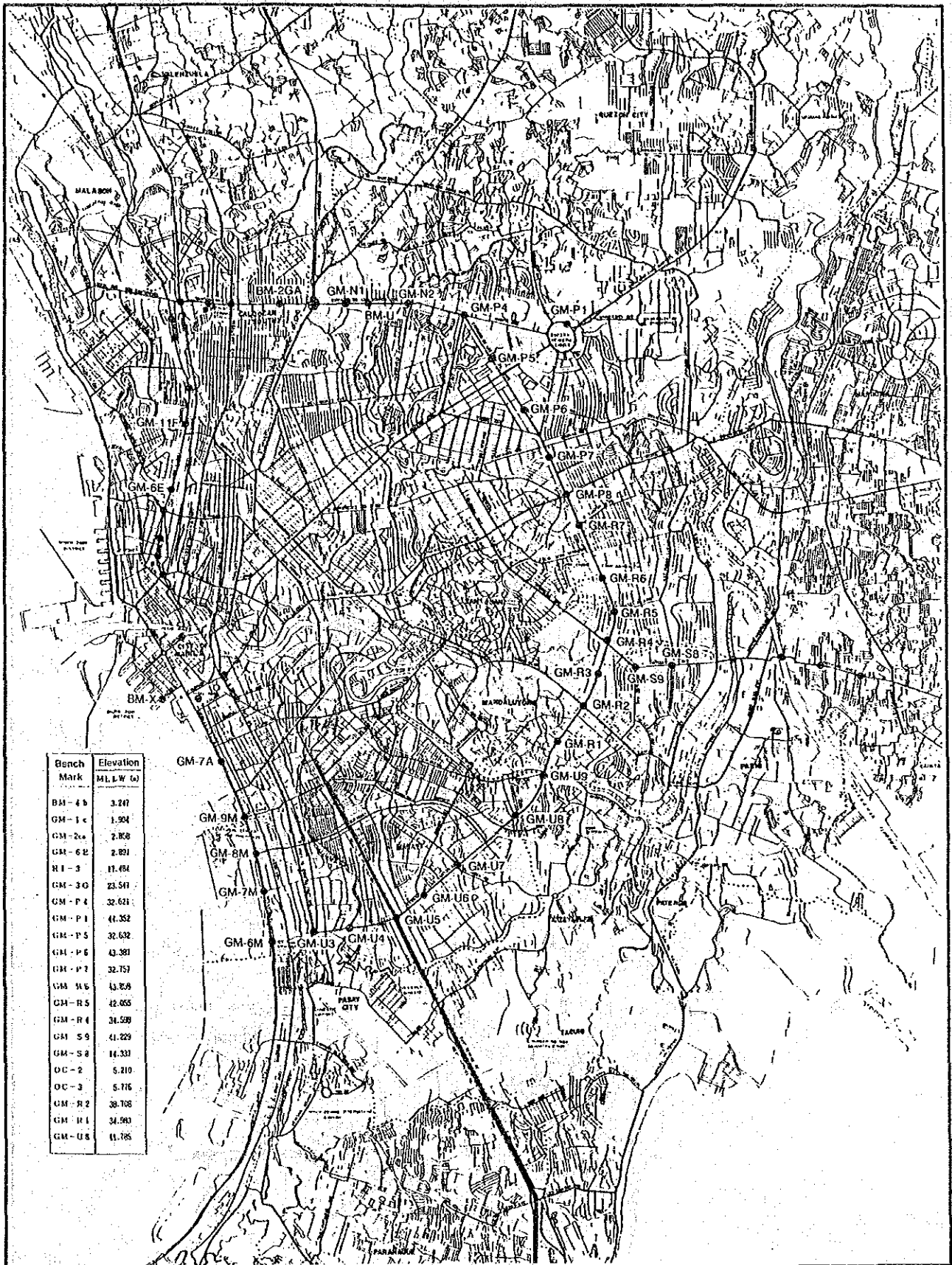
All of the above survey results were as shown in DATA BOOK (2), THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA.





## FIGURES



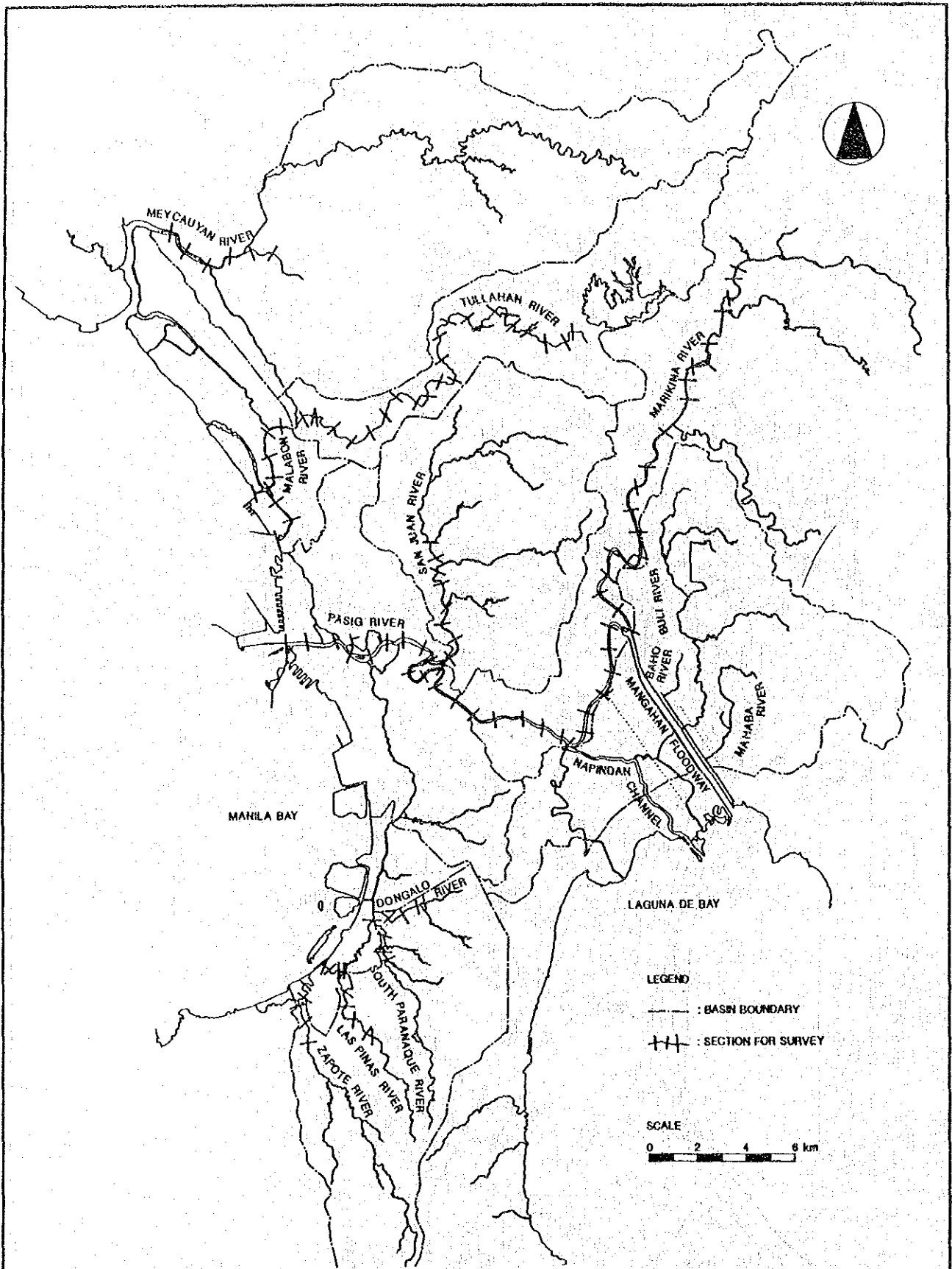


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

BENCH MARK NETWORK AND ELEVATION

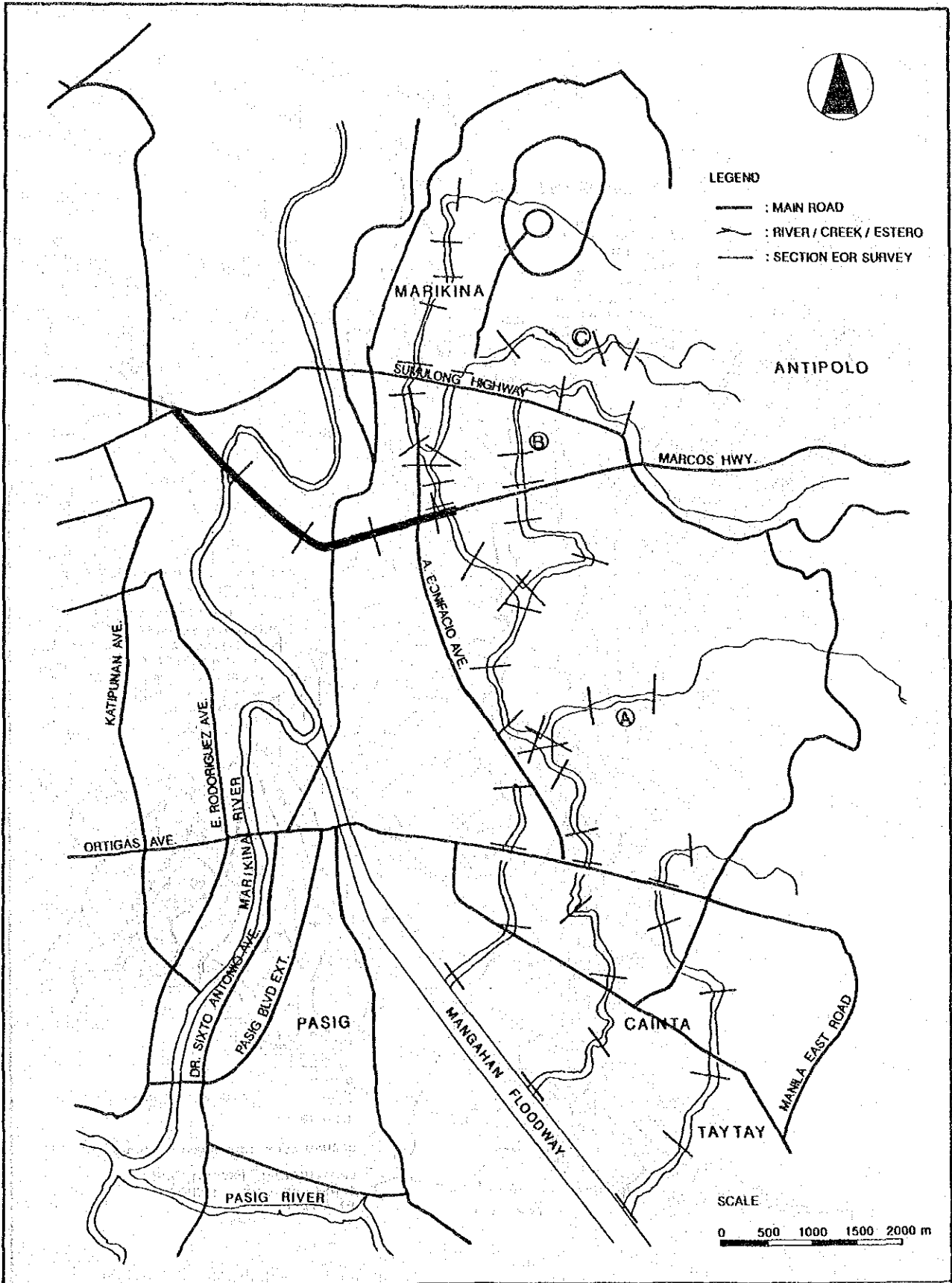
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.12-2-1



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
 IN METRO MANILA, PHILIPPINES  
 JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION OF SURVEY WORK (MASTER PLAN STAGE -1-)  
 Fig.12-2-2

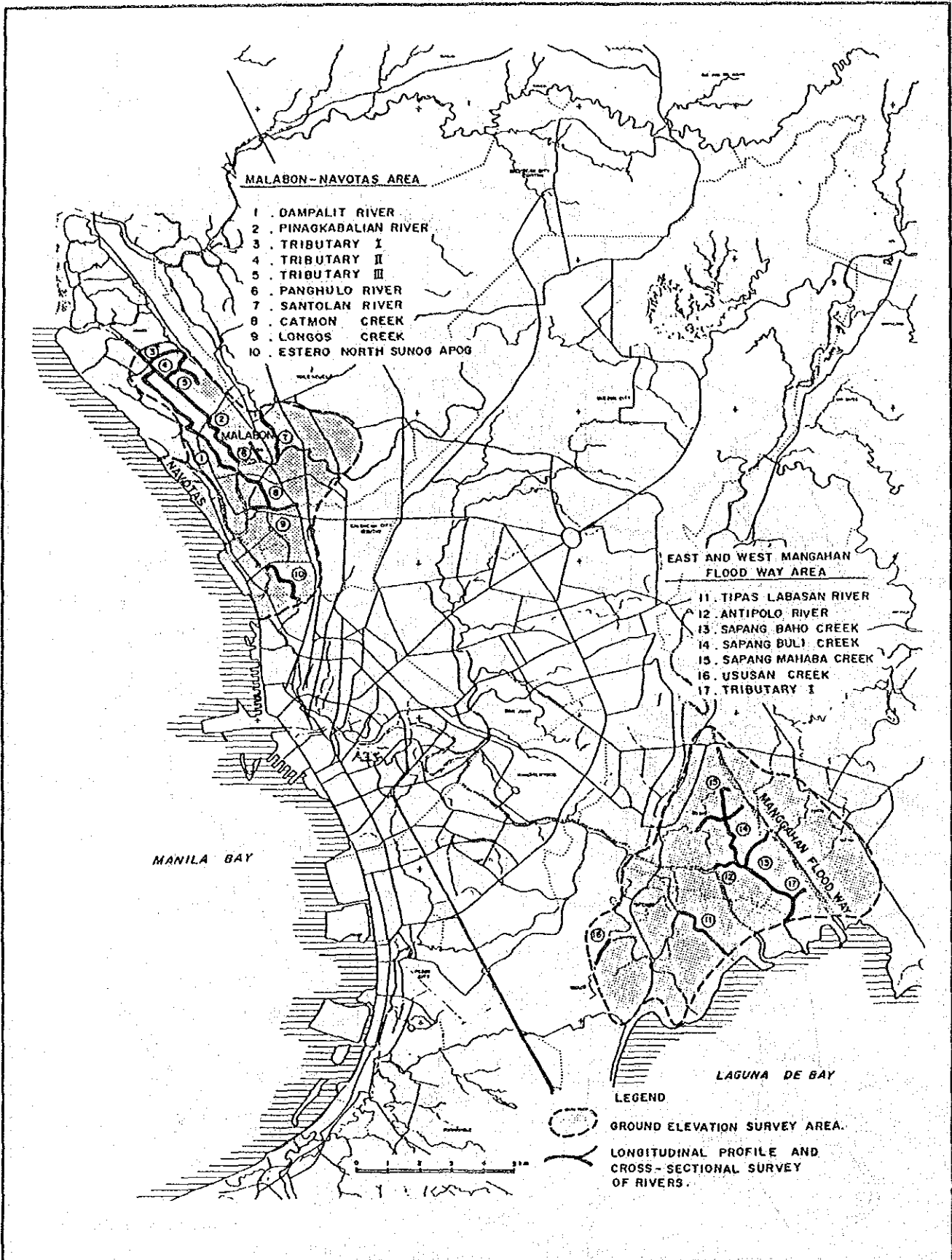


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION OF SURVEY WORK (MASTER PLAN STAGE -2-)

Fig.12-2-3



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT  
 IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION OF SURVEY WORK  
 (FEASIBILITY STUDY STAGE)

Fig.12-2-4









爪哇