社会開発協力部報告書

No. 8

MALAYSIA

MASTER PLAN AND FEASIBILITY STUDY FOR SEWERAGE AND DRAINAGE SYSTEM PROJECT IN KELANG, PORT KELANG AND ITS ENVIRONS

VOLUME VII DRAINAGE

FEASIBILITY STUDY

NOVEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

MALAYSIA

MASTER PLAN AND FEASIBILITY STUDY
FOR
SEWERAGE AND DRAINAGE SYSTEM PROJECT
IN
KELANG, PORT KELANG AND ITS ENVIRONS

VOLUME VII DRAINAGE

FEASIBILITY STUDY

NOVEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

This Master Plan and Feasibility Study consists of eight volumes:

I	Sewerage Summary Report
II	Sewerage Master Plan
III	Sewerage Feasibility Study
IV	Sewerage Appendices
V	Drainage Summary Report
VI	Drainage Master Plan
VII	Drainage Feasibility Study
VIII	Drainage Appendices

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

LIST OF FIGURES

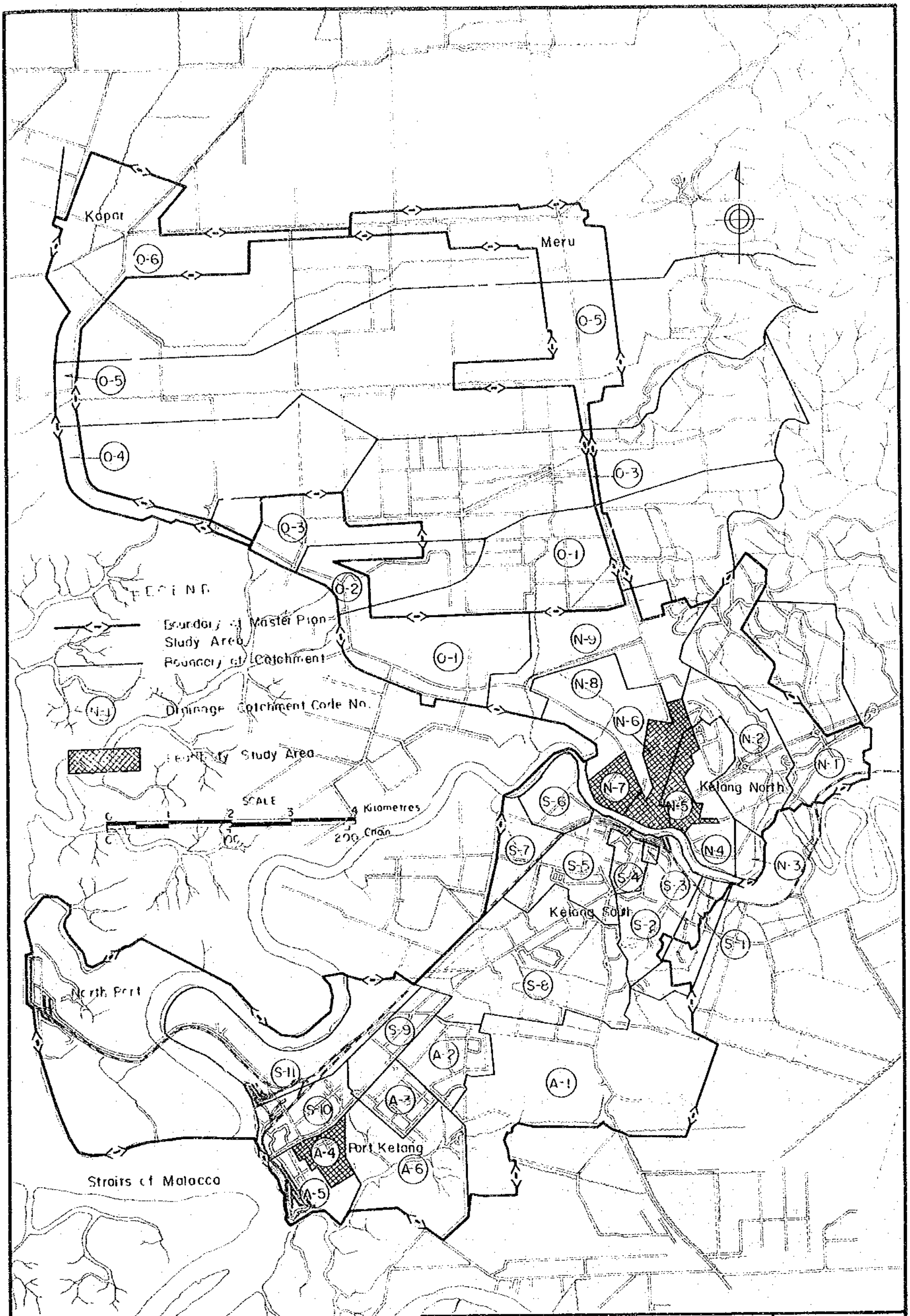
Fig. No.	Title	Page
Fig. 5.2.	Implementation Schedule in A-4 Catchment	81
Fig. 6.1.	Relationship between Cash Accumulated up to 1995 and Drainage Surcharge Tax Rate	91
Fig. 8.1.	Analysis of Property Assessment Value Increase by Flood Mitigation Measures	126

LIST OF ABBREVIATIONS

AC	Asbestos Cement
BOD	Biochemical Oxygen Demand
DID	Drainage and Irrigation Department, Ministry of Agriculture and Fisheries
F.C.	Foreign Currency
F.M.P.	Fourth Malaysia Plan
Fig.	Figure
GDP	Gross Domestic Product
ha	hectares
HDPE	High Density Polyethlene
hr	hours
Jalan	Road
JICA	Japan International Cooperation Agency
JKR	Public Works Department
Jln.	Jalan, Road
JT	Jambatan Telecom
Kg.	Kampung
km	kilometers
KTM	Malayan Railway
L.C.	Local Currency
LLN	National Electric Board
Lrg.	Lorong
m	meters
m^2	square meters
m^3	cubic meters

MPK	Kelang Municipality (Majlis Perbandaran Kelang)
M$	Malaysian Dollars
O & M	Operation and Maintenance
PVC	Polyvinyl Chloride
R.L.	Reduced Level
SEDC (PKNS)	State Economic Development Corporation
SS	Suspended Solids
TCP	Town and Country Planning
VC	Vitrified Clay
WWD	Waterworks Department

OUTLINE



Study Area

Fig. 1

OUTLINE

1. The Study Area

The Feasibility Study covers those areas of highest priority for implementation in the First Phase (1983 - 1990) proposed in the Master Plan, based on such factors as flooding situation, population density, future development, and damage to main roads consisting of part of Kelang North (N-5, N-6 and N-7 catchments: 190.0 ha) and Port Kelang (A-4 catchment: 52.5 ha).

2. Flooding and Existing Drainage System

The condition of the Study Area and the existing drainage system which causes frequent inundation and consequent inconvenience and damages for the residents are as follows:

1) The Area is flat and low with ground elevation generally ranging from R.L. +2.0 m to 4.0 m.

2) The Area is greatly affected by tide, with river or tidal levels fluctuating from R.L. -2.4 m to 3.0 m.

3) The watertightness of the tidal gates which exist at each outlet of the trunk drains, is inadequate.

4) Bunds are also insufficient and inadequate.

5) The capacity of the trunk drains is considerably lower than the estimated stormwater discharge.

3. Proposed Drainage System

Taking into consideration future development of the Study Area up to the year 2000, the proposed drainage facilities consist of trunk drains, tidal gates, bunds, and telemeter system, involving the following work:

1)	Trunk drains:	Widening, deepening and lining existing open channel of 7,460 m length
2)	Tidal gates:	Replacement of four existing gates, which will improve watertightness and capacity
3)	Bunds:	Construction of bunds of 1,980 m length
4)	Telemeter system:	Inspection center for 26 tidal gates and telemeter system for four gates

4. Construction Cost

Total construction cost is estimated at M$11.9 million at 1981 price level (M$17.8 million with annual escalation of 6.5 percent in accordance with Fourth Malaysia Plan), as shown in Table 1 and annual operation and maintenance cost at 1981 price level at M$149,000.

Table 1. Construction Cost

(Unit: M$ million at 1981 price level)

Item	Cost
1. Construction Work	
Trunk Drains	8.7
Tidal Gates	0.6
Bunds	0.1
Telemeter System	0.3
2. Land Acquisition	0.1
3. Engineering Fee	1.0
4. Contingency Cost	1.1
Total	11.9

5. Financial Plan

Financial planning for the drainage system Feasibility Study is examined, based on its study in the Master Plan. As a result, the following financial plan is recommended:

1) The construction cost is to be financed by the Federal Government.

2) A developer's fee of M$3,000 per acre is to be imposed on new developments.

3) A two percent property surcharge tax for drainage service is to be imposed on all property within the MPK area.

4) Kelang Municipality is to bear its share of the financial burden in the amount of M$3 million up to 1995 for the proposed system.

6. Institutional and Legal Aspects

The enlargement of the Engineering Department, based on a review of the existing organizational units engaged in drainage activities at each governmental level -- Federal, State, and Kelang Municipality, consists of the following main features proposed in the Master Plan.

1) Three new units are to be set up in the existing Sewer & Drain Section -- Design, Construction, and Operation & Maintenance units.

2) The current Work Shop Unit of the Sewer & Drain Section is to be made an independent section.

3) The required staff (excluding the labor pool) is to be as follows: 17 in the initial year of 1983, and 28 in 1990 at the end of the First Phase.

The present situation in Kelang Municipality with its shortage of qualified and trained engineers prevents its undertaking of the urban drainage works. Thus, it is recommended that MPK recruit a drainage staff as soon as possible.
Initially, the members are to be assigned temporarily to State DID for execution of the First Phase work, and later to be transferred back to MPK for subsequent work, based on their training at State DID.

As revealed by a review of existing laws and regulations related to drainage activities, no legal problems stand in the way of implementing the drainage project.

7. Benefits and Other Effects

The study and analysis of benefits and other effects expected from the proposed drainage system present the following positive picture:

1) Extensive reduction of flood damage, providing relief from flooding for 87.6 ha of flood-prone areas and 5,600 persons.

2) Environmental improvement, which is expected to contribute significantly to raising the daily life quality for the populace of Kelang Municipality and its environs.

3) The accompanying increase in land value from the proposed drainage system will also bring additional revenue to Kelang Municipality. Results of the multivariate analysis show that after completion of the drainage system, the average increase rate of the property assessment value would be 1.6 percent; however, the rate for the existing low population density area of the flood-prone areas would reach 20.5 percent. Moreover, the general revenue income for MPK is expected to be increased by about M$26,000 annually.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1. Flooding Problem in Kelang Municipality

The problem of flooding faced by Kelang Municipality is caused mainly by its extremely flat and low topography with inadequate drainage facilities to cope with the stormwater runoff. Another contributing factor includes the wide fluctuations of the Kelang River water level, ranging up to 5 m (17 ft), and exceeding the ground elevation at its highest level in some areas, thus causing extensive flooding in the lower areas during heavy rainfalls and high river stages or tides.

The capacity of the existing drainage system, which has had only a bare amount of improvement work since its construction some 30 to 40 years ago, is only one-third of the estimated stormwater discharge. Furthermore, the flood problem is expected to worsen unless immediate remedial actions are taken, since by the year 2000 the Kelang Municipality population is estimated to increase by 150,000.

The construction of the required drainage facilities are expected to require substantial investment due to the amount of work needed for augmenting and extending existing facilities with the use of rectangular concrete drains, as the entire Municipality area, including the Study Area, is fairly well developed. However, there is no doubt that such investment is required as early as practicable to cope with the immediate problem of flooding in the Kelang Municipality, and ensure prevention of similar problem during future urbanization.

1.2. Objectives of the Drainage Feasibility Study

The purpose of this Report is to appraise the technical and financial feasibility of an urban drainage system to alleviate and prevent flooding, in the Study Area (consisting of a part of Kelang North and Port Kelang) selected to meet the urgent requirements during the First Phase Program (1983 - 1990) for completion of the Master Plan up to the year 2000.

The basic concept and works necessary for this Feasibility Study are identified on the basis of recommendations proposed in the Master Plan. The principle for the work considered for this Study, therefore, is as defined in the scope of work agreed between the Governments of Malaysia and Japan to develop the drainage improvement works covering both trunk and secondary drains.

The studies thus carried out in the present Report include the following:

(a) Definition of the Study Area
(b) Evaluation of flood problem including drainage system and review of Master Plan
(c) Projection of land use pattern
(d) Development of design basis
(e) Development of the drainage improvement works
(f) Estimation of costs for construction, operation and maintenance
(g) Establishment of construction and disbursement program
(h) Consideration of financial arrangement
(i) Consideration of institutional arrangement
(j) Benefit assessment

During the course of field works from September to December, 1981, detailed field reconnaissance and surveys were conducted to further identify the problems, based on the findings of the Master Plan concerning the present condition of the drainage system in the Study Area, followed by analysis and evaluation of the requirements for drainage improvement.

Together with the cost estimates for the facilities required, the most appropriate construction and disbursement program has been developed for approximately five years, in line with the urgent necessity for improvement of the existing drainage system.

CHAPTER 2

STUDY AREA

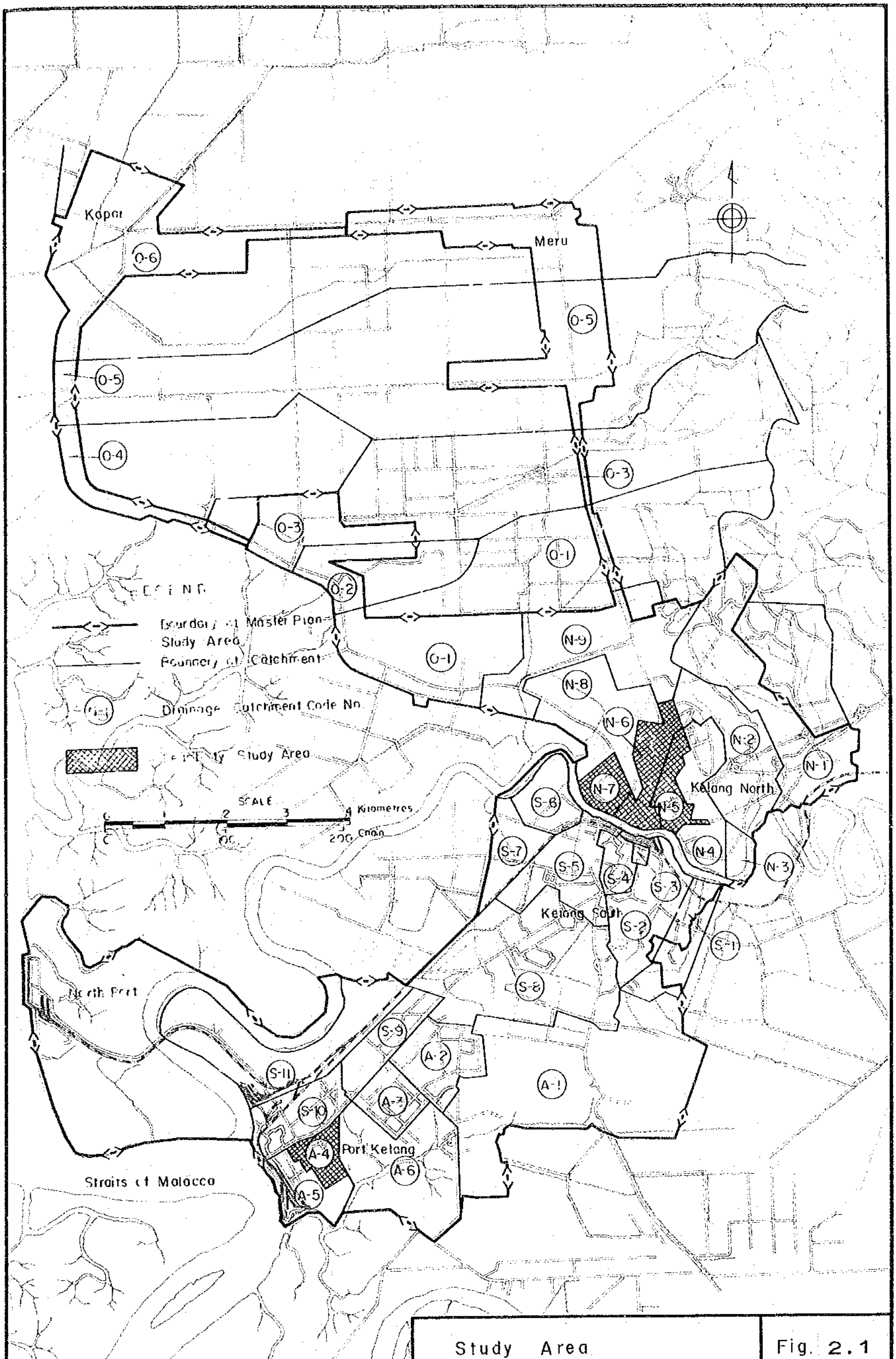
CHAPTER 2 STUDY AREA

2.1. General

Although Kelang Municipality is comprised of Kelang North, Kelang South, Port Kelang, Kapar and Meru, the Study Area as shown in Fig. 2.1, is concentrated on both the center of Kelang North and Port Kelang. Central Kelang North includes Kelang's largest commercial area, surrounded by a developed residential area, and the center of Port Kelang is also a large commercial area with the highest population density in Kelang.

The Study Area, based on recommendations given in the Master Plan Report, covers the following catchments: N-5 (69.5 ha), N-6 (72.3 ha), N-7 (48.2 ha) in Kelang North, and A-4 Catchment (52.5 ha) in Port Kelang.

These four catchment areas are those given top priority, based on a rating assessment of such factors as flooding situation, population density, future development and damage to main roads. These four catchments were selected for the Feasibility Study from the 16 scheduled to be implemented by the year 2000, based on a study of the entire 32 catchments in Kelang Municipality, as recommended in the Master Plan. Descriptions of the four selected catchments follow:



Study Area	Fig. 2.1

2.2. N-5 Catchment

2.2.1. Topography

This catchment has an area of 69.5 ha which covers mainly developed residential areas. The ground elevation in this catchment is generally low, with a height of R.L. +2.5 m to 4.5 m. (Ref.: Fig. 2.2.)

2.2.2. Existing Land Use

The major part of the catchment consists of developed residential areas. A commercial area lies along the Federal Highway, with vacant land near the commercial area and in the north end of the catchment.

Existing land use and area for each category in Kelang North, including not only N-5 but also N-6 and N-7 catchments, are presented in Fig. 2.3. and Table 2.1.

Table 2.1. Existing Land Use in Kelang North (1980)

Land Use	Area	
	(Hectare)	(Percentage)
Residential	68	35.8
Commercial	42	22.1
Industrial	16	8.4
Vacant	43	22.6
Open Space	9	4.7
School	12	6.3
Total	190	100.0

2.2.3. Existing Drainage System

The existing drainage system, which was constructed in the early '60s, has had no major changes to keep pace with the rapid development of the town. Fig. 2.4. shows the layout of the existing drainage system. The drain originating in the hills in the north runs south to the Kelang River.

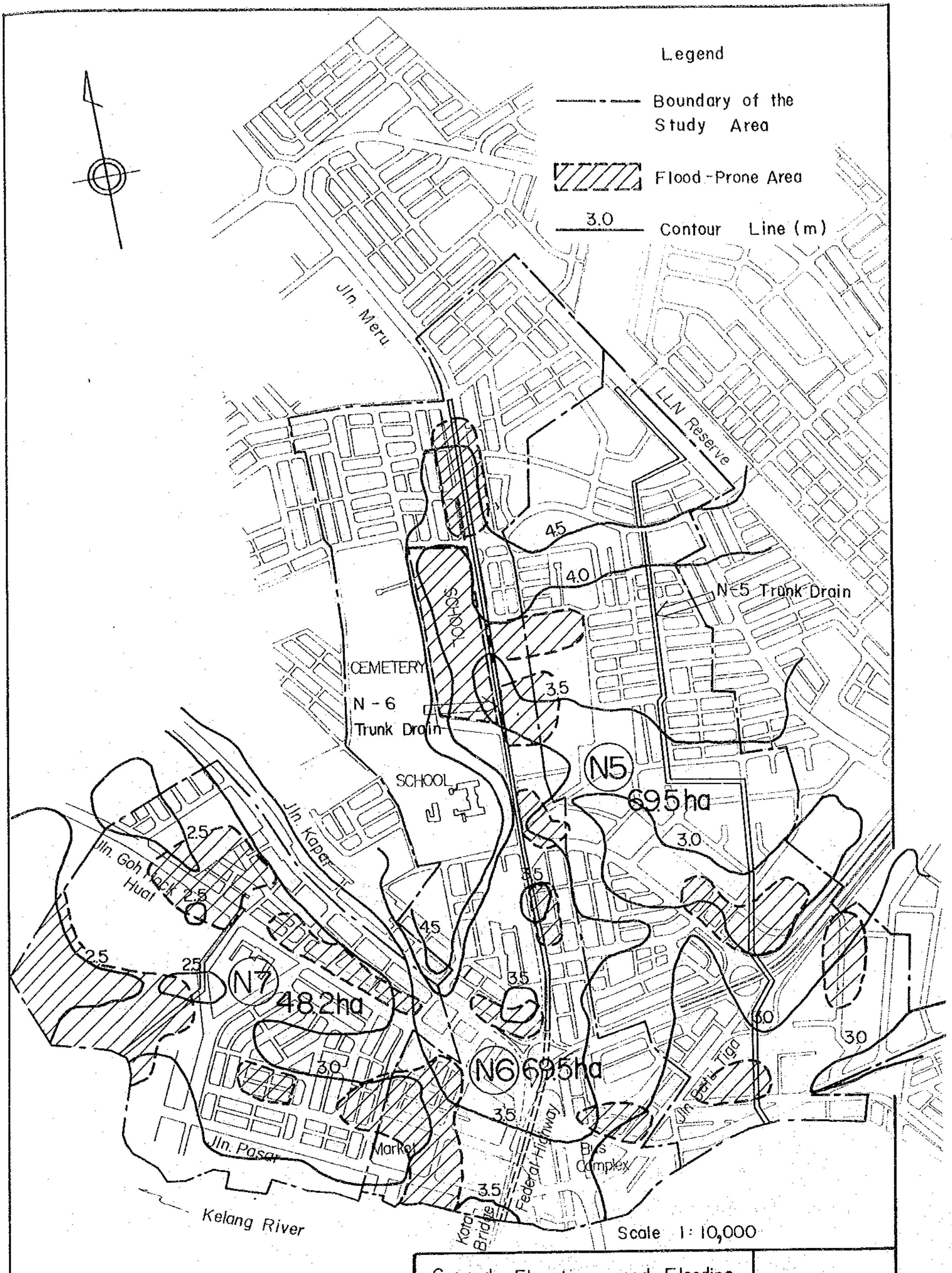
The trunk drain comprises lined and unlined sections of various widths and depths. The capacity of this trunk drain is about 2.5 m^3/sec, which is inadequate to accommodate the surface runoff. Although a tidal gate to keep out back-up water from the river exists at the outlet of the trunk drain, the areas downstream are likely to be affected by high river water level or tide because of its defective watertightness. The tidal gate is however now being improved in the same size by the State DID as an interim measure.

Throughout the whole area, an open channel system of U-shape or rectangular section has been provided as the infrastructural drainage system. Although these drains have generally been working well so far, some are inadequate to accommodate flow capacities.

2.2.4. Flooding

Generally, inundation of the Study Area is caused by one or more of the following factors:

- Extremely low and flat topography of the Study Area.
- River water level easily affected by tide which fluctuates often by as much as 5 meters.
- Insufficient watertightness of tidal gates causing back-up water in the drainage system.
- Overflow of the Kelang and the Aur rivers.
- Inadequate capacities of the trunk drains, including box culverts, whereas small or infrastructural drains functioned fairly well on the whole.



Ground Elevation and Flooding Area in Kelang North

Fig. 2.2

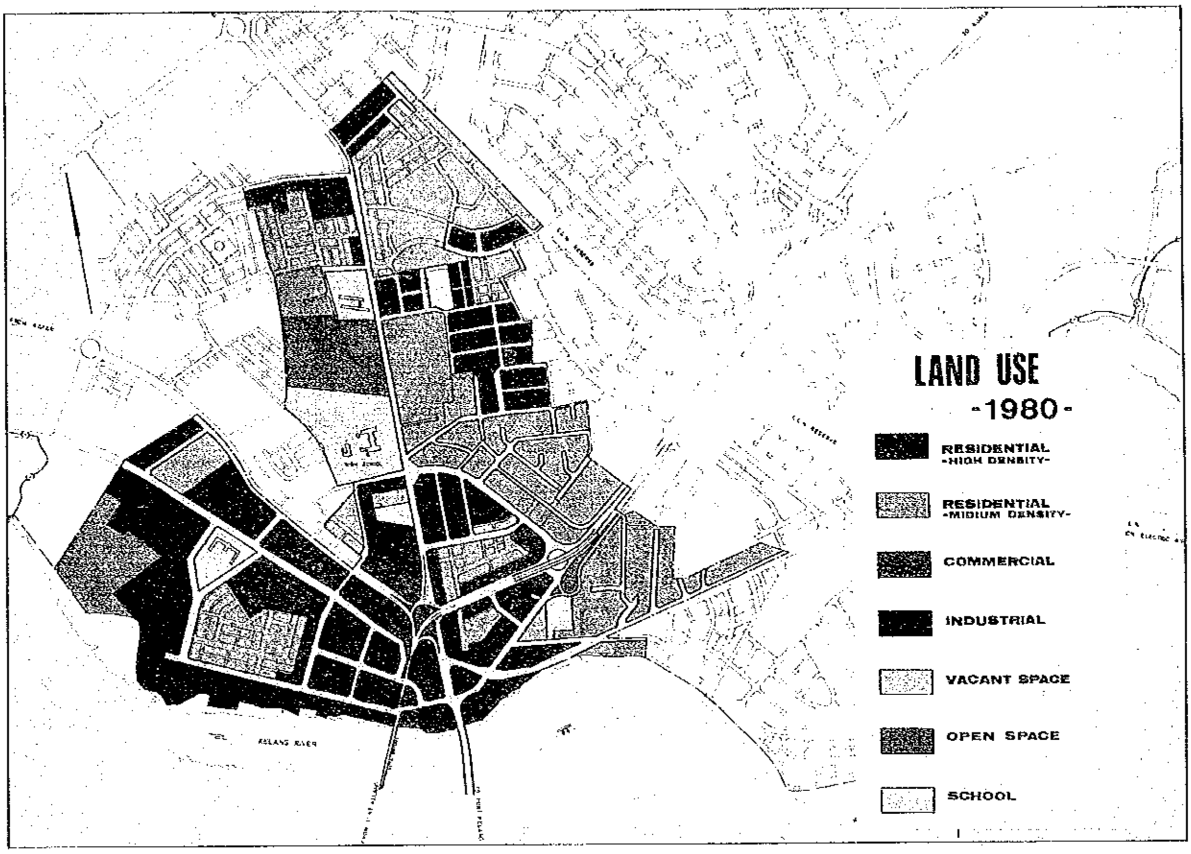


Fig. 2.3. Existing Land Use in Kelang North (1980)

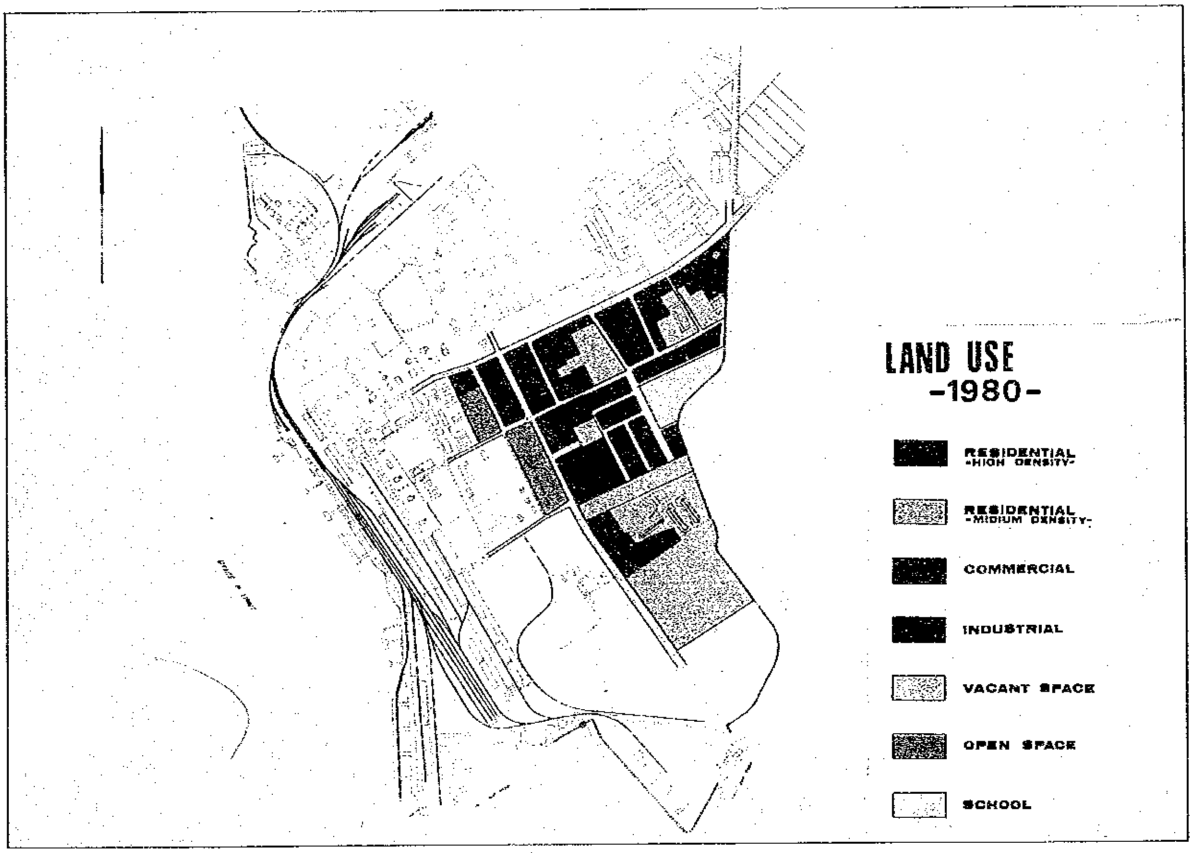
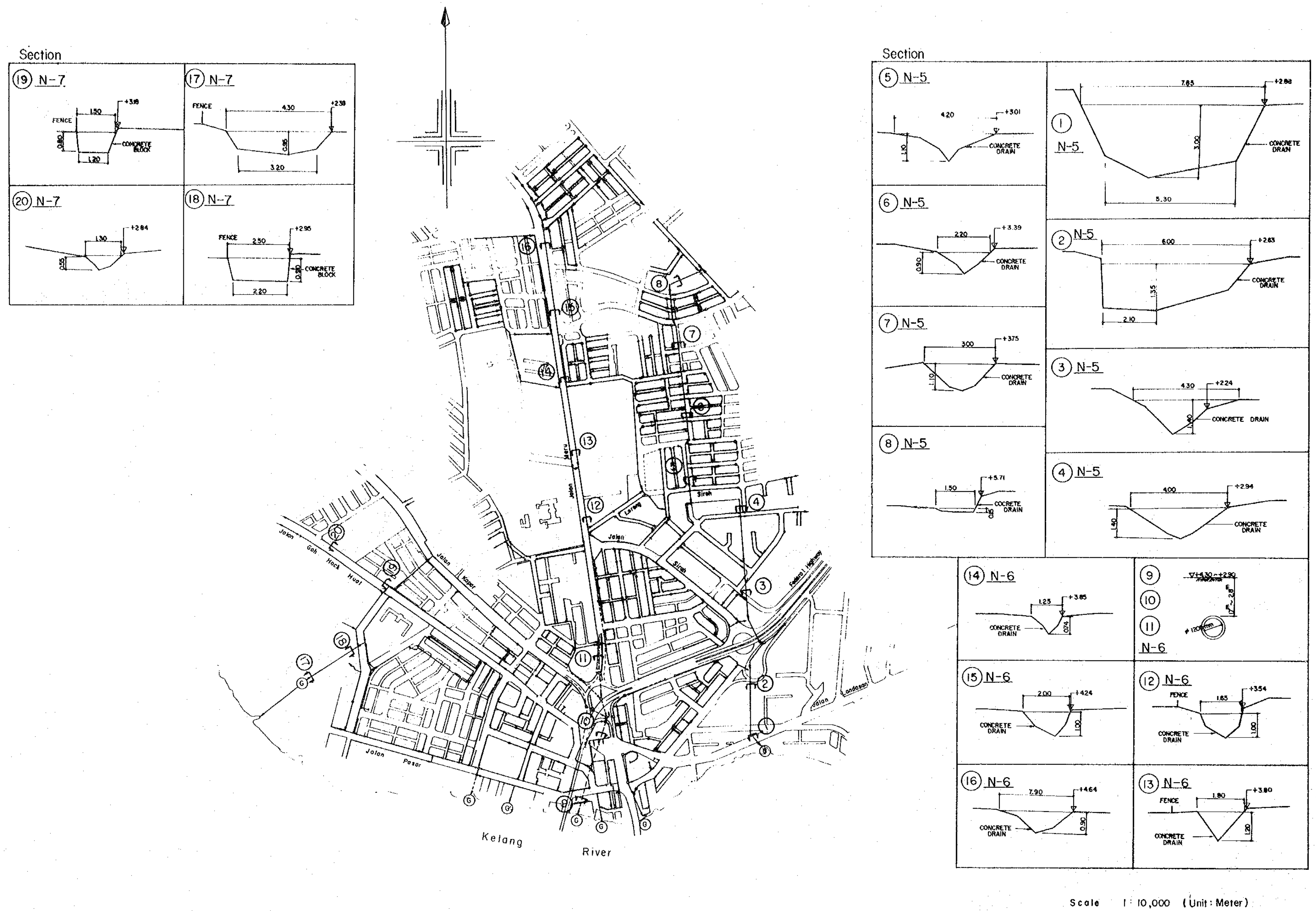


Fig. 2.6. Existing Land Use in A-4 Catchment (1980)



Scale 1 : 10,000 (Unit: Meter)

Existing Drainage System in Kelang North

Fig. 2.4.

Data and other information on flood-prone areas in the Study Area obtained from related agencies and field investigations and questionnaires on floods are summarized in Fig. 2.2.

Total size and population of the flood-prone areas in N-5 Catchment are 18.2 ha and 1,900 persons (1980) respectively.

2.3. N-6 Catchment

2.3.1. Topography

This rectangular-shaped catchment of about 300 m width covers an area of 72.3 ha along Jalan Meru. The ground elevation in this flat catchment is generally low with a height of R.L. +3.2 m to 4.5 m, except in the hilly area bordering N-7 Catchment, the height of which reaches R.L. +20 m. (Ref.: Fig. 2.2.)

2.3.2. Existing Land Use

The downstream area in this catchment is the largest commercial area in Kelang. Schools and a cemetery covering 15 ha exist in the midstream area, while housing development is underway in the upstream area.

2.3.3. Existing Drainage System

The existing drainage system of this catchment, similar to that for N-5 Catchment, has had no major changes since its construction in the early '60s. Its layout is shown in Fig. 2.4.

The trunk drain, which lies along Jalan Meru, is lined in the upstream, but in the downstream it consists of underground pipe which exists only in this catchment of the Municipality.

The capacity of this drain is about 4 m^3/sec, which is insufficient to accommodate surface runoff. Although a tidal gate exists at the outlet of the trunk drain, its watertightness does not seem to be reliable. However, it is now being improved in the same size by the State DID as an interim measure.

2.3.4. Flooding

The surface runoff from the west of Jalan Meru; namely, from the schools and cemetery, flows into the trunk drain running on the east side of Jalan Meru through a box culvert. However, it is of such small capacity that the western area has often experienced flooding.

Other flood-prone areas are in the downstream due to inadequate watertightness of tidal gates.

Total size and population of the flood-prone areas in N-6 Catchment are 29.1 ha and 400 persons (1980), respectively.

2.4. N-7 Catchment

2.4.1. Topography

This catchment covers 48.2 ha. The ground elevation in this flat catchment is generally low with a height of R.L. +2.1 m to +3.6 m. (Ref.: Fig. 2.2.)

2.4.2. Existing Land Use

The major part of this catchment consists of developed commercial areas in the east and an industrial area in the west. The surrounding area is now vacant, but is due to be developed for commercial use.

2.4.3. Existing Drainage System

As in the case of catchments N-5 and N-6, the existing drainage system of N-7 Catchment has had no major changes since its construction over 30 years ago.

The trunk drain which serves the north-western area lies near the north border adjacent to N-8 Catchment. The capacity of the trunk drain is 3 m^3/sec, which is inadequate to accommodate surface runoff. Hence, a secondary drain is provided to accommodate the surface runoff of the south-eastern area. Accordingly, there are two large tidal gates which, however, are not sufficiently watertight.

The infrastructural drainage system consists of an open channel system throughout the entire area. Generally, these drains have been working well so far but some are inadequate for accommodating flow capacities.

2.4.4. Flooding

Size and population of flood-prone areas are 30.7 ha and 1,700 persons respectively. Flooding in the east is due to the lack of a trunk drain and inadequate watertightness of the tidal gate, while in the west, inadequate height and seepage of the bund contribute to flooding, in addition to the faulty tidal gates.

2.5. A-4 Catchment

2.5.1. Topography

A-4 Catchment is in Port Kelang which covers an area of 52.5 ha. The ground elevation in the commercial area in the northern part is from R.L. +2.0 m to 3.0 m, while in the southern housing develop area it is being raised to R.L. +2.0 m from a predominantly low-level average height of R.L. +1.6 m. (Ref.: Fig. 2.5.)

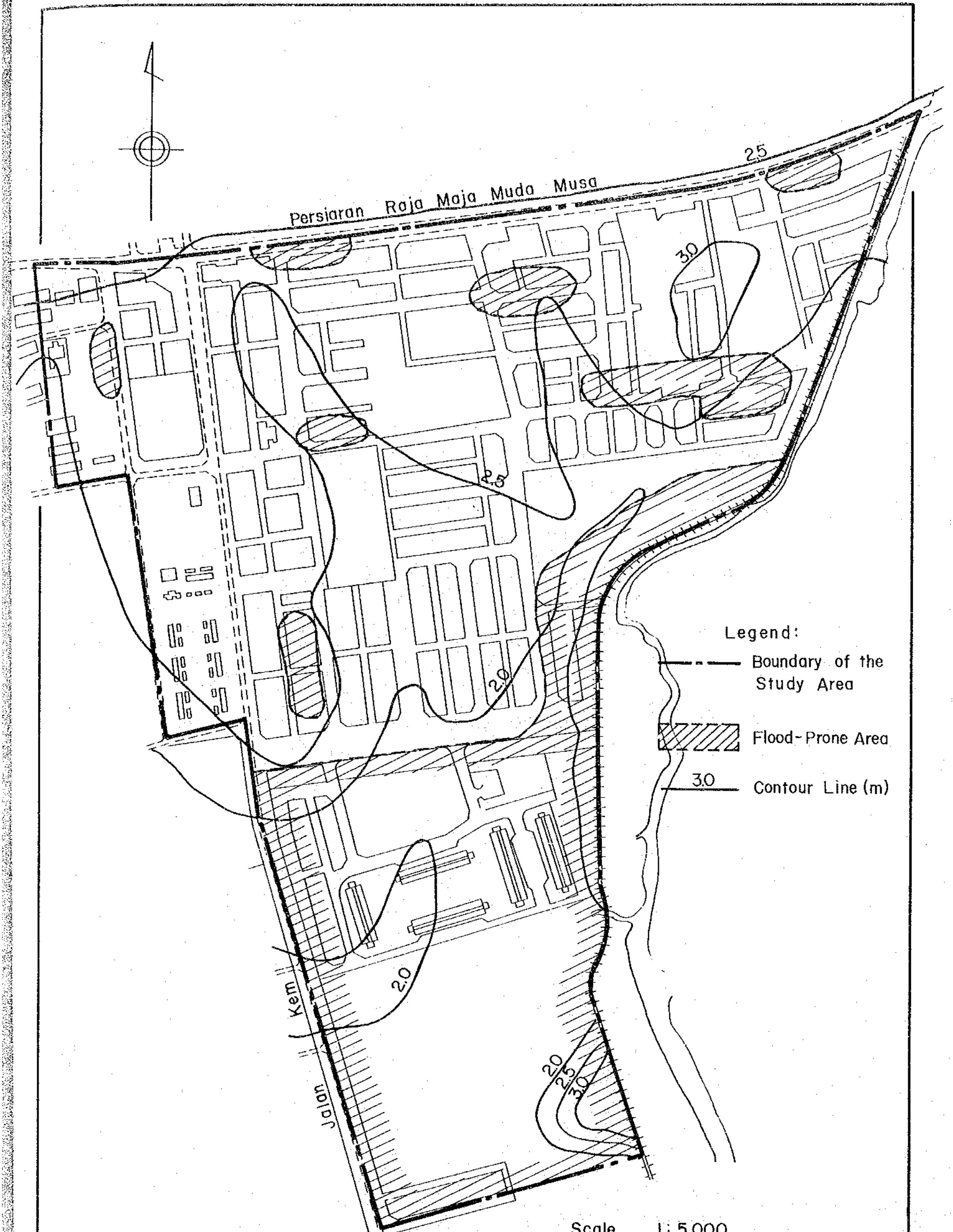
2.5.2. Existing Land Use

This area is comprised of a developed commercial area and developing housing area.

The present situation regarding land use of the A-4 Catchment is shown in Fig. 2.6 and the areas earmarked for the various categories are given in Table 2.2.

Table 2.2. Existing Land Use in A-4 Catchment (1980)

Land Use	Area	
	(ha)	(Percentage)
Residential	18.5	35.2
Commercial	10.5	20.0
Vacant	20.5	39.0
School	3.0	5.8
Total	52.5	100.0



Ground Elevation and Flooding Area in Port Kelang

Fig. 2.5

2.5.3. Existing Drainage System

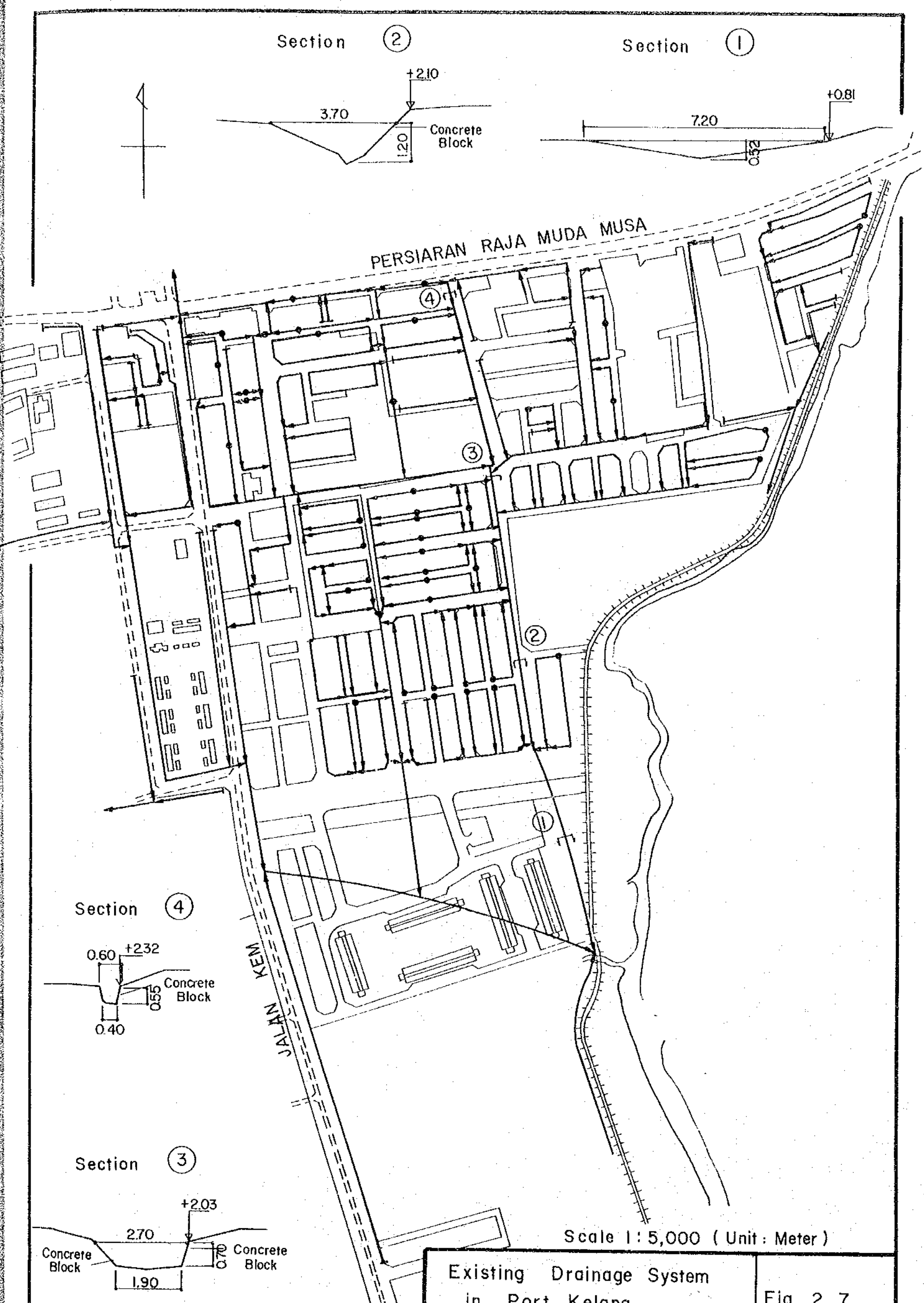
The existing drainage system for A-4 Catchment is in the same antiquated state of inadequacy and disrepair as the foregoing. Consequently, the 3 m^3/sec capacity of the trunk drain is insufficient to accommodate the flow. Fig. 2.7 shows its layout.

2.5.4. Flooding

Although a tidal gate exists at the outlet of the trunk drain to the tributary of the Aur River, this catchment has often experienced flooding due to inadequate watertightness of the tidal gate, as well as the low ground elevation.

However, floods in the southern part of A-4 Catchment are expected to be reduced to some degree because the ground elevation of this area has recently been raised by landfill in conjunction with housing development.

Size and population of flood-prone areas in this catchment are 14.6 ha and 600 persons (1980) respectively.



Existing Drainage System in Port Kelang

Fig. 2.7

CHAPTER 3

BASIS OF DESIGN AND COST ESTIMATES

CHAPTER 3 BASIS OF DESIGN AND COST ESTIMATES

Design bases presented herein are basically in accordance with those recommended in the Master Plan except land use plan which is developed by the Study Team. Design for the First Phase Program is briefly described below. Unit cost is also developed in this Chapter.

3.1. Land Use Plan

Further detailed consideration was given on the future land use in the Study Area based on the proposed Master Plan. Supplementary development plans proposed by the TCP, Selangor State, were collected through the Kelang Municipality. Discussions with the consultants conducting the city planning for Kelang Town were held and suggestions were received from them. Subsequent adjustments and modifications were made as a result of information obtained during the field survey.

This land use plan becomes the basis for calculating stormwater discharge, one of the elements of which is runoff coefficient, which varies depending on land use pattern.

3.1.1. Land Use Plan in Kelang North (N-5, N-6 and N-7 Catchments, 2000)

Land use plan in the year 2000 is developed using projected population and various planning parameters projected in the Master Plan, such as population density for each land use category, number of persons in a household, etc. The land use plan developed are shown in Fig. 3.1 and Table 3.1.

3.1.2. Land Use Plan in A-4 Catchment (2000)

Taking into account the existing land use and the conceptual plan, the future land use plan is shown in Fig. 3.2. On the basis of the land use plan, details of the areas to be allocated for various land use purposes are tabulated in Table 3.2.

Table 3.1. Land Use Plan in Kelang North (2000)

Land Use	Area				
	Total		N-5	N-6	N-7
	(ha)	(Percentage)	(ha)	(ha)	(ha)
Residential	65.5	34.5	44.2	17.7	3.6
Commercial	80.5	42.4	20.2	37.7	22.6
Industrial	17.0	8.9	0.0	0.0	17.0
Open Space	15.0	7.9	3.5	8.5	3.0
School	12.0	6.3	1.6	8.4	2.0
Total	190.0	100.0	69.5	72.3	48.2

Table 3.2. Land Use Plan in A-4 Catchment (2000)

Land Use	Area	
	(ha)	(Percentage)
Residential	15.5	29.5
Commercial	26.0	49.5
Industrial	5.5	10.5
Open Space	2.5	4.3
School	3.0	5.7
Total	52.5	100.0

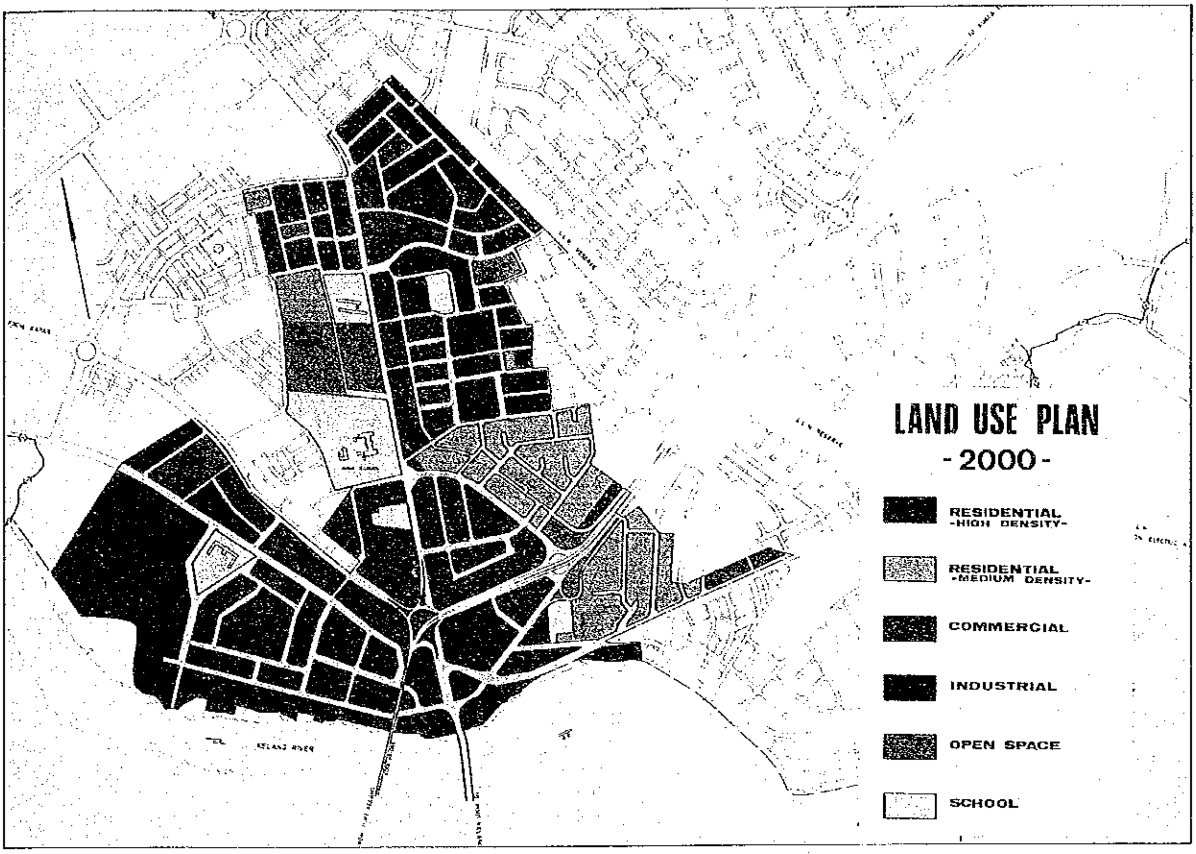


Fig. 3.1. Land Use Plan in Kelang North (2000)

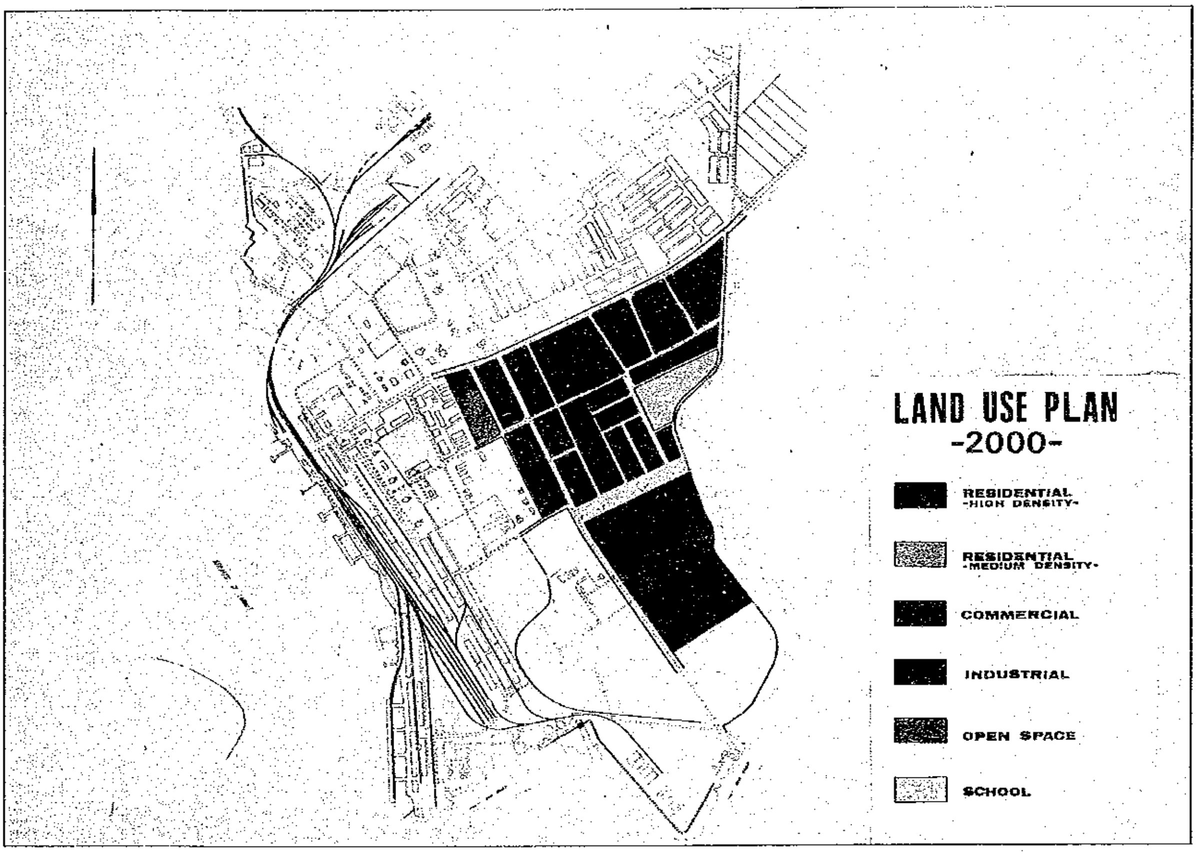


Fig. 3.2. Land Use Plan in A-4 Catchment (2000)

3.2. Kelang River Water Level

Since the Study Area lies in the most downstream basin of two rivers; namely, the Kelang River and the Aur River, the discharge of the stormwater runoff originating from the Study Area is significantly affected by the river water levels. The river water levels therefore are taken into consideration in this study to enable carrying out the actual design for the drainage system for the Study Area.

In accordance with the study for the Master Plan, 5-year river flood levels obtained from hydrological analysis is applied as the basis for design of the urban drainage system.

Furthermore, considering the proximity of the Study Area to the sea, special attention shall be given to sea level. The mean high water springs of R.L. +2.1 m is used while this is not the highest level. This is because frequency of flood level usually occurs twice a day, but that frequency exceeding mean high water springs is only about one-seventh. Furthermore, if water level higher than the adopted mean high water springs is selected, the cost of the drainage facilities would be significantly increased, since inclusion of a pumping system would become necessary in the plan, considering the low ground elevation within the Study Area.

Using the mean high water springs of R.L. +2.1 m, river water levels are determined to be R.L. +2.2 m in Kelang North (N-5, N-6 and N-7 catchments) and R.L. +2.1 m in A-4 catchment, Port Kelang.

3.3. Stormwater Discharges

3.3.1. Runoff Formula

The "Rational Formula" with a storage coefficient is applied for estimating the stormwater runoff, which is expressed below:

$$Q = \frac{1}{360} \text{CsCIA}$$

Where,

Q : Peak discharge of return period T-year (m^3/sec)

I : Average intensity of rainfall for duration equal to the time of concentration tc and a return period T-year (mm/hr)

A : Catchment area (ha)

C : Runoff coefficient

Cs : Storage coefficient which is expressed as

$$Cs = \frac{2tc}{2tc + td}$$

tc : Time of concentration (min.)

td : Time of flow in the drain (min.)

3.3.2. Rainfall Frequency

The national standard for the average frequencies of rainfall occurrence is used in drainage design for the respective land use patterns as follows:

Residential area	2-year
Commercial area	5-year
Industrial area	5-year

However, a 5-year return period is used for design of trunk drains. These figures are in accordance with those recommended in "Urban Drainage Design Standards and Procedures for Peninsular Malaysia, 1975," prepared by DID for the sake of national conformity.

3.3.3. Rainfall Intensity-Duration-Frequency Formula

Rainfall intensity - duration - frequency relationships for the major 13 cities including Kuala Lumpur, are developed by DID. Rainfall relationship ranging from 1 to 30 days in Kelang is almost the same as that in Kuala Lumpur as stated in the Master Plan. Therefore, rainfall intensity as developed for Kuala Lumpur is used, which is expressed as follows:

2-year frequency $I = \frac{5,850}{t + 28}$ (mm/hr)

5-year frequency $I = \frac{7,000}{t + 29}$ (mm/hr)

100-year frequency $I = \frac{10,240}{t + 32}$ (mm/hr)

Where, t : Time of concentration (min.)

3.3.4. Runoff Coefficient

The runoff coefficients proposed in the following are determined with due consideration of Malaysian standards as well as the Team's experience.

Residential Area (High Density)	0.75
Residential Area (Medium Density)	0.55
Residential Area (Low Density)	0.45
Commercial Area	0.90
Industrial Area	0.65
Institutional Area	0.50
Open Space, Plantation	0.30

3.3.5. Time of Concentration

The time of concentration consists of the inlet time of runoff flow over the ground surface to the nearest drain plus the time of flow in the drain from the most remote inlet to the point under consideration. The recommended inlet time is 10 minutes as described in Appendix C, Vol VIII, and the time of flow in the drain is estimated depending on the hydraulic properties of the individual drain.

3.4. Drainage Facilities

3.4.1. Storm Drains

The proposed drains are basically open channels, considering its advantages over closed conduits -- such as low cost and ease of maintenance.

The size of drain is based on an additional allowance of 20 percent of the stormwater discharge and 10 percent freeboard. But should additional space be required or properties be affected, the allowance is reduced to meet local conditions, taking into account the existing land use, drain size, property lines, etc. The proposed size of drains is presented in the following chapter.

While the channel which has the best hydraulic characteristics is that which most closely approaches a half circle, these proportions are not applicable to local conditions, because the Study Area is so highly developed that widening of the area would not be practical. Hence, deep and narrow rectangular drains are designed on the whole as shown in Fig. 3.3.

In addition to the actual width of the channel, an access strip on one or both sides in the form of either a road or green belt should be provided for maintenance and repair. Typical cross-sections of the recommended reserve width for maintenance including width of drain structure are shown in Fig. 3.4. However, only a few land acquisitions are required since almost all the proposed drains, which are routed the same as the existing drains, run along the existing and planned roads.

1) Open Channel

For the main drain, rectangular reinforced concrete channel drains, either pre-cast or cast-in-place, are used.

a) Flow Friction Formula

For the hydraulic design of open channels, the Manning's Formula is applied as expressed below:

$$V = \frac{1}{n} R^{\frac{2}{3}} I^{\frac{1}{2}}$$

Where,
V : Velocity (m/sec)
n : Roughness coefficient
R : Hydraulic Radius (m)
I : Gradient

The value of "n" is determined, depending on the type of drain, as defined below:

Concrete Drain
Cast-In-Place : n = 0.015
Pre-cast : n = 0.013
Masonry Drain : n = 0.025

b) Velocity of Flow

Considering prevention of grit and sand deposits in storm drains, and erosion of drains, the recommended minimum and maximum velocities for various types of drain are given below:

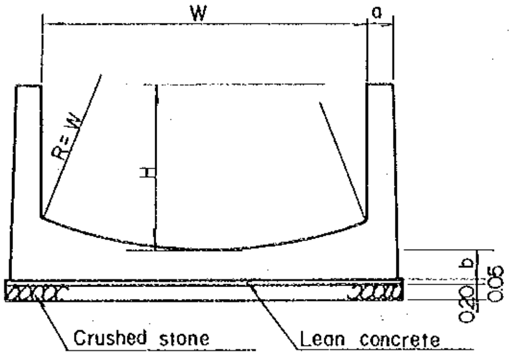
Design Velocity by Type of Drain

Type of Drain	Design Velocity (m/sec)	
	Minimum	Maximum
Concrete Drain	0.6	3.0
Masonry Drain	0.6	2.5

2) Box Culverts

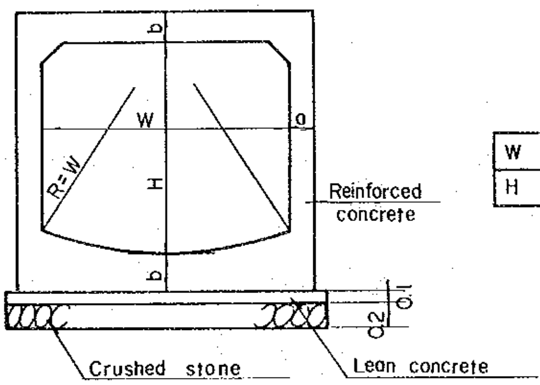
At a road crossing, the box culvert is generally used. Currently the available market size of the pre-cast box culvert is limited to small ones; hence, multiple numbers of box culverts are laid parallel to enable the flow of stormwater in large capacity drains. A typical cross-section of box culvert is shown in Fig. 3.3.

R.C. Open Channel



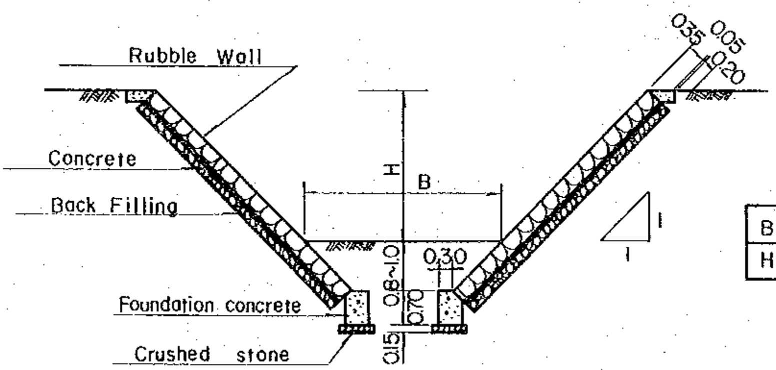
			m
W	0.8 ~ 2.9	a	0.10 ~ 0.25
H	0.8 ~ 2.9	b	0.10 ~ 0.25

R.C. Box Culvert



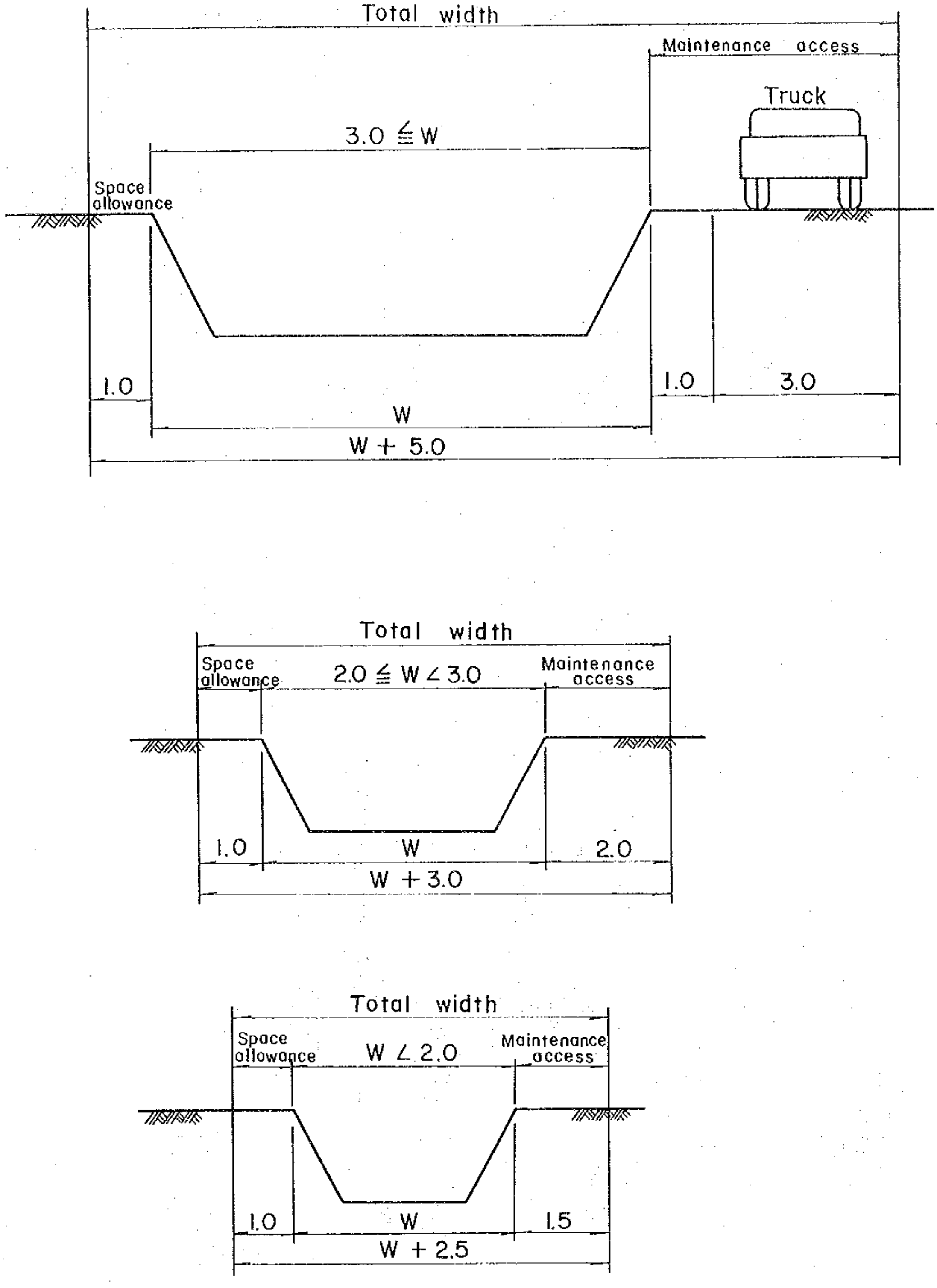
			m
W	1.3 ~ 2.8	a	0.15 ~ 0.25
H	1.3 ~ 2.8	b	0.15 ~ 0.25

Rubble Wall Channel



	m
B	2.5 ~ ∞
H	2.1 ~ 2.7

Cross-Section of Standard Drain	Fig. 3.3



(Unit : Meter)

Cross-Section of Standard Drain Reserve	Fig. 3.4

3.4.2. Tidal Gates

A gate is used at or near a drain outlet for the purpose of preventing back-flooding of the drainage system by high tides or high stages in the receiving stream. While flap gates are often used due to their ease of operation and maintenance, these are not recommended in the Study Area, due to their unavailability in size to fit the drain outlets. Sluice gates are recommended in the Study Area. A typical gate structure is shown in Fig. 3.5.

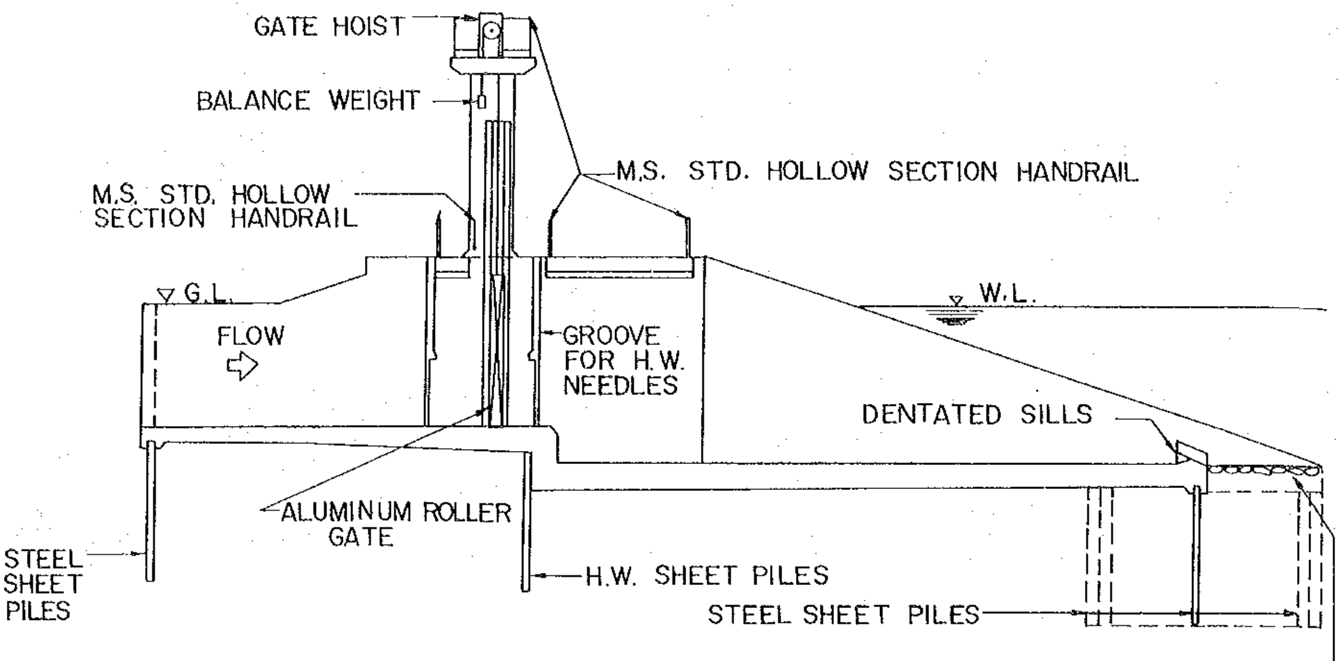
3.4.3. Bunds

The Study Area is strongly affected by tide, the level of which fluctuates from R.L. -2.4 m to +2.6 m, according to Tide Table, 1981. But the maximum water level recorded by State DID at Jambatan Kota near the N-6 or N-7 catchments was R.L. +3.03 m, which was higher than that predicted by the tide table.

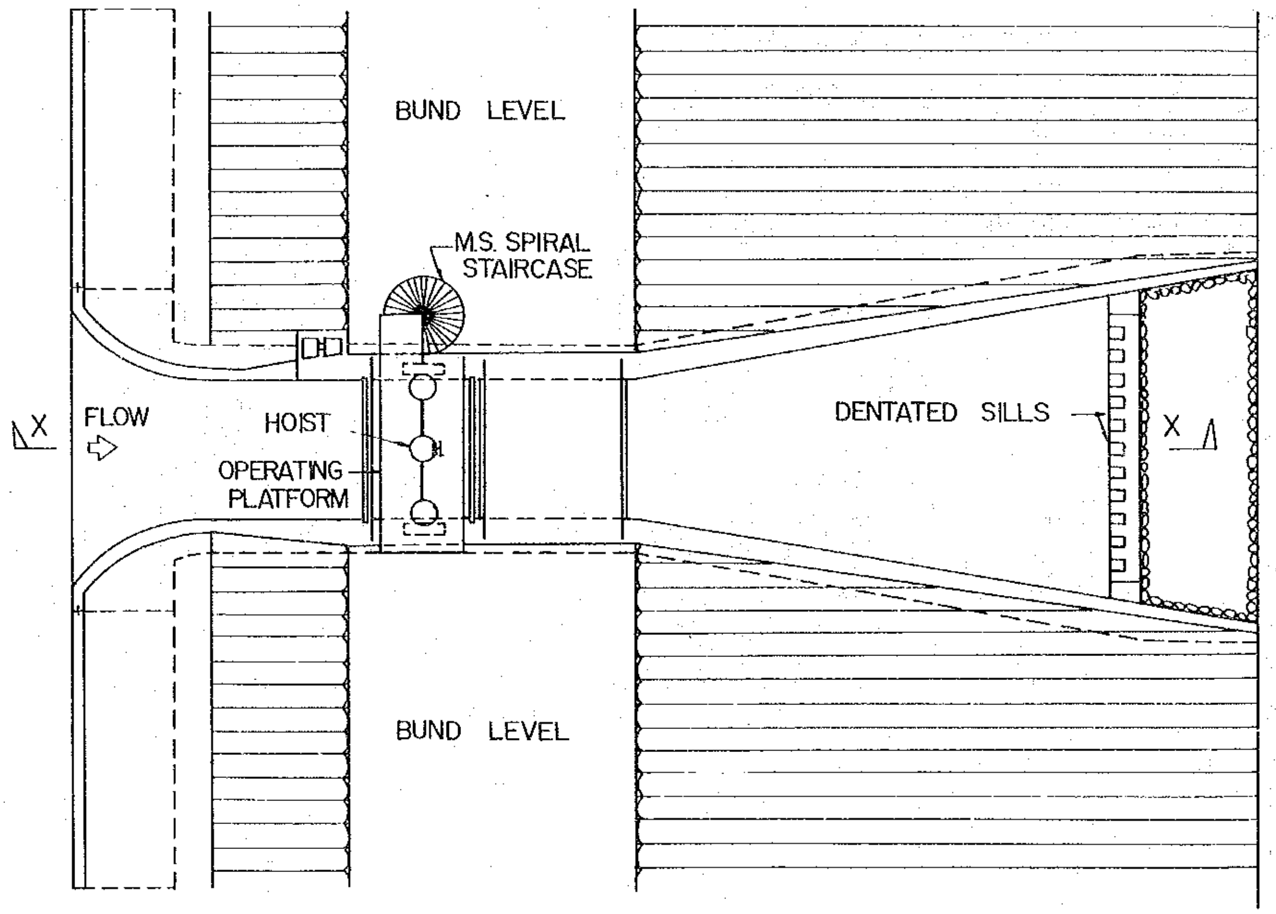
On the other hand, the ground elevation in each catchment as expressed below is lower than the maximum water level given above.

N-5 Catchment	R.L. +2.5 m - 4.5 m
N-6 "	R.L. +3.2 m - 4.5 m
N-7 "	R.L. +2.1 m - 3.6 m
A-4 "	R.L. +2.0 m - 3.0 m

Therefore, bund is proposed along the Kelang River and the Aur River, although some bunds have been constructed, as in A-4 catchment which is part of the Study Area. The proposed crest level for bund is R.L. +3.6 m with a freeboard of half a meter, based on the maximum recorded level.



SECTION X-X

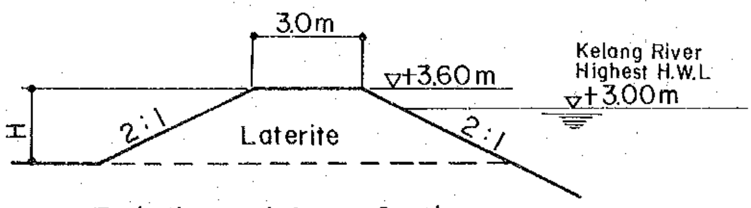


PLAN

Typical Gate Structure	Fig. 3.5

The structure for bund construction is presented in Fig. 3.6.

Fig. 3.6. Bund Structure



Typical Bund Cross Section

3.5. Materials and Methods of Construction

3.5.1. Construction Materials

Drainage improvement works to be implemented in the First Phase comprise construction of main drains and bunds and installment of tidal gates. Necessary materials for these works, such as steel bar, cement and pre-cast box culvert, are mostly available in Malaysia, except sheet pile and control facilities for tidal gates.

3.5.2. Construction Methods

1) Drain Construction

The critical factors in drain construction are excavation, bracing and sheeting, and dewatering. It is also necessary to consider minimum hindrance to the residents and traffic in the vicinity of the construction area, along with the minimum risk to the workmen.

a) Excavation

To economize on the construction work, excavators such as backhoe and cramshell should be used; however, manual excavation is also required at the trench bottom and where underground pipes or cables are located; care should always be taken not to interfere with existing underground structures.
To limit interference with traffic in narrow roadways or highly congested downtown areas, the excavated soil should be removed from the area temporarily and returned later for backfilling.
Excavation should be undertaken immediately prior to installation of the pre-cast drain for the same reason. It is also advisable to limit the length of open trenches to a maximum 100 m in open areas and 30 to 40 m in developed areas.

b) Bedding, Bracing and Sheeting

According to the soil investigation conducted in the previous sewerage study by Proctor and Redfern in 1968, the soils in the Study Area are classified as soft or very soft silty-clay and also, high water table may be encountered.
Thus, the use of timber for sheeting in shallow trenches and steel sheet pile in deep trenches will be required in most parts of the Study Area except for very shallow trenches, taking into account soil, as well as groundwater, condition. For deep excavation, special precaution is required against heaving caused by low shear strength in wet condition, by using trench sheet driven deep into the ground. This problem may be overcome by driving sheet pipes sufficiently deeper than trench depth.

c) Dewatering

For most of the areas in the Study Area, removal of groundwater from the excavated trench will be required. Dewatering can be accomplished by sand pumps at the lower end of the trench in most cases, considering the rather low permeability of the soil.

d) Backfilling

Excavated soil can be used for backfilling. However, the excavated soil should be dried and large stones, roots, and lumps of clay removed before backfilling. Also, the backfilled soil should be compacted uniformly and thoroughly.

2) Construction of Tidal Gate

Tidal gates require a foundation extending approximately 5 to 10 m below the ground surface. To support the structure, piles will be required, considering the poor soil condition. Many bakau piles of 5 to 10 m length will be used as friction pile, considering their low cost and common usage in Malaysia.

3) Construction of Retention Pond

Despite its simplicity, the retention pond should be constructed properly in order to ensure economy and durability, as well as satisfactory performance. Major considerations to be given for the structural design of the pond are described in the following:

a) Embankments

The area where the embankments are to be constructed should be completely cleared. Embankments should be constructed of impervious material to the extent possilbe and be sufficiently compact to form a stable structure.

b) Pond Bottom

The pond bottom should be made as level as possible in its entirety. The soil at the bottom should be made impervious to avoid percolation or seepage of the contents. Therefore, although compacted subsoil at the bottom after removing porous topsoil may increase the water-holding capacity to some extent, the pond bottom should be replaced by well-compacted clay or other suitable impervious material. Furthermore, vinyl sheeting may be used to cover the bank and a part of the pond bottom, extending about 10 m beyond the bottom fringe of the pond.

c) Miscellaneous

The pond area should be enclosed with a suitable fence to preclude livestock and discourage public trespassing. A vehicle access gate of sufficient width to accommodate maintenance and operational equipment shall be provided.

4) Construction of Bund

The area where the bunds are to be constructed should be completely cleared. Bunds shuold be constructed of laterite, an impervious material, which is currently used in Malaysia and sufficiently compact to form a stable structure. To provide added stability, wire cylinder, which is inexpensive and simple to construct, is laid over the bund surface. Being subject to corrosion, the wire cylinder should be of the vinyl-coated type commonly used in Malaysia.

3.6. Unit Cost Estimates

3.6.1. General Basis for Cost Estimates

Information and data on basic costs, including labor and material costs, as well as some unit construction cost, have been collected from various sources such as MPK, DID, JKR, LLN, WWD, KTM, JT, statistics department, manufacturers, suppliers of equipment and materials and contractors. The labor cost and material cost are presented in Table 3.3 and Table 3.4 respectively. All cost obtained from the sources referred to above are expressed at 1981 price level in Malaysia.

Using these basic cost, unit construction cost have been developed with due consideration for the suitability of materials and construction methods, including availability of local materials and ability of local contractors.

These unit construction cost estimates, including contractor's profit, overhead, relevant customs tax, surtax and sales tax, are presented in Table 3.5.

Table 3.3. Labor Cost

Type of Labor	Labor Cost (M$/day) (@8 hrs/day)
Common Laborer	17.0
Skilled Laborer	24.0
Welder	27.0
Mason	27.0
Carpenter	27.0
Mechanic	27.0
Brick Layer	28.0
Concrete Worker	28.0
Steel Bender and Fixer	28.0
Painter	28.0
Lorry Driver	30.0
Equipment Operator	35.0
Foreman	45.0

Table 3.4. Price of Basic Materials

Item	Unit	Price (M$)	Remarks
Cement	t	196.18	
Sand	m^3	11.00	
Laterite	"	3.00	
Aggregates			
9 - 13 mm	m^3	35.00	
25 - 38 mm	"	31.00	
Crusher-Run	"	25.00	
Diesel Oil	liter	0.46	
Light Oil	"	0.50	
Steel Bar	t	960.00	
Timber	m^3	210.00	Grade A
Timber	"	260.00	Grade B
Ready-Mixed Concrete			
1 : 1½ : 3 mix	m^3	160.00	
1 : 2 : 4 mix	"	152.00	
1 : 3 : 6 mix	"	141.00	
Mortar	"	164.00	
H-shape Beam	t	1,100.00	
Sheet Pile	"	1,034.43	
Bakau Pile			
10 cm	6 m	6.90	
11.3 cm	"	7.50	
12.5 cm	"	8.50	
15 cm	"	10.30	
Box Culvert			
610mm x 455mm (24"x18")	1.22 m	185.50	
760 x 610 (30"x24")	"	217.50	
915 x 760 (36"x30")	"	247.50	
1,220 x 915 (48"x36")	"	328.00	
1,830 x 1,220 (72"x48")	"	609.50	
1,830 x 1,525 (72"x60")	"	691.00	
1,830 x 1,830 (72"x72")	"	745.00	
Tidal Gate (Aluminum Roller)			
4,267mm x 3,658mm (14'x12')		39,000	
3,962 x 3,658 (13'x12')		38,000	
3,658 x 3,658 (12'x12')		36,500	
3,353 x 3,658 (11'x12')		35,500	
3,048 x 3,658 (10'x12')		34,000	

Table 3.5. Unit Construction Cost

Item	Unit	Rate (M$)
1. Excavation		
Backhoe	m^3	1.61
Clamshell	"	7.08
2. Transporting Soil (average distance of 2 km)	m^3	3.91
3. Transporting, Placement and Compacting of Soil (Bulldozer)	m^3	1.36
4. Transporting, Placement and Compacting of Soil (Bund)	m^3	14.64
5. Supply and Placement of Concrete		
1 : 1½ : 3 mix	m^3	243.51
1 : 2 : 4 mix	"	233.11
1 : 3 : 6 mix	"	218.81
6. Supply, Cutting, Bending and Placement of Mild Steel		
13.0 mm and below	kg	1.74
16.0 mm and above	"	1.65
7. Forming		
Timber for small structure	m^2	2.66
Timber for other structure	"	14.28
Metal	"	14.95
8. Installing Box Culvert		
1,500 mm x 1,500 mm	m	766.34
2,500 x 2,500	"	1,375.94
3,000 x 3,000	"	1,702.94
9. Pitching and Driving Bakau Pile		
100 mm x 3 m	each	17.70
113 mm x 3 m	"	18.00
125 mm x 3 m	"	18.51
150 mm x 3 m	"	19.41
125 mm x 5 m	"	25.04
150 mm x 5 m	"	26.54
10. Supply and Placement of Mortar		
1 : 2, 20 mm thickness	m^2	11.90
1 : 3, 30 mm thickness	"	10.97
11. Steel Sheet Piling Work		
2.0 m depth	m	98.55
2.5 "	"	108.72
3.0 "	"	118.92
4.5 "	"	172.61
5.5 "	"	200.22
6.5 "	"	225.51
7.5 "	"	250.84
8.5 "	"	280.76
9.5 "	"	306.06
10.5 "	"	335.99

Note: Cost includes not only labor but also material.

3.6.2. Construction Cost

Based on the unit construction costs of Table 3.5, the cost of constructing structures such as drains and tidal gates are estimated as follows:

1) Trunk Drains

The cost of constructing trunk drains of various sizes are computed and plotted in Fig. 3.7.

Factors included in the consideration of cost are excavation, reinforced concrete, rubble stone, dewatering, steel sheet piling, etc. The major cost items for these drains are reinforced concrete and sheet piling which constitute 50 percent and 20 percent respectively.

2) Tidal Gate and Box Culvert

Since the recommended drain facilities include gates and box culverts, construction cost for these items are also estimated. Construction cost of box culverts are developed as shown in Fig. 3.8, while the cost for gates are estimated in the actual expenditure for construction on the basis of the proposed structure as shown in Fig. 3.9.

3) Bund

Unit construction cost of bunds is estimated on the basis of length. The unit costs per meter are M$29.28 for 0.5 m height, M$73.20 for 1.0 m height and M$ 131.76 for 1.5 m height.

3.6.3. Contingency Cost and Engineering Fees

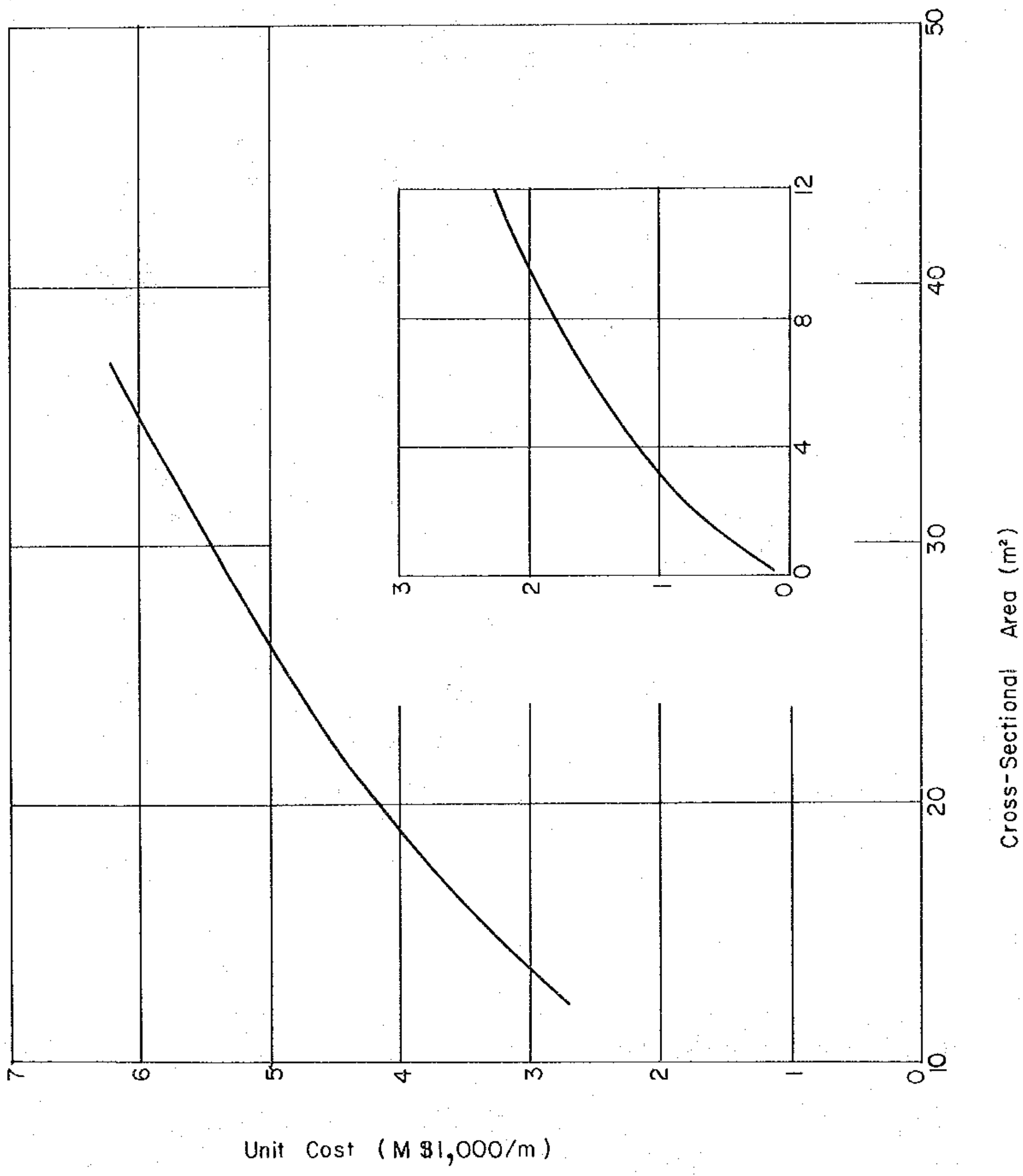
Contingency cost to cover unforeseen conditions is included in the cost estimates as a separate item at the rate of 10 percent, although the rate was 20 percent in the Master Plan.

Engineering fees, which include detailed design with tender documentation and construction supervision, are also included as a separate item at a rate of 10 percent, although the rate was 15 percent in the Master Plan.

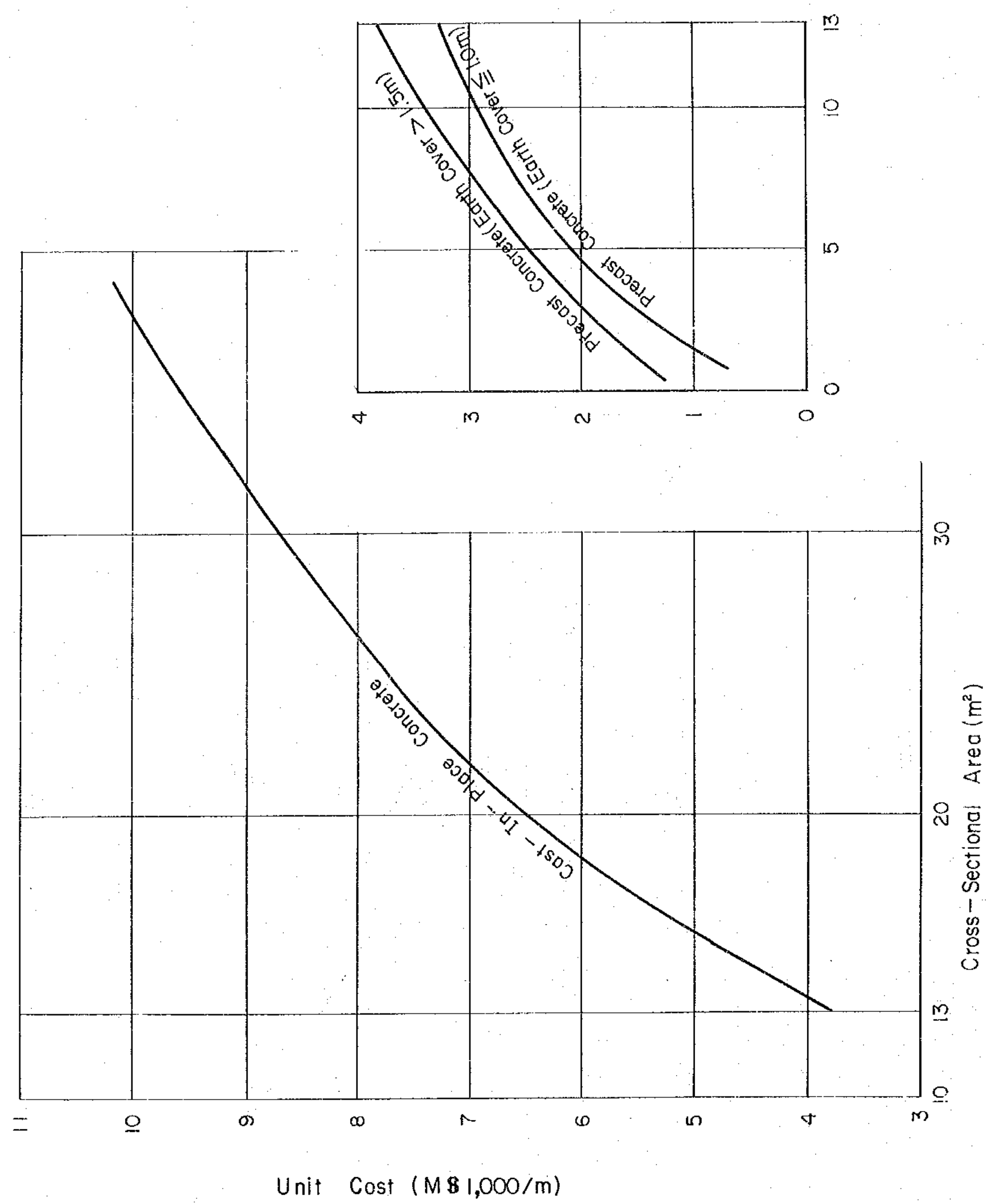
3.6.4. Unit Land Acquisition Cost

When new land is required for expansion of drain, land acquisition cost is added to the cost estimates.

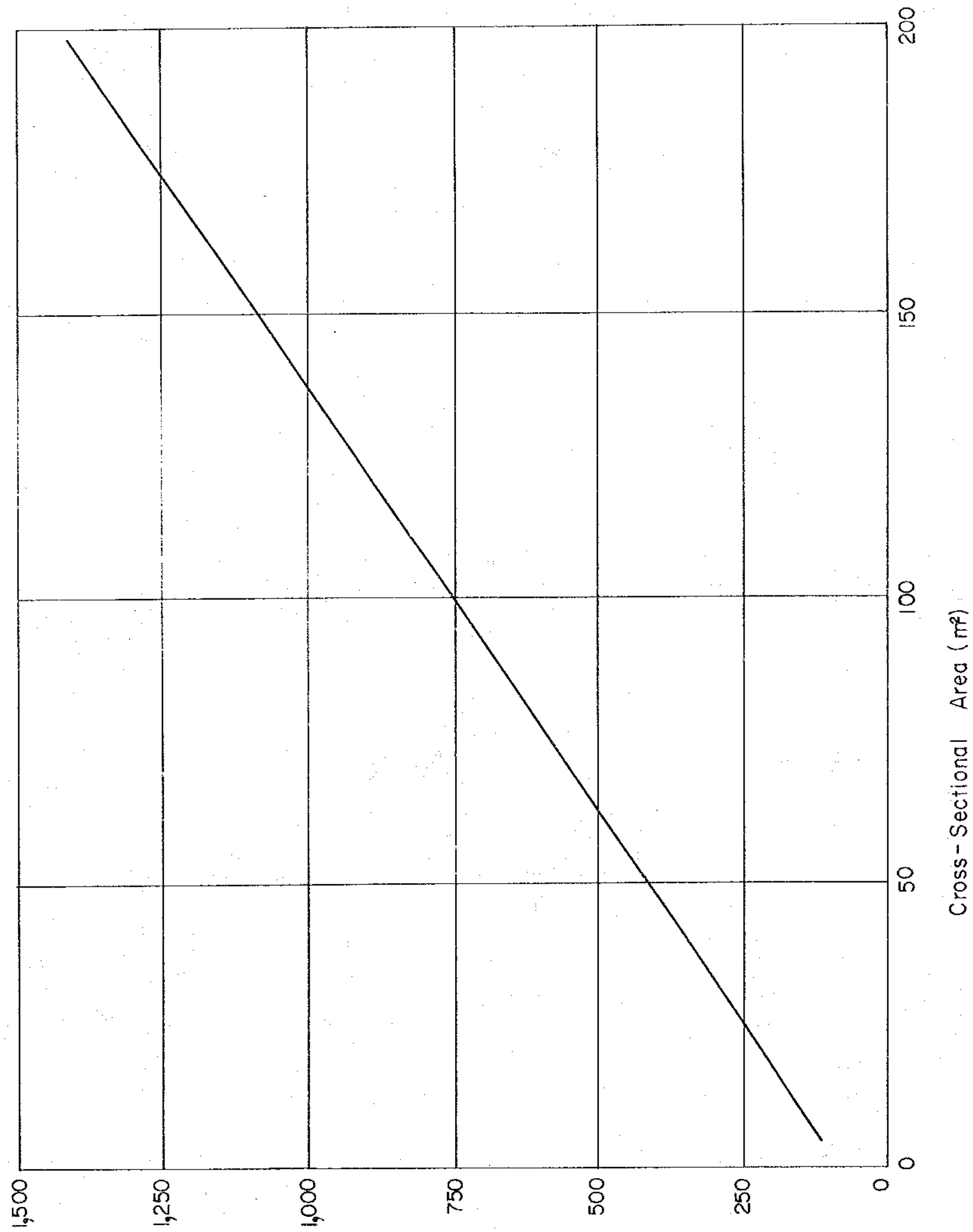
Unit land acquisition cost for N-7 catchment only where land is to be acquired is at M$78/$m^2$.



Cost Curve for Concrete Rectangular Open Channel	Fig. 3.7



Cost Curve for Box Culvert	Fig. 3.8



Unit Cost (M$1,000/each)

Cost Curve for Tidal Gate	Fig. 3.9

3.6.5 Unit Operation and Maintenance Costs

Operation and Maintenance works for the drainage system consist of the removal of deposits from drains, operation of gates, and repair of damaged parts of all drainage facilities.

1) Removal of Deposits

The unit cost of removing deposits is calculated on the assumption that a) an average volume in drain deposits is 10 percent of the cross-sectional area on an annual basis, b) machine excavation is applicable for trunk drains and retention pond, c) manual excavation is applicable for smaller drains, d) cost of removing deposits from drains is 20 percent higher than the excavation cost estimated in Table 3.5 and e) cost of transporting removed materials from the site to the designated dumping sites is the same as that of excess earth disposal cited in Table 3.5.

The unit cost for the removal of deposits, and disposing of refuse materials from trunk drains and retention ponds is estimated at M\$19.13/m^3 with M\$16.63/m^3 for small drains. The average volume of small drain is estimated at 11.4 m^3 per hectare.

2) Operation of Gates and Inspection of Drains

As discussed in the Master Plan, 15 laborers are required for operation of 26 tidal gates, as well as inspection of all drains in the Master Plan area, covering 6,628 hectares. Therefore, operation of four (4) tidal gates as well as inspection of all drains for the Study Area (consisting of four catchments) would be performed by two (2) laborers. The annual rate of laborer is M$4,020.

3) Repair and Replacement

The annual repair cost for drain facilities is assumed to be 0.5 percent of the construction cost of each facility.

CHAPTER 4

PROPOSED DRAINAGE SYSTEM

CHAPTER 4 PROPOSED DRAINAGE SYSTEM

4.1. General

Following the presentation in Chapter 2 of the condition and evaluation of the existing drainage systems within the Study Area, optimum First Phase Program for the improvement of the existing systems are described in this Chapter. These are planed, taking into consideration the future land use plan presented in Section 3.1, in conformity with the design basis outlined in Chapter 3.

The basic approach for alleviating flooding is, as described in the Master Plan, to prevent back-up waters and increase channel capacity. As proposed in the Master Plan, smaller or infrastructural drains are not included in the Feasibility Study.

4.2. Description of the Proposed Drainage System

Based on the consideration stated above, the proposed drainage system is further defined.

All the main drains are to be improved because the capacity of the existing drains is much smaller than the estimated runoff discharge. Implementation schedule as well as cost estimation is described in the following chapter.

Figs. 4.1 to 4.2 show the layouts and dimensions of the proposed drainage system as listed below:

N-5 Catchment	:	Fig. 4.1.
N-6 "	:	Fig. 4.1.
N-7 "	:	Fig. 4.1.
A-4 "	:	Fig. 4.2.

The hydraulic computations and proposed profiles of the trunk drains are shown in Tables K.1 to K.4 and Figs. K.3 to K.4 in the Appendix K, Vol VIII.

As for the sub-trunk drains which are not scheduled for implementation, hydraulic computations and plans are also shown in Tables K.1 to K.4 and in Figs. K.1 to K.2 in the Appendix of Volume VIII for reference.

4.2.1. Trunk Drains and Box Culverts

Due to the extremely flat ground condition in the Study Area, the gradients for the recommended drains are gentle and the design velocity is low, ranging from 0.9 m/sec to 2.0 m/sec. Thus, a large cross-sectional area is required to accommodate peak discharge. Furthermore, taking into account the developed nature of the Study Area and unfeasibility of the diversion or relief channel, widening and deepening of the existing drain is the only way to accommodate peak discharge.

Therefore, rectangular concrete channel is recommended, as discussed under Design Basis, to reduce the necessary cross-sectional area and land requirements for the drains, even though this might increase construction cost compared with that in other towns. The proposed trunk drains are summarized in Table 4.1. The dimensions of each part of trunk drains are presented in Table 5.2.

Whenever the channel crosses a roadway, the box culvert is used. Many of the existing channels at road crossings are undersized box culverts, which cause flooding during heavy rains; therefore, these should be replaced with those of larger capacity, as recommended in Figs. 4.1 to 4.2. (Ref.: Table 5.2.)

Since the necessary drainage improvement works consist mostly of widening, deepening and lining the existing channels which run along main roads, no reserve land for drain maintenance is necessary, except for a downstream channel of the N-7 trunk drain.

Table 4.1. Proposed Trunk Drains (including Box Culverts)

Catchment Code No.	Length (m)	Size
N-5	1,425	1.4mx1.4m ∿ 2.8mx2.8m
N-6	2,985	1.5 x1.5 ∿ 2.4 x2.4
N-7	1,455	1.2 x1.2 ∿ 2.9 x2.9
A-4	1,595	1.1 x1.1 ∿ 2.9 x2.9
Total	7,460	

4.2.2. Tidal Gates and Retention Ponds

To prevent back-up waters from the rivers during high water stages, the sluice gates at each outlet of the trunk drain in N-5, N-6, N-7 and A-4 catchments are replaced with one of appropriately larger size. The size of the gates shall be the same as that of the proposed drain, since stormwater runoff shall be drained promptly during low river water stages.

The proposed location of the retention pond could be utilized at present, because the proposed location is now a swampy area in a tributary of the Aur River, the ground elevation of which is R.L. +1.5 m, lower than the surrounding A-4 catchment level. For that purpose, installation of a tidal gate is proposed at the outlet of the retention pond instead of the outlet of the trunk drain as shown in Fig. 4.2. Nevertheless, the size of the gate in A-4 catchment is the same as that of the drain, because the gate size is determined on the basis that the drain would be emptied as soon as possible, even though the accumulated stormwater might be drained during low river water stage.

The recommended size of the gates and their locations are shown in Table 4.2 and Figs. 4.1 to 4.2 respectively.

Table 4.2. Proposed Tidal Gates

Catchment Code No.	Size (width x height)	Quantity
N-5	3.6m x 3.0m	1
N-6	"	1
N-7	"	1
A-4	"	1

Basic considerations for operating the gates are as follows:

(1) To be kept closed during the time river water level is higher than drain water level.

(2) To be kept open during the time river water level is lower than drain water level.

Accordingly, the following operational procedure is proposed:

1) Absence of rainfall

a) Gates are to be kept closed during the time river water level is higher than invert level of drain.

b) Gates are to be kept open during the time river water level is lower than invert level of drain.

2) During rainfall

Operation of the gates is rather difficult during rainfall and significant flooding would be caused by improper or faulty operation. Therefore, further study of the method of operation should be conducted, taking into consideration such factors as intensity of rainfall and river water level.

The above-mentioned operation shall be conducted properly and promptly, especially considering the 5-meter difference in the river water level. Therefore, a central data collection center as well as electrically-operated gates are planned, which will be preceded for the present by a telemeter system to indicate whether the gates are open or closed.

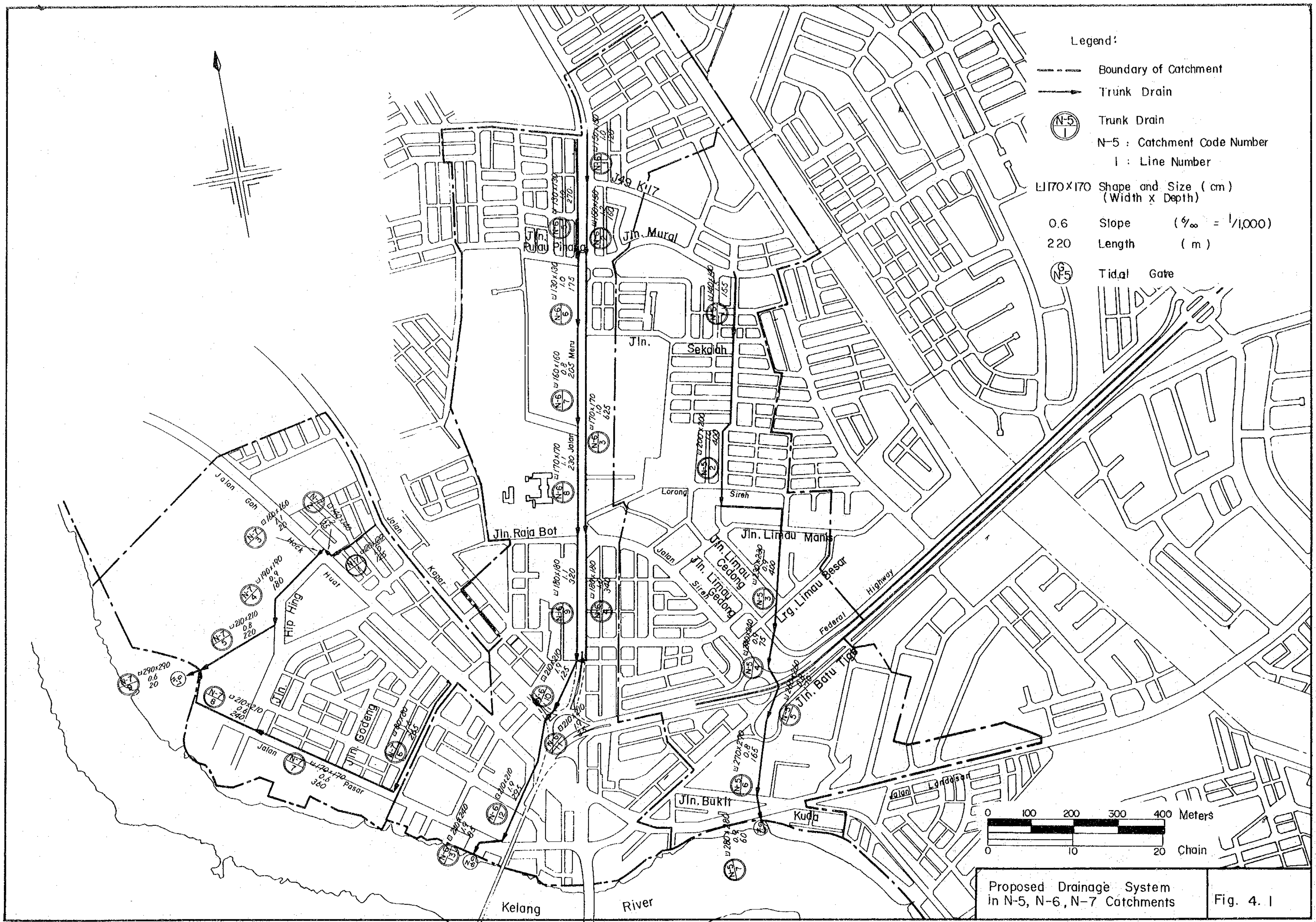
4.2.3. Bunds

The design for the urban drainage system for solution of the flood problems must meet the design flows when the design frequencies of rainfall occurrence coincide with the river flood flows. However, since the ground elevation of the Kelang Municipality (including the Study Area) is very low, the problems of flooding would not be solved even if the drainage system were to be designed to meet local storms, due to back-flooding from the river. Thus, bunds are required and proposed to protect the Kelang Municipality. The proposed bund alignments and lengths are shown in Fig. 4.3 and Table 4.3 respectively.

Determination of the crest level of the bund at R.L. +3.6 m is based on the maximum recorded level as discussed previously, while a 2- or 5-year return period urban drainage system is proposed to meet the storm-water runoff.

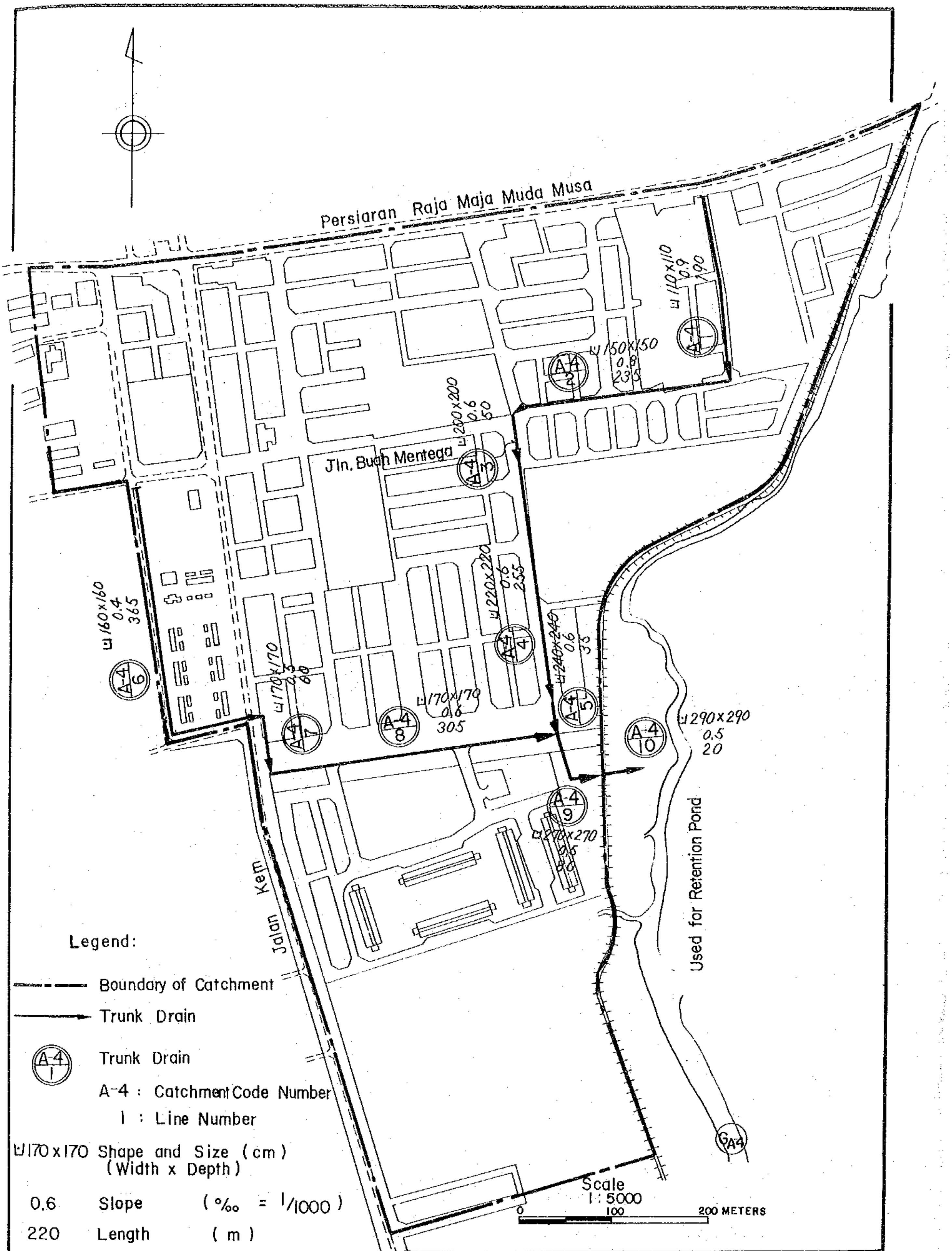
Table 4.3. Proposed Bunds

Catchment Code No.	Height of Bund (m)	Length (m)
N-5	0.5	270
N-6	0.5	830
N-7	0.5	580
	1.0	110
	1.5	190
Total		1,980



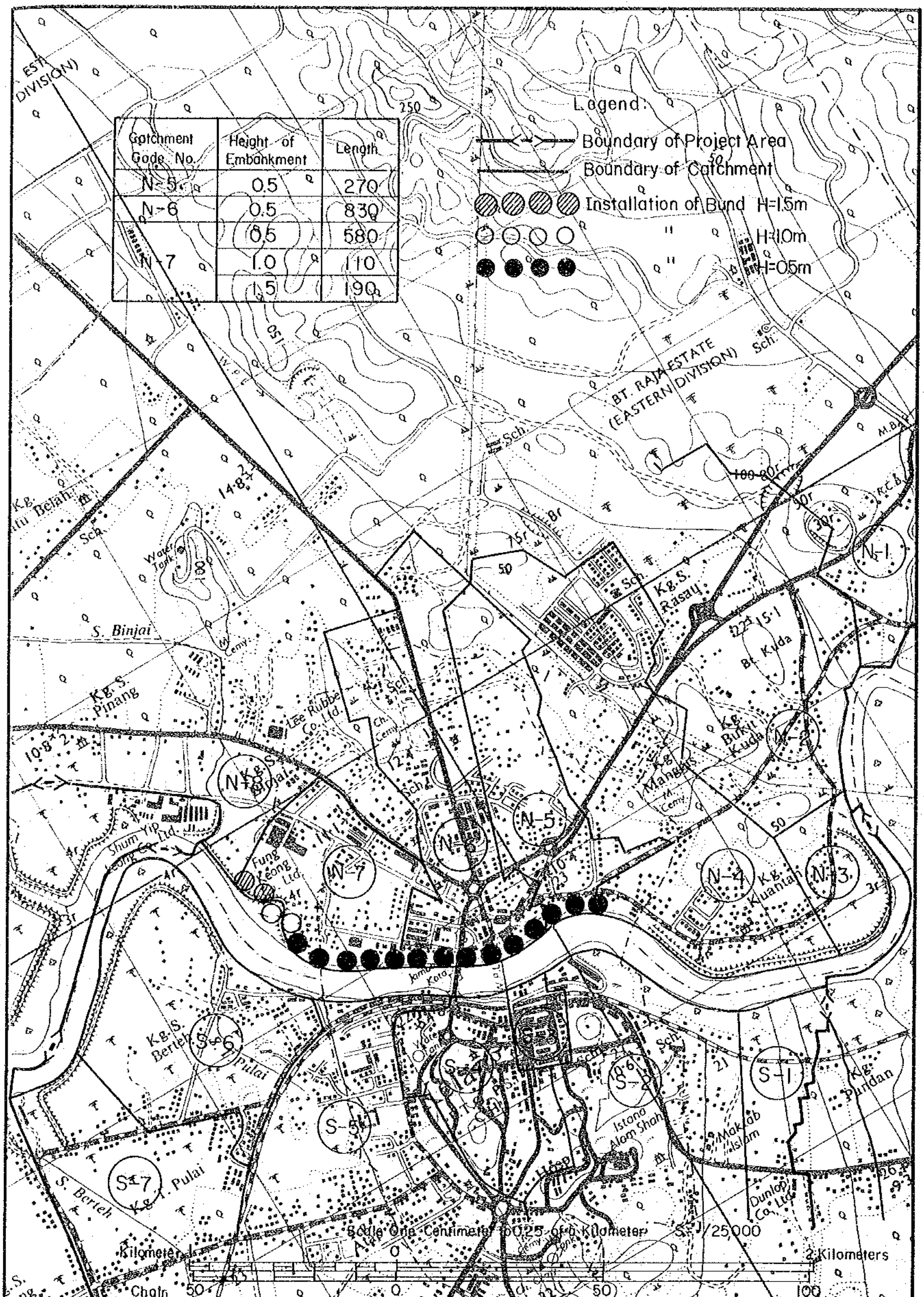
Proposed Drainage System in N-5, N-6, N-7 Catchments

Fig. 4. I



Proposed Drainage System in A-4 Catchment

Fig. 4.2



Proposed Bunds in Kelang North

Fig. 4.3

CHAPTER 5

CONSTRUCTION COST AND IMPLEMENTATION SCHEDULE

Chapter 5 CONSTRUCTION COST AND IMPLEMENTATION SCHEDULE

5.1. Construction Cost

Total construction cost is estimated at M$11.9 million at 1981 price level (M$17.8 million with annual escalation of 6.5 percent in accordance with Fourth Malaysia Plan), and annual operation and maintenance cost at 1981 price level at M$149,000, which are shown in Tables 5.2 and 5.3, respectively.

Table 5.1. Construction Cost Summary

(Unit: M$ million at 1981 price level)

Item	Cost
1. Construction Work	
Trunk Drains	8.7
Tidal Gates	0.6
Bunds	0.1
Telemeter System	0.3
2. Land Acquisition	0.1
3. Engineering Fee	1.0
4. Contingency Cost	1.1
Total	11.9

Table 5.2. Detailed Construction Costs by Catchments

I. N-5 Catchment

C: Concrete rectangular channel
B; Box Culvert

A. Trunk Drain (* Locations of line are presented in Fig. 4.1)

Line No.*	Length (m)	Size (m)	Unit Cost (M$/m)	Construction Cost (M$)	
1	135	C 1.4 x 1.4	730	98,550	
	20	B 1.4 x 1.4	1,200	24,000	
2	360	C 2.0 x 2.0	1,170	421,200	
	40	B 2.0 x 2.0	1,850	74,000	
3	320	C 2.3 x 2.3	1,400	448,000	
	80	B 2.3 x 2.3	2,170	173,600	
4	55	C 2.4 x 2.4	1,470	80,850	
	20	B 2.4 x 2.4	2,250	45,000	
5	100	C 2.6 x 2.6	1,650	165,000	
	70	B 2.6 x 2.6	2,450	171,500	
6	145	C 2.7 x 2.7	1,730	250,850	
	20	B 2.7 x 2.7	2,550	51,000	
7	40	C 2.8 x 2.8	1,800	72,000	
	20	B 2.8 x 2.8	2,650	53,000	
Sub Total	1,425 (Inclusive of 270m Length Box Culvert)				2,128,550

B. Tidal Gate $3.6^{m} \times 3.0^{m} \times 1^{No.}$ 155,000

C. Bund (See Item V)

Total 2,283,550

II. N-6 Catchment

A. Trunk Drain (* Locations of line are presented in Fig. 4.1)

Line No.*	Length (m)	Size (m)	Unit Cost (M$/m)	Construction Cost (M$)	Remark
1	100	C 1.5 x 1.5	800	80,000	
	20	B 1.5 x 1.5	1,300	26,000	
2	160	C 1.5 x 1.5	800	128,000	
3	555	C 1.7 x 1.7	950	527,250	
	70	B 1.7 x 1.7	1,500	105,000	
4	270	C 1.8 x 1.8	1,030	278,100	
	70	B 1.8 x 1.8	1,650	115,500	
5	270	C 1.3 x 1.3	650	175,500	
6	155	C 1.3 x 1.3	650	100,750	
	20	B 1.3 x 1.3	1,070	21,400	
7	185	C 1.6 x 1.6	870	160,950	
	20	B 1.6 x 1.6	1,400	28,000	

Table 5.2. (Cont.)

Line No.	Length (m)	Size (m)	Unit Cost (M$/m)	Construction Cost (M$)	
8	210	C 1.7 x 1.7	950	199,500	
	20	B 1.7 x 1.7	1,500	30,000	
9	300	C 1.8 x 1.8	1,030	309,000	
	20	B 1.8 x 1.8	1,650	33,000	
10	125	B 2.1 x 2.1	1,950	243,750	
11	35	B 2.1 x 2.1	2,350	82,250	
12	295	B 2.1 x 2.1	2,350	693,250	
13	85	B 2.4 x 2.4	2,650	225,250	
Sub Total	2,985 (Inclusive of 780m Length Box Culvert)				3,562,450
B. Tidal Gate		3.6^m x 3.0^m x $1^{No.}$		155,000	
C. Bund	(See Item V)				
Total					3,717,450

III. N-7 Catchment

A. Trunk Drain (* Locations of line are presented in Fig. 4.1)

Line No.*	Length (m)	Size (m)	Unit Cost (M$/m)	Construction Cost (M$)	
1	125	C 1.2 x 1.2	600	75,000	
2	25	C 1.4 x 1.4	730	18,250	
3	20	B 1.6 x 1.6	1,400	28,000	
4	180	C 1.9 x 1.9	1,100	198,000	
5	220	C 2.1 x 2.1	1,250	275,000	
6	265	C 0.8 x 0.8	300	79,500	
7	340	C 1.7 x 1.7	950	323,000	
	20	B 1.7 x 1.7	1,500	30,000	
8	210	C 2.1 x 2.1	1,250	262,500	
	30	B 2.1 x 2.1	1,950	58,500	
9	20	C 2.9 x 2.9	1,850	37,000	
Sub Total	1,455 (Inclusive of 70m Length Box Culvert)				1,384,750
B. Tidal Gate		3.6^m x 3.0^m x $1^{No.}$		155,000	
C. Bund	(See Item V)				
D. Land Acquisition Cost					
8	210	width 7.0 m (C 2.1 x 2.1)	78	114,660	
Total					1,654,410

Table 5.2. (Cont.)

IV. A-4 Catchment

A. Trunk Drain (* Locations of line are presented in Fig. 4.2)

Line No.*	Length (m)	Size (m)	Unit Cost (M$/m)	Construction Cost (M$)	
1	190	C 1.1 x 1.1	500	95,000	
2	215	C 1.5 x 1.5	800	172,000	
	20	B 1.5 x 1.5	1,300	26,000	
3	30	C 2.0 x 2.0	1,170	35,100	
	20	B 2.0 x 2.0	1,850	37,000	
4	255	C 2.2 x 2.2	1,330	339,150	
5	35	B 2.4 x 2.4	2,250	78,750	
6	345	C 1.6 x 1.6	870	300,150	
	20	B 1.6 x 1.6	1,400	28,000	
7	60	C 1.7 x 1.7	950	57,000	
8	305	C 1.7 x 1.7	950	289,750	
9	80	C 2.7 x 2.7	1,730	138,400	
10	20	C 2.9 x 2.9	1,850	37,000	
Sub Total	1,595 (Inclusive of 95m Length Box Culvert)				1,633,300

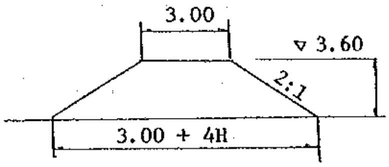
B. Tidal Gate $3.6^{m} \times 3.0^{m} \times 1^{No.}$ 155,000

C. Bund (See Item V)

Total 1,788,300

Table 5.2. (Cont.)

V. Bunds



A (3.00 + 2H) x H = 3H + $2H^2$

H=0.5 – Type A V = 2.0 m^3/m

H=1.0 – Type B V = 5.0 m^3/m

H=1.5 – Type C V = 9.0 m^3/m

Catchment Code No.	Type of Bund	Length (m)	V (m^3/m)	Volume (m^3)	Cost (M$)
N-5	A	270	2.0	540	8,000
N-6	A	830	2.0	1,660	24,000
N-7	A B C	580 110 190	2.0 5.0 9.0	3,420	50,000
Total		1,980		5,620	82,000

VI. Telemeter System	M$240,000
VII. Engineering Fees	M$997,000
VIII. Contingency Cost	M$1,087,290
Grand Total	M$11,850,000

Table 5.3. Annual Operation & Maintenance Costs

(Unit: M$1,000)

Catchment Code No.	Deposit Removal Costs		Repair Cost	Gate Operation	Total
	Trunk Drain	Small Drain			
N-5	14	12	12	---	38
N-6	17	14	19	---	50
N-7	8	9	8	---	25
A-4	9	10	9	---	28
Total	48	45	48	8*	149

* for four catchments

5.2. Implementation Schedule

As proposed in the Master Plan, the First Phase Program for drainage improvement in the Study Area covers up to the year 1990 including provision of budgeting, detailed design with tender documentation and award of contracts.

Phasing of the recommended drainage improvement works is based on the following points:

(1) Replace the existing tidal gates to prevent back-flooding from the river which is one of the main causes of flooding.

(2) Provide bunds along the Kelang and Aur Rivers to prevent spill-over from the river.

(3) Improvement of trunk drains along with reconstruction of box culverts for alleviation of the existing flood problems, based on the flood investigations carried out during the field survey (Ref.: Chapter 2).

Based on a preliminary assessment of the above, a phased implementation schedule is recommended as presented in Tables 5.4 to 5.5 and Figs. 5.1 to 5.2, with estimated construction cost.

It is to be noted that since the cost is constrained, small drains are not included for implementation as proposed in the Master Plan. Hence, financing for all new construction and improvement of the drainage facilities as recommended herein shall be contributed by the Government.

Table 5.4. Implementation Schedule

Item	1983-1984	1985	1986	1987	1988	1989	1990
I. Trunk Drains							
(1) N-5 Catchment						4-7	1-3
(2) N-6 "			10-13	4,8,9	3,6,7	1,2,5	
(3) N-7 "		6-8			1-5		
(4) A-4 "			5,8-10	1-4		6,7	
II. Tidal Gates							
(1) N-5 Catchment		▨					
(2) N-6 "		▨					
(3) N-7 "		▨					
(4) A-4 "		▨					
(5) Telemeter System							▨
III. Bunds							
(1) N-5 Catchment		▨					
(2) N-6 "		▨					
(3) N-7 "		▨					
IV. Other Activities							
(1) Land Acquisition		8(N-7)					
(2) Detailed Design, Tender Documentation and Contract Awards	▨						

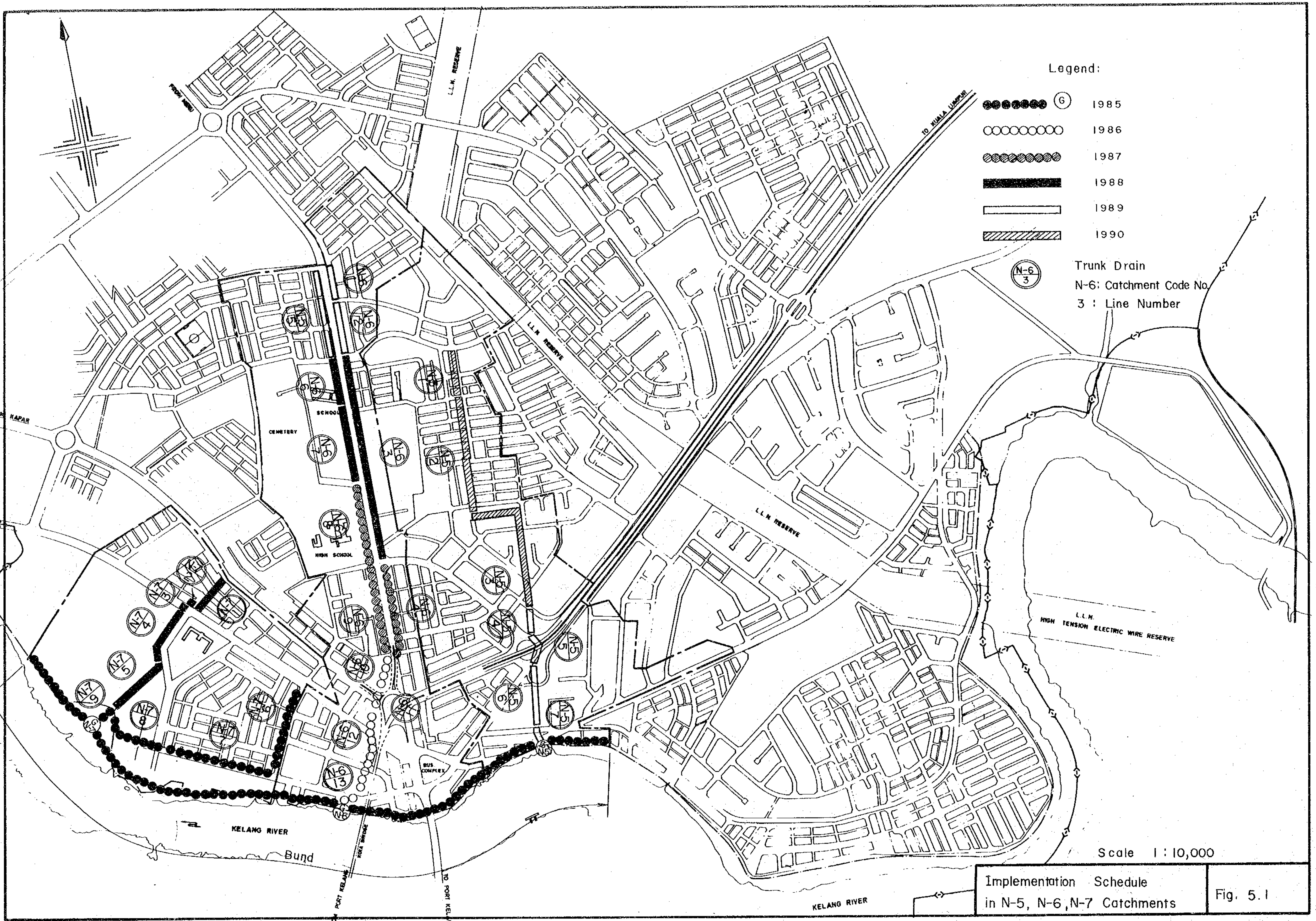
Note: Figures are line numbers of the trunk drains (Ref.: Figs. 5.1 to 5.2)

Table 5.5. Implementation Schedule by Year

(Unit: M$ at 1981 price level)

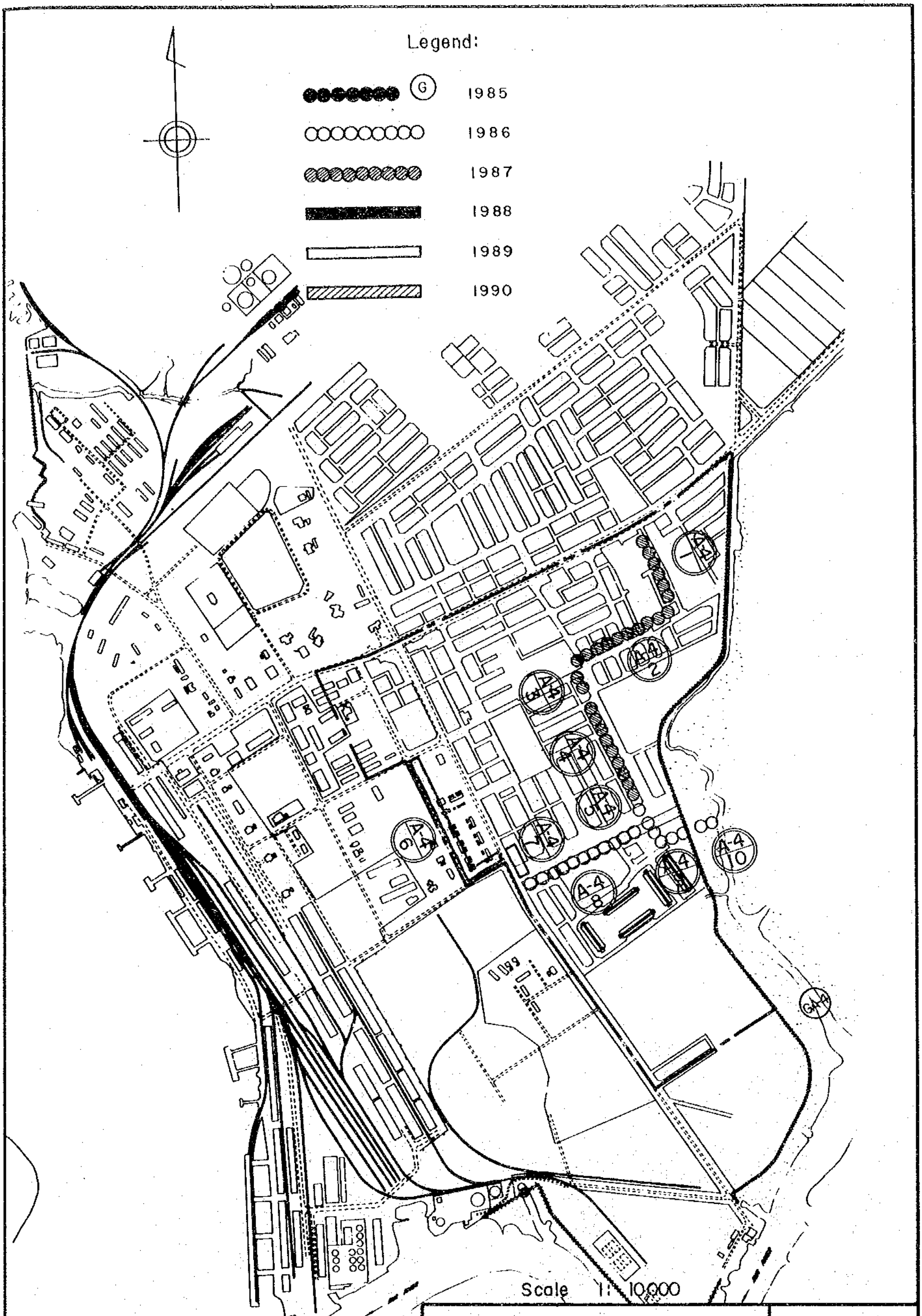
Item	Total	1983-1984	1985	1986	1987	1988	1989	1990
I. Construction Works								
(1) Trunk Drains								
1) N-5 Catchment	2,128,550						889,200	1,239,350
2) N-6 "	3,562,450			1,244,500	965,100	943,350	409,500	
3) N-7 "	1,384,750		790,500			594,250		
4) A-4 "	1,633,300			543,900	704,250		385,150	
(2) Tidal Gates								
1) N-5 Catchment	155,000		155,000					
2) N-6 "	155,000		155,000					
3) N-7 "	155,000		155,000					
4) A-4 "	155,000		155,000					
5) Telemeter System	240,000							240,000
(3) Bunds								
N-5, N-6 and N-7 Catchments	82,000		82,000					
(4) Construction Work Sub-Total	9,966,050		1,492,500	1,788,400	1,669,350	1,537,600	1,683,850	1,479,350
II. Land Acquisition	114,660		114,660					
III. Engineering Fee	997,000	307,000	115,000	115,000	115,000	115,000	115,000	115,000
IV. Contingency Cost	1,087,290	31,000	164,840	194,600	182,650	169,400	184,150	160,650
Total	11,850,000	338,000	1,887,000	2,098,000	1,967,000	1,822,000	1,983,000	1,755,000
	(17,785,191)	(408,287)	(2,427,562)	(2,874,442)	(2,870,133)	(2,831,363)	(3,281,856)	(3,091,548)

Note: Figures in parentheses are adjusted at 6.5 percent increase annually.



Implementation Schedule in N-5, N-6, N-7 Catchments

Fig. 5.1



Implementation Schedule in A-4 Catchment

Fig. 5.2

CHAPTER 6

FINANCE

CHAPTER 6 FINANCE

6.1. Financial Projection

According to the study of financial planning in the Master Plan Report, financial projections are developed on the following basis:

(1) The initial investment for the First Phase work would be financed by Federal Government loan.

(2) Developers' contribution and the property surcharge tax for the drainage tax are allocated for amortization of principal and interest for the construction cost.

(3) The required revenue for the operation and maintenance of the drainage system should be raised through appropriate charges against those who will benefit from its service.

Under these bases, various financial projections were made in order to determine the most viable financing schedule. The financial statements (Revenues and Expenditures) are prepared for the financial period 1983 through 1995.

6.1.1. Fund Requirements

The funds required for the proposed drainage construction and subsequent operation and maintenance cost are estimated to include allowance for price escalation assumed at 6.5 percent annum, as shown in Table 6.1 to 6.2.

Table 6.1. Project Cost Estimation

(Unit: M$1,000)

Year	Construction Cost	
	1981 Price Level	Escalated at 6.5% per annum
1983	338	408
1984	0	0
1985	1,887	2,428
1986	2,098	2,874
1987	1,967	2,870
1988	1,822	2,831
1989	1,983	3,282
1990	1,755	3,092
Total	11,850	17,785

Table 6.2. Operation and Maintenance Cost

(Unit: M$1,000)

Year	Items			Total O/M Cost
	Payroll	Operation and Maintenance	Administ-ration	
1983	156	109	16	281
1984	166	116	17	299
1985	214	123	21	358
1986	228	131	23	382
1987	242	140	24	406
1988	258	149	26	433
1989	275	159	28	462
1990	372	169	37	578
1991	412	1,939	41	2,392
1992	439	2,065	44	2,548
1993	467	2,199	47	2,713
1994	497	2,342	50	2,889
1995	553	2,495	55	3,103
Total	4,279	12,136	429	16,844

Note: Escalated at 6.5% per annum from original price of the year 1981.

6.1.2. Sources of Fund

The funds for the construction and O/M cost of the proposed drainage system are provided by loans from the Federal Government and by revenue collection from beneficiaries of this system such as developers' contribution and property surcharge tax including the drainage service and MPK's contribution.

1) Loan

The Federal Government loan which is expected to cover all construction costs of M$18 million is assumed to be made at 6 percent interest rate per annum and 30 equal annual repayments with a 5-year grace period.

2) Developers' Contribution

Developers' contribution is estimated under the assumption that half of the predicted increment of residential areas will be developed by private developers who are required to pay a developer's fee of M$3,000 per acre (M$7,413 per hectare). Table 6.3 shows the developers' contribution.

Table 6.3. Projected Developers' Contribution

Year	Residential Area (ha)	Increment of Residential Area (ha)	Developers' Contribution (M$1,000)
1983	1,793	105	389
1984	1,898	112	415
1985	2,010	117	434
1986	2,127	125	463
1987	2,252	132	489
1988	2,384	140	519
1989	2,524	148	549
1990	2,672	156	578
Sub-Total		1,035	3,836
1991	2,828	166	615
1992	2,994	176	652
1993	3,170	186	689
1994	3,356	196	726
1995	3,552	209	775
Sub-Total		933	3,457
Total		1,968	7,293

3) Property Surcharge Tax

As mentioned in Master Plan Report (Vol. VI, Chapter 7), the local government can impose a property tax on the residents for the construction of the drainage system. According to the Local Government Act, the revenue from this tax must be allocated not to the operation and maintenance cost but to only the construction cost. Therefore, in case the operation and maintenance cost exceeds considerably the revenue from the proposed drainage system, an additional property tax, which is the current source of the municipality's general revenue, would be required to make the financial plan viable.

The revenue to be obtained from the additional property surcharge tax is presented in Table 6.4.

Table 6.4. Property Surcharge Tax Revenue According to Tax Rate

(Unit: M$1,000)

Year	Surcharge Tax Rate				
	max 5%	max 4%	max 3%	max 2%	max 1%
1981 (For Reference)	3,263	2,624	1,983	1,273	634
1988	4,591	3,692	2,790	1,791	892
1989	4,821	3,877	2,930	1,881	937
1990	5,062	4,071	3,076	1,975	984
Sub-Total	14,474	11,640	8,796	5,647	2,813
1991	5,315	4,274	3,230	2,074	1,033
1992	5,581	4,488	3,392	2,177	1,084
1993	5,860	4,712	3,561	2,286	1,139
1994	6,153	4,948	3,739	2,400	1,196
1995	6,461	5,195	3,926	2,520	1,225
Sub-Total	29,370	23,671	17,848	11,457	5,677

Ref.: Table 6.5.

From the viewpoint of income redistribution, it is considered reasonable to levy the property surcharge tax for drainage service in proportion to the prevailing property tax rate, which is now imposed at a different rate according to area, as shown in Table 6.5.

This tax is levied on the entire area of Kelang Municipality.

Table 6.5. Property Surcharge Tax Rate

Area	Prevailing Tax Rate (%)	Case Max 5 (%)	Max 4 (%)	Max 3 (%)	Max 2 (%)	Max 1 (%)
Within Sectors 1-32 (Inside the town)	15	5	4	3	2	1
Zone 'A' (Telok Gadong Rd)	15					
Zone 'B' (Eng Ann Estate)	15					
Mukim (Outside the town area)	14					
Extension Area	11	3	2.5	2	1	0.5
Village (Pendamaran) (Pendamaran Jaya)	10					
Kapar Town	10					
Meru Town	10					
Malay Reservation in Meru Town	8	2	1.5	1	0.5	0
Existing Malay Reservation Area	7					

4) Municipality's Contribution

It is inevitable that if the following financial projections should result in a deficit, MPK should bear some of the financial burden. The amount of MPK's contribution in this case is forecasted in the following section.

6.2. Comparison of Costs and Revenues

In order to develop viable financial plans, financial statements (Revenues and Expenditures) are prepared, based on various property surcharge tax rates. In these calculations, the property surcharge tax rate varies at 1, 2, 3, 4 and 5 percent of annual property value as shown in Table 6.5. According to the results of this calculation, Table 6.6 shows MPK's contribution up to 1995.

The relationship between the property surcharge tax rates and the accumulated income up to 1995 is analyzed in detail in Fig. 6.1. In this figure, the vertical line represents the cash accumulated (MPK's contribution) up to 1995 and the horizontal line represents the property surcharge tax rate. The space above the horizontal line represents the surplus and the space below the horizontal line represents the deficit. The intersecting points of the horizontal and the diagonal lines represent zero contribution by MPK; that is, there are no deficits from the proposed drainage operation and there will be no need for any contribution.

6.3. Proposed Financial Plan

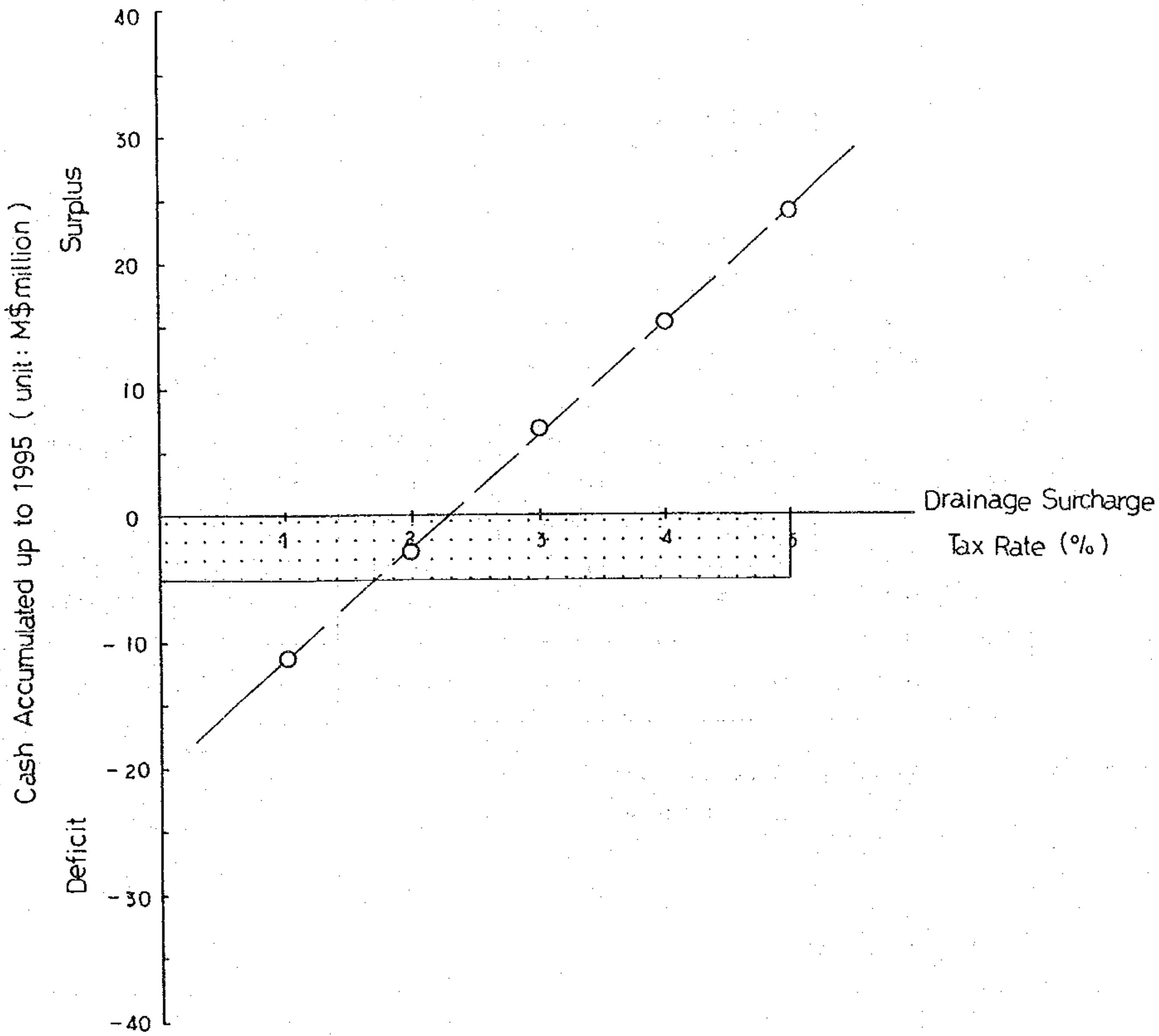
Since drainage service, similar to sewerage service, is a form of public service, profit is unnecessary. Should MPK profit from its operation, it should lower the property surcharge rate. On the other hand, compensation for a large amount of deficit would be difficult from MPK's current general revenues. Therefore, the most desirable and feasible financing plan is considered to be one which minimizes the financial burden on MPK's contribution as much as possible.

It is reasonable to consider that MPK would be able to compensate a deficit of about M$0.5 million each year, judging from the size of MPK's general revenues (M$0.5 million corresponds to about 2.5 percent of MPK's current general revenues).

Therefore, judging from the viewpoint that MPK can bear a maximum burden of about M$5 million up to 1995, a viable financial plan is selected, with a 2 percent property surcharge tax rate. The revenue from this tax is comprised of two sources. One is based on the Local Government Act and is allocated to the amortization of principal and interest of the construction cost. The other is an additional property tax and is allocated to the operation and maintenance cost.

The projected revenues and expenditures of the five financial plans (Ref.: Table 6.5) based on different tax rates are shown in Table 6.7.(1~5).

Fig. 6.1. Relationship between Cash Accumulated up to 1995 and Drainage Surcharge Tax Rate



Feasible Area

within (1) 5% of the Property Surcharge Tax

(2) M$ 5 Million of MPK's Contribution up to 1995

Table 6.6. MPK's Contribution

(Unit: M$1,000)

Year	Property Surcharge Tax Rate (%)				
	1	2	3	4	5
1983	281	281	281	281	281
1984	299	299	299	299	299
1985	358	358	358	358	358
1986	382	382	382	382	382
1987	406	406	406	406	406
1988	314	(585)	(1,584)	(2,486)	(3,385)
1989	268	(676)	(1,725)	(2,672)	(3,616)
1990	308	(683)	(1,784)	(2,779)	(3,770)
1991	2,036	995	(161)	(1,205)	(2,246)
1992	2,104	1,011	(204)	(1,300)	(2,393)
1993	2,177	1,030	(245)	(1,396)	(2,544)
1994	2,259	1,055	(284)	(1,493)	(2,698)
1995	2,395	1,100	(306)	(1,575)	(2,841)
Total	13,587	4,973	(4,567)	(13,180)	(21,767)

Note: ( ) means deficit.

* Ref.: Table 6.5.

Table 6.7. (1) Projected Revenues and Expenditures

(Max. Property Surcharge Tax Rate 1%, Ref.: Table 6.5.) (Unit: M$1,000)

Item	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Revenues														
Developer's Contribution						519	549	578	615	652	689	726	775	5,103
Property Surcharge Tax (Max. 1%)						892	937	984	1,033	1,084	1,139	1,196	1,225	8,490
Drainage Tax (based on the Local Gov. Act)						773	743	714	677	640	603	566	517	5,233
Additional Property Tax						119	194	270	356	444	536	630	708	3,257
Federal Government Loan	408	0	2,428	2,874	2,870	2,831	3,282	3,092						
MPK's Contribution	281	299	358	382	406	314	268	308	2,036	2,104	2,177	2,259	2,395	13,587
Total Revenues	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Expenditures														
Capital Expenditure	408	0	2,428	2,874	2,870	2,831	3,282	3,092						
Operation & Maintenance	281	299	358	382	406	433	462	578	2,392	2,548	2,713	2,889	3,103	16,844
Debt Service														
Principal						225	238	253	268	284	301	319	338	2,226
Interest						1,067	1,054	1,039	1,024	1,008	991	973	954	8,110
Total Expenditure	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Accumulated MPK's Contribution	281	580	938	1,320	1,726	2,040	2,308	2,616	4,652	6,756	8,933	11,192	13,587	

Note: ( ) indicates surplus

Table 6.7. (2) Projected Revenues and Expenditures

(Max. Property Surcharge Tax Rate 2%, Ref. : Table 6.5.)

(Unit: M$1,000)

Item	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Revenues														
Developer's Contribution						519	549	578	615	652	689	726	775	5,103
Property Surcharge Tax (Max. 2%)						1,791	1,881	1,975	2,074	2,177	2,286	2,400	2,520	17,104
Drainage Tax (based on the Local Gov. Act)						773	743	714	677	640	603	566	517	5,233
Additional Property Tax						1,018	1,138	1,261	1,397	1,537	1,683	1,834	2,003	11,871
Federal Government Loan	408	0	2,428	2,874	2,870	2,831	3,282	3,092						
MPK's Contribution	281	299	358	382	406	(585)	(676)	(683)	995	1,011	1,030	1,055	1,100	4,973
Total Revenues	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Expenditures														
Capital Expenditure	408	0	2,428	2,874	2,870	2,831	3,282	3,092						17,785
Operation & Maintenance	281	299	358	382	406	433	462	578	2,392	2,548	2,713	2,889	3,103	16,844
Debt Service														
Principal						225	238	253	268	284	301	319	338	2,226
Interest						1,067	1,054	1,039	1,024	1,008	991	973	954	8,110
Total Expenditure	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Accumulated MPK's Contribution	281	580	938	1,320	1,726	1,141	465	(218)	777	1,788	2,818	3,873	4,973	

Note: ( ) indicates surplus

Table 6.7. (3) Projected Revenues and Expenditures

(Max. Property Surcharge Tax Rate 3%, Ref. : Table 6.5.)

(Unit: M$1,000)

Item	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Revenues														
Developer's Contribution						519	549	578	615	652	689	726	775	5,103
Property Surcharge Tax (Max. 3%)						2,790	2,930	3,076	3,230	3,392	3,561	3,739	3,926	26,644
Drainage Tax (based on the Local Gov. Act)						773	743	714	677	640	603	566	517	5,233
Additional Property Tax						2,017	2,187	2,362	2,553	2,752	2,958	3,173	3,409	21,411
Federal Government Loan	408	0	2,428	2,874	2,870	2,831	3,282	3,092						17,785
MPK's Contribution	281	299	358	382	406	(1,584)	(1,725)	(1,784)	(161)	(204)	(245)	(284)	(306)	(4,567)
Total Revenues	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Expenditures														
Capital Expenditure	408	0	2,428	2,874	2,870	2,831	3,287	3,092						17,785
Operation & Maintenance	281	299	358	382	406	433	462	578	2,392	2,548	2,713	2,889	3,103	16,844
Debt Service														
Principal						225	238	253	268	284	301	319	338	2,226
Interest						1,067	1,054	1,039	1,024	1,008	991	973	954	8,110
Total Expenditure	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Accumulated MPK's Contribution	281	580	938	1,320	1,726	142	(1,583)	(3,367)	(3,528)	(3,732)	(3,977)	(4,261)	(4,567)	

Note: ( ) indicates surplus

Table 6.7. (4) Projected Revenues and Expenditures

(Max. Property Surcharge Tax Rate 4%, Ref.: Table 6.5.)

(Unit: M$1,000)

Item	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Revenues														
Developer's Contribution						519	549	578	615	652	689	726	775	5,103
Property Surcharge Tax (Max. 4%)						3,692	3,877	4,071	4,274	4,488	4,712	4,948	5,195	35,257
Drainage Tax (based on the Local Gov.Act)						773	743	714	677	640	603	566	517	5,233
Additional Property Tax						2,919	3,134	3,357	3,597	3,848	4,109	4,382	4,678	30,024
Federal Government Loan	408	0	2,428	2,874	2,870	2,831	3,282	3,092						17,785
MPK's Contribution	281	299	358	382	406	(2,486)	(2,672)	(2,779)	(1,205)	(1,300)	(1,396)	(1,493)	(1,575)	(13,180)
Total Revenues	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Expenditures														
Capital Expenditure	408	0	2,428	2,874	2,870	2,831	3,282	3,092						17,785
Operation & Maintenance	281	299	358	382	406	433	462	578	2,392	2,548	2,713	2,889	3,103	16,844
Debt Service														
Principal						225	238	253	268	284	301	319	338	2,226
Interest						1,067	1,054	1,039	1,024	1,008	991	973	954	8,110
Total Expenditure	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Accumulated MPK's Contribution	281	580	938	1,320	1,726	(760)	(3,432)	(6,211)	(7,416)	(8,716)	(10,112)	(11,605)	(13,180)	

Note: ( ) indicates surplus

Table 6.7. (5) Projected Revenues and Expenditures

(Max. Property Surcharge Tax Rate 5%, Ref.: Table 6.5.)

(Unit: M$1,000)

Item	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
Revenues														
Developer's Contribution						519	549	578	615	652	689	726	775	5,103
Property Surcharge Tax (Max. 5%)						4,591	4,821	5,062	5,315	5,581	5,860	6,153	6,461	43,844
Drainage Tax (based on the Local Gov.Act)						773	743	714	677	640	603	566	517	5,233
Additional Property Tax						3,818	4,078	4,348	4,638	4,941	5,257	5,587	5,944	38,611
Federal Government Loan	408	0	2,428	2,874	2,870	2,831	3,282	3,092						17,785
MPK's Contribution	281	299	358	382	406	(3,385)	(3,616)	(3,770)	(2,246)	(2,393)	(2,544)	(2,698)	(2,841)	(21,767)
Total Revenues	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Expenditures														
Capital Expenditure	408	0	2,428	2,874	2,870	2,831	3,282	3,092						17,785
Operation & Maintenance	281	299	358	382	406	433	462	578	2,392	2,548	2,713	2,889	3,103	16,844
Debt Service														
Principal						225	238	253	268	284	301	319	338	2,226
Interest						1,067	1,054	1,039	1,024	1,008	991	973	954	8,110
Total Expenditure	689	299	2,786	3,256	3,276	4,556	5,036	4,962	3,684	3,840	4,005	4,181	4,395	44,965
Accumulated MPK's Contribution	281	580	938	1,320	1,726	(1,659)	(5,275)	(9,045)	(11,291)	(13,684)	(16,228)	(18,926)	(21,767)	

Note: ( ) indicates surplus

CHAPTER 7

INSTITUTIONAL ORGANIZATION AND LEGAL ASPECT

CHAPTER 7 INSTITUTIONAL ORGANIZATION AND LEGAL ASPECT

7.1. Introduction

Comprehensive sewerage and urban drainage systems in Malaysia are a relatively new development concept which has recently been gaining increasing attention. Such programs have already been initiated or are planned for some municipal areas, being urgently needed for protection of water resources and flood control, including public health and environmental improvement.

The responsibility for carrying out these programs is vested in the local authorities under the Local Government Act; however, an adequate organization for administrating the sewerage and drainage systems within the Kelang Municipality is lacking. Thus, instituting such an organization is of primary importance, especially since the work on these systems is scheduled to start in 1983, according to the proposed Master Plan.

For this purpose, studies on organization and management for Kelang Municipality's sewerage and drainage project in Selangor State are presented in this chapter, based on a review of the existing organizations dealing with sewerage and drainage activities at each governmental level -- federal, state and municipality.

7.2. Organizational Requirements

In contrast to Kelang Municipality's rapid commercial and industrial development, that of its sewerage and drainage systems has been negligible. No more than rudimentary works, such as septic tanks, night soil bucket collection, surface drains, and construction of the small drains, have been provided. Considering this situation and the increasing pace of commercial, industrial and urban development expected in the near future, a steady increase in the water consumption rate, the burden on the primitive sewerage and drainage systems and in waste discharges to the natural waterways and open seas can be expected. Consequently, there is