社会開発調査部報告書

No. 52

THE GOVERNMENT OF THE REPUBLIC OF INDONESIA

THE STUDY ON URBAN DRAINAGE AND WASTEWATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

MASTER PLAN STUDY

MAIN REPORT

MARCH 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

THE GOVERNMENT OF THE REPUBLIC OF INDONESIA

THE STUDY ON URBAN DRAINAGE AND WASTEWATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

MASTER PLAN STUDY

MAIN REPORT

MARCH 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Japanese Government decided to conduct a Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Ryuji Yanai, and composed of members from Pacific Consultants International and Nippon Koei Co., Ltd, three times between September 1989 and December 1990.

The team held discussions with the officials concerned of the Government of Indonesia and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

March, 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

THE STUDY ON URBAN DRAINAGE
AND
WASTEWATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Mr. Kensuke YANAGIYA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

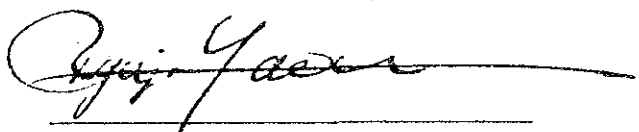
We are pleased to submit to you the final report entitled "THE STUDY ON URBAN DRAINAGE AND WASTEWATER DISPOSAL PROJECT IN THE CITY OF JAKARTA". This report has been prepared by the Study Team in accordance with the contract signed on 25 August 1989 and 17 May 1990 between the Japan International Cooperation Agency and the Joint Venture of Pacific Consultants International and Nippon Koei.

The report examines the existing conditions of urban drainage and wastewater disposal in the city of Jakarta, presents a master plan of drainage, sanitation and sewerage development and the results of a feasibility study on drainage and sewerage development for the priority areas selected by the master plan.

The report consists of the Executive Summary, Main Report, and Supporting Study Report. The Summary summarizes the results of all studies. The Main Report contains background conditions, overall drainage, sanitation and sewerage development plan, urgent drainage and sewerage development project, conclusions and recommendations. The Supporting Study Report includes data and technical details. In addition, a Data Book has been prepared and is submitted herewith.

All members of the Study Team wish to express grateful acknowledgement to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs. Ministry of Construction, and Embassy of Japan in Indonesia, and also to officials and individuals of the Government of Indonesia for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to the socio-economic development and the improvement of health and hygiene in Jakarta.

Yours faithfully,



Ryuji YANAI
Team Leader

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AIT	Asian Institute of Technology
B/C	Benifit Cost Ratio
BAPPENAS	National Planning and Development Board
BAPPEDA	Regional Planning and Development Board, DKI Jakarta
BPPT	Agency of Assessment and Application of Technology
BOD	Biochemical Oxygen Demand
CIPTA KARYA	Directorate General of Human Settlement
Cl^-	Chloride Ion
cm	Centimeters
COD	Chemical Oxygen Demand
Dept.	Department
DKI	Jakarta Metropolitan Government
DO	Dissolved Oxygen
EIRR	Economic Internal Rate of Return
ENSIC	Environmental Sanitation and Information Center of AIT
FC	Fecal Coliform Density
Fig.	Figure
gcd	Gram per Capita per Day
ha	Hectares (10,000 m^2)
hrs	Hours
HWL	High Water Level
JICA	Japan International Cooperation Agency
JFCP	Jakarta Flood Control Project
JSSP	Jakarta Sewerage and Sanitation Project
JUDP	Jakarta Urban Development Project
kg/d	Kilogram per Day
Kec.	Kecamatan
Kel.	Kelurahan
KIP	Kampung Improvement Project
KKC	Kokusai Kogyo Co., Ltd.
km	Kilometers
km^2	Square Kilometers
kw	Kilowatt
kwh	Kilowatt-hour
lcd	Litter per Capita per Day
m	Meters

m^2	Square Meters
m^3	Cubic Meters
m^3/s	Cubic Meters per Second
m^3/d	Cubic Meters per Day
mg/l	Milligram per Litter
mm	Millimeters
MPN	Most Probable Number
MSL	Mean Sea Level
MWL	Mean Water Level
NEDECO	Netherlands Engineering Consultants
NH_4-N	Ammonia Nitrogen
NK	Nippon Koei Co., Ltd.
NPV	Net Present Value
NWL	Normal Water Level
OECF	Overseas Economic Cooperation Fund (of Japan)
PCI	Pacific Consultants International
PEI	Project Economy Institute, Inc.
P4L	Cities and Environmental Research and Development Center, DKI Jakarta
p.p.	Priok Pile
ppm	Parts per Million
%	Percent
P3O	Center for Oceanological Research and Development
RBC	Rotating Biological contactor
R.C.	Reinforced Concrete
Rd.	Road
Rp.	Rupiah (Indonesian Currency) US$=approximately Rp.1850
SS	Suspended Solids
TEC	Tokyo Engineering Consultants
T-P	Total Phosphorus
TS	Total Solids
TVS	Total Volatile Solids
WHO	World Health Organization

Chapter 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Jakarta, the capital of Indonesia, is the political and economic centre of the nation. The Study Area, shown in Fig. 1.1, encompasses the whole administrative area of the city, under the jurisdiction of DKI Jakarta, with an area of about 650 sq.km, which is undergoing rapid urbanization in recent years. Accordingly, the population has almost doubled from 4.6 million in 1975 to 8.8 million in 1988, and is expected to grow further to 12.8 million in the year 2010.

However, the city virtually lacks an environmentally and sanitarily acceptable means of wastewater disposal in commensuration with its urbanization and high growth of population.

Bulk of the gray water generated by miscellaneous domestic use of washing and bathing, and even a portion of toilet waste from households with inadequate and no toilet facilities, is discharged to nearby ditches and drains with no treatment. As the consequence, the waterways and rivers, especially in the central region of the Study Area with high population density, have virtually become open sewers with no beneficial use. They are black in colour and emanate offensive odour with their stream BOD levels reaching even a 100 mg/l during dry season, not to mention the associated public health risk. Hence, the requirement of a comprehensive sanitation and sewerage development for the Study Area is an overdue and need not be further emphasized.

In fact, since 1985 a pilot sanitation and sewerage development project is on-going by JSSP (Jakarta Sewerage and Sanitation Project), covering Kecamatan Setia Budi and Tebet Manggarai in the administrative region of South Jakarta, with financial assistance from IBRD. This project is based on the sewerage master plan of 1977 conducted for World Health Organization (WHO), but this master plan was not fully implemented due to its inflexibility with respect to stagewise implementation and the associated high project cost.

Concerning drainage development in the Study Area, it has progressed well in comparison to sanitation and sewerage. Conventionally drainage development precedes that of sewerage due to its higher priority.

The first major project of flood control and drainage implemented in the Study Area is the West Banjir Canal completed in 1920. A similar East Banjir Canal project is on-going. In addition, some major flood control and drainage projects have already been completed and also still on-going since 1972, under the Jakarta Flood Control Project, which include the East Banjir Canal Project.

Nevertheless, these projects are restricted to the improvement of large rivers only. Furthermore, the recent rapid urbanization and the resultant change in landuse has already created new flood prone areas not envisaged in the previous plans. Such flood prone areas are expected to expand further in the future, especially along the still relatively undeveloped eastern and western regions.

As a consequence, formulation of an urban drainage development plan, conforming the present and future landuse of the Study Area, has become necessary.

1.2 Objectives of the Study

The objectives of the Study are as follows:

- Formulation of a master plan of drainage, sanitation and sewerage development encompassing the whole Study Area for the target year of 2010.
- Conduct a feasibility study for drainage and sewerage development for the priority areas selected by the master plan.

However, this master plan report deals with only the master plan study and criteria and selection of the priority areas of both drainage and sewerage for feasibility study. The feasibility study itself is dealt with separately in feasibility study report.

1.3 Implementation of the Study

Directorate General of Human Settlements (Cipta Karya), Ministry of Public Works and Jakarta Metropolitan Government (DKI, Jakarta) were assigned as the counterpart executing agencies of the Government of Indonesia, while the Japan International Cooperation Agency (JICA) was assigned as the official agency responsible for the implementation of the technical cooperation program of the Government of Japan.

The Study was carried out by the Japanese consultant team retained by JICA and Indonesian counterpart staff.

The whole study, consisting of master plan and feasibility studies, was conducted from September, 1989 to January 1991. The members involved in master plan study, carried out during September 1989 ~ August 1990, are listed below.

(1) JICA Study Team

Mr. Ryuji Yanai	(PCI)	: Team Leader
Mr. Naohito Murata	(PCI)	: Deputy Team Leader /Drainage System Planning
Mr. Masami Kondo	(PCI)	: Sewerage System Planning
Mr. Nobuyuki Gonohe	(PCI)	: Sewerage Facility Planning
Mr. Masahiro Kawachi	(TEC)	: Sewerage Facility Design (I)
Mr. Yoshikazu Katagiri	(PCI)	: Sewerage Facility Design (II) /Environmental Analysis
Dr. Somasundaram Jayamohan	(PCI)	: Human Waste Treatment
Dr. Akira Uchida	(PCI)	: Environmental Analysis
Mr. Seiichi Nakao	(NK)	: Drainage Facility Planning
Mr. Mamoru Hirose	(KKC)	: Drainage Facility Design
Mr. Hitoshi Ichihara	(NK)	: Hydrological Analysis
Mr. Naomichi Ishibashi	(PEI)	: Economic/Financial Analysis
Mr. Masayuki Ikeda	(PCI)	: Topographic Survey

(2) JICA Advisory Committee

Chairman

Dr. Kazuhiro Tanaka	Sewerage Planning Japan Sewage Works Agency

Members

Mr. Ichiro Kobayashi	Sewerage Facility Planning Ministry of Construction
Mr. Kunihiro Tomita	Urban Drainage Planning Ministry of Construction
Mr. Yoshimasa Furuhata	Water Pollution Control Tokyo Metropolitan Government

(3) Steering Committee of Indonesia

Chairman

Ir. Soenarjono Danoedjo	Director General, Directorate General of Human Settlement (CIPTA KARYA)

Vice Chairman

Ir. Herbowo	Vice Governor, Jakarta Metropolitan Government (DKI Jakarta)

Secretaries

Ir. Darmawan Salch	Director, Directorate of Environmental Sanitation, Directorate General of Human Settlement (CIPTA KARYA)
Ir. Tb.M. Rais	Director, Regional Planning and Development Board, DKI Jakarta

Members

Ir. Martono	Director of Program & Development, Directorate General of Water Resources Development, (PENGAIRAN)
Drs. Sukrisno	Chief of Bureau of Overseas Committee, Dept. of Public Works

Ir. Parulian Sidabutar	Director of Program & Development, Directorate General of Human Settlement (CIPTA KARYA)
Ir. A.R Tambing, Dipl. SE	Director of Water Supply, Directorate General of Human Settlement (CIPTA KARYA)
Ir. Hendro Pranoto S.,MPW	Director of Urban and Regional Planning, Directorate General of Human Settlement (CIPTA KARYA)
Ir. Hally Dezar	Chief of Regional DKI Jakarta Office, Dept. of Public Works
Drs. Komaruddin, MA	Director of System Assessment, Agency of Assessment and Application of Technology (BPPT)
Ir. Sudarsono	Director of Urban Development, Dept. of Home Affairs
Drs. Saad A Basaib, Msc.	Chief of Bureau of Social Welfare and Housing, National Planning and Development Board (BAPPENAS)
Drs. Yusuf Anwar	Director of Overseas Fund, Dept. of Finance
Ir. Aca Sugandi A.,Msc.	Second Assistant of State Minister of Demography and Environment for Natural Resources.
Ir. Prawoto S. Danoemihardjo	Head of Public Works Office,
Ir. H. Syamsu Ramli(Former)	DKI Jakarta
Ir. E. Budihardjo	Head of Public Cleansing Office, DKI Jakarta
Ir. Syamsul Ardi Rahman	Chief of Bureau of Demography and Environment, DKI Jakarta
Ir. K.H Madjid	Chief of Bureau of Regional Development, DKI Jakarta
Ir. Udin Abimanyu	Head of Urban Regional Planning,
Ir. Ery Chayaridipura(Former)	DKI Jakarta

(4) Technical Committee of Indonesia

Chairman	
Ir. Darmawan Saleh	Director of Environmental Sanitation, CIPTA KARYA
Vice Chairman	
Ir. H.T. Arifin Akbar	Deputy Head of Public Works Office, DKI Jakarta
Secretaries	
Ir. M.Sidarta Reksoatmo	Chief of Physical Division of Regional Planning and Development Board (BAPPEDA), DKI Jakarta
Ir. M.Djihad, Dip,HE	Chief of Sub-Directorate of Drainage, Directorate of Environmental Sanitation (CIPTA KARYA)
Members	
Ir. Krisno D.	Chief of Sub-Directorate of Wastewater, Directorate of Environmental Sanitation (CIPTA KARYA)
Ir. Budiman Arief	Chief of Sub-Directorate of Solid Waste, Directorate of Environmental Sanitation (CIPTA KARYA)
Ir. Risyana, Dipl. H	Chief of Sub-Directorate of Technical Planning, Directorate of Program & Development (CIPTA KARYA)
Ir. Rachmat Rani, Dipl.SE	Chief of Sub-Directorate of Environmental Sanitation, Directorate of Water Supply (CIPTA KARYA)
Ir. Soenarjo SD, Dipl.HE	Chief of Sub-Directorate of Development Planning, Directorate of Program & Development (PENGAIRAN)

Ir. Aboejoewono	Deputy Head, Public Cleansing Office, DKI Jakarta
Ir. H. Suharto	Chief of Bina Program, Public Works Office, DKI Jakarta
Ir. B.Bambang Achmadi Ir. Gunawan (former)	Chief of Urban Infrastructure, Urban Regional Planning Office, DKI Jakarta
Ir. Rochadi R.	Chief of Environmental Sanitation, Public Works Office, DKI Jakarta
Ir. E.Budirahardjo	Director of Cities and Environmental Research and Development Center (P4L), DKI Jakarta
Ir. Suharto	Chief of Water Resources (BAPPEDA), DKI Jakarta
Ir. Muzahiem M.,Dipl.SE	Chief of Natural Resources and Environment (BAPPEDA), DKI Jakarta
Ir. Masnellyarti Hilman	Staff Assistant of State Minister of Statistics and Environment
Ir. Sri Bebassari	Staff, Agency of Assessment and Application of Technology (BPPT)

(5) Counterparts

Public Works Office, DKI Jakarta

Ir. Posma Hutabarat D.E.S.
Ir. E.Setiawati
Ir. Palti Barita
Ir. Irvan Amtha

Agency of Assesment & Application of Technology (BPPT)

Dr. Amanda Niode Katili
Ir. Sri Rudatin Msc.
Drs. Soesmarkanto
Dra. Komariah Tamsil

Ir. Pudji Prawoto
Ir. Nusa Idaman Said
Drs. M.P. Imam Sudjana. M.Eng.
Ir. Budi Rahayu

Directorate of Environmental Sanitation (CIPTA KARYA)
Arsono, M.Eng.
Harry Simanjuntak
Bayu Krisnanto, BE.

Public Cleansing Office, DKI Jakarta
Ir. H. Ali Rozi
Ir. Sugiono

Flood Control Project (PRO BANJIR)
Ir. Supriana Dipl. HE

Bureau of Demography and Environment, DKI Jakarta
Ir. Peni Susanti Dipl. SE

Urban Regional Planning Office
Ir. Surtadi

Cities and Environmental Research and Development Center (P4L), DKI Jakarta
Ir. Yunani

1.4 Composition of Report

This Master Plan Report consists of three (3) volumes : Main Report and Supporting Report in two (2) volumes.

The Main Report presents the summarized results of all the studies. In Chapter 2 through 7, the basic information for the Study are described. In Chapter 8 and 9, the master plans for urban drainage development, and sanitation and sewerage development are presented. In Chapter 10 and 11, prioritization, implementation programme, and evaluation of the proposed projects are described.

The Volume I of Supporting Report deals with in details essentially on the existing condition of the Study Area (Appendix A~F), while that of Volume II the proposed drainage and sanitation and sewerage master plan and the related implementation programme and evaluation of the projects. It incorporates a supplementary study as well (Appendix G~K).

The Supporting Report is comprised of the following Studies as appendices.

Volume I

- A : Socio-Economic Conditions
- B : Hydrology, Floods and Flood Damages
- C : Environmental Conditions
- D : Pollution Load Generation
- E : Existing Urban Drainage System
- F : Existing Sanitation and Sewerage Projects and Facilities

Volume II

- G : Urban Drainage Development Plan
- H : Sanitation and Sewerage Development Plan
- I : Implementation Programme
- J : Project Evaluation
- K : Supplementary Study

The Feasibility Study Report of this master plan study, which deals with the drainage and sewerage development of the priority areas concerned as identified in the master plan for immediate project implementation, which is also comprised of both main report and supporting report, is compiled separately.

The whole study consists of the following reports :

(1) MASTER PLAN STUDY
(MAIN REPORT)

(2) MASTER PLAN STUDY
(SUPPORTING REPORT,VOLUME I)

(3) MASTER PLAN STUDY
(SUPPORTING REPORT,VOLUME II)

(4) FEASIBILITY STUDY
(MAIN REPORT)

(5) FEASIBILITY STUDY
(SUPPORTING REPORT)

(6) DATA BOOK

(7) DRAWING

(8) EXECUTIVE SUMMARY

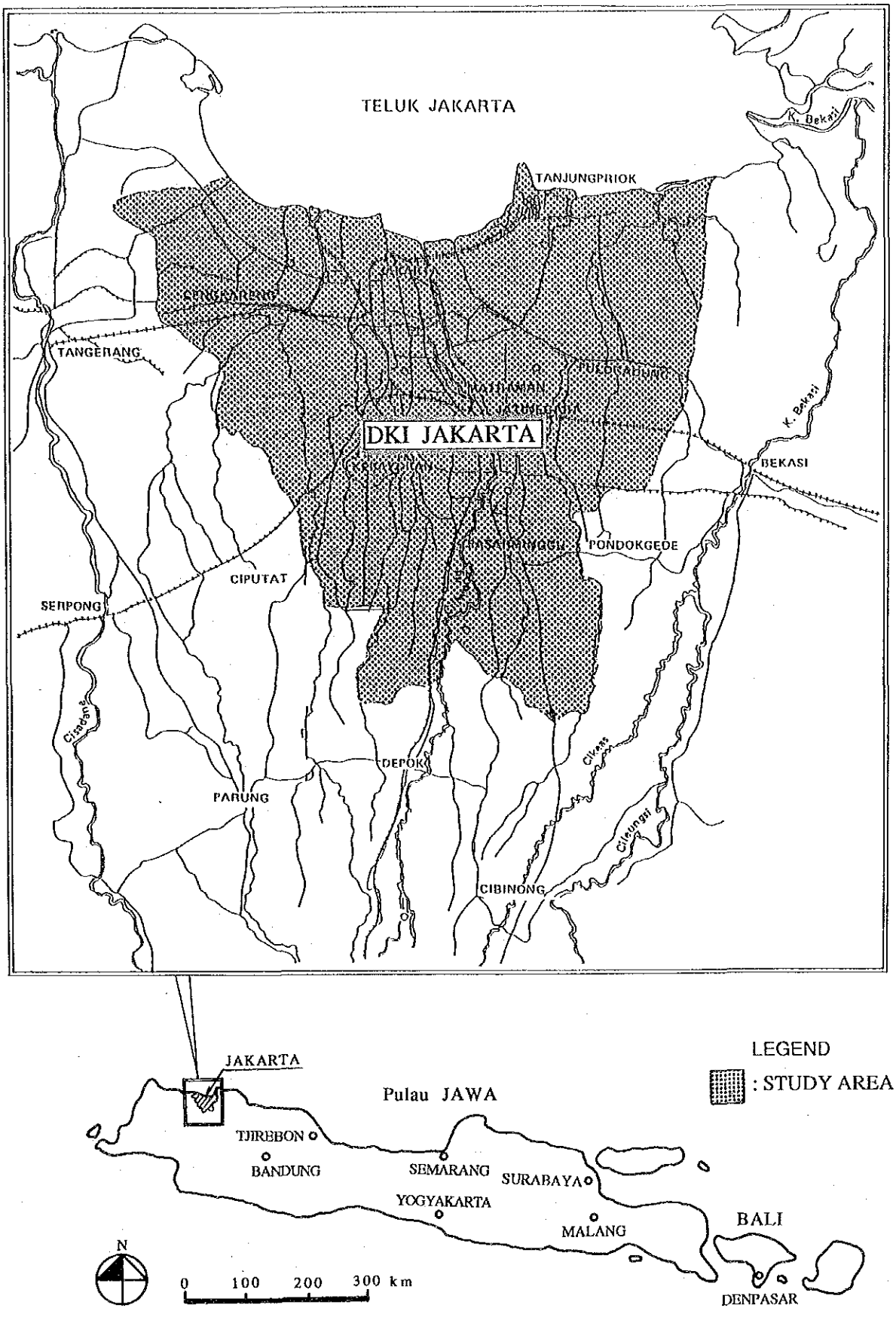


FIG. 1.1 LOCATION OF STUDY AREA

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Chapter 2

SOCIO-ECONOMIC CONDITIONS

CHAPTER 2 SOCIO-ECONOMIC CONDITIONS

2.1 Population

The Study Area has been undergoing a rapid urbanization in the recent years. The population has increased from 4.6 million in 1975 to 6.5 million in 1980 and 8.0 million in 1985 with an average annual growth rate of 4.05%. The population in 1988 is estimated to be 8.8 million with an average population density of 134.9 person/ha.

The future population of the Study Area in 2005 is estimated at 12.0 million by the DKI Jakarta Structure Plan 2005. The population in 2010 is estimated to be 12.8 million by further extending the above projection upto the year 2010. The average population density of the Study Area in 2010 is 196.5 person/ha.

The number of Kelurahan by population density distribution in 1988 and 2010 is shown below.

Population Density (Person/ha)	Nos. of Kelurahan 1988	2010
More than 501	36	48
401 - 500	21	24
301 - 400	23	35
201 - 300	41	54
101 - 200	57	56
Less than 100	78	39
	256	256

The regional distribution of the population density in 1988 and 2010 by Kelurahan is shown in Fig. 2.1 and Fig. 2.2.

2.2 Land Use

The share of urban land use including residential, commercial and institutional and industrial uses of the Study Area has increased from 59.6% in 1983 to 76.5% in 1988 due to the increasing population

pressure. On the contrary, the share of the rural land use covering farmland, green land and swamp has decreased from 40.4% to 23.5% during this period.

In this Study, the land use in 2010 is assumed to be the same as that in 2005 projected by the DKI Jakarta Structure Plan 2005. The urban land use in 2010 is expected to cover 85.8% of the Study Area.

The land use pattern of the Study Area in 1988 and 2010 are compared as shown below.

Land Use	1988		2010	
	Area(ha)	Ratio(%)	Area(ha)	Ratio(%)
Residential	37,907	(58.2)	38,232	(58.7)
Commercial & Institutional	9,292	(14.3)	11,241	(17.3)
Industrial	2,610	(4.0)	6,383	(9.8)
Others	15,340	(23.5)	9,293	(14.2)
Total	65,149	(100.0)	65,149	(100.0)

The land use of the Study Area in1988 and 2010 are shown in Fig 2.3 and Fig. 2.4 respectively.

2.3 People's Income Level

The people's income level of the Study Area was estimated based on the sampling survey conducted in the course of the Study.

Households in the Study Area were classified into three (3) categories, i.e. high, middle and low income classes according to house types. The existing composition of high, middle and low income classes across the Study Area is estimated to be 3.9%, 48.6% and 47.5% respectively.

The average per capita income per month in 1989 is estimated at Rp.115,189 for high class, Rp.57,527 for middle class and Rp.29,298 for

low class. The average per household income per month is calculated to be Rp.725,691 for high class, Rp.339,409 for middle class and Rp.152,350 for low class, based on their corresponding average family sizes of 6.3, 5.9 and 5.2. The average per capita income per month and per household income per month for the whole classes in 1989 is estimated at Rp.46,637 and Rp.261,167 respectively.

Out of the total Kelurahans of 256, 161 Kelurahans or 62.9% have the average per capita per month income ranging between Rp.40,000 and Rp.54,999. Fifty (50) or 19.5% have the income levels of less than Rp.40,000 and 45 or 17.6% have the income levels of more than Rp.55,000. The regional distribution of per capita per month income in 1989 by Kelurahan is shown in Fig. 2.5.

Both income level and populational composition of income classes will change as GDP per capita grows in future. The average per capita per month income and population composition in 2010 are estimated to be Rp.236,092 (15.1%) for high class, Rp.111,266 (48.8%) for middle class and Rp.56,667 (36.1%) for low class, assuming an average annual growth rate of the per capita income of 4.22%.

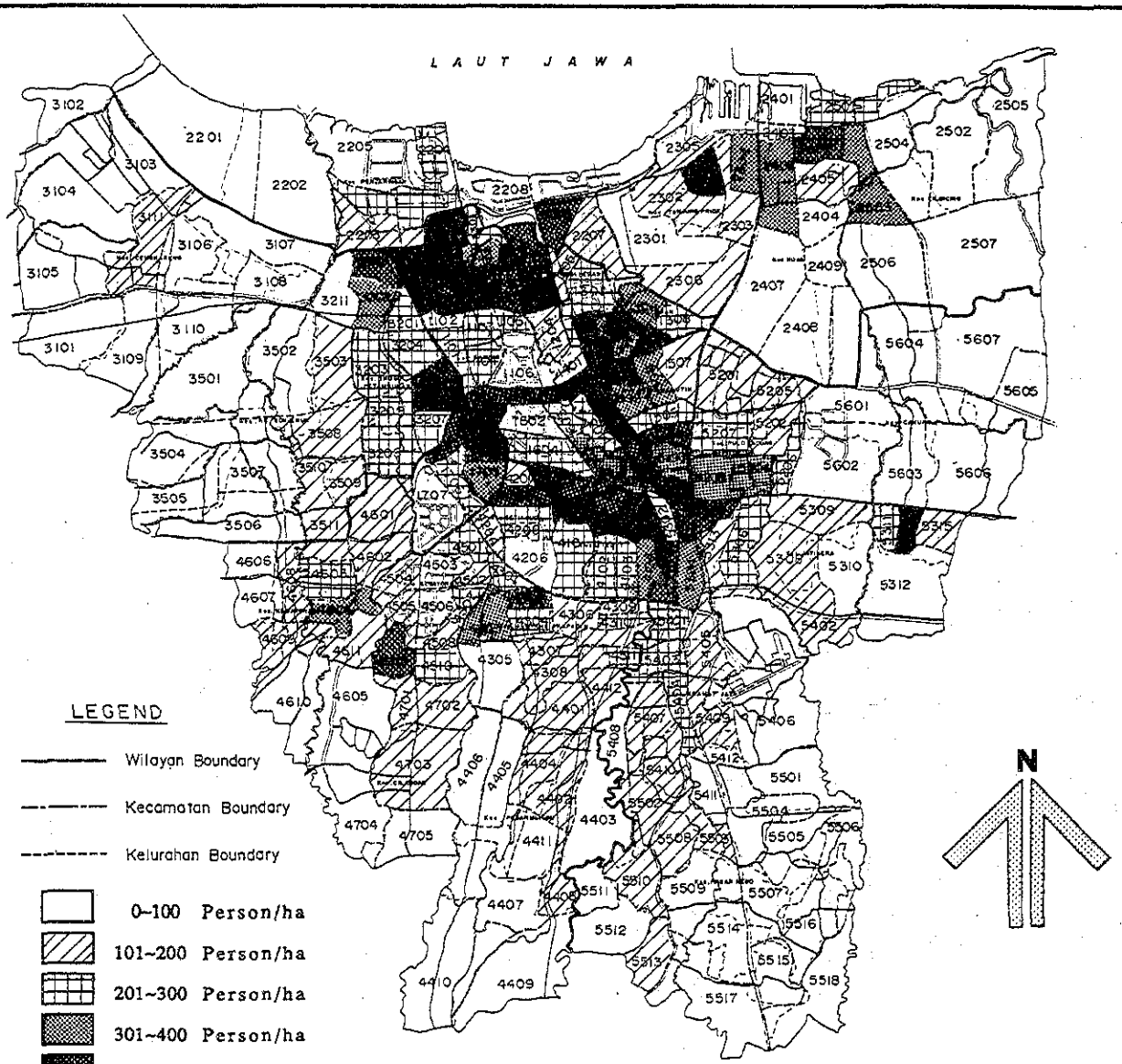


FIG. 2.1 EXISTING POPULATION DENSITY BY KELURAHAN (1988)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

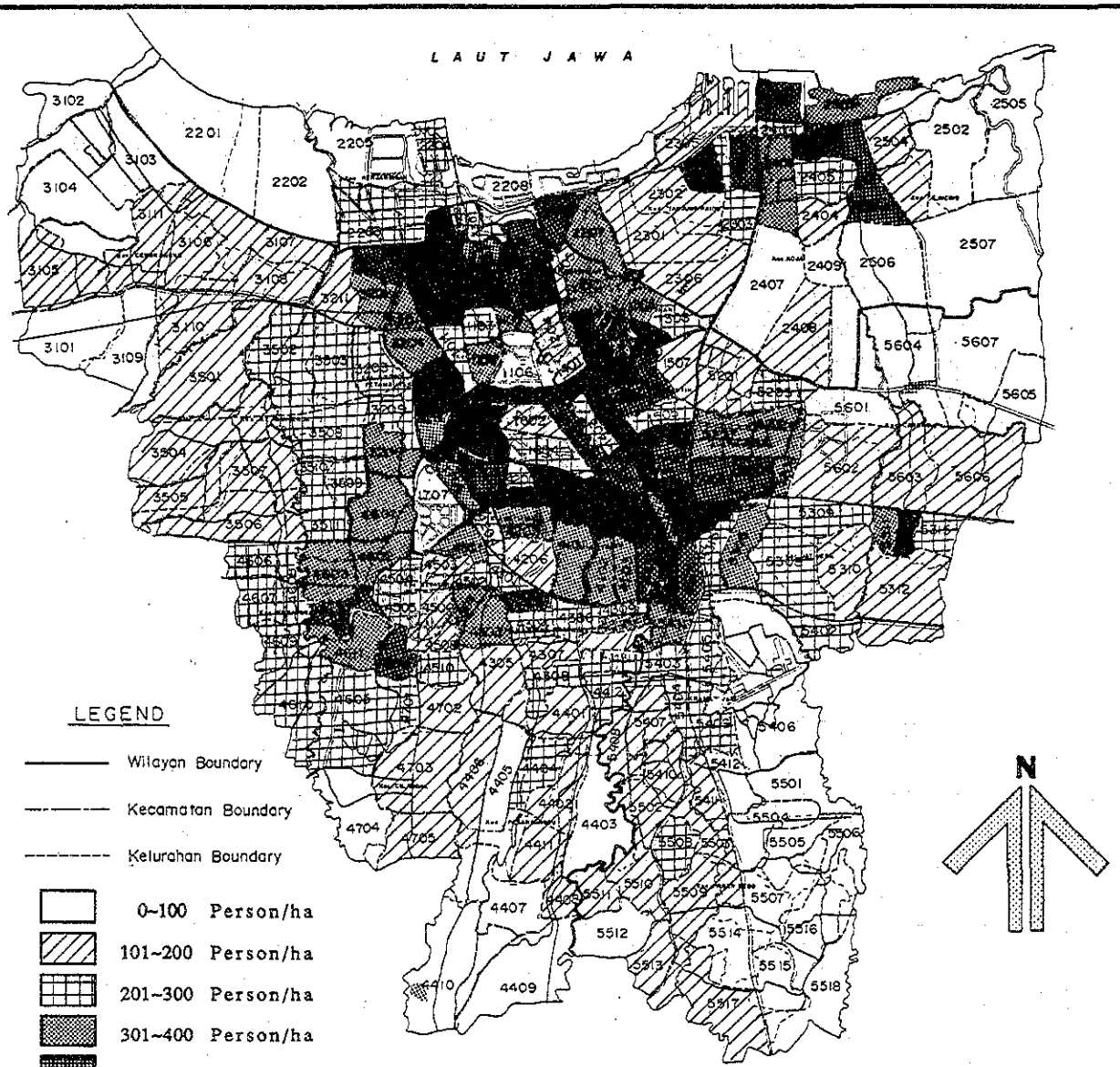


FIG. 2.2 FUTURE POPULATION DENSITY BY KELURAHAN (2010)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

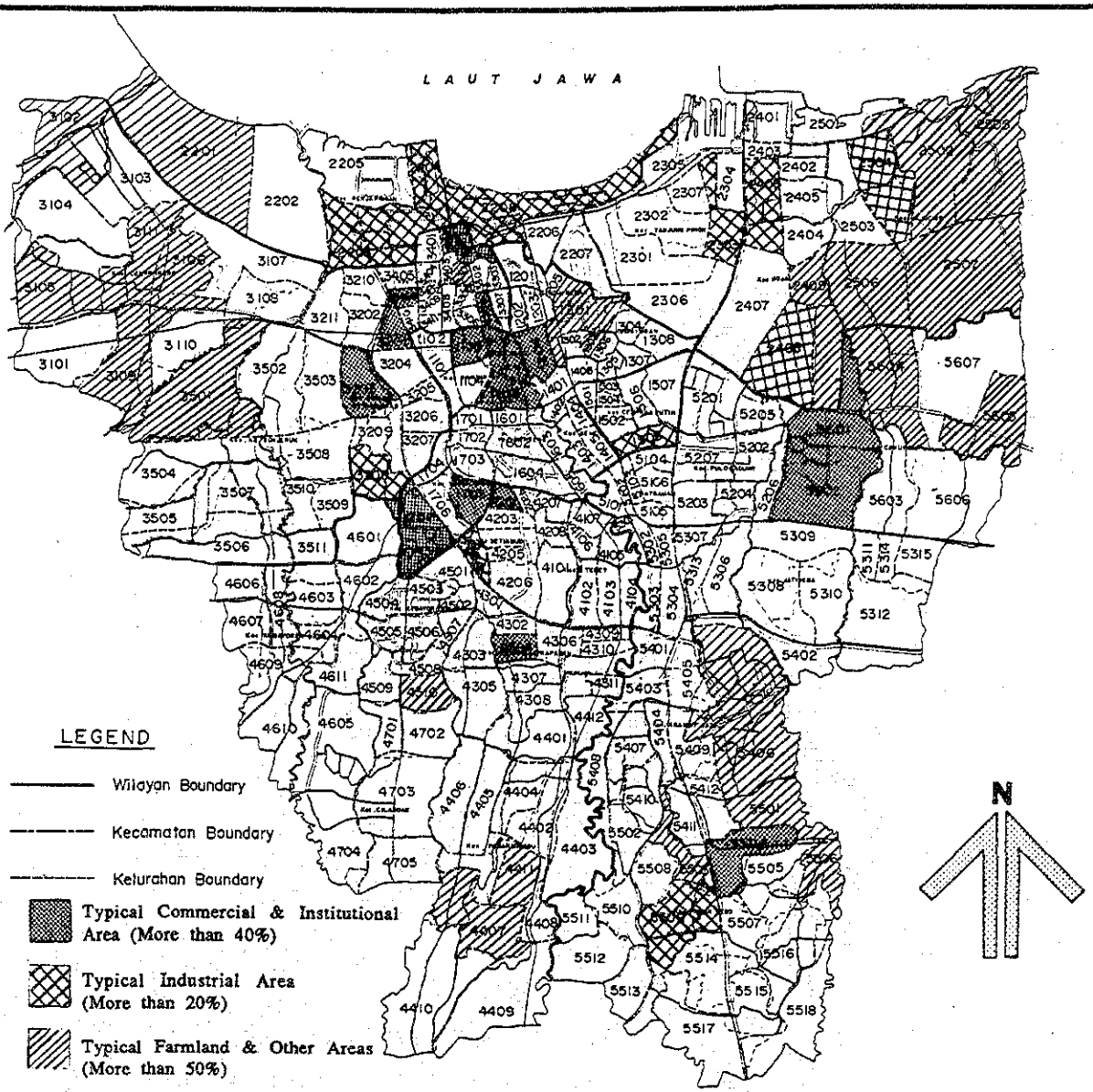


FIG. 2.3 EXISTING LAND USE OF STUDY AREA (1988)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

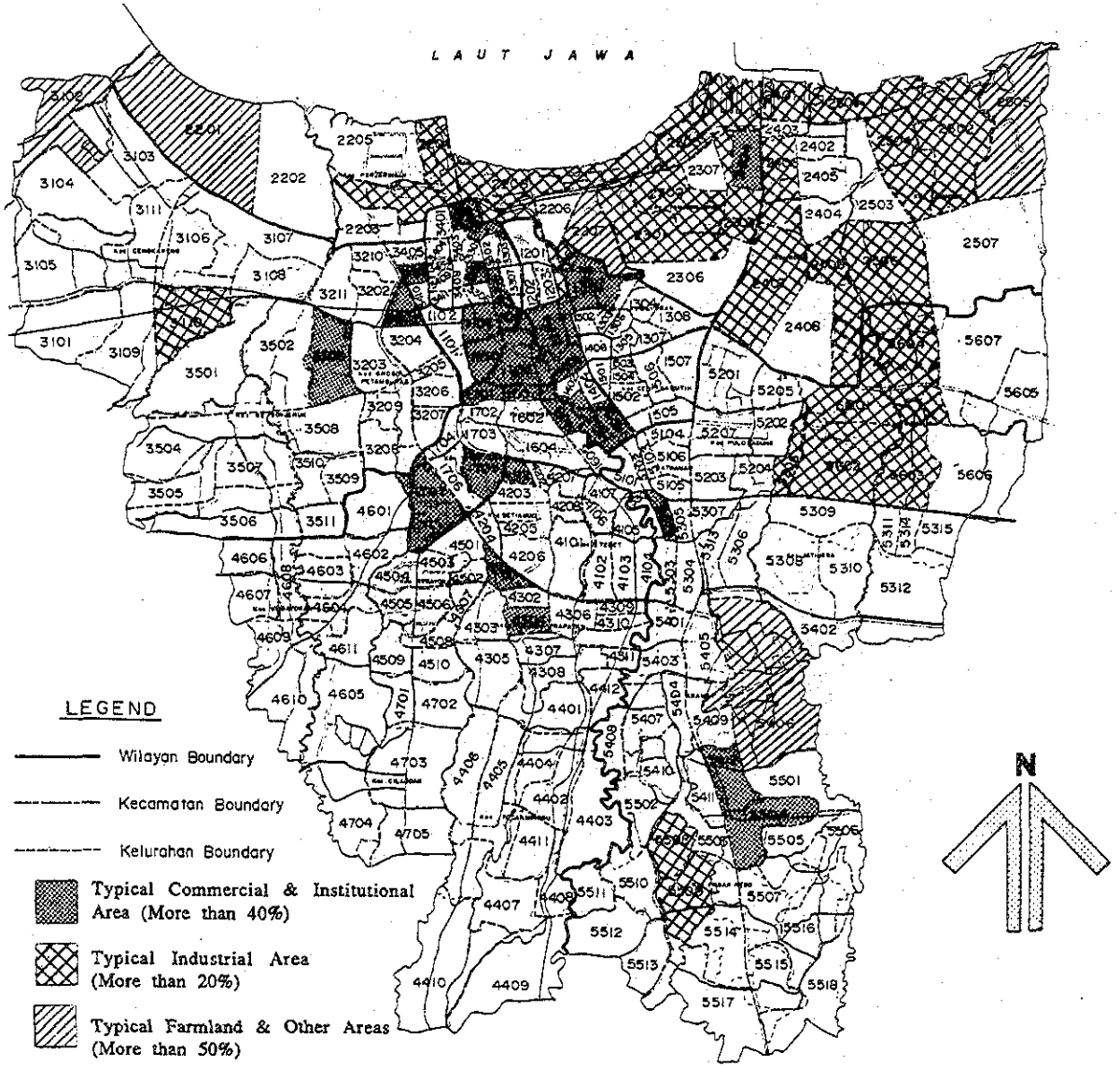


FIG. 2.4 FUTURE LAND USE OF STUDY AREA (2010)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

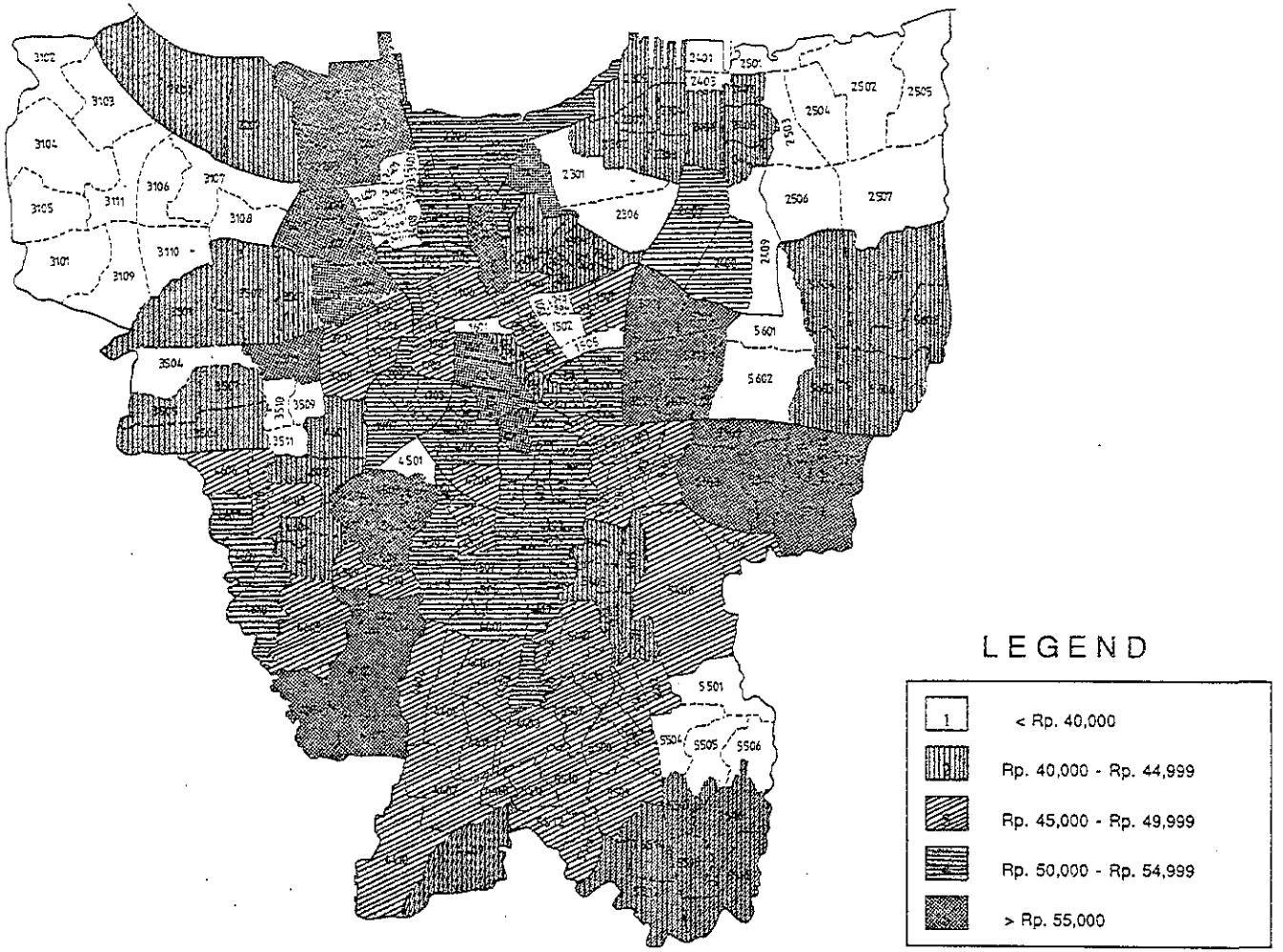


FIG. 2.5 PER CAPITA PER MONTH INCOME BY KELURAHAN IN 1989

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Chapter 3

HYDROLOGY, FLOODS AND FLOOD DAMAGES

CHAPTER 3 HYDROLOGY, FLOODS AND FLOOD DAMAGES

3.1 River and Channel Networks

The Study Area (651 km2) is drained by many rivers and drainage channels connecting with the rivers. Among them, 11 rivers are large and originate in the southern mountainous or hilly aras located outside the Study Area. They are:

- Mookervart, Angke, Pesanggrahan, Grogol, Krukut, Ciliwung, Cipinang, Sunter, Buaran, Jati Kramat and Cakung.

While, the remaining small rivers and drainage channels collect local rainfall within the Study Area.

In 1920, a flood way called the Banjir Canal (West Banjir Canal) was constructed to divert floods of the five (5) rivers located in the western part of the Study Area into the Bay of Jakarta. The diverted rivers are:

- Krukut, Cideng, Kali Baru Barat/Ps.Minngu, Kali Bata and Ciliwung.

In 1983, the Cengkareng Flood way was also completed to divert the floods of the Mookervart, Angke, Pesanggrahan and Grogol Rivers. Further, the Government is preparing for construction of the East Banjir Canal to divert the floods of the Cipinang, Sunter, Buaran, Jati Kramat and Cakung Rivers into the Bay of Jakarta.

In the future, the upper catchments of all the rivers existing towards the east from the West Banjir Canal, except the Sentiong River, are to be cut off. The inner area of the Banjir Canals (northern low-lying area encompassed by both Banjir Canals including the whole drainage basin of the Sentiong River) will cover 275 km2. The rivers and channels in the inner areas of the both Banjir Canals will drain only local rainfall in rainy season. while in dry season, run-offs from the upper catchments of the Banjir Canals are expected to be introduced into the inner areas.

The name and location of the existing river and channel networks are shown in Fig. 3.1.

3.2 Rainfall Intensity

The first rainfall intensity-duration curve for the Study Area was prepared by the Master Plan for Drainage and Flood Control of Jakarta in 1973 as shown in Fig. 3.2. all the flood control and drainage plans of the Study Area have been prepared by using this relationship of rainfall intensity and its duration since the Master Plan Report was published.

In this Study, availability of this relationship was checked by adding the rainfall data observed thereafter. The check study confirmed that the original rainfall intensity-duration curve is still valid.

3.3 Flood Conditions

(1) General

The rivers and channels causing flooding problems in the Study Area are classified into two (2) kinds by their functions, that is, (i) flood control river (ii) urban drainage channels. The classification of the rivers and channels for the two (2) kinds are described in details in Section 6.2 of Chapter 6 (Demarcation of Flood Control and Urban Drainage Systems) and depicted in Fig. 6.1

This Project covers only major urban drainage, excluding flood control and minor drainage. Hence, floods to be dealt with in this Study are limited to the floods from the major urban drainage channels. Such floods are caused by local rainfall within the Study Area and high tide of the Bay of Jakarta. Flood waters form the flood control rivers and minor drainage channels are not considered.

Therefore, it is assumed that, since the East Banjir Canal (flood control river) is expected to be completed in the near future,

the rivers and channels encompassed by the East Banjir Canal does not receive floods from the upper catchments of the Banjir Canal but collects only local rainfall in the downstream.

(2) Habitual Flood conditions

The habitual inundation areas due to the spill-over of urban drainage channels are distributed at 79 locations as shown in Fig. 3.3. They sum up to 3,835.3 ha or 5.9 % of the Study Area.

Inundation depth and duration of the habitual floods was estimated by the sampling interview surveys. The mean inundation depth of each flood area ranges form 0.10 m to 0.53 m and its mean duration time is in the range of one (1) hour and 48 hours.

The frequency of floods in the habitual flood map is estimated to be more than twice a year on average, according to the interviews.

(3) Potential Flood Conditions

The potential flood areas due to the spill-over of urban drainage channels are located at 96 places as shown in Fig. 3.4. The total flood area is 11,098.6 ha or 17.0 % of the Study Area.

The mean inundation depth of each flood area ranges from 0.19 m to 2.02 m and its mean duration time is in the range of two (2) hours and 238 hours.

The return period of the potential flood is estimated to be approximately 40 years based on the probability analysis of basin average daily rainfall.

3.4 Flood Damage

The expected major flood damages in the Study Area are:

(i) Direct damage to house, shop, factory and other properties

(ii) Income losses due to closure of shop, factory and other enterprises

(iii) Damage to traffic

(iv) Damage to infrastructures

The above flood damages caused by the habitual and potential floods under the existing socio-economic conditions are estimated based on the sampling questionnaire surveys.

In future, potential of the above damages will increase according to the increase of property quantity, property value, income level and growth of other economic factors. The flood damages due to habitual and potential floods in future are also estimated.

The estimated habitual flood damages in 1988 and 2010 are Rp.13.8 billion and Rp.48.1 billion at 1990 price respectively. The potential flood damages in 1988 and 2010 are also estimated to be Rp.135.2 billion and Rp.444.4 billion at 1990 price respectively.

The expected average annual flood damages without project in 1988 and 2010 are Rp.47.1 billion and Rp.161.0 billion at 1990 price respectively. Damage to house property is the largest flood damage component with a share of 70.0% in 1988 and 68.6 % in 2010. The break-down of the above average annual flood damages is shown in Table 3.1.

Table 3.1 Summary of Estimated Average Annual Flood Damages - "Without Project" Case

(Unit : Rp.)

Item	1988	2010
1. Direct Damages to Property		
1) House	32,924,186,000	110,409,076,000
2) Shop	1,491,725,000	5,784,115,000
3) Factory	1,291,569,000	5,298,272,000
4) Other Specified Property 1/	1,367,153,000	4,644,628,000
Sub-Total	37,074,633,000	126,136,091,000
2. Indirect Damages		
1) Income Losses due to Shop Closure		
(1) Shop	291,591,000	1,080,776,000
(2) Factory	568,440,000	2,287,572,000
(3) Other Specified Property 2/	57,707,000	192,669,000
Sub-Total	917,738,000	3,561,017,000
2) Traffic Damages		
(1) Time Cost	368,335,000	1,318,060,000
(2) Incremental VOC	856,789,000	3,134,571,000
Sub-Total	1,225,124,000	4,452,631,000
Total (1.+2.)	39,217,495,000	134,149,739,000
3. Damages to Other Unspecified Property Including Infrastructure		
(1.+2.+3.) x 20 %	7,843,499,000	26,829,948,000
Grand Total (1.+2.+3.)	47,060,994,000	160,979,687,000

Note : 1/: Hotel, Restaurant, Hospital, Office, School, (Primary, Junior General Hight & High) and Religious Facilities (Mosque, Church & Temple)

2/: Hotel, Restaurant and Hospital

Damages to other specified property were estimated based on the ratios between the number of shops/factories and that of other specified property.

Source : JICA

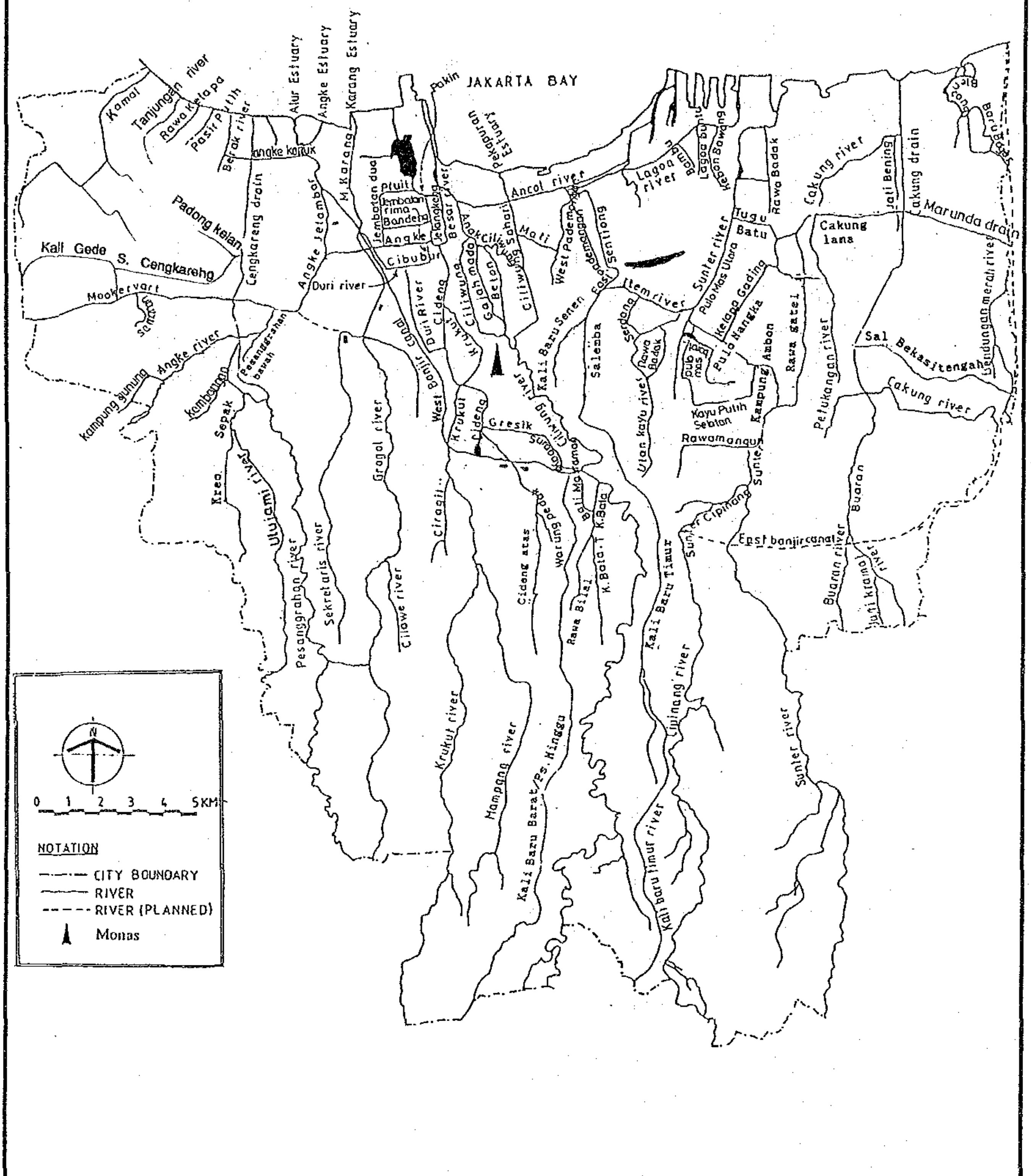


FIG. 3.1	EXISTING RIVER AND CHANNEL NETWORK

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

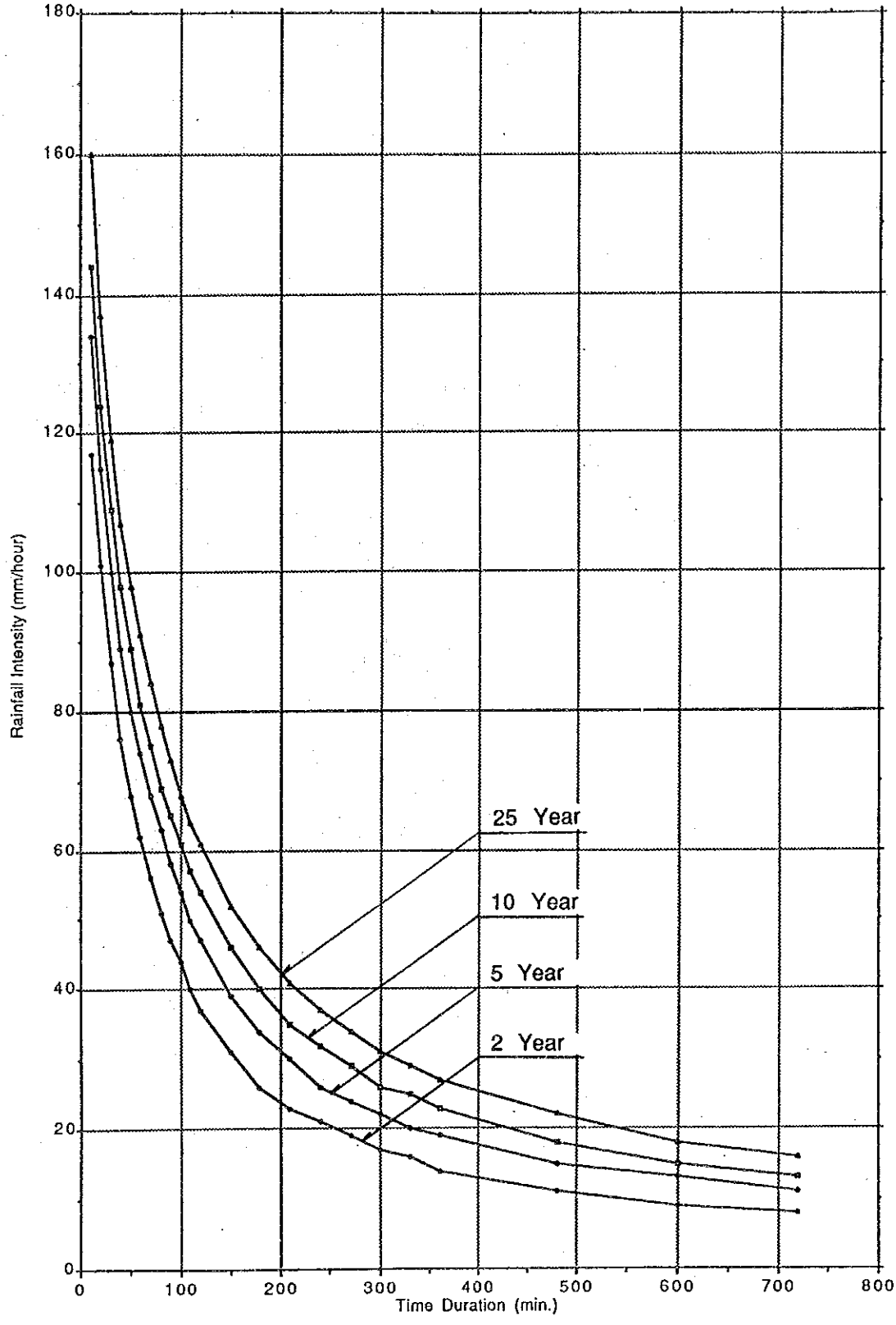


FIG. 3.2 RAINFALL INTENSITY DURATION CURVE OF 1973 MASTER PLAN

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

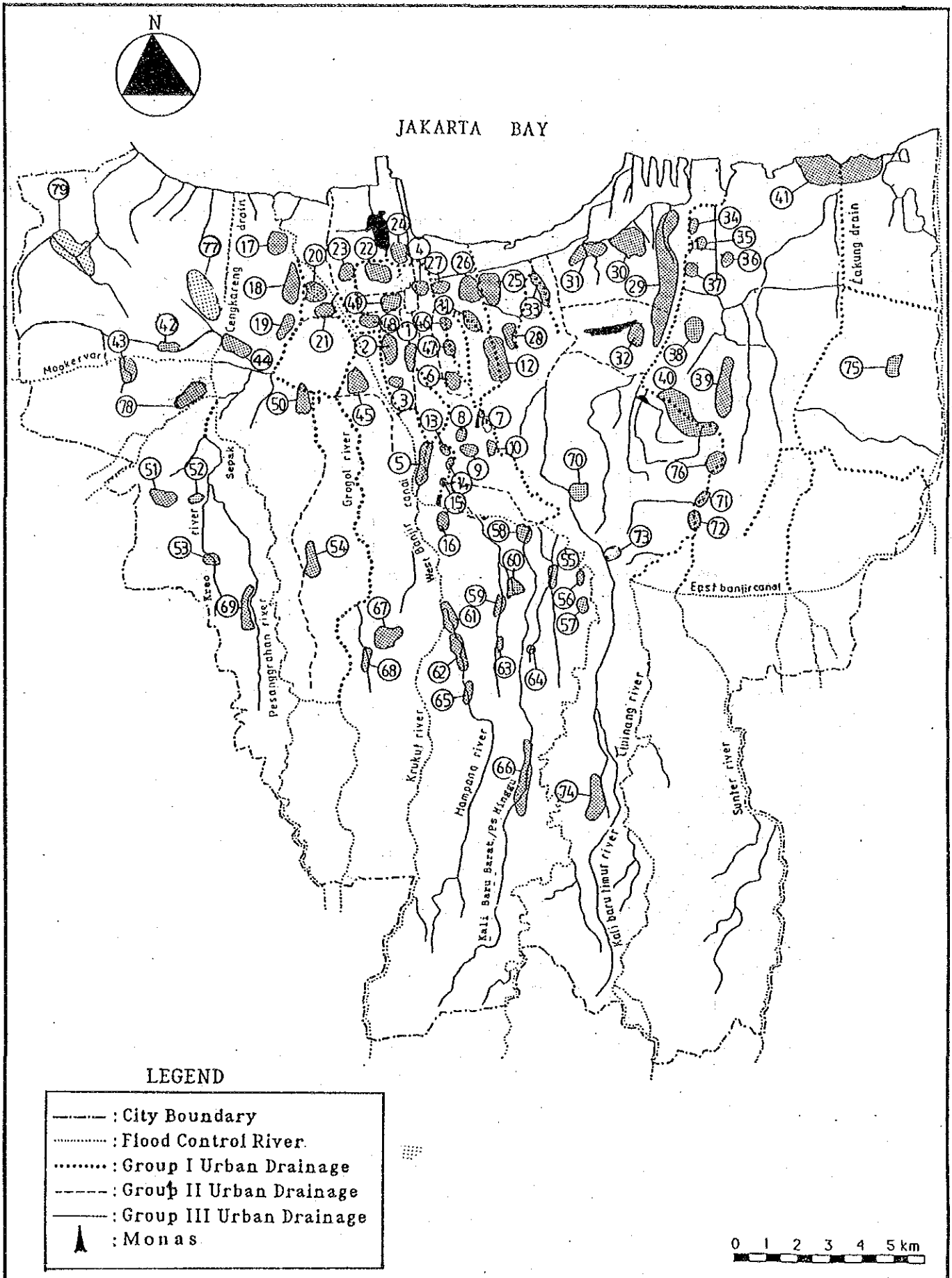


FIG. 3.3 LOCATION OF HABITUAL FLOOD AREA

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

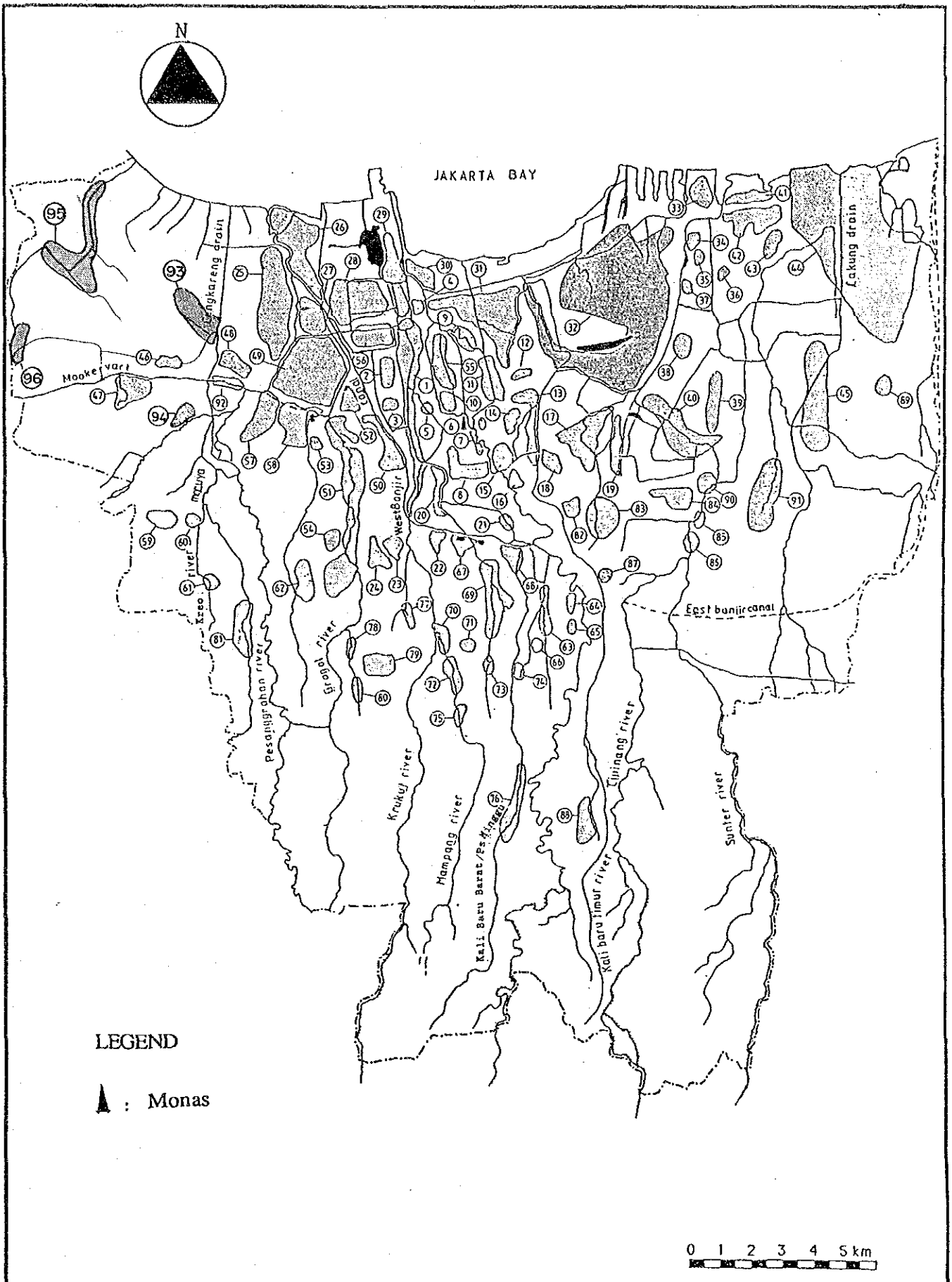


FIG. 3.4 LOCATION OF POTENTIAL FLOOD AREA (40-YEAR FREQUENCY)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

Chapter 4

ENVIRONMENTAL CONDITIONS

CHAPTER 4 ENVIRONMENTAL CONDITIONS

4.1. River Water Quality

River water quality has been observed by P4L at 42 stations of the Study Area since 1979. The JICA Study Team conducted a river water quality observation at additional 52 stations during the dry season of 1989 to supplement the existing data.

No significant yearly variation in water quality is recognized based on the available data in the recent five (5) years (1983/84 - 1987/88). However, clear seasonal changes of the water quality have been observed in the highly polluted reaches. In such areas, the river water pollution in rainy season decreases approximately to half that of during dry season due to the increased dilution effects of river flow.

The regional distribution of river water quality in dry season is established by incorporating both the JICA data and the existing ones.

(1) BOD

The regional variation of BOD in the Study Area is wide with the range of 10 mg/l to 255 mg/l (See Fig. 4.1). The maximum value is observed in the Ancol River, while the minimum in the uppermost of the Ciliwung River.

High BOD is observed in the river reaches:

- downstream of Grogol, middle and lower reaches of Cideng, Kali Bata, Ancol, Sentiong, Kali Baru Timur, Cipinang, tributaries of Sunter, Lagoa and downstream of Cakung.

BOD concentration exceeds 100 mg/l at about 50% of the observation stations in the above-mentioned rivers. Most of

the above rivers are affected mainly by domestic and commercial wastewater. However, the major pollution source of the Kali Baru Timur, Cipinang and Cakung Rivers is industrial wastes.

The lower Ciliwung and lower Sunter main stream mark low BOD concentration of 10-40 mg/l due to the dilution effect of the Tarum Barat Canal. The West Banjir Canal is still less polluted with BOD concentration of 10-30 mg/l. The southern and western edge areas are also still less polluted. The BOD is in the range of 10-30 mg/l.

(2) Fecal Coliform

Fecal coliform of more than 10^6 (MPN/100 ml) is observed at almost all observation stations (See Fig. 4.2). This means that all the river waters of the Study Area are affected by human wastes to a great extent.

The existing water pollution of the rivers and channels in the Study Area is classified into four (4) classes in terms of BOD as shown below.

Class		BOD (mg/l)	Pollution Condition
I	:	0 - 30	Slight
II	:	30 - 60	Significant
III	:	60 - 90	Heavy
IV	:	90	Very Heavy

Herein, BOD of 30 mg/l is the upper limit for maintaining of aquatic biota in the Environment Standards of Indonesia.

The classified river stretches are shown in Fig. 4.3.

4.2 River Water Use

The rivers and canals in the Study Area are mostly used for only drainage of storm water and domestic wastewater. Beneficial uses such as water supply, irrigation and fishery are limited to a few rivers and canals. In some particular rivers and canals, industrial wastewater is discharged.

The rivers being used for water supply, irrigation and fishery, and industrial wastewater disposal are as follows.

(1)	Water Supply	:	Angke River, Krukut River, Ciliwung River & Banjir Canal, Sunter River and Tarum Barat Canal, at 10 locations.
(2)	Irrigation & Fishery	:	Kamal River, Maja River, Mookervat River, Angke River, Buaran River, Malang River and Cakung River.
(3)	Industrial Wastewater Disposal	:	Kali Baru Timur River, Cipinang River, Sunter River, Petukangan River and Cakung River.

The river reaches used for the above purposes are shown in Fig. 4.4.

4.3 Sea Water and Sediment Quality

The existing conditions of sea water and sediment quality in the Bay of Jakarta is established by combining both the existing available data and the JICA data observed during this Study.

COD in the Bay of Jakarta ranges from 18 mg/l to 81mg/l with an average of 28 mg/l. This COD is mostly composed of dissolved COD.

Average Fecal Coliform of the Bay is estimated at 2,530 (MPN/100 cc). The Bay, especially its coastal area is much affected by human waste.

Average concentration of heavy metals in the sea sediment is 18.5 mg/kg for Cu, 18.3 mg/kg for Pb, 11.7 mg/kg for Cr and 1.27 mg/kg for Hg. These average values are of normal level. However, high concentrations of the above heavy metals are observed in some specified areas. Those are Cu of 81.5 mg/kg, Pb of 30.5 mg/kg, Cr of 22.1 mg/kg and Hg of 4.1 mg/kg close to the estuaries of Kamal River and Cengkareng Drain. At Tanjung Priok, Cu is 35.6 mg/kg.

The observed ignition loss (I-L) in the sediment is rather high on an average of 12%. Especially close to the estuaries of Kamal River and Cengkareng Drain, it is very high (about 23%). This indicates progressing of organic pollution in the Bay.

4.4 Current of Jakarta Bay

Marine current is generally a complicated one which consists of constant current and tidal current with various cycles.

Harmonic analysis was applied for the 24-hour consecutively observed current data of the Jakarta Bay by P3O in order to clarify the characteristics of the current in the Jakarta Bay. The identified major characteristics are as follows :

- Constant current is prevailing and is considered to be representative of the Jakarta Bay.
- There are two (2) typical patterns of constant current in the Jakarta Bay : east monsoon and west monsoon patterns.
- The average velocity of typical current in the Jakarta Bay is estimated at 13 cm/sec both during east monsoon (Apr. - Oct.) and west monsoon (Nov. - Mar.).

4.5 Groundwater Quality

The groundwater in the northern low-lying areas of the Study Area are affected by sea water intrusion. The affected areas, having Cl^- content more than 500 mg/l, cover about 30% of the Study Area.

The shallow wells of the Study Area are much affected by organic pollution. NH_4-N in dry season ranges from 0 mg/l to 10.7 mg/l with an average of 0.9 mg/l. Fecal Coliform observed in dry season is in the range between 0 and 460,000 with an average of 33,000 in unit of MPN/100ml.

4.6 Waterborne Disease

Many people in the Study Area suffer from such waterborne diseases as shown below every year.

- Malaria, Gastroenteritis, Cholera, Tuberculosis, DHF, Typhoid, Dysentry, Diphtheria, Measles, Hepatitis A, Hepatitis B and Skin Diseases.

Number of people who contracted the waterborne diseases in the Study Area was estimated by the sampling questionnaire survey.

The average contraction rate of the above diseases for the last three (3) years across the Study Area is 56.5 cases (cumulative cases of three years) per 1,000 population. Disease wise, gastroenteritis, having the highest share of 45.8%, was contracted by 25.9 persons per 1,000 population. Other diseases with comparatively high contraction rates are skin diseases (9.3), dysentery (6.2), typhoid (3.9), DHF (3.2), malaria (2.1) and diphtheria (2.0). Kecamatan wise, the contraction rate ranges from 14.5 cases per 1,000 people in Kebon Jeruk to 155.9 cases per 1,000 population in Tanah Abang.

The regional distribution of the contraction rate of waterborne diseases is shown in Fig. 4.5.

The major causes of infant mortality in the Study Area are fever, small pox, typhoid, malaria, cholera, diphtheria, dysentery, tuberculosis, beri-beri, etc. Infant mortalities are most prevalent among low income families. The combined infant mortality rate for the last three (3) years across the Study Area was 16.3 cases per 1,000 infants.

4.7 Water Quality Standards

Environmental water quality standards for rivers in the Study Area was stipulated by the Governor's Decree No. 1608 in 1988. River courses within the Study Area are classified into four (4) groups depending on the intended use of river water. The standards according to the intended beneficial use is classified into four (4) groups as shown below.

	BOD (mg/l)		Fecal Coliform (MPN/100 ml)	
	Desirable Limit	Permissible Limit	Desirable Limit	Permissible Limit
Group A :	5	10	2,000	2,000
Group B :	20	20	4,000	4,000
Group C :	20	20	--	--
Group D :	30	30	2,000	2,000

Note: Group A : drinking water source
Group B : fishery use
Group C : agricultural use
Group D : other uses and suitable to support aquatic biota.

Class designation of river reaches in the Study Area in accordance with the above grouping is shown in Fig. 4.6.

The Governor's Decree No. 1608 stipulates effluent water quality standards for industry in DKI Jakarta. The water quality standards as BOD, COD and SS are respectively 75 mg/l, 100 mg/l and 100 mg/l.

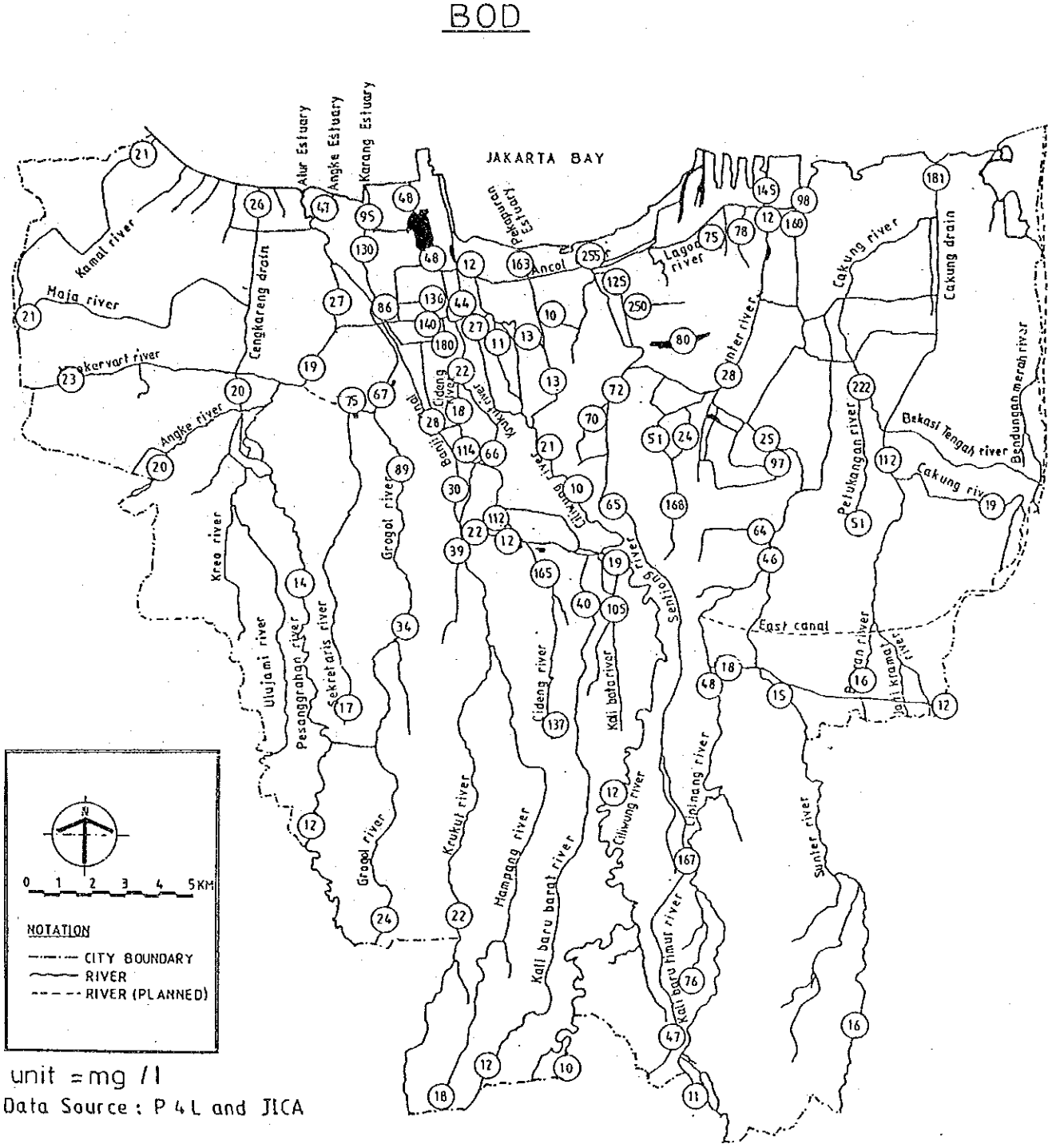


FIG. 4.1 REGIONAL DISTRIBUTION OF RIVER WATER QUALITY

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

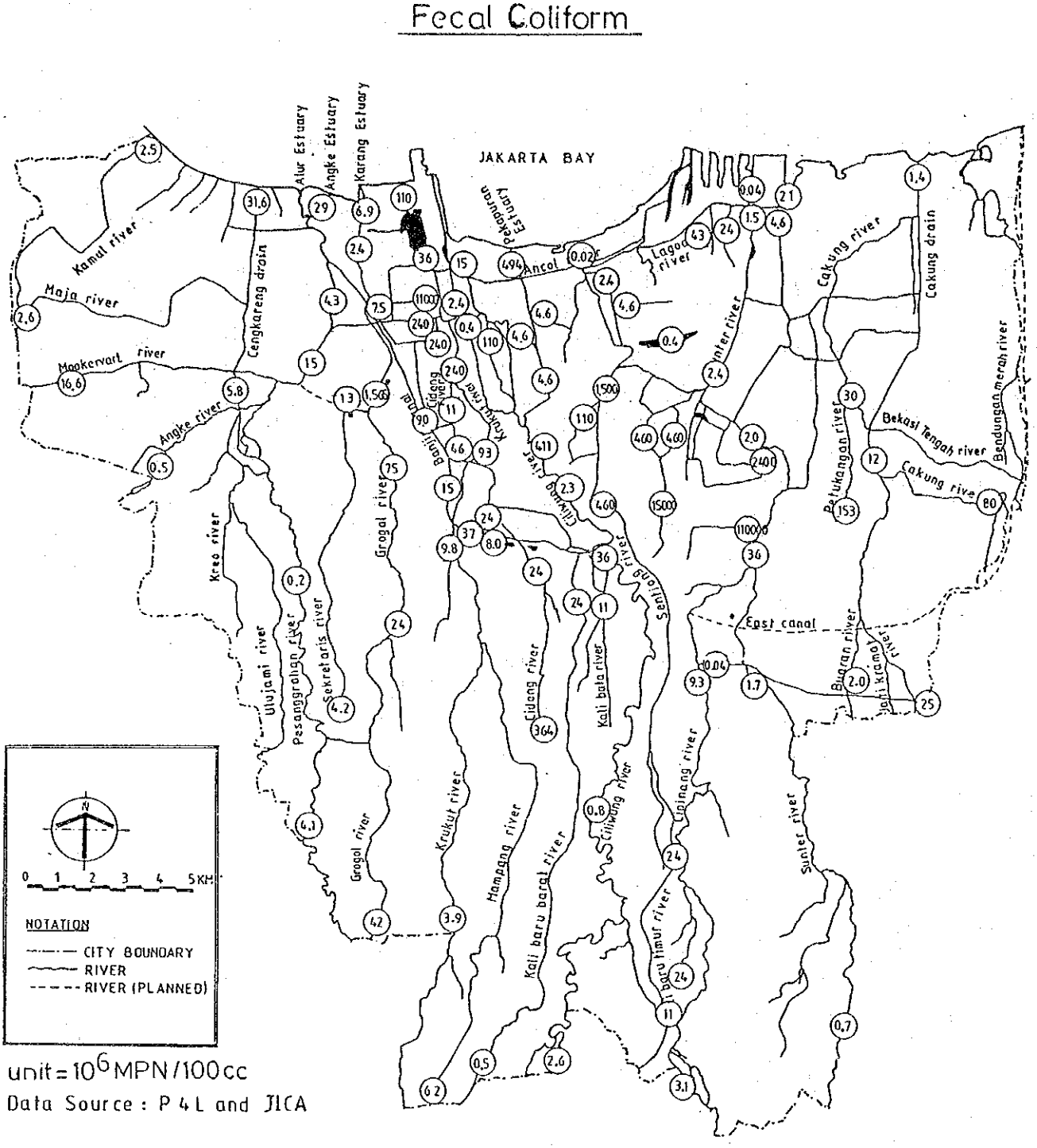


FIG. 4.2 REGIONAL DISTRIBUTION OF RIVER WATER QUALITY

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

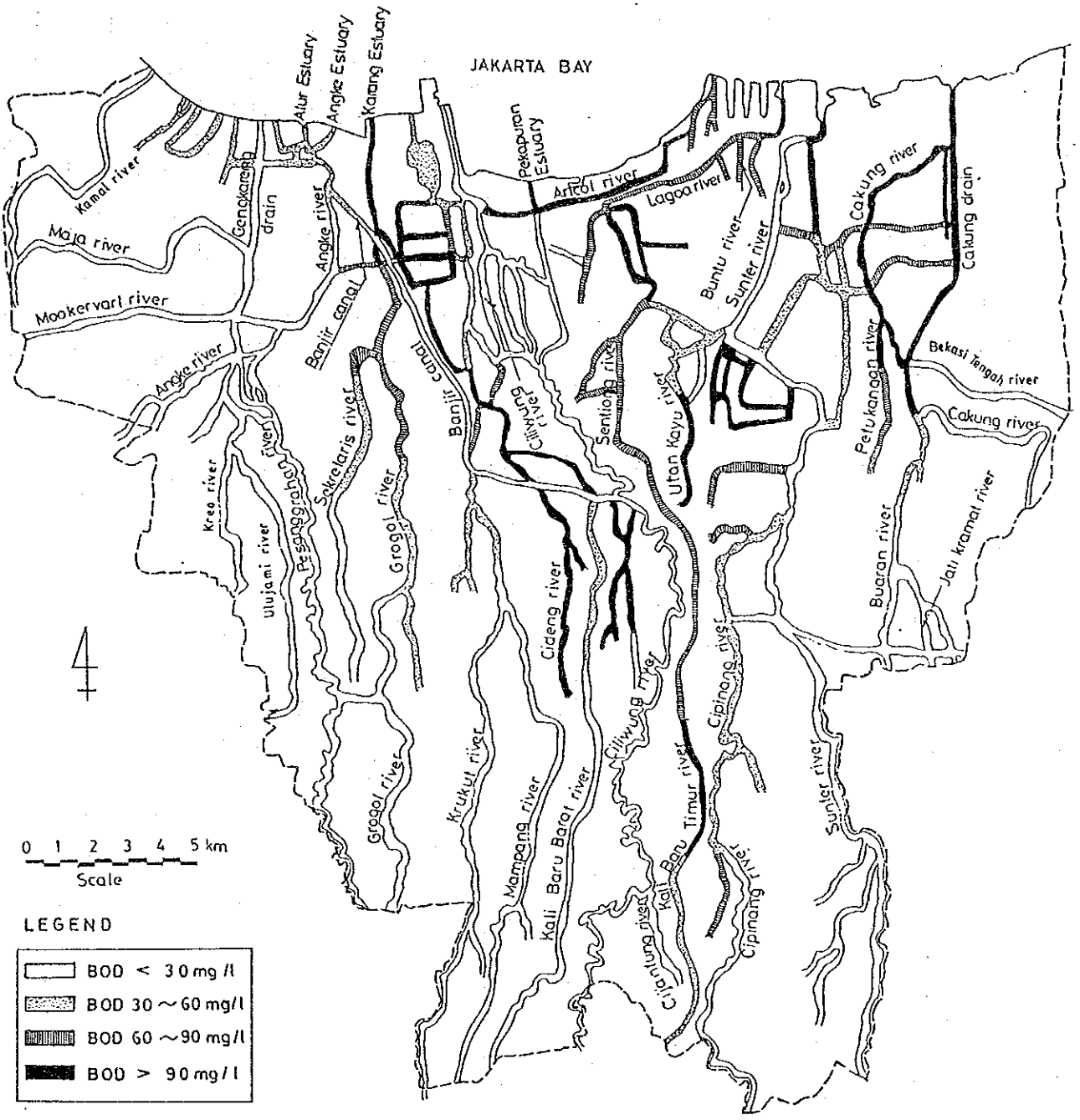


FIG. 4.3 CLASSIFICATION OF RIVER STRETCHES BY WATER QUALITY

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

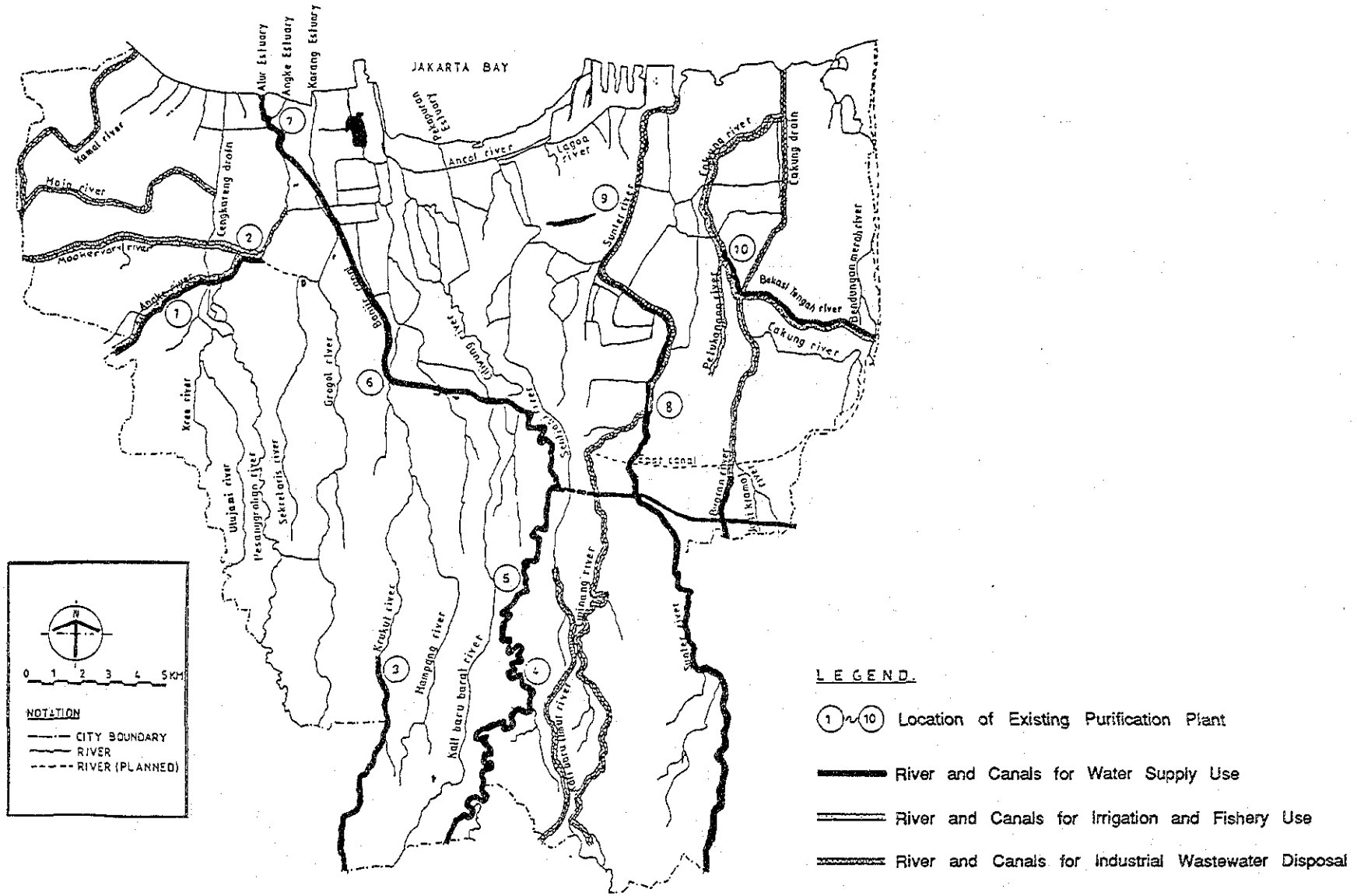
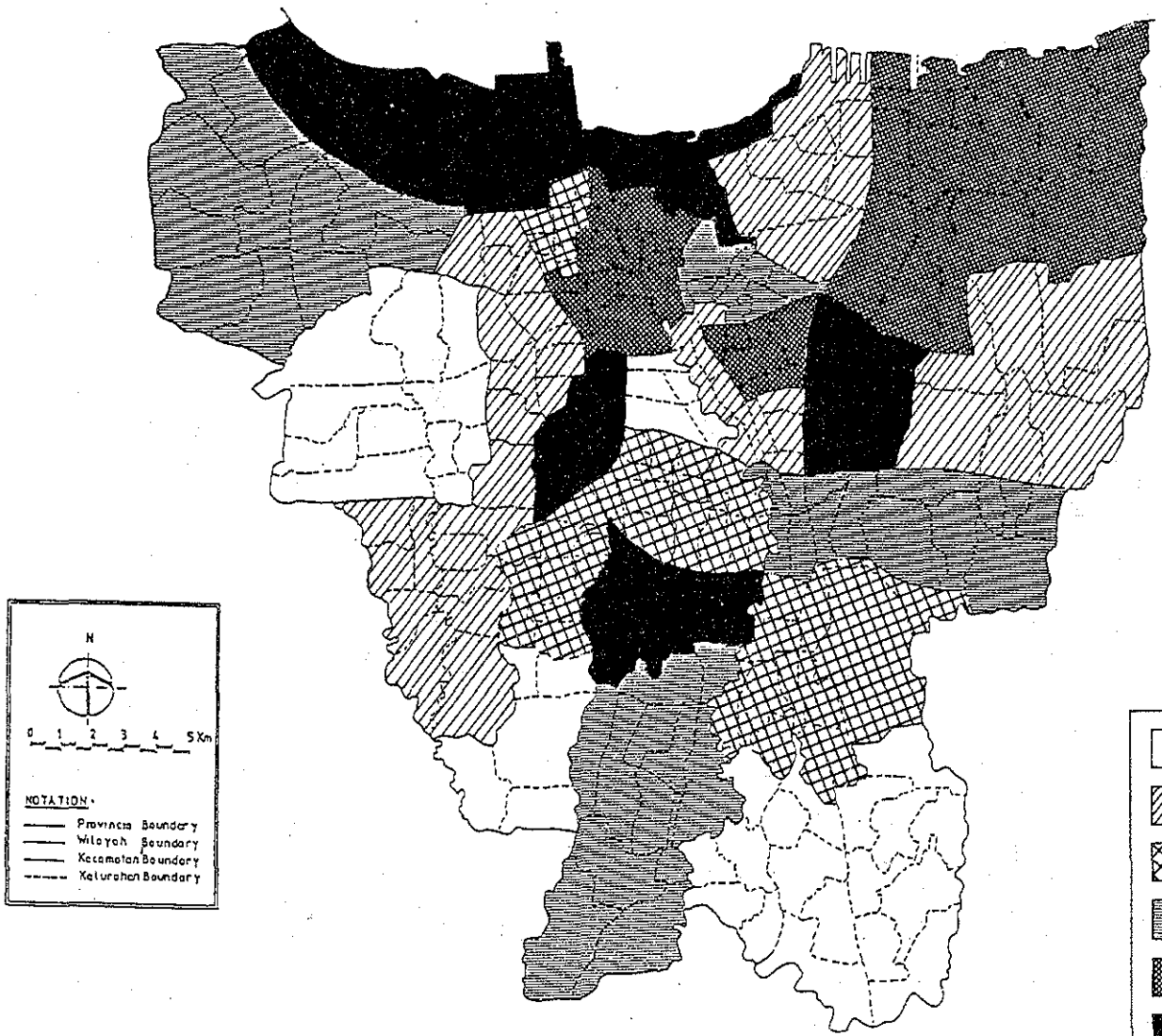


FIG. 4.4 CLASSIFICATION OF THE RIVERS AND CANALS BY WATER USE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



LEGEND

1	< 25 Cases
2	25 to 34 Cases
3	35 to 49 Cases
4	50 to 64 Cases
5	65 to 89 Cases
6	90 Cases < =

FIG. 4.5 NUMBER OF THOSE CONTRACTED MAJOR WATER-BORNE DISEASES IN THE LAST THREE YEARS (PER 1,000 POPULATION)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

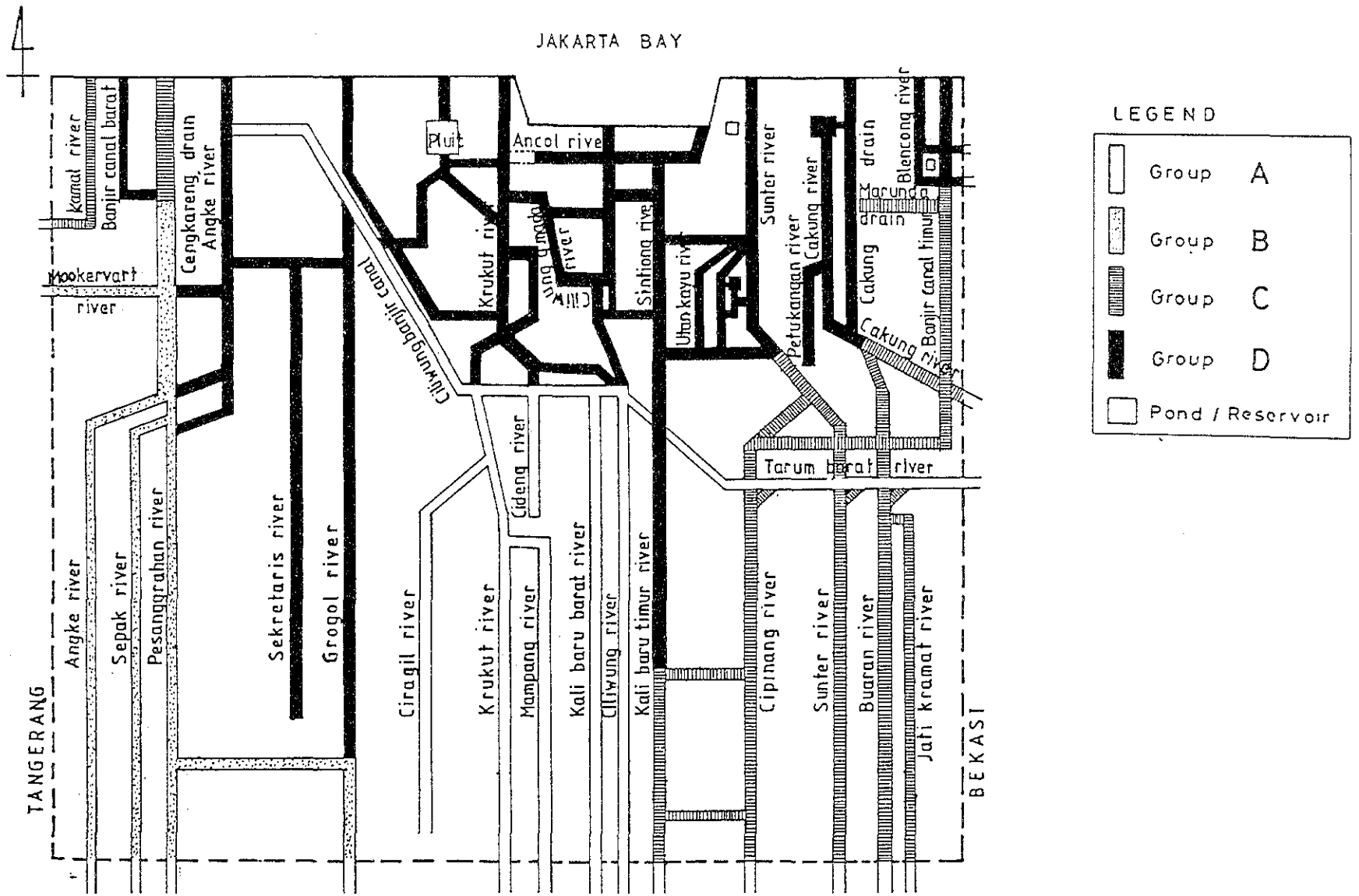


FIG. 4.6 CLASS DESIGNATION OF RIVER SECTIONS IN DKI JAKARTA

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

Chapter 5

POLLUTION LOAD GENERATION

CHAPTER 5 POLLUTION LOAD GENERATION

5.1 Water Consumption

(1) Domestic Water Consumption

The existing domestic water consumption of the Study Area was estimated based on the sampling questionnaire surveys. The future consumption was also estimated based on the existing water supply master plan for the target year 2005. The estimated existing and future per capita domestic water consumption by people's income class are as follows.

	Existing (1989)	Future (2010)
High Class	190 lcd	250 lcd
Middle Class	130 lcd	150 lcd
Low Class	100 lcd	100 lcd

The existing and future domestic water consumption of an area can be obtained by multiplying the above per capita water consumption by its total population.

(2) Commercial and Institutional Water Consumption

The existing and future commercial and institutional water consumption of an area in the Study Area are estimated by multiplying its domestic water consumption by a certain ratio. This ratio varies depending on land use pattern of the area and is given by the following formula.

$$Y\ (\%) = 0.757 \cdot X\ (\%) + 2.05$$

where,

Y (%) : Existing (or future) commercial & institutional ratio

X (%) : Existing (or future) percentage of commercial & institutional land area to domestic land area.

(3) Industrial Water Consumption

The existing industrial water consumption of the Study Area was estimated by the sampling questionnaire surveys. The estimated existing industrial unit water consumption by industrial classification ranges from 0.002 m^3/day/million Rp/year for manufacture of textile to 0.027 m^3/day/million Rp/year for manufacture of non-metallic products, iron and steel, and machinery and equipment.

The future industrial unit water consumption is assumed to be the same as the existing one.

The existing and future industrial water consumption of an area can be obtained by multiplying the above unit water consumption by the total industrial product amount of the area concerned.

5.2 Unit Pollution Load Generation

(1) Domestic Waste

Domestic wastewater covers toilet wastewater and gray water from kitchen, bathing and laundry.

The existing domestic unit pollution load of the Study Area was estimated by the sampling observations. The future one is estimated on the assumption that the future water quality of domestic waste is the same as the existing one. The existing and future average unit pollution load of domestic waste is as shown below.

	Existing (1989)	Future (2010)
Gray Water (gcd)	17.4	22.9
Toilet Waste (gcd)	10.5	10.5
Total	27.9	33.4

The existing and future unit wastewater discharge and unit pollution load by type of waste and by income class are shown in Table 5.1.

(2) Commercial and Institutional Waste

The existing wastewater quality of commercial and institutional waste is established to be 220 mg/l as BOD based on the sampling observations.

Its future wastewater quality is assumed to be the same as the existing one.

(3) Industrial Waste

The existing wastewater quality of industrial waste is established for the respective industrial classifications based on the existing available data.

The existing unit pollution load of industrial waste is estimated by multiplying the existing unit industrial water consumption estimated in the previous Section 5.1 by the wastewater quality.

The unit pollution load by industrial classification is in the range of 0.38 (g/d/million Rp/year) as BOD for textile and 18.0(g/d/million Rp./year) as BOD for food, beverages and tobacco. The existing unit wastewater discharge and pollution load by industrial classification are shown in Table 5.2.

The future unit pollution load is assumed to be equivalent to the existing one.

5.3 Generated Pollution Load

Existing and future pollution load generation is estimated by multiplying wastewater discharge (equivalent to water consumption) by unit pollution load.

The estimated total existing and future wastewater discharge and pollution load generation are as follows.

	Existing (1989)	Future (2010)
Wastewater Discharge ($10^3 m^3/d$)	1,316	2,588
Pollution Load Generation(ton/d)	308	606

Break-down of the above wastewater discharge and pollution load generation by type of waste in each wilayah is shown in Table 5.3.1. For break-down by Kelurahan, refer to Appendix D

The average specific wastewater discharge of the Study Area will increase from 20.2 $m^3/d/ha$ to 39.7 $m^3/d/ha$. Their regional distributions by Kelurahan are shown in Fig. 5.1 and Fig. 5.2.

Table 5.1 Estimated Unit Pollution Load of Domestic Waste

	Existing				Future			
	High Class	Middle Class	Low Class	Average	High Class	Middle Class	Low Class	Average
Gray Water								
Unit Wastewater Discharge (lcd)	167	107	77	95	227	127	77	124
Wastewater Quality (BOD, mg/l)	182	182	185	183	182	182	185	182
Unit Pollution Load (BOD, gcd)	30.4	19.5	14.2	17.4	41.3	23.1	14.2	22.6
Toilet Waste								
Unit Wastewater Discharge (lcd)		23				23		
Wastewater Quality (BOD, mg/l)		457				457		
Unit Pollution Load (BOD, gcd)		10.5				10.5		
Total								
Unit Wastewater Discharge (lcd)	190	130	100	118	250	150	100	147
Wastewater Quality (BOD, mg/l)	215	231	247	236	207	224	247	224
Unit Pollution Load (BOD, gcd)	40.9	30.0	24.7	27.9	51.8	33.6	24.7	33.4

Note : Average is obtained by assuming the following population share by class

	Existing	Future
High Class	4%	15%
Middle Class	49%	48%
Low Class	47%	36%

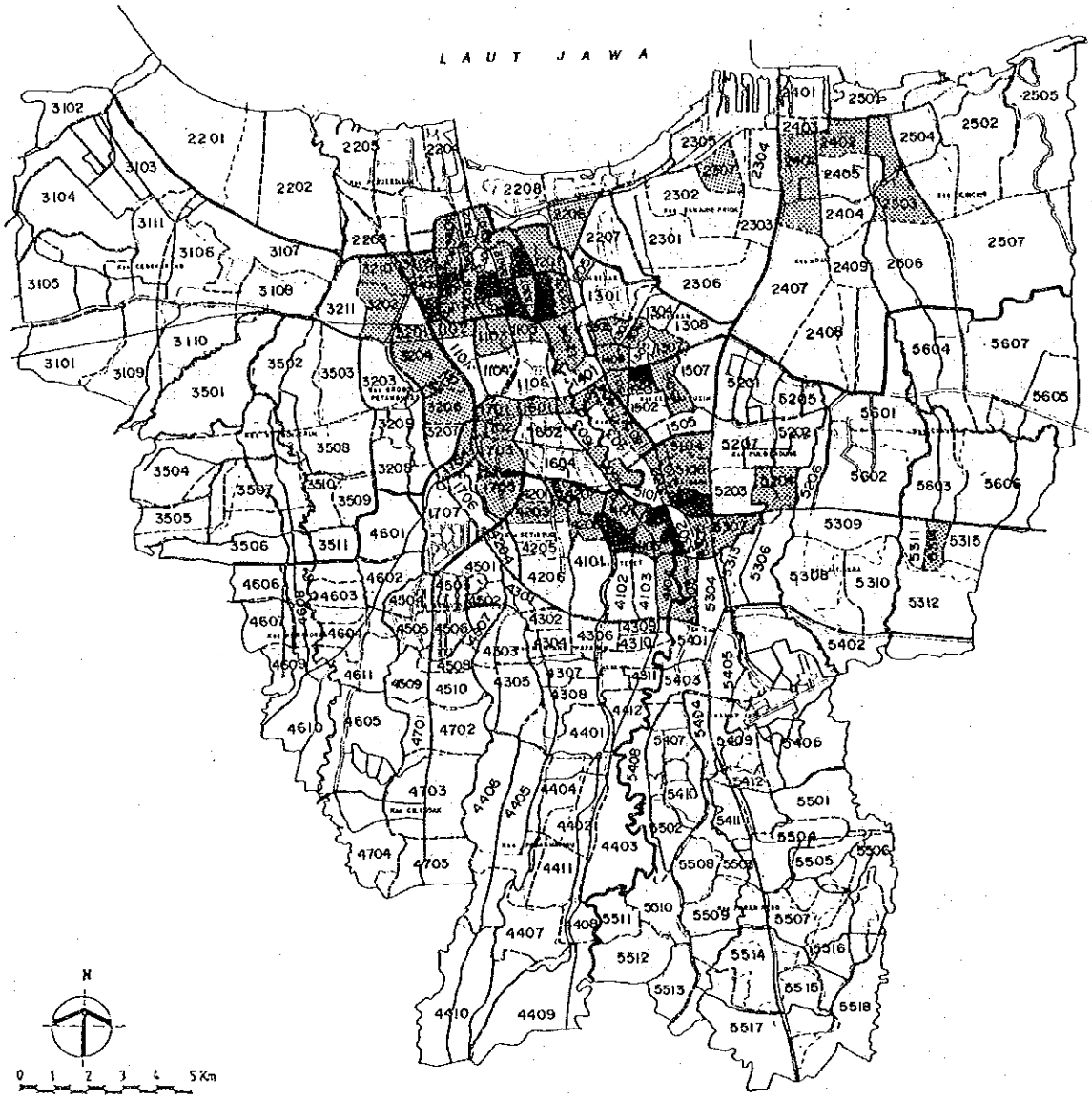
Table 5.2 Estimated Unit Pollution Load of Industrial Waste

Industrial Classification	Unit Wastewater Discharge (m3/d/million Rp./yr.)	Wastewater Quality (BOD. mg/l)	Unit Pollution Load (g/d/million Rp./yr.)
Food. Beverages and Tobacco	0.010	1800	18.00
Textile	0.002	190	0.38
Wood & Wood Products	0.003	140	0.42
Paper & Paper Products	0.003	960	2.88
Industrial Chemicals	0.010	760	7.60
Non-metallic Mineral Products	0.027	280	7.56
Iron & Steel Basic industries	0.027	280	7.56
Fabricated Mineral Products, Machinery and Equipment	0.027	280	7.56
Other Industries	0.010	110	1.10

Table 5.3 Existing and Future Wastewater Discharge and Pollution Load by Wilayah

Wilayah / Waste		Wastewater Discharge (m3/d)								Specific Wastewater Discharge (m3/d/ha)
		Domestic		Comercial & Institutional		Industrial		Total		
Existing	JAKARTA PUSAT	179,432	(78.0)	45,741	(19.9)	4,722	(2.1)	229,895		46.6
	UTARA	143,506	(68.6)	20,622	(9.9)	45,188	(21.6)	209,316		15.0
	BARAT	210,790	(79.2)	35,770	(13.4)	19,424	(7.3)	265,984		20.6
	SELATAN	247,350	(85.1)	35,146	(12.1)	8,015	(2.8)	290,511		19.9
	TIMUR	256,947	(80.2)	35,372	(11.0)	28,088	(8.8)	320,407		17.1
	TOTAL	1,038,025	(78.9)	172,651	(13.1)	105,437	(8.0)	1,316,113		20.2
Future	JAKARTA PUSAT	253,756	(67.0)	121,227	(32.0)	3,906	(1.0)	378,889		76.8
	UTARA	266,233	(57.6)	60,298	(13.1)	135,485	(29.3)	462,016		33.1
	BARAT	398,882	(76.6)	86,312	(16.6)	35,718	(6.9)	520,912		40.4
	SELATAN	468,354	(84.0)	87,205	(15.6)	2,328	(0.4)	557,887		38.2
	TIMUR	495,461	(74.1)	93,891	(14.0)	79,194	(11.8)	668,546		35.6
	TOTAL	1,882,686	(72.7)	448,933	(17.3)	256,631	(9.9)	2,588,250		39.7

Wilayah / Waste		Pollution Load (kg/d)								Specific Pollution Load (kg/d/ha)
		Domestic		Comercial & Institutional		Industrial		Total		
Existing	JAKARTA PUSAT	42,431	(76.9)	10,568	(19.1)	2,192	(4.0)	55,191		11.2
	UTARA	34,159	(57.0)	4,763	(8.0)	20,970	(35.0)	59,892		4.3
	BARAT	49,827	(74.3)	8,264	(12.3)	9,017	(13.4)	67,108		5.2
	SELATAN	58,361	(83.1)	8,120	(11.6)	3,721	(5.3)	70,202		4.8
	TIMUR	60,486	(74.0)	8,173	(10.0)	13,037	(16.0)	81,696		4.4
	TOTAL	245,264	(73.4)	39,888	(12.0)	48,937	(14.6)	334,089		5.1
Future	JAKARTA PUSAT	57,216	(65.7)	28,004	(32.2)	1,806	(2.1)	87,026		17.6
	UTARA	60,604	(44.2)	13,929	(10.1)	62,615	(45.7)	137,148		9.8
	BARAT	89,917	(71.1)	19,937	(15.8)	16,505	(13.1)	126,359		9.8
	SELATAN	105,354	(83.2)	20,144	(15.9)	1,075	(0.9)	126,573		8.7
	TIMUR	111,121	(65.6)	21,687	(12.8)	36,599	(21.6)	169,407		9.0
	TOTAL	424,212	(65.7)	103,701	(16.0)	118,600	(18.3)	646,513		9.9



LEGEND

Wilayah Boundary

Kecamatan Boundary

Kelurahan Boundary

SPECIFIC WASTEWATER DISCHARGE

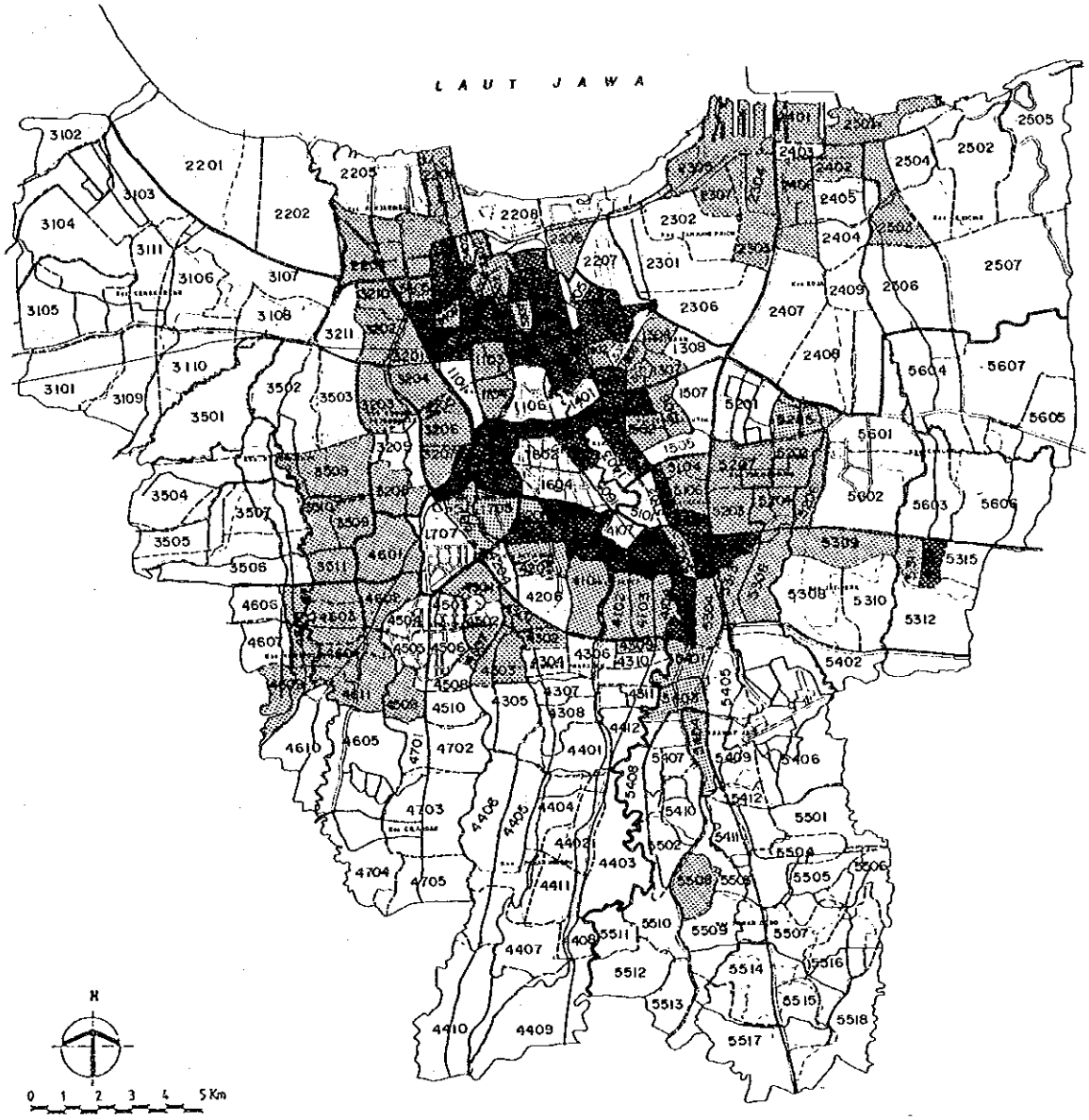
0 ～ 50 m³/d/ha

51～100 m³/d/ha

>101 m³/d/ha

FIG. 5.1 REGIONAL DISTRIBUTION OF EXISTING SPECIFIC WASTEWATER DISCHARGE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



LEGEND

Wilayah Boundary

Kecamatan Boundary

Kelurahan Boundary

SPECIFIC WASTEWATER DISCHARGE

0 ～ 50 m³/d/ha

51～100 m³/d/ha

>101 m³/d/ha

FIG. 5.2 REGIONAL DISTRIBUTION OF FUTURE SPECIFIC WASTEWATER DISCHARGE

Chapter 6

EXISTING URBAN DRAINAGE SYSTEM

CHAPTER 6 EXISTING URBAN DRAINAGE SYSTEM

6.1 General

The first major project in the recent history of flood control and urban drainage for the Study Area is the West Banjir Canal completed in 1920. It is a flood canal of 16.5 km long (Manggarai-Muara) to divert the floods of the western part of Jakarta and has the capacity to cope with a 100-year flood.

In February, 1965, the Government established the Command Project of Flood Control (KOPRO BANJIR) under the responsibility of Ministry of Public Works and Electric Power which was succeeded by the Jakarta Flood Control Project (JFCO) under the responsibility of Ministry of Public Works in May 1972. Several major flood control and urban drainage projects were completed since 1965. Those are:

- Cengkareng flood-way (7 km) completed in 1983
- Cakung drain (10 km) completed in 1983
- 14 pumps stations with a total capacity of m3/s

A number of flood control and urban drainage projects are still on-going, under construction or detailed design by the Jakarta Flood Control Project. The largest project among the on-going ones is the East Banjir Canal of 23.7 km long to divert the floods of the eastern part of Jakarta. It is planned to meet a 100-years flood.

6.2 Objective Channels for the Study

(1) Demarcation of Flood Control and Urban Drainage

Flood problems in urban areas are mitigated by urban drainage and urban flood control. According to the Ministerial Decree No. 239 of May 1987, the demarcation of urban drainage and urban flood control activities are defined as follows.

i) The urban drainage network comprises all water courses, natural or man-made, which have their origin in the urban area, down to the point where they leave the urban area.

ii) The natural or man-mad water courses which are not covered by the above category belongs to urban flood control.

The water courses in the Study Area are classified into flood control river and urban drainage channel based on the above stipulations as shown in Fig. 6.1.

(2) Objective Channel for the Study

This Study will cover all the major urban drainage channels but will exclude the minor drainage channels. The flood control rivers will also be excluded.

The objective urban drainage channel networks consists of the main channels, tributaries and distributaries of 158 in total. The main channels of long drain length are divided into several sections in establishing the above channel networks.

Among them, a considerable number of channel sections are on-going, under detailed design or under construction by the Jakarta Flood Control Project Office (JFCP). The channel sections of on-going drainage improvements by JFCP are affixed by marks a,b,c,... (Group I) and those sections where the design discharge has been proposed by JFCP (however, no structural plan has yet been proposed) are affixed by marks (A), (B), (C),... (Group II). While, those sections where no drainage improvement plan has been proposed are affixed by marks (1), (2), (3), ... (Group III).

The channel sections by Group are shown in Fig. 6.2.

In this Study, urban drainage master plan will be prepared in accordance with the following policies.

(i) The design discharge proposed by JFCP for the channel sections of Group II will be followed. However, structural plan will be newly proposed.

(ii) Urban drainage plan for the channel sections of Group III will be newly proposed.

(iii) The urban drainage plans of the channel sections of Group I will be incorporated into the master plan of this Study.

6.3 Existing Urban Drainage Facilities and Related Structure

(1) Pump Station

In the Study Area, 14 pump stations are provided to drain local storm rainfall in the low-lying areas. Its total capacity is 114.15 m^3/s. The oldest pump situation with a capacity of 13.75 m3/s constructed in 1967, while the latest one is the Cideng Pump Station of 40 m^3/s constructed in 1989.

Further, six (6) pump sections are on-going by the Jakarta Flood Control Office. They will drain the area of Lower Angke, Kemayoran Airport, Ancol, Sunter West, Sunter West II, Sunter West III. Its total capacity is 57.7 m^3/s.

Their locations ares shown in Fig. 6.3.

(2) Weir

Thirty-three (33) gated weirs exist in the Study Area. They function mostly for flood control and urban draining. Water supply irrigation and flushing purpose are included in some gates.

Further, six (6) gated weirs are on-going by JFCP in the East Banjir, Sunter River and Cakung River. Their functions are flood control and salinity intrusion prevention.

Their locations are shown in Fig, 6.4.

(3) Bridge

The JICA Study Team carried out an inventory survey of all the existing bridges of 314 along the major urban drainage channels. Their bridge lengths are in the range of 1.2 m and 59.0 m with an average of 13.6 m. The bridge clearances (height between river bed and bridge beam) range from 0.8 m to 10.5 m with an average of 2.4 m.
For their locations and main features, refer to Appendix E.

6.4 Existing Flow Capacity of Urban Drainage Channels

(1) Channel Sections

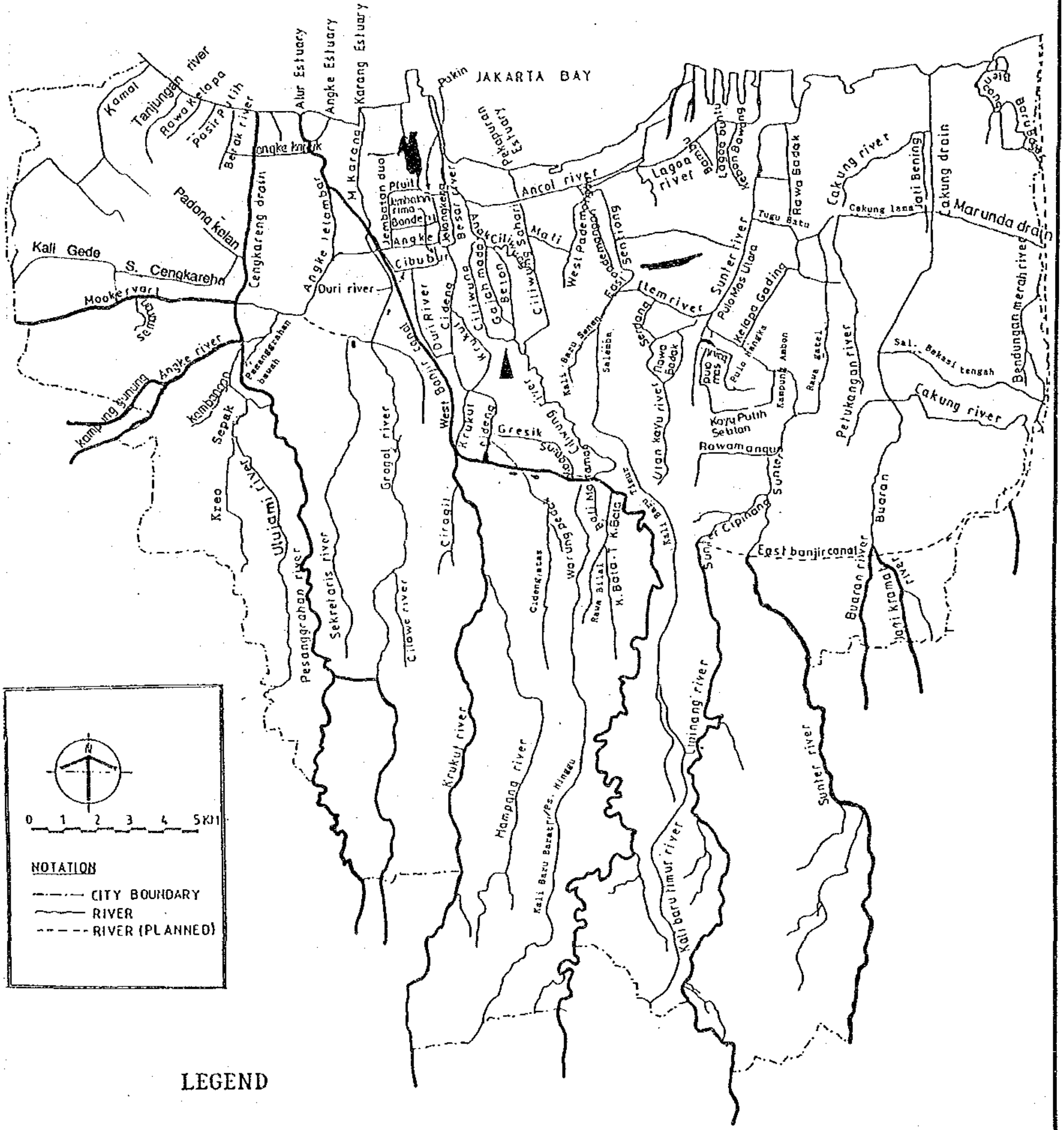
The existing flow capacity of the 138 channel sections of Group II and Group III was estimated by using the manning Uniform Flow Formula.

The flow capacity ranges from $2m^3/s$ to 212 m^3/s with an average of 43 m^3/s. For details, refer to Appendix E.

(2) Bridge Crossing

The channel sections of Group II and Group III have bridge crossings at 240 locations. Some of these existing bridges interfere with free flood discharge either due to their narrow channel cross-sections of other structural obstructions.

The existing flow capacity of the channel sections at bridge crossing for Group II and Group III was also estimated by using the above Uniform Flow Formula.
For their estimated flow capacity, refer to Appendix E.



LEGEND

Existing Flood Control River

Future Flood Control River

Existing Urban Drainage Channel

Monas

FIG. 6.1 CLASSIFICATION OF WATER COURSES

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

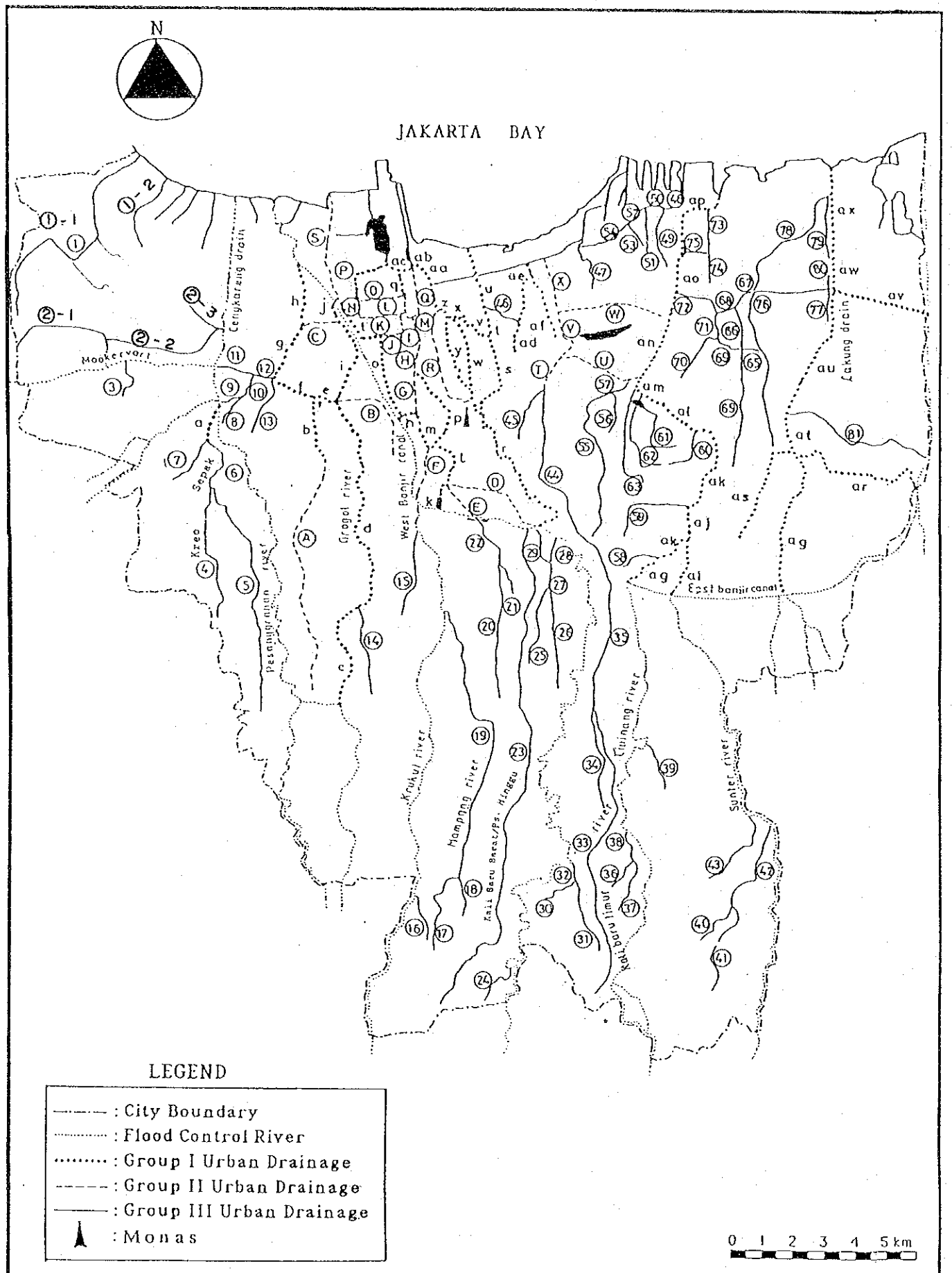
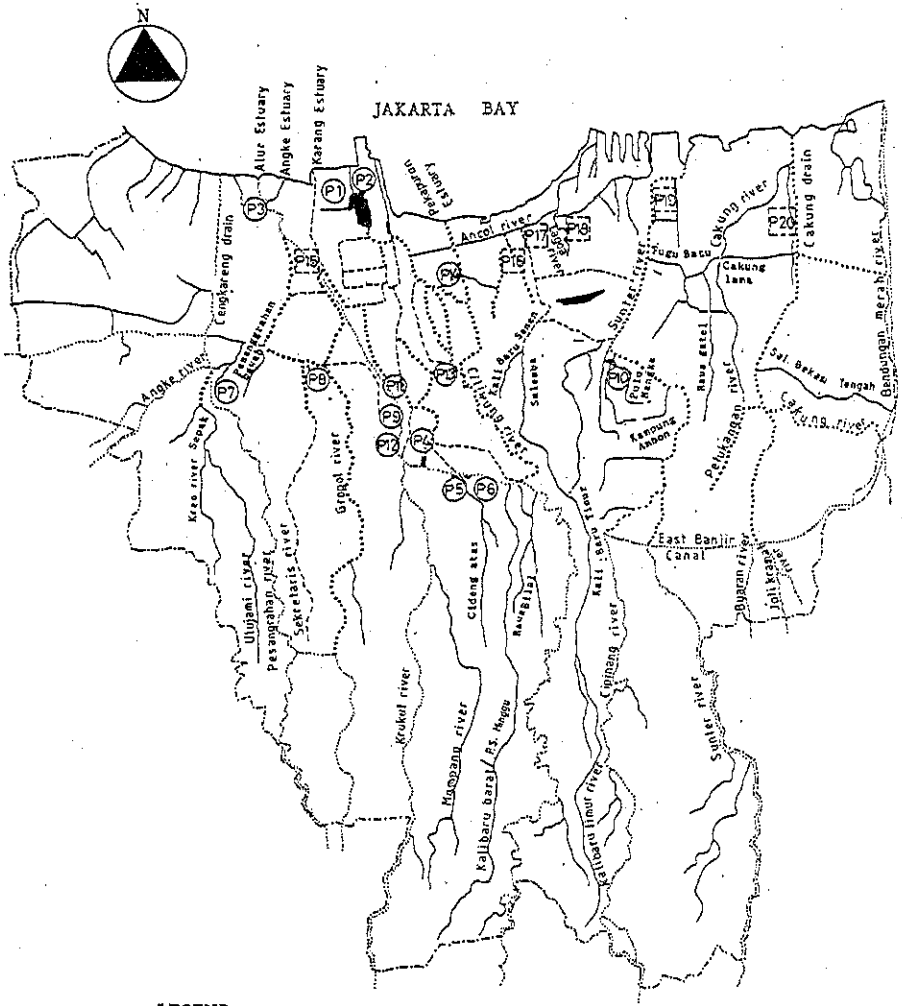


FIG. 6.2 OBJECTIVE URBAN DRAINAGE CHANNELS

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991



LEGEND

——— : City Boundary
——— : Flood Control River
····· : Group I Urban Drainage
– – – : Group II Urban Drainage
——— : Group III Urban Drainage
▲ : Monas

Name of Existing and On-Going Pumping Stations

No.	Name of Station	Name of River/Drainage to be installed	Total Capacity (m3/sec)	Remarks (*1)
Existing Pumping Station				
P1	Pluit	Pluit pond	13.75	Managed by K
P2	Pluit	- do -	16.0	Managed by K
P3	Muara Angke	Angke river	2.6	Managed by K
P4	Melati	Banjir Canal	6	Managed by K
P5	Setiabudi Barat	K. Cideng	5.35	Managed by K
P6	Setiabudi Timur	K. Cideng	3.3	Managed by K
P7	Waduk Grogol	Pesanggarahan River	1.7	Managed by K
P8	Tomang Barat	Sekretaris River	4.0	Managed by K
P9	Cideng	West Banjir Canal	40.0	Managed by K
P10	Pulo Mas	K. Sunter	7.5	Managed by D
P11	Rawa Kepa	West Banjir Canal	8.0	Managed by K
P12	Pondok Bandung	- do -	2.6	Managed by D
P13	Istana	Ciliwung	0.75	Managed by K
P14	Mangga Dua	Cideng	2.6	Managed by K
		Sub Total	114.15	
On-Going Pumping Stations				
P15	Lower Angke	Angke	8.0	Managed by K
P16	Kemayoran Airport Redevelopment	To be named	4.0	Managed by K
P17	Ancol	Sunter	15.0	Managed by K
P18	Sunter West	Lagoa	10.0	Managed by K
P19	Sunter East III	Sunter	15.5	Managed by K
P20	Sunter East II	Sunter	5.2	Managed by K
		Sub Total	57.70	
		TOTAL	171.85	

Note : (*1) "K" means : J.F.C.P. Management of these station will be transferred to DKI in the future.

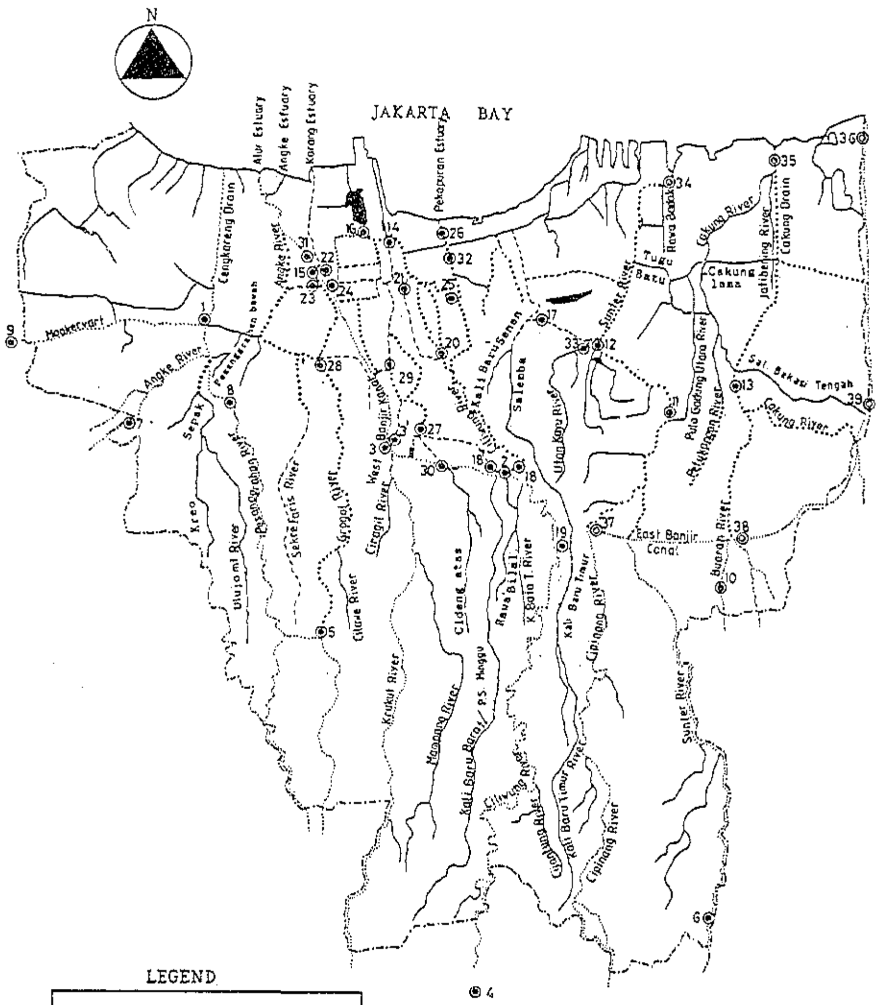
"D" means : DKI.

(P1), (P2) --- (P14) Existing Pumping Station

[P15], [P16] --- [P20] On-Going Pumping Station

FIG. 6.3 LOCATION OF EXISTING AND ON-GOING PUMP STATIONS

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



LEGEND

- ——— : City Boundary
- ········ : Flood Control River
- ········ : Group I Urban Drainage
- – – – : Group II Urban Drainage
- ——— : Group III Urban Drainage

◉ Existing Gatedweirs

◎ On-Going Gatedweirs

Monas

Name of Station and its Function

No.	Name of Station	Name of River/ Channel to be installed	Pupose of Control for	Remarks (*1)
1	Cengkareng	Cengakreng	Flood	Managed by K
2	Maggarai 1	Ciliwung	Drainage	Managed by D
3	Karet	anjir Canal	Flood	Managed by D
3'	Karet II	- do -	Flushing	Managed by D
4	Katulampa	Pond	Drainage	Managed by K
5	Pondok Pinang	Pasanggarahan	- do -	Managed by K
6	Sunter Hulu	Sunter	- do -	Managed by K
7	Polor	Angke	Irrigation/ Drainage	Managed by K
8	Koneng	Pasanggarahan	- do -	Managed by K
9	Sewan	Mookervart	- do -	Managed by K
10	Tarum Barat to Saluran	Tarum Barat Canal	Water Supply/ Irrigation	Managed by K Managed by K
11	Pulo Gadung	Sunter	Flood	Managed by K
12	Sunter	- do -	- do -	Managed by K
13	Cakung	Cakung	- do -	Managed by K
14	Pasar Ikan	-	Drainage	Managed by D
15	Saringan Sampah Teluk Gong	Angke - do -	- do -	Managed by K
16	Syphon Pluit	Pluit Pond	Flood	Managed by K
17	Bendungan Jago	Jiung	- do -	Managed by K
18	Manggarai II	Ciliwung	Flood/Flushing	Managed by D
18'	Manggarai III	Surabaya Canal	Flushing	Managed by D
19	Tarum Barat II	Tarum Barat Canal		Managed by D
20	Capitol (Istiqlal)	Ciliwung	- do -	Managed by D
21	Tangi	- do -	- do -	Managed by D
22	Kali Duri	Duri	Flood	Managed by K
23	Kampung Gusti	Angke	Drainage	Managed by D
24	Jembatan Dua	Grogol	- do -	Managed by D
25	Jembatan Merah	Gunung Sahari	- do -	Managed by K
26	Pekapuran	- do -	Flood	Managed by K
27	Cideng	Cideng	- do -	Managed by K
28	Kyai Tapa	Ciliwung	- do -	Managed by K
29	Siantar	Duri	Flood	Managed by K
30	Syphon Cideng	Cideng	- do -	Managed by K
31	Syphon Teluk Gong	Angke	- do -	Managed by K
32	Saringan Sampah Gunung Sahari	Gunung Sahari	Drainage Flood	Managed by D Managed by K
33	Kali Item	Item	- do -	Managed by K
34	Salinity Barries I	Sunter	Salinity Barries	Managed by K
35	Salinity Barries II	Cakung	- do -	Managed by K
36	Salinity Barries III	East Banjir Canal	- do -	Managed by K
37	Doversion Structure	- do -	Flood	Managed by K
38	Weir I	- do -	- do -	Managed by K
39	Weir II	- do -	- do -	Managed by K

Note : (*1)
"K" means J.F.C.P Management of thesee stations will be transferred to DKI in the future.
"D" means DKI

FIG. 6.4 LOCATION OF EXISTING AND ON-GOING GATEDWEIRS

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Chapter 7

EXISTING SANITATION AND SEWERAGE PROJECTS AND FACILITIES

CHAPTER 7 EXISTING SANITATION AND SEWERAGE PROJECTS AND FACILITIES

7.1 Existing On-site Sanitation Facilities

(1) General

The existing on-site sanitation facilities in the Study Area are classified into two (2) categories, namely, domestic sanitation facilities and sanitation facilities of commerce and institutions.

The domestic on-site sanitation facilities, including those equipped with septic tanks, are used for the treatment of toilet waste only. The gray water originating from kitchen, bathing and laundry is directly discharged to the drains.

In case of commerce and institutions, some treat both their toilet waste and gray water, while others treat only their toilet waste.

(2) Domestic On-site Sanitation Facilities

The domestic on-site sanitation facilities are basically toilets, which could be classified into three (3) types.

(i) Individual toilet with treatment

This covers both septic tanks, with or without effluent infiltration/drain field and soakway, and leaching pits.

(ii) Individual toilet with no treatment

This refers to pit latrines and those toilets which discharge human waste directly to nearby ditches/drains.

(iii) Public Toilet

Public toilet is a group of toilets for communal use of neighboring communities, which are generally provided with bathing and washing facilities as well. These are provided with septic tanks.

Based on the sampling survey results conducted by the Study Team it is determined that 68% of the population have individual toilets with treatment. While, another 17% use toilets with no treatment. Public toilet is used by 6% of the population. The remaining 9% have no access to toilet facilities. The ratio of households having individual on-site sanitation facilities with treatment in each Kelurahan is illustrated in Fig. 7.1.

A detailed survey of existing public toilet in the Study Area was conducted on a Kelurahan basis. Public toilets are constructed mainly by the following organizations; Cleansing Department, Bappem, community organization and recently by JSSP. The operation and maintenance of the public toilets are entrusted either to the Cleansing Department, local authority or local community.

Most public toilets are concentrated in the high population centres of Central Jakarta and Tanjung Priok area, though there are some in the western part of Jakarta as well. There are no public toilets in southern part of Jakarta and the fringes of the Study Area, having low population density. Regional distribution of public toilet is shown in Fig. 7.2.

In reference to the treatment efficiency of these on-site facilities, if the leaching/infiltration capacity of the soil is assumed to be sufficient, a condition still valid basically in the fringes and southern part of the Study Area with low population density, the treatment efficiency of toilet waste only will be 100%. Even then, as the gray water is discharged with no treatment, the overall treatment efficiency with

respect to BOD removal is only about 40%. This is evident from the ratio of unit pollution load generation between toilet waste and gray water as described in Section 5.2 of Chapter 5.

It is to be noted that in principle a septic tank is intended for the treatment and disposal of both the toilet waste and gray water and the leaching pit for toilet waste. However in the Study Area traditionally both septic tank and leaching pit receives only the toilet waste, and hence there is no functional difference in their usage.

(3) On-site Sanitation Facilities of Commerce and Institution

Sampling questionnaire surveys were also carried for the existing on-site sanitation facilities of commerce and institutions covering shops, factories, restaurants, hotels, hospitals, offices and schools.

Based on the sampling survey, it is determined that 5.6% of the existing commerce and Institutions in the Study Area are provided with on-site package treatment facilities capable of treating both toilet waste and gray water, 90.0 % are equipped with septic tank to treat only toilet waste and the remaining 4.4% use no treatment facilities. Service level of on-site sanitation facilities of the respective commerce and institutions is shown in Table 7.1.

In addition the JICA Study Team conducted an evaluation of treatment system and water quality of effluent discharged by 18 major establishments of hotels, offices and commerce.

Out of these 18 establishments, ten (10) treated their whole wastewater, both the wastewater from toilet and gray water from all other miscellaneous water use, in their individual treatment plants. While, the rest eight (8) establishments treated only their toilet waste and discharged the gray water untreated.

Further more, of these ten (10) establishments that treated their whole wastewater, eight(8) used extended aeration systems.

On the other hand the establishments that are designed to treat toilet wastewater only, which is not a recommended design practice for a commerce/institutions, basically used septic tanks.

The water quality analysis pointed out that the septic tank effluents were of very poor quality having BOD levels more than even 1000 mg/l. In comparison, the effluent quality of extended aeration systems were better around 50 - 100 mg/l as BOD.

However in all plants, the fecal coliform density (FC) of the effluent is very high because disinfection is not generally practised, even when the facility exists, in order to economize treatment cost.

Finally to conclude, the performance of the surveyed treatment systems are in an overall sense not satisfactory. Especially septic tanks are designed in areas where sufficient infiltration/drain fields are probably no longer available to treat the high effluent loading. In comparison, package treatment plants of extended aeration performed better, however their operation and maintenance are inadequate because of shortage of skilled operators. The practice of not disinfecting the effluent is deplorable, from public health view point.

7.2 Desludging and Treatment

(1) General

The Cleansing Department (Dinas Kebersihan) of DKI, Jakarta is the organization responsible for desludging, transport and treatment of sludge of septic tanks in Jakarta, in addition to its major function of solid waste management.

Several registered private companies carry out desludging operations in addition to the Cleansing Department. However, their constribution is small in comparrison to the Cleansing Department. It was only a 2.3 % in the fiscal year 1989/1990.

(2) Desludging and Transportation of Sludge

Desludging is performed in response to the request of residents. Annually on an average, 66,173 m^3 of sludge was collected from 24,646 households in the Study Area by the Cleansing Department during the last five (5) fiscal years (1985/86 - 1989/90). The average quantity of sludge collection per household per one (1) time is estimated at 2.7 m^3.

The charge of desludging by the Cleansing Dept. from residents is Rp. 5000 per m^3 capacity of the septic tank, and typical capacity of residential septic tank is about 2-4 m^3. The average frequency of desludging is estimated at once in two (2) years.

The Cleansing Department owns 108 vacuum trucks with an average capacity 2.9 m^3 in 1990 which are used for desludging and transportation of sludge to the existing sludge treatment plants.

(3) Sludge Treatment

The Cleansing Department owns two (2) number sludge treatment plants ; Pulo Gebang and Kebon Nanas plants with the respective capacities of 300 m^3/d and 60 m^3/d. However, at present the Kebon Nanas plant has stopped functioning for renovation. Another one with a capacity of 300 m^3/d is under construction at Duri Kosambi.

The treatment process of the existing main treatment plan of Pulo Gebang consists of the following three (3) main steps.

(i) Aerobic digestion

- Digestion time is six (6) days
- Average BOD reduction is 30 %