3.7 Proposed Drainage Improvement Plan

3.7.1 Proposed Drainage System

The proposed drainage system of the Cengkareng West Area consists of the following five (5) sub-systems of the Basin A, B, C, D and E.

(i) Basin A : Tanjungan River drainage system
(ii) Basin B : Kamal River drainage system
(iii) Basin C : Kali Gede and Kali Bor channel drainage system
(iv) Basin D : Saluran Cengkareng channel drainage system
(v) Basin E : Padongkelan channel drainage system

All the above basins are drained by gravity. No pump drainage is proposed. The existing main river and channel sections in all the above drainage systems will be widened/deepened to increase carrying capacity. The existing river/channel reaches will be extended to drain the upstream areas in the drainage systems of the Basin A, B and E. For the extension, excavation of the new drainage channels is proposed. Moreover, the existing sluice gate at the confluence of the Padongkelan channel to the Cengkareng Floodway will be improved.

The proposed length of the existing river/channel improvement and new drainage river/channel excavation for the five (5) basins are summarized below.

Basin	A	B	C	D	E	Total
Catchment Area (ha)	777	1,637	563	331	515	3,823
Improvement of Existing Channel (km)	3.2	7.4	4.8	4.5	1.1	21.0
Excavation of New Channel (km)	4.0	0.7	-	-	1.7	6.4

Location of the existing channel improvement and new channel excavation is shown in Fig. 1.3.4.

All the proposed drainage improvement works will be designed to meet the flood discharge with a 10-year return period (Refer to Section 3.1). The

proposed design discharge at the downstream end of the respective rivers/channels are shown below.

River/Channel	Catchment Area (ha)	Design Discharge (m^3/s)	Specific Design Discharge ($m^3/s/km^2$)
Tanjungan	777	24.0	3.1
Kamal	1,637	47.0	2.9
Kali Bor	563	27.0	4.8
Salurang Cengkareng	331	18.0	5.4
Padongkelan	515	30.0	5.8

The design discharge distribution for the respective river/channel systems are shown in Table 1.3.3 and Fig. 1.3.5.

3.7.2 Profile and Cross Section of Proposed Channel

Design high water level is determined taking into consideration the land elevation of the existing developed areas and future urban development. Excavated type of channel is applied as much as possible. However, river embankment is proposed for the reaches with low bank elevation.

The proposed river/channel banks will be protected by revetment of wet masonry type to prevent scouring, and to minimize land acquisition in the reaches of the already urbanized area and future urban development area. However, no bank protection works are proposed for the river reaches of the green area in order to minimize the project cost.

The length gradient, width and depth of the proposed channels are summarized as follows.

Drainage System	Length (km)	Gradient	Width (m)	Depth (m)
Tanjungan	7.2	1/3,000	7.0 - 16.0	2.5
Kamal	8.1	1/1,600-1/3,000	8.9 - 25.2	2.4
Kali Gede/Kali Bor	4.8	1/2,000	8.2 - 8.5	2.5 - 3.0
Salurang Cengkareng	4.5	1/2,000	6.5 - 7.5	2.5
Padongkelan	2.8	1/2,000	5.9 - 10.7	2.5

For details, refer to Table 1.3.4 and Fig. 1.3.6 - Fig. 1.3.11.

3.7.3 Related Drainage Facilities

(1) Revetment

Revetment of wet masonry type will be provided for the river/channel reaches of the already developed and future development areas. Its total length is 46 km or 84% of the total river/channel improvement length. Typical section of the revetment is shown in Fig. 1.3.12.

(2) Sluice Gate

The existing sluice gate at the confluence of the Padongkelan channel to the Cengkareng Floodway will be improved. The existing one has two (2) gates of 2.1 (W) m x 2.6 (H) m. Additional three (3) gates of the same size will be installed. The structure of the proposed sluice gate is shown in Fig. 1.3.12.

(3) Highway Crossing

The existing Tanjungan and Kamal rivers are provided with culvert, one (1) each at the crossings of the Toll Road to the Cengkareng Airport. These culverts will be improved as follows.

	Existing	Improved (Additional)
Tanjungan River	Culvert 1.10m (H) x 1.10m (W) x 1	Culvert 2.50 (H) x 3.75 (W) x 2
Kamal River	Culvert 2.50m (H) x 5.30m (W) x 2	Culvert 2.50 (H) x 4.50 (W) x 4

The structure of the proposed highway crossings are shown in Fig. 1.3.13.

3.7.4 Proposed Construction Works

Major construction works of the proposed drainage improvement plan are channel excavation, embankment, revetment works, bridge improvement, highway crossing, sluice gate improvement and inspection road. The required construction works are as follows.

- Channel excavation : 469,000 m^3
- Embankment : 106,000 m^3
- Revetment works : 46 km, 195,000 m^2
- Bridge improvement : 15 places, 700 m^2
- Highway crossing : 2 places, 360 m^2
- Inspection road : 35 km, 138,000 m^2
- Sluice gate improvement : 1 place

Break-down by drainage basin is shown in Table 1.3.5.

3.7.5 Land Acquisition and Compensation

Land acquisition and resettlement compensation are required prior to the implementation of the construction works. The quantities of land acquisition and compensation are summarized below.

(1) Land acquisition
- Residential area : 32.9 ha
- Green area : 9.1 ha

(2) Resettlement compensation: 230 houses, 1.2 ha

Note: 1) Residential area includes future development area.
2) Green area covers farmland, swamp and fish pond.

Break-down by drainage basin is shown in Table 1.3.6.

Table 1.3.1 (1) Design Discharge and Main Features of Proposed Channel

(Case A-I)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
a_0 - a_1	1.90	13.0	1.10	1:3,000	7.50	2.50
a_1 - a_2	2.23	15.0	0.45	1:3,000	9.50	2.50
a_5 - a_4	2.35	15.0	2.30	1:3,000	7.00	2.50
a_4 - a_2	3.43	17.0	1.70	1:3,000	8.50	2.50
a_2 - a_3	7.77	24.0	1.60	1:3,000	16.00	2.50

(Case A-II)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
a_0 - a_1	1.90	13.0	1.10	1:3,000	7.50	2.50
a_1 - a_2	2.23	15.0	0.45	1:3,000	9.50	2.50
a_4 - a_2	1.08	9.0	1.70	1:3,000	4.50	2.50
a_2 - a_3	5.42	21.0	1.60	1:3,000	9.50	2.50
a_4 - a_5	2.35	15.0	2.30	1:3,000	7.00	2.50

Table 1.3.1 (2) Design Discharge and Main Features of Proposed Channel

(Case B-I)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
b_0 - b_2	4.64	22.0	2.98	1:1,600	5.40~8.90	2.40
b_8 - b_2	7.11	15.0	-	1:3,000	5.40~8.40	2.40
b_2 - b_4	10.81	47.0	1.30	1:3,000	11.90~18.00	2.40
b_4 - b_5	14.53	47.0	1.88	1:3,000	18.00	2.40
b_5 - b_6	16.37	47.0	1.88	1:3,000	25.10	2.40

(Case B-II)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
(Kamal River) b_0 - b_2	4.64	22.0	2.98	1:1,600	5.40~8.90	2.40
b_8 - b_2	7.11	15.0	-	1:3,000	5.40~8.50	2.40
b_2 - b_4	10.81	47.0	1.30	1:3,000	11.90~18.00	2.40
b_4 - b_5	14.53	30.0	1.88	1:3,000	13.40	2.40
b_5 - b_6	16.37	30.0	1.88	1:3,000	20.60	2.40
(Diversion Channel) b4 - a1	-	17.0	1.50	1:3,000	8.20	2.50
(Tanjungang River) a_0 - a_1	1.90	13.0	1.10	1:3,000	7.50	2.50
a_1 - a_2	12.71	20.0	0.45	1:3,000	10.00	2.50
a_5 - a_4	2.35	15.0	2.30	1:3,000	8.00	2.50
a_4 - a_2	3.43	17.0	1.70	1:3,000	8.50	2.50
a_2 - a_3	18.58	43.0	1.60	1:3,000	24.50	2.50

Table 1.3.1 (3) Design Discharge and Main Features of Proposed Channel

(Case C/D-I)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
(Kali Gede & Kali Bor River)						
c_0 - c_1	3.32	23.0	1.95	1:2,000	5.20~8.20	2.50
c_1 - c_2	4.91	24.0	1.48	1:2,000	8.20	2.50
c_2 - c_4	5.63	27.0	1.33	1:2,000	8.50	3.00
(Saluran Cengkareng)						
d_0 - d_1	1.39	13.0	1.65	1:2,000	5.50~6.50	2.50
d_1 - d_2	3.31	18.0	2.88	1:2,000	6.50~7.50	2.50

(Case C/D-II)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
(Kali Gede, Kali Bor & Salurang Cengkareng)						
c_0 - c_1	3.32	23.0	1.95	1:2,000	5.20~8.20	2.50
c_1 - c_2	4.91	24.0	1.48	1:2,000	8.20	2.50
d_1 - d_0	1.39	13.0	1.65	1:2,000	5.50~6.50	2.50
c_2 - c_4	7.02	31.0	1.33	1:2,000	9.80	3.00
(Saluran Cengkareng)						
d_2 - d_1	1.92	14.0	2.88	1:2,000	5.50~6.50	2.50

Table 1.3.1 (4) Design Discharge and Main Features of Proposed Channel

(Case E-I)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
e_0 - e_1	0.91	12.0	0.75	1:2,000	5.50~5.90	2.50
e_1 - e_2	2.06	16.0	1.00	1:2,000	5.90~7.00	2.50
e_2 - e_3	3.42	22.0	0.95	1:2,000	7.00~8.60	2.50
e_3 - e_4	5.15	30.0	0.10	1:2,000	8.60~10.70	2.50

(Case E-II)

Section	Catchment Area (km^2)	Design Discharge (m^3/s)	Length (km)	Gradient	Width (m)	Depth (m)
(Padongkelan River) e_4 - c_0	5.15	30	2.80	1:8,500	5.50~20.00	2.50
(Tanjungang River) c_0 - a_4 - a_2	10.81	35	5.20	1:8,500	22.00	2.50
a_2 - a_3	12.92	35	6.80	1:8,500	29.50	2.50

Table 1.3.2 (1) Construction Cost for Alternative Plans (Basin-A)

No.	Work Items	Unit	Unit Cost (Rp.)	Case A-I		Case A-II	
				Quantity	Cost (10^6 Rp.)	Quantity	Cost (10^6 Rp.)
1	Excavation	m^3	3,600	111,000	399.6	94,200	339.1
2	Embankment	m^3	4,400	26,000	114.4	27,000	118.8
3	Wet Masonry	m^2	74,100	38,500	2,852.9	38,500	2,852.9
4	Bridge Improvement	No. m^2	881,800	-	-	-	-
5	Crossing Bridge	No. m^2	881,800	1 200	176.4	1 158	139.3
6	Road Pavement	m^2	15,400	25,400	391.2	25,400	391.2
7	Land Acquisition (Residential Area)	m^2	77,400	72,100	5,580.5	70,800	5,479.9
8	Land Acquisiton (Green Area)	m^2	6,400	37,100	237.4	34,400	220.2
9	Compensation (Residential Area)	m^2	51,700	-	-	-	-
10	Compensation (Green Area)	m^2	700	-	-	-	-
	Total				9,752.4		9,541.4

Table 1.3.2 (2) Construction Cost for Alternative Plans (Basin-B)

No.	Wor Items	Unit	Unit Cost (Rp.)	Case B-I				Total Cost (mil. Rp.)	Case B-II	
				B-1		A-1			Integration of Basin A and B	
				Quantity	Cost (mil. Rp.)	Quantity	Cost (mil. Rp.)		Quantity	Cost (mil. Rp.)
1	Excavation	m^3	3,600	229,000	824.4	111,000	399.6	1,224.0	39,900	1,436.4
2	Embankment	m^3	4,400	24,000	105.6	26,000	114.4	220.0	102,000	448.8
3	Wet Masonry	m^2	74,100	52,900	3,919.9	38,500	2,852.9	6,772.8	92,900	6,883.9
4	Bridge Improvement	No. m^2	881,800	7 440	388.0	-	-	388.0	955	842.1
5	Crossing Bridge	No. m^2	881,800	1 158	139.3	1 200	176.4	315.7	298	262.8
6	Road Pavement	m^2	15,400	64,300	990.2	25,400	391.2	1,381.4	91,600	1,410.6
7	Land Acquisition (Residential Area)	m^2	77,400	122,200	9,458.3	72,100	5,580.5	15,038.8	187,200	14,489.3
8	Land Acquisition (Green Area)	m^2	6,400	53,400	341.8	37,100	237.5	579.3	53,400	341.8
9	Compensation (Residential Area)	m^2	51,700	5,100	263.7	-	-	263.7	5,100	263.7
10	Compensation (Green Area)	m^2	700	-	-	-	-	-	-	-
Total					16,431.2		9,752.4	26,183.6		26,379.4

Table 1.3.2 (3) Construction Cost for Alternative Plans (Basin-C/D)

No.	Work Items	Unit	Unit Cost (Rp.)	Case C/D-I		Case C/D-II	
				Quantity	Cost (10^6 Rp.)	Quantity	Cost (10^6 Rp.)
1	Excavation	m^3	3,600	95,000	342.0	87,000	313.2
2	Embankment	m^3	4,400	42,100	185.2	42,100	185.2
3	Wet Masonry	m^2	74,100	81,100	6,009.5	81,100	6,009.5
4	Bridge Improvement	No. m^2	881,800	7 241	212.6	4 162	142.9
5	Crossing Bridge	No. m^2	881,800	-	-	-	-
6	Road Pavement	m^2	15,400	37,200	572.9	37,200	572.9
7	Land Acquisition (Residential Area)	m^2	77,400	94,800	7,337.5	90,700	7,020.2
8	Land Acquisiton (Green Area)	m^2	6,400	-	-	-	-
9	Compensation (Residential Area)	m^2	51,700	6,400	330.9	6,400	330.9
10	Compensation (Green Area)	m^2	700	-	-	-	-
	Total				14,990.6		14,574.8

Table 1.3.2 (4) Construction Cost for Alternative Plans (Basin-E)

No.	Wor Items	Unit	Unit Cost (Rp.)	Case E-I				Total Cost (mil. Rp.)	Case E-II	
				Case E-1		Case A-1			Integration of Basin E and A	
				Quantity	Cost (mil. Rp.)	Quantity	Cost (mil. Rp.)		Quantity	Cost (mil. Rp.)
1	Excavation	m^3	3,600	34,200	123.1	111,000	399.6	522.7	300,000	1,080.0
2	Embankment	m^3	4,400	14,000	61.6	26,000	114.4	176.0	45,000	198.0
3	Wet Masonry	m^2	74,100	22,900	1,696.9	38,500	2,852.9	4,549.8	91,200	6,757.9
4	Bridge Improvement	No. m^2	881,800	1 16	14.1	-	-	14.1	-	-
5	Crossing Bridge	No. m^2	881,800	-	-	1 200	176.4	176.4	438	386.2
6	Road Pavement	m^2	15,400	11,200	172.5	25,400	391.2	563.7	32,200	495.9
7	Land Acquisition (Residential Area)	m^2	77,400	40,000	3,096.0	72,100	5,580.5	8,676.5	146,600	11,346.8
8	Land Acquisition (Green Area)	m^2	6,400	-	-	37,100	237.4	237.4	57,800	369.9
9	Compensation (Residential Area)	m^2	51,700	-	-	-	-	-	1,900	98.2
10	Compensation (Green Area)	m^2	700	-	-	-	-	-	-	-
11	Gates Installation	L/S	1	-	30.0	-	-	30.0	-	-
	Total				5,194.2		9,752.4	14,946.6		20,732.9

Table 1.3.3 Design Flood Discharge Distribution of Proposed Channel System

Basin	Sub-basin	Channel Section	Catchment Area (km^2)	Design Discharge (m^3/sec)
A	A-1	a_0 - a_1	1.90	13.0
	A-2 (1)	a_1 - a_2	2.23	15.0
	A-4	a_5 - a_4	2.35	15.0
	A-2 (2)	a_4 - a_2	3.43	17.0
	A-3	a_2 - a_3	7.77	24.0
B	B-1	b_0 - b_2	4.64	22.0
	B-2	(b_8 - b_2)	2.47	15.0
	B-3	} b_2 - b_4	10.81	47.0
	B-4			
	B-5	b_4 - b_5	14.53	47.0
	B-6	b_5 - b_6	16.37	47.0
C	C-1	c_0 - c_1	3.32	23.0
	C-2	c_1 - c_4	5.63	27.0
D	D-1	d_0 - d_1	1.39	13.0
	D-2	d_1 - d_2	3.31	18.0
E		c_0 - e_1	0.91	12.0
		c_1 - c_2	2.06	16.0
		e_2 - e_3	3.42	22.0
		e_3 - e_4	5.15	30.0

Note: (b8 - b2): Not to be improved

Table 1.3.4 Profile and Cross Section of Proposed Channel

Basin	Sub-basin	Channel Section	Channel Gradient	Length (km)	Top width (m)	Bottom Width (m)	Depth (m)
A	A-1	a_0 - a_1	1:3,000	1.10	7.50	5.00	2.50
	A-2 (1)	a_1 - a_2	1:3,000	0.45	9.50	7.00	2.50
	A-4	a_5 - a_4	1:3,000	2.30	7.00	4.50	2.50
	A-2 (2)	a_4 - a_2	1:3,000	1.70	8.50	6.00	2.50
	A-3	a_2 - a_3	1:3,000	1.60	16.00	6.00	2.50
B	B-1	b_0 - b_2	1:1,600	2.98	8.90	6.50	2.40
	B-3, B-4	b_2 - b_4	1:3,000	1.30	18.00	15.60	2.40
	B-5	b_4 - b_5	1:3,000	1.88	18.00	15.60	2.40
	B-6	b_5 - b_6	1:3,000	1.88	25.20	15.60	2.40
C	C-1	c_0 - c_1	1:2,000	1.95	8.20	5.70	2.50
	C-2	c_1 - c_2	1:2,000	1.48	8.20	5.70	2.50
	C-2	c_2 - c_4	1:2,000	1.33	8.50	5.50	3.00
D	D-1	d_0 - d_1	1:2,000	1.65	6.50	4.00	2.50
	D-2	d_1 - d_2	1:2,000	2.88	7.50	5.00	2.50
E		c_0 - c_1	1:2,000	0.75	5.90	3.40	2.50
		c_1 - c_2	1:2,000	1.00	7.00	4.50	2.50
		c_2 - c_3	1:2,000	0.95	8.60	6.10	2.50
		c_3 - c_4	1:2,000	0.10	10.70	8.20	2.50

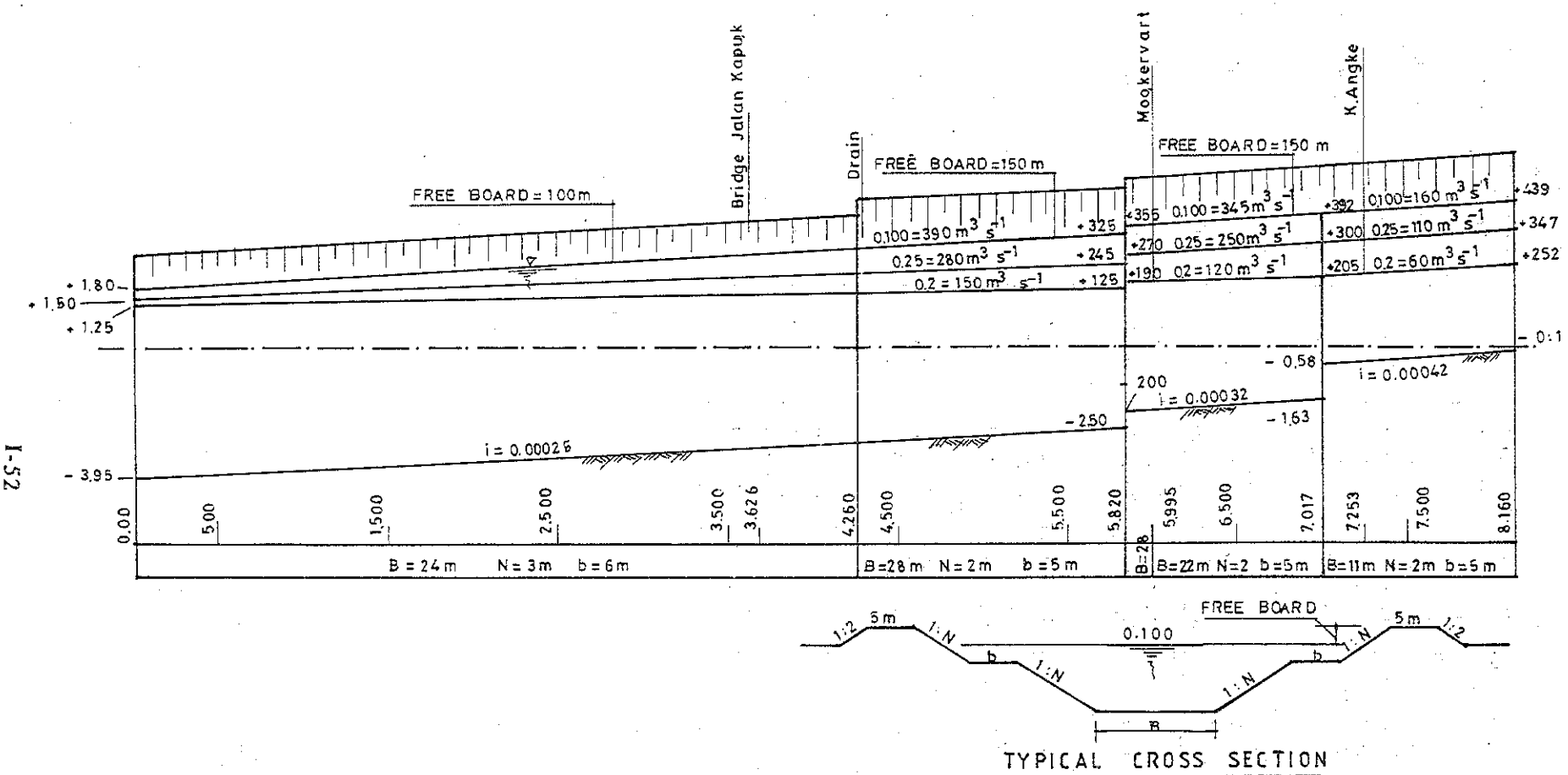

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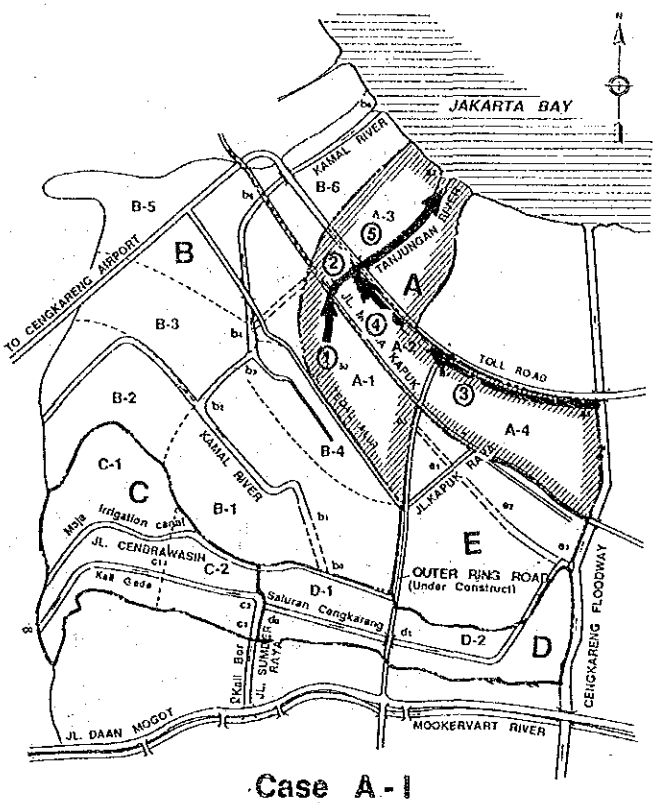
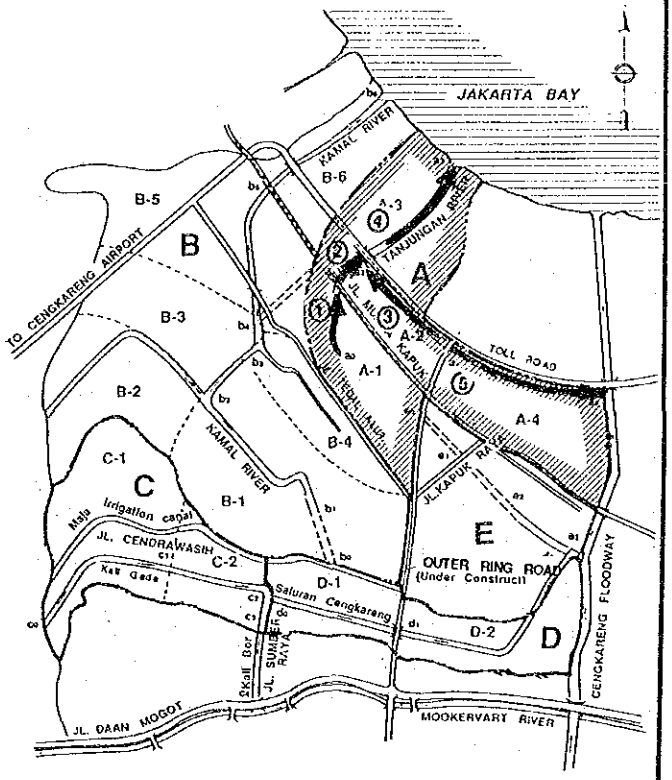
FIG. 1.3.1 LONGITUDINAL SECTION OF CENGKARENG FLOODWAY

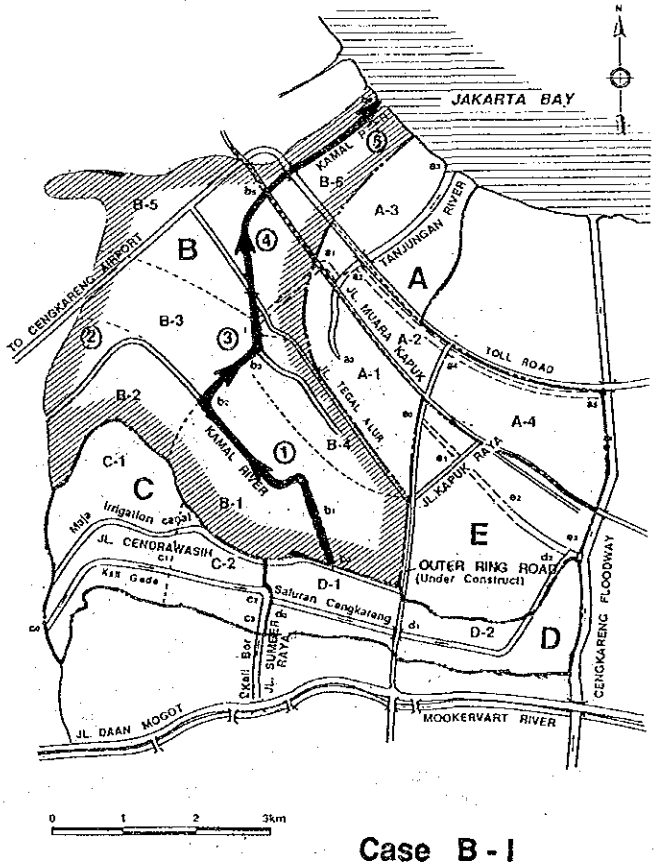
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Case A - I



Case A - II



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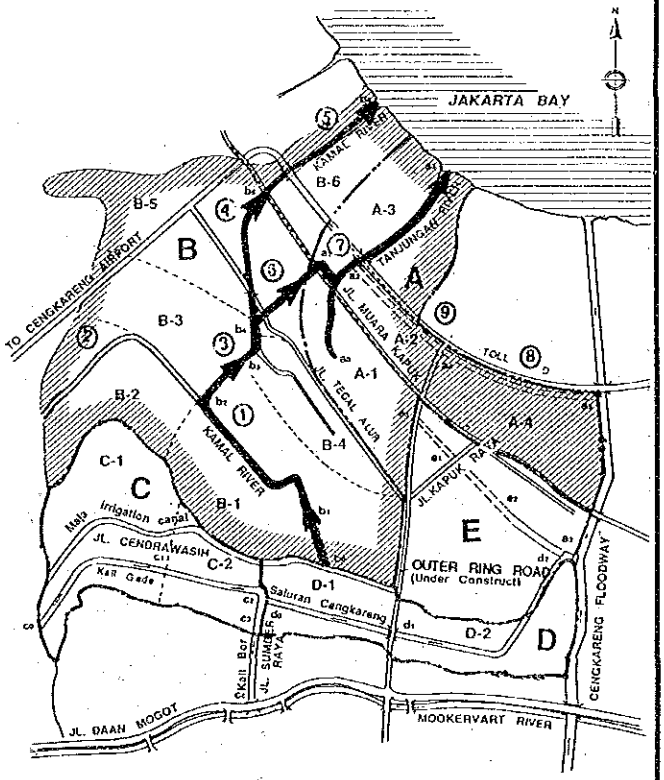
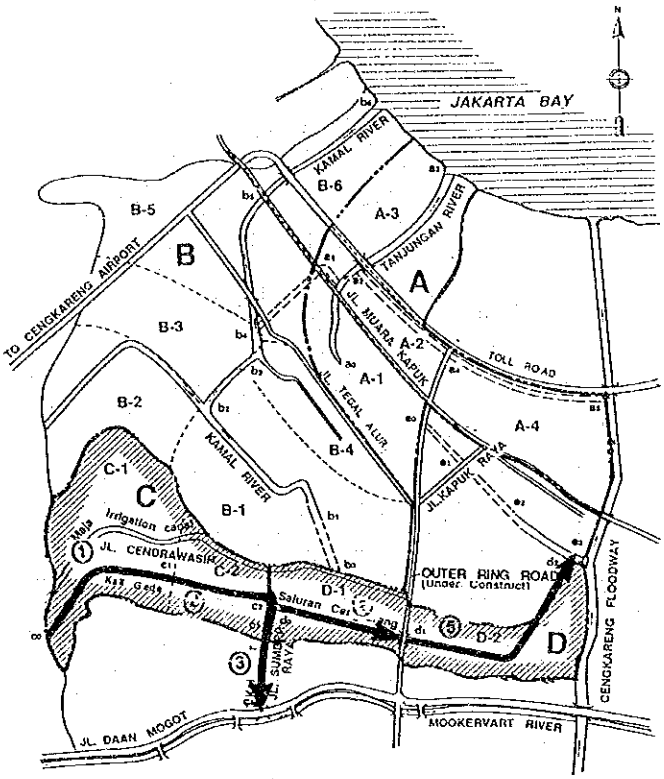


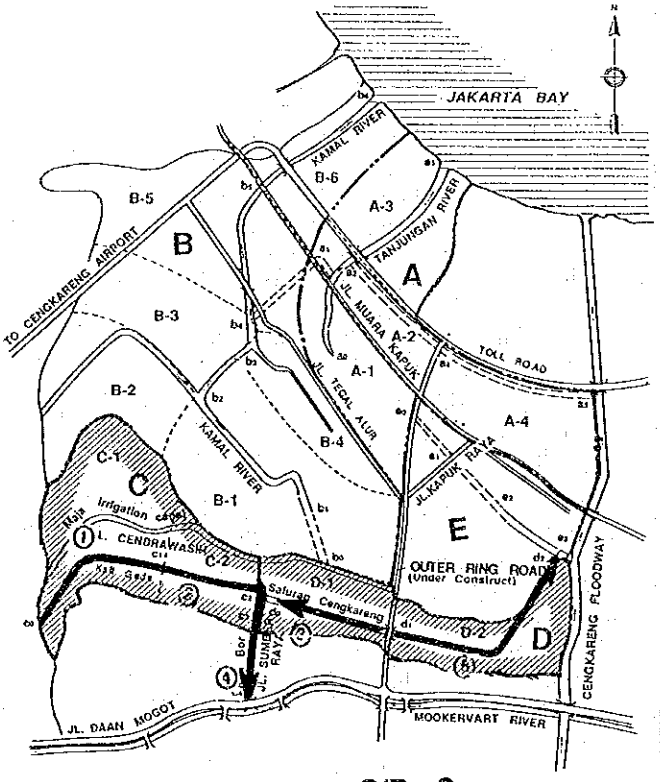
Case B - II

FIG. 1.3.2 LOCATION OF ALTERNATIVE CHANNEL IMPROVEMENT FOR BASIN A & B

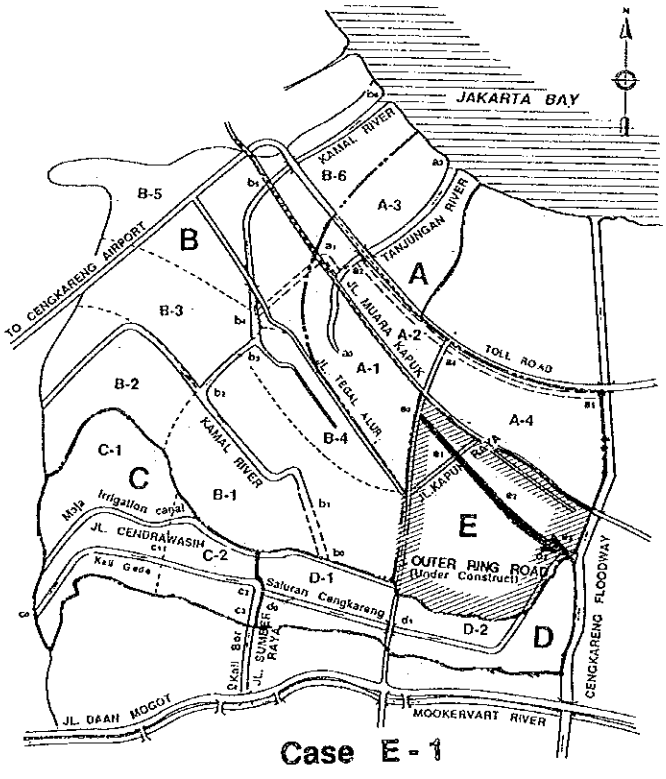
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



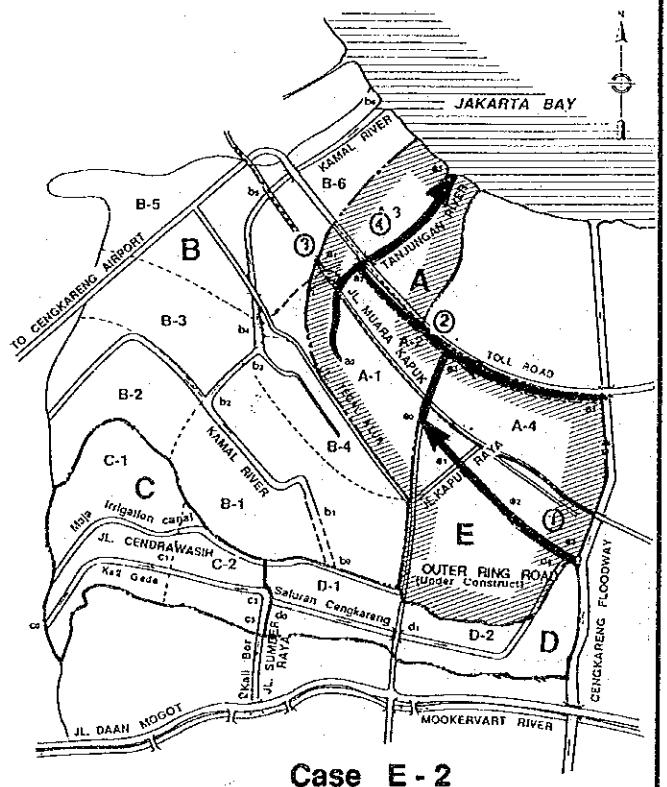
Case C/D - 1



Case C/D - 2



Case E - 1



Case E - 2

0 1 2 3km

FIG. 1.3.3 LOCATION OF ALTERNATIVE CHANNEL IMPROVEMENT FOR BASIN C/D & E

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

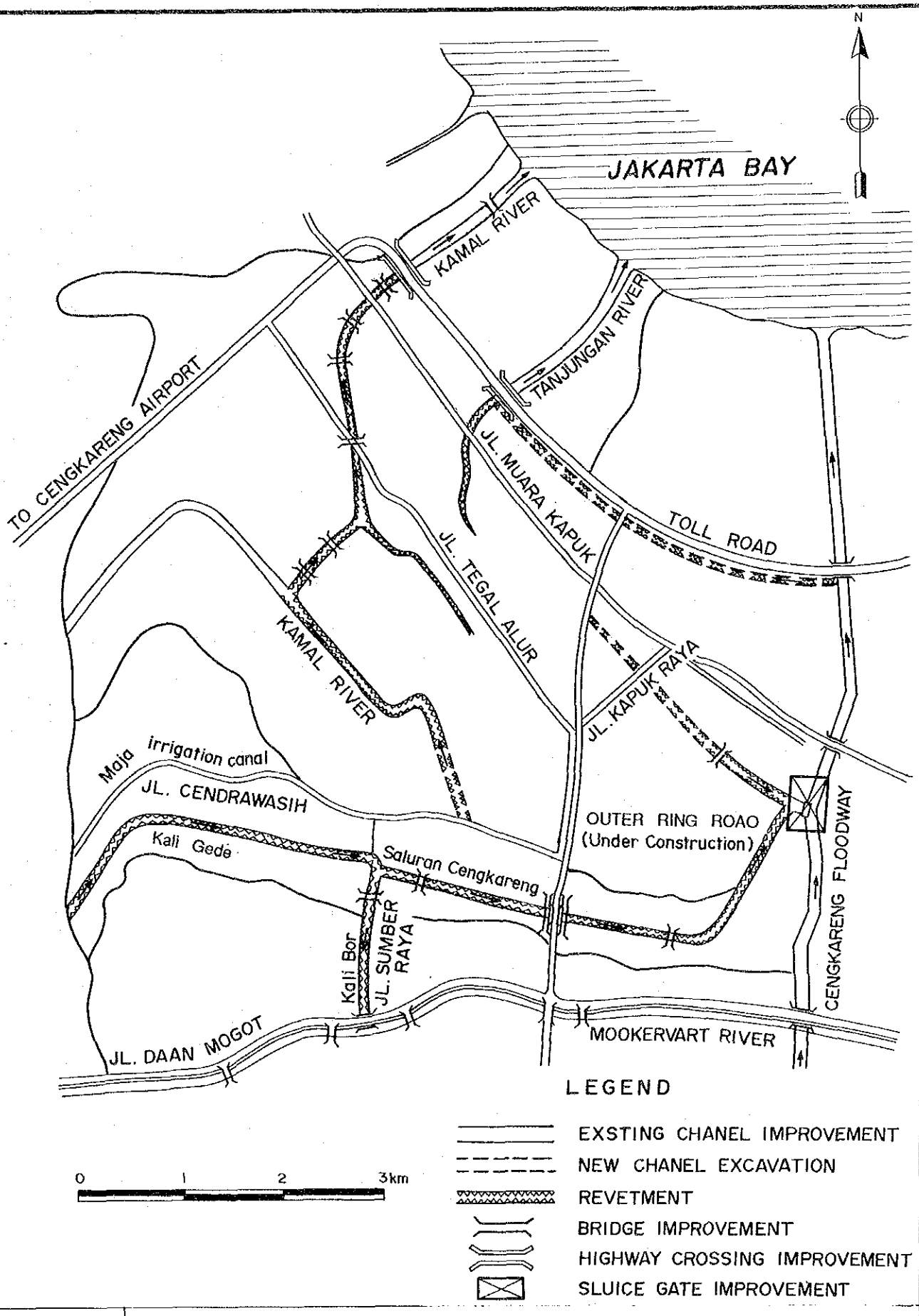


FIG. 1.3.4 LOCATION OF PROPOSED CHANNEL IMPROVEMENT

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

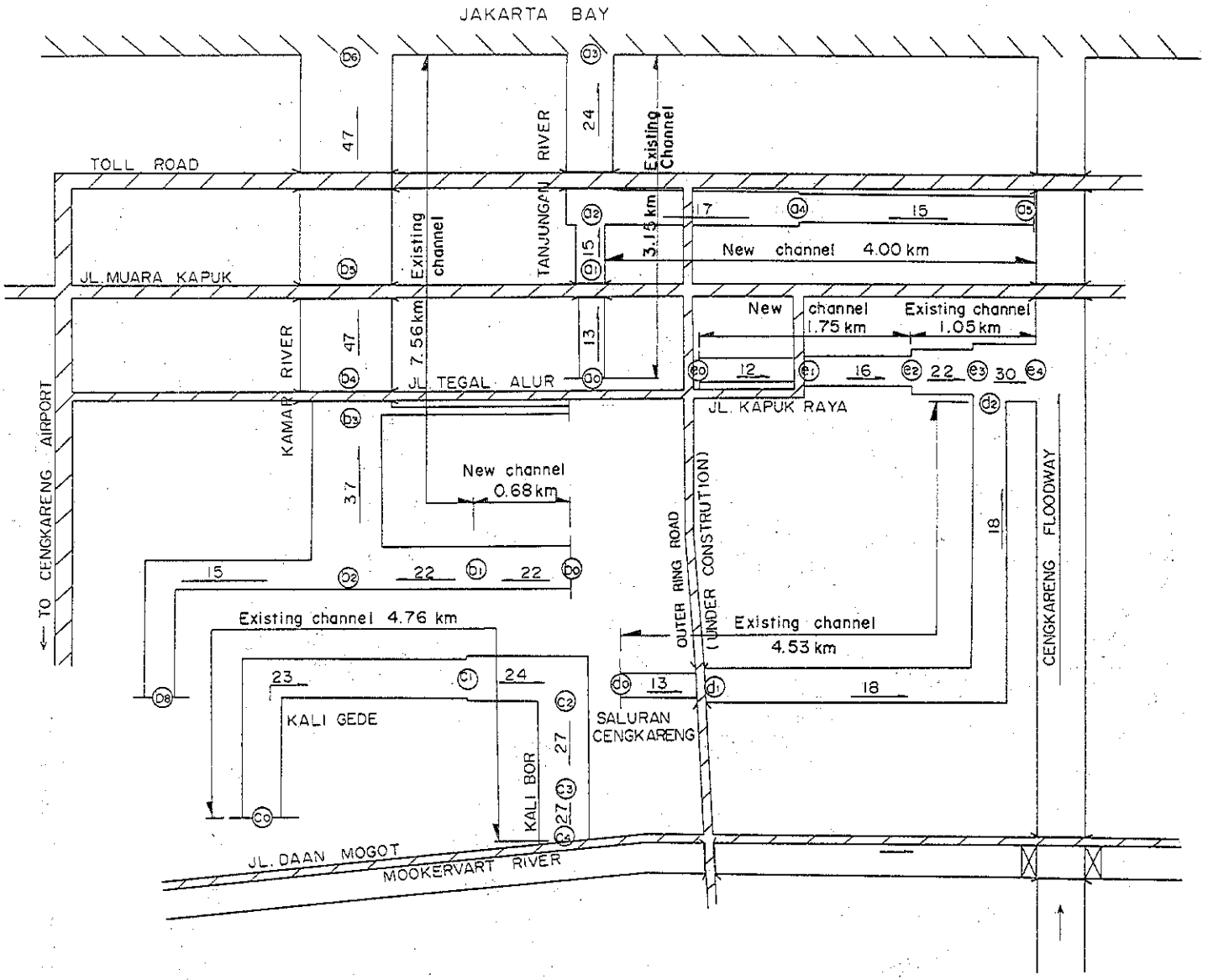
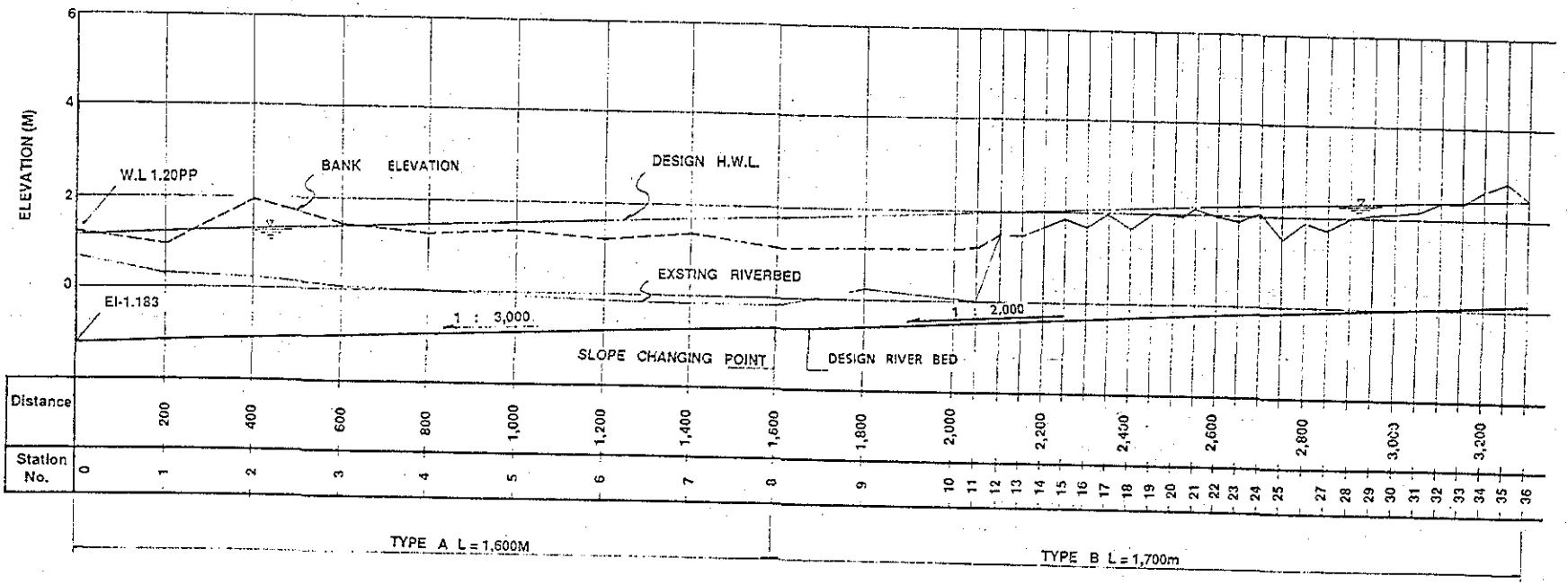
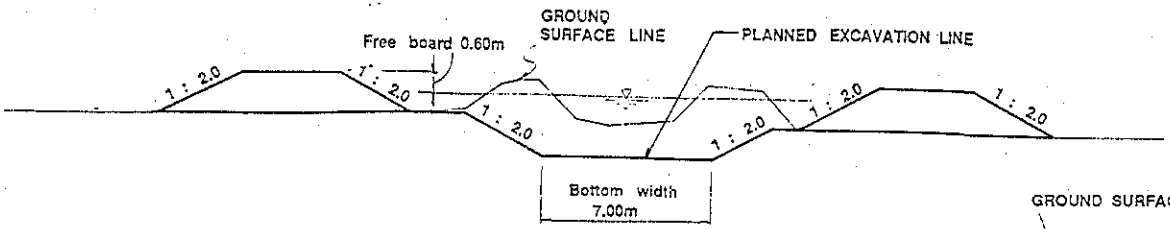


FIG. 1.3.5 DESIGN FLOOD DISCHARGE DISTRIBUTION OF PROPOSED CHANNEL

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

JICA A.D 1991





TYPE A

TYPICAL CROSS SECTION

Note : Free Board

- Excavated Portion 0.20m
- Revetment Portion 0.20m
- Embankment Portion 0.60m

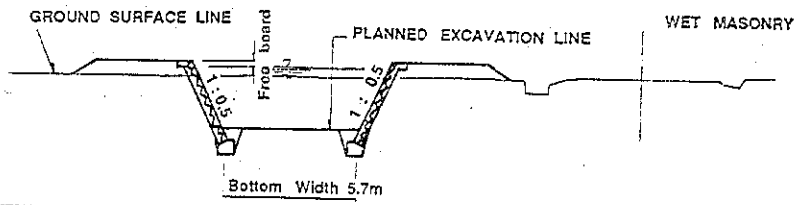


FIG. 1.3.6 PROFILE AND CROSS SECTION OF TANJUNGAN RIVER

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

JICA A.D 1991

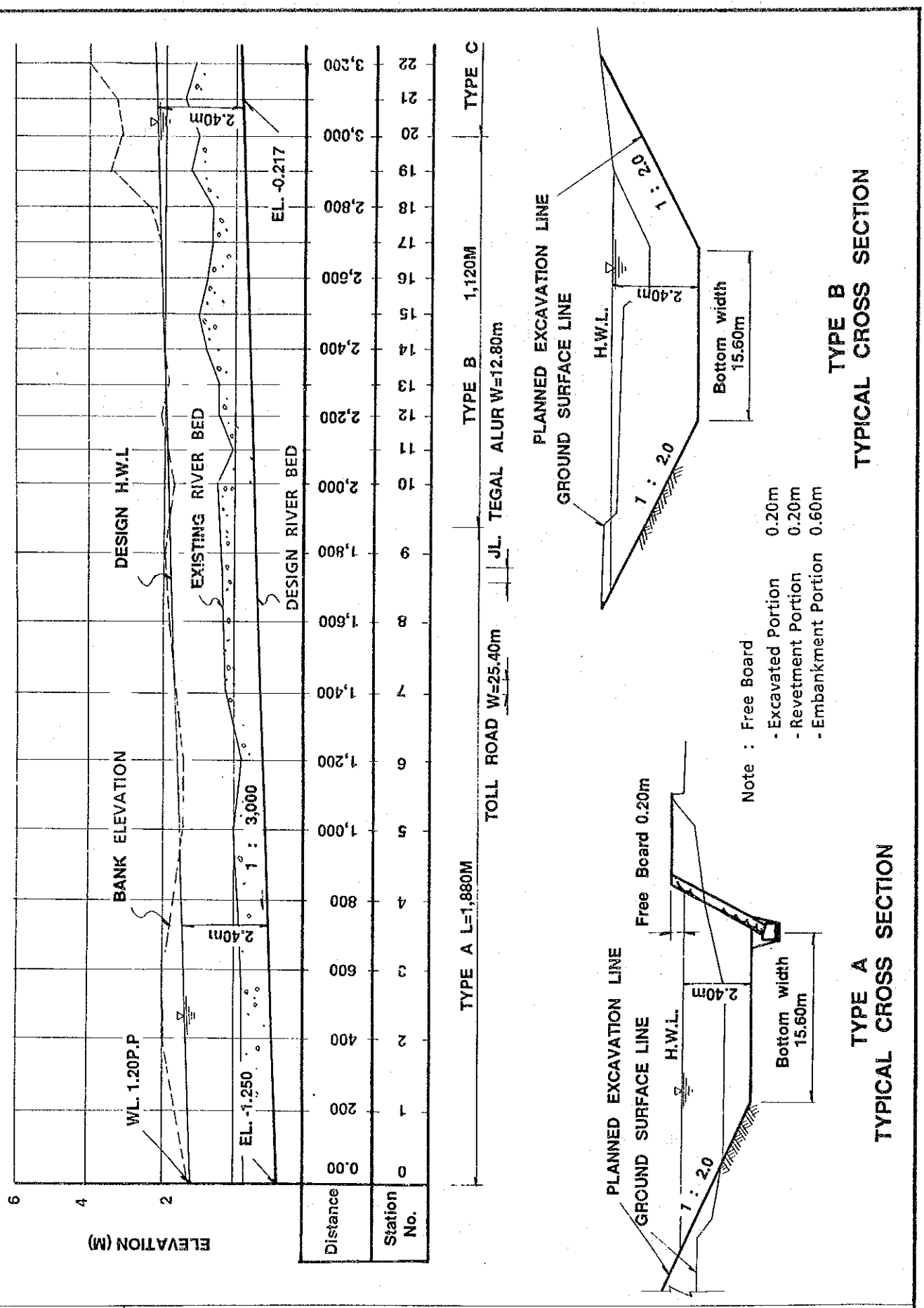


FIG. 1.3.7(1) PROFILE AND CROSS SECTION OF KAMAL RIVER

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

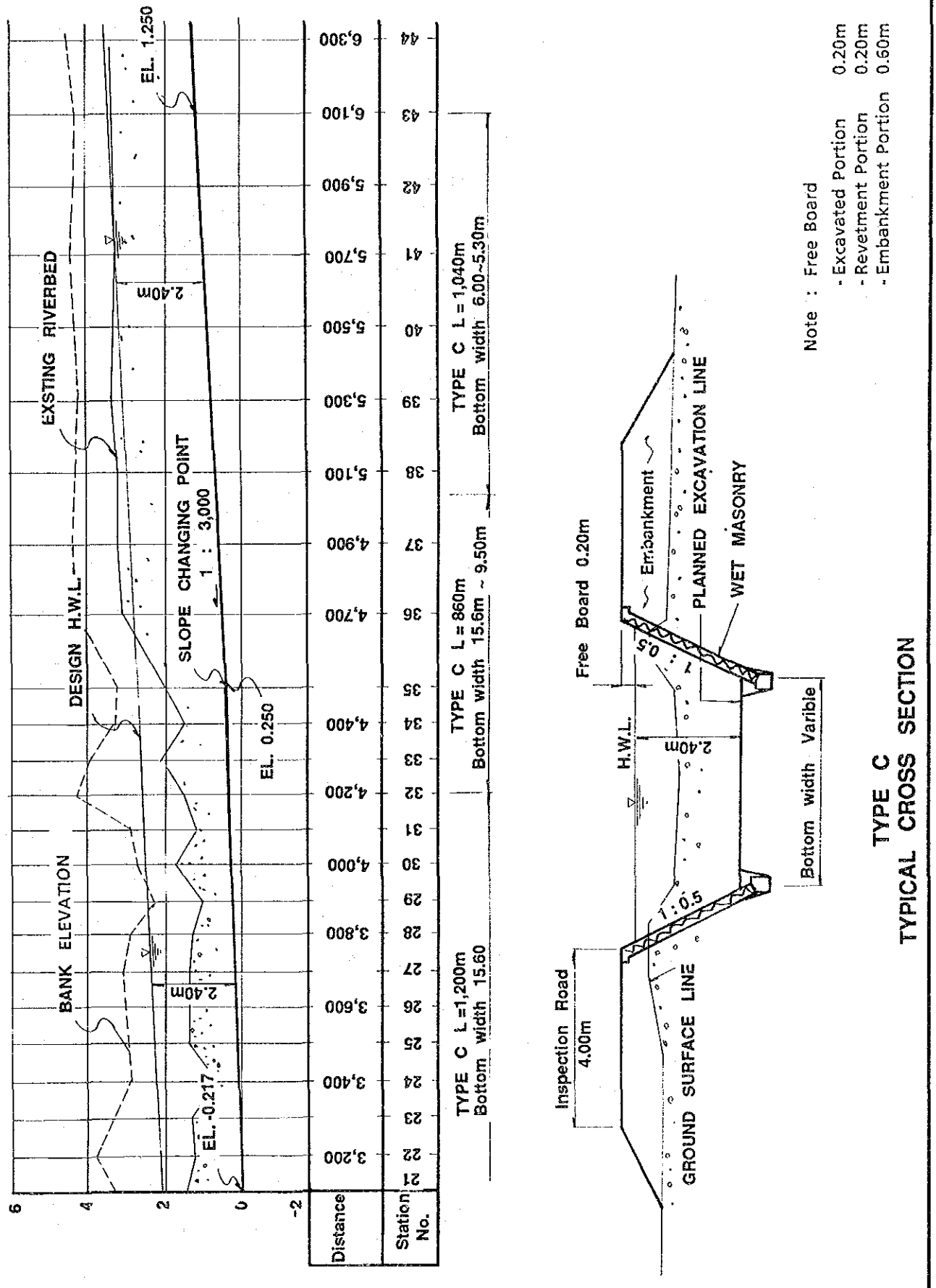
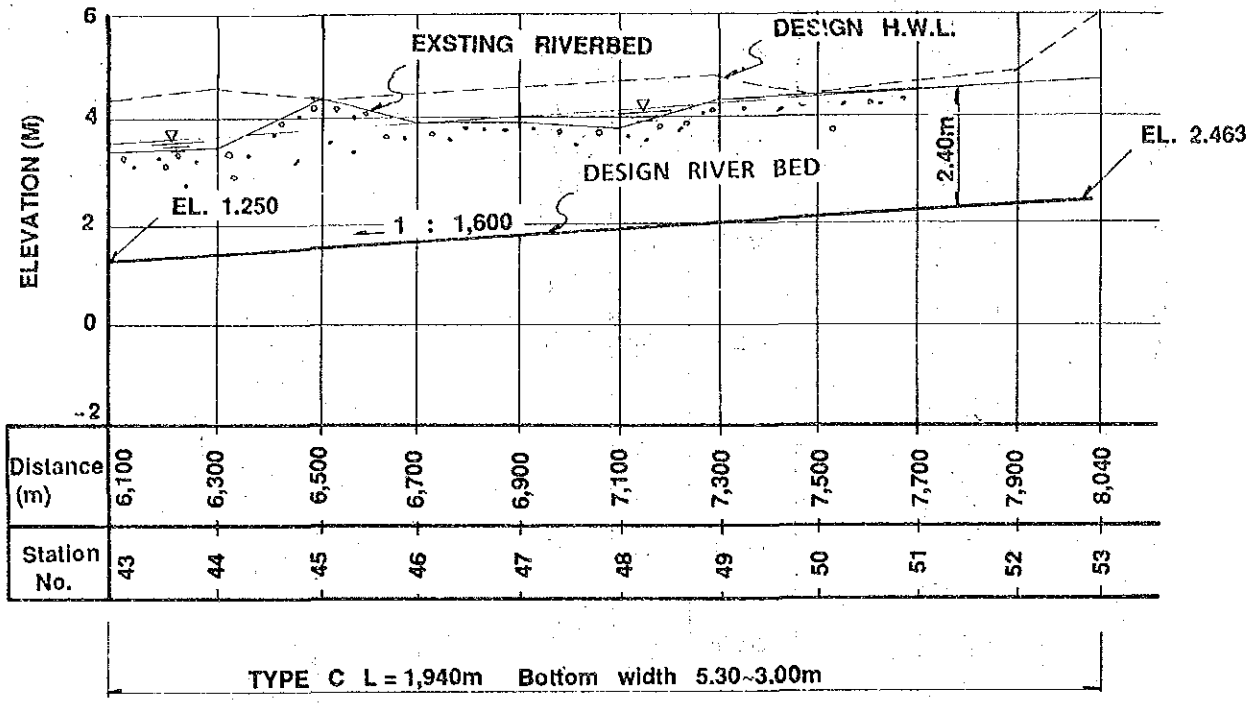
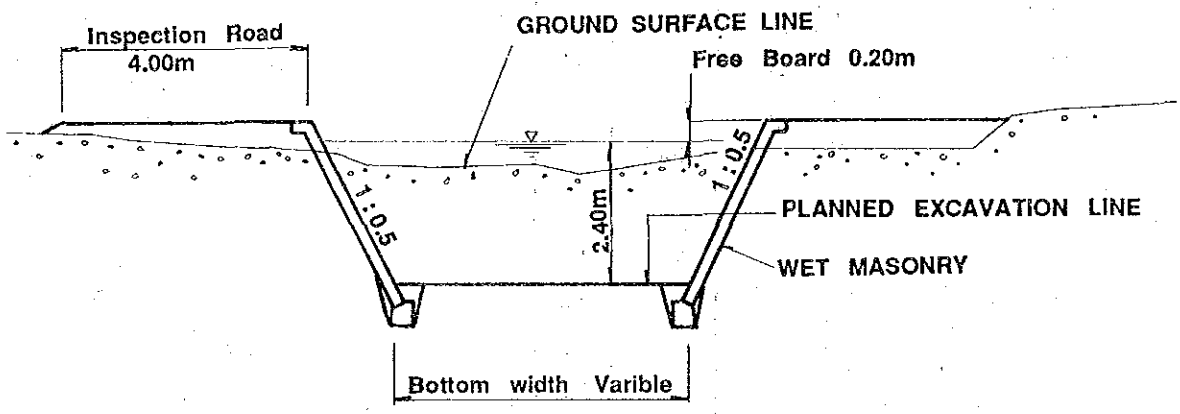


FIG.1.3.7(2) PROFILE AND CROSS SECTION OF KAMAL RIVER

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





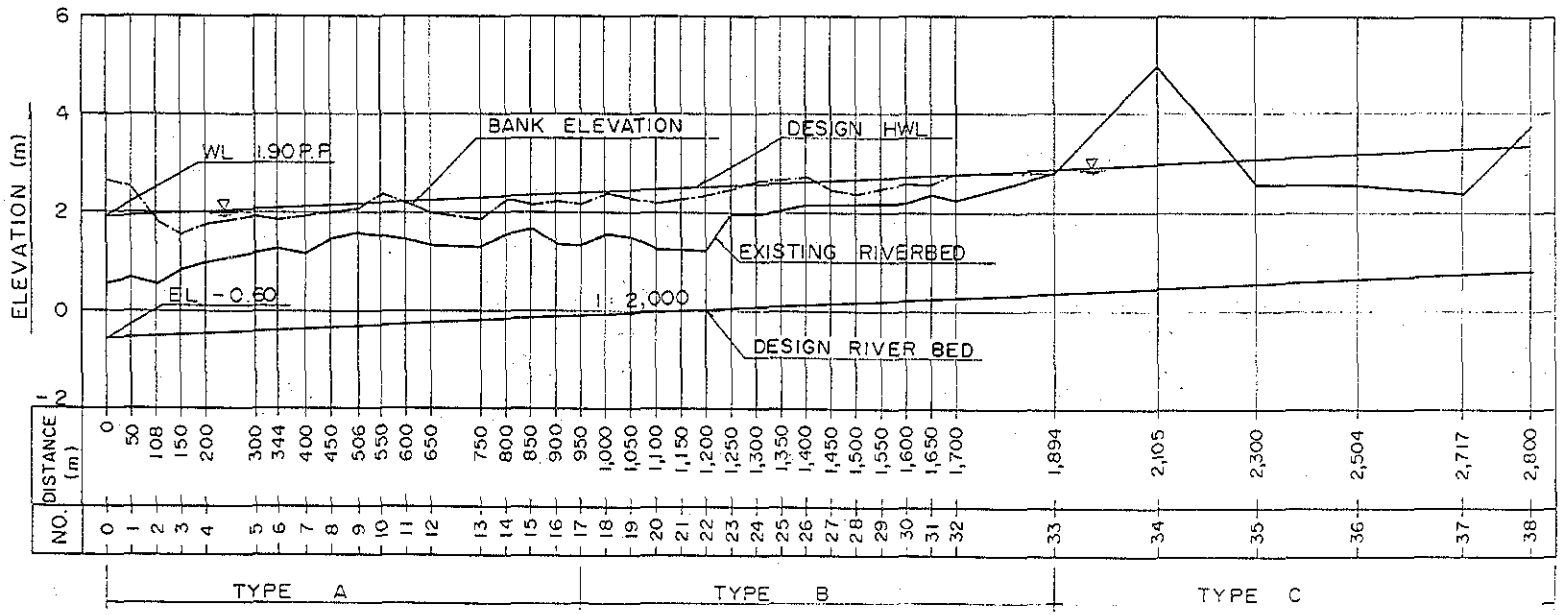
TYPE C
TYPICAL CROSS SECTION

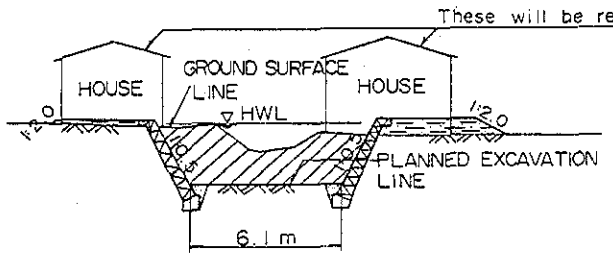
Note : Free Board

- Excavated Portion	0.20m
- Revetment Portion	0.20m
- Embankment Portion	0.60m

FIG.1.3.7(3) PROFILE AND CROSS SECTION OF KAMAL RIVER

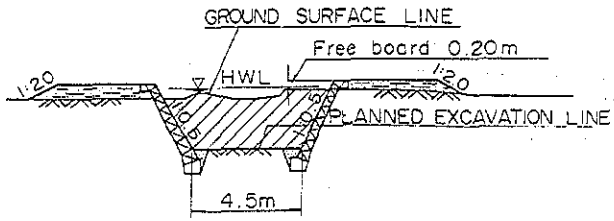
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA





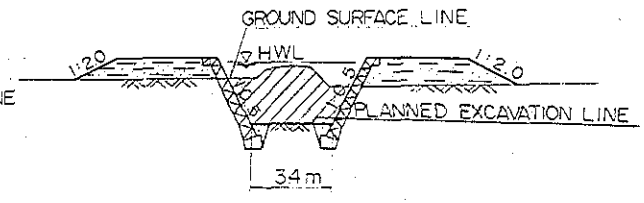
TYPE A

TYPICAL CROSS SECTION



TYPE B

TYPICAL CROSS SECTION



TYPE C

TYPICAL CROSS SECTION

FIG. 1.3.8 PROFILE AND CROSS SECTION OF PROPOSED PADONGKELAN CHANNEL

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

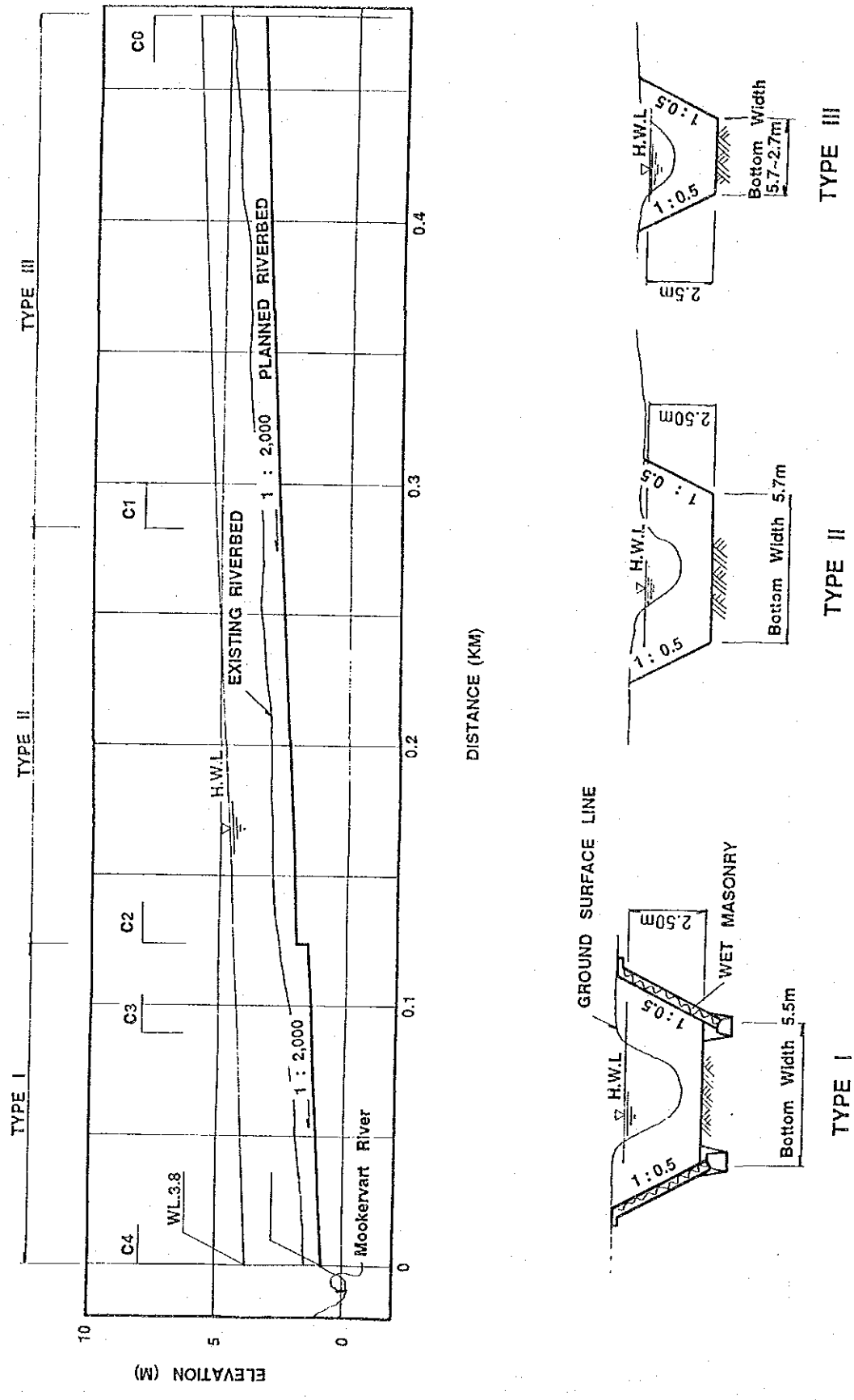


FIG. 1.3.9 PROFILE AND CROSS SECTION OF PROPOSED KALI GEDE & KALI BOR CHANNEL

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

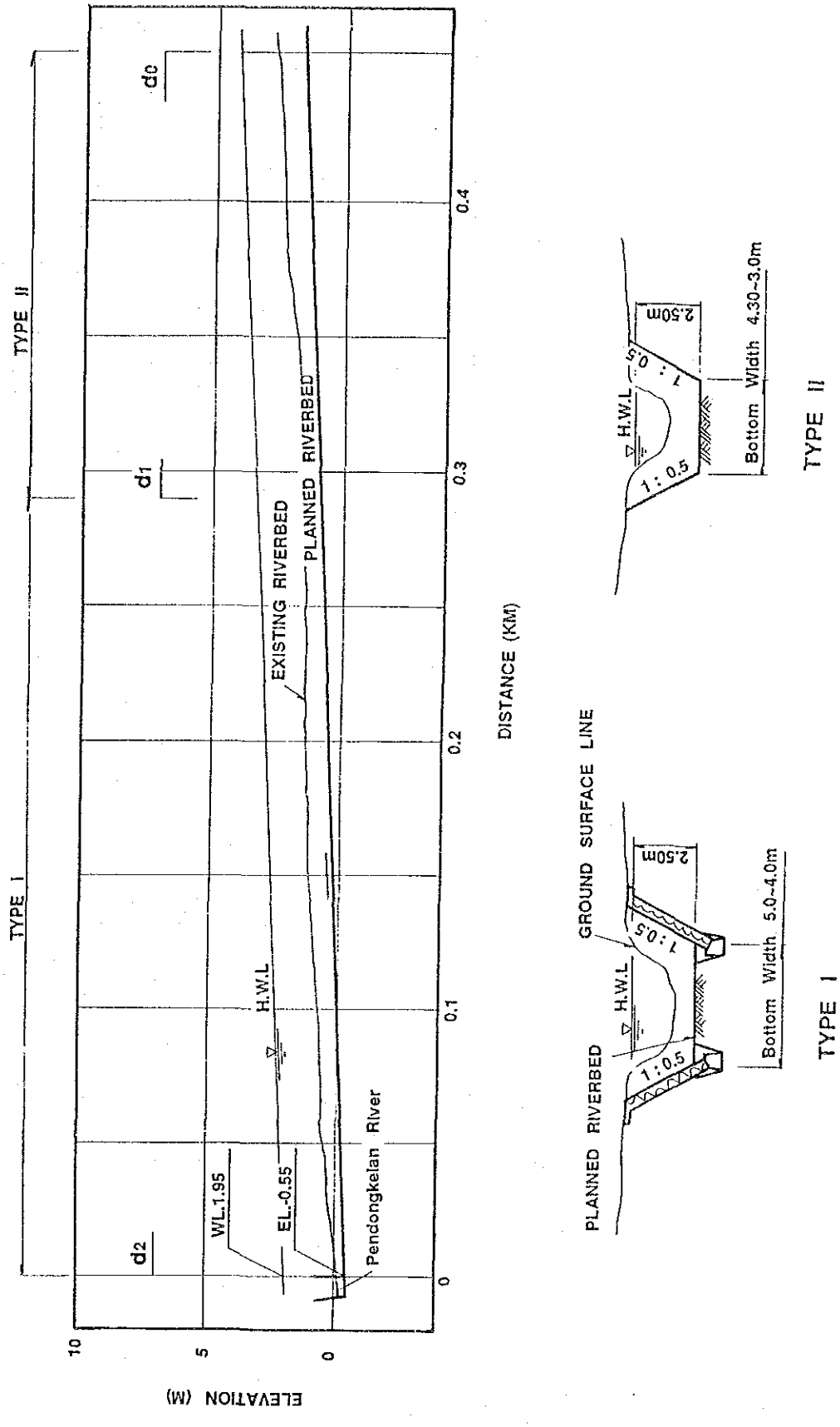


FIG. 1.3.10 PROFILE AND CROSS SECTION OF PROPOSED SALURAN CENGKARENG CHANNEL

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

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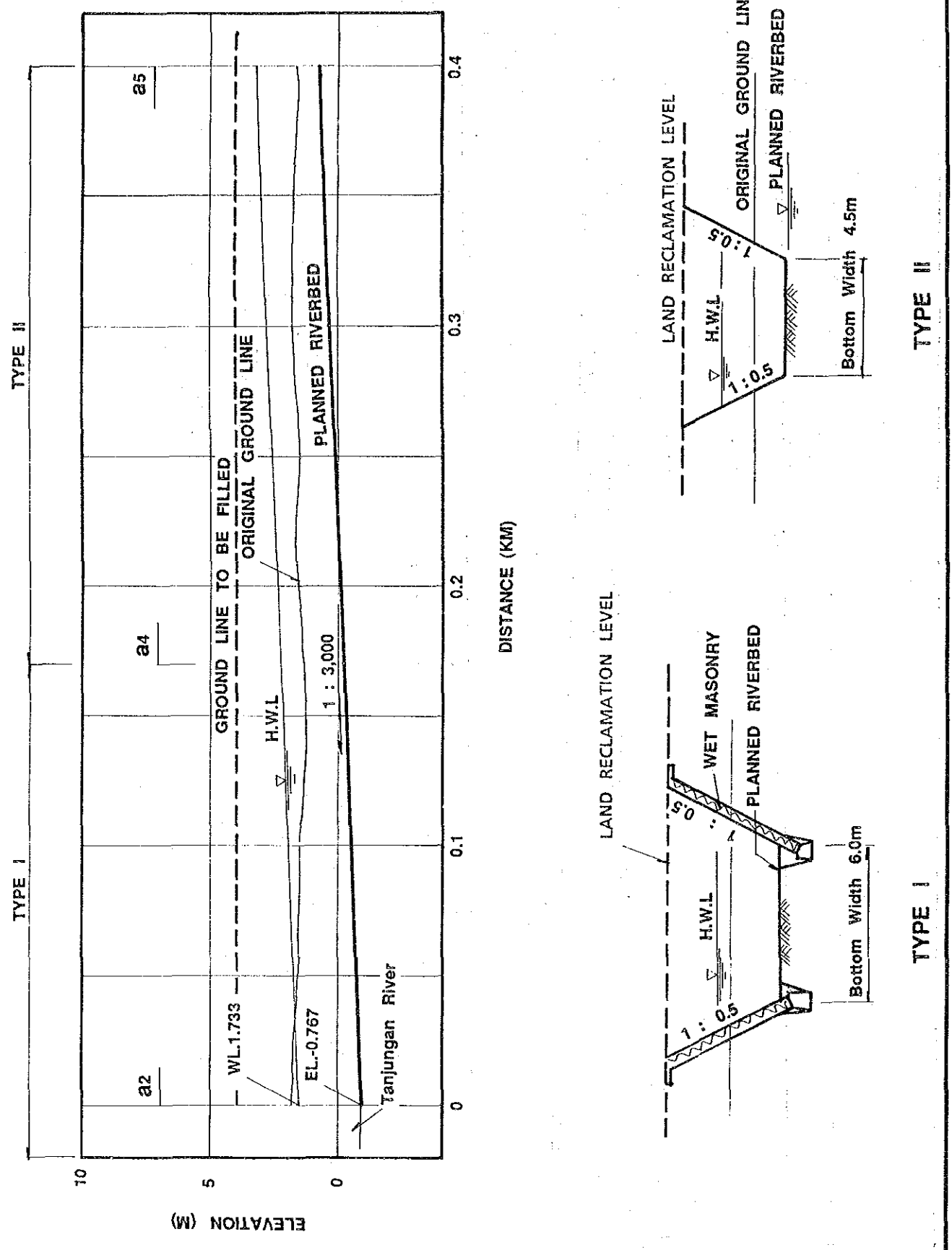
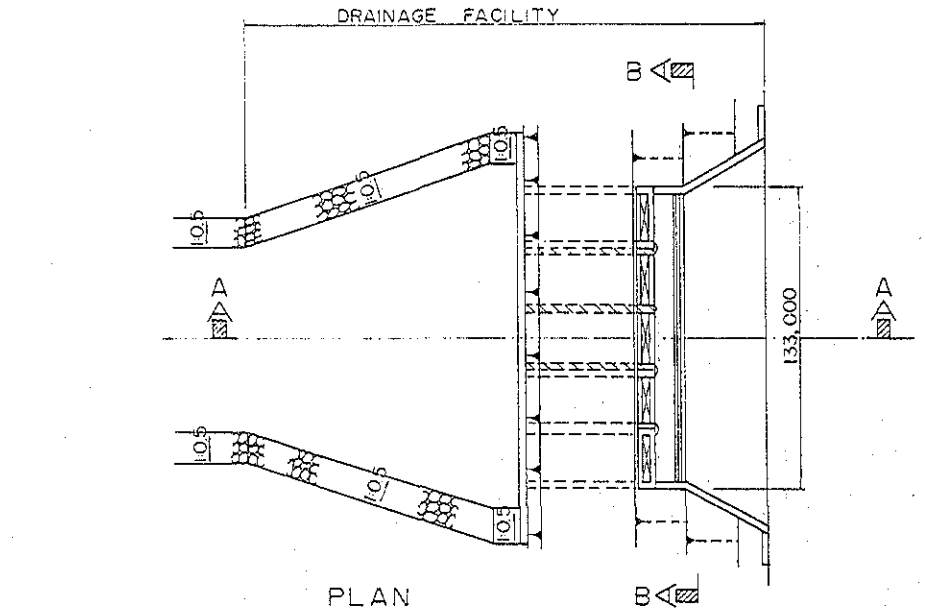
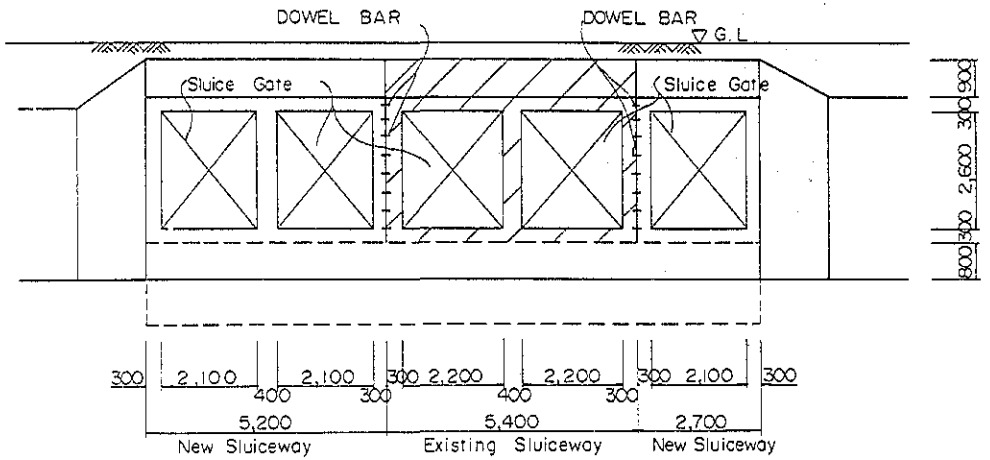
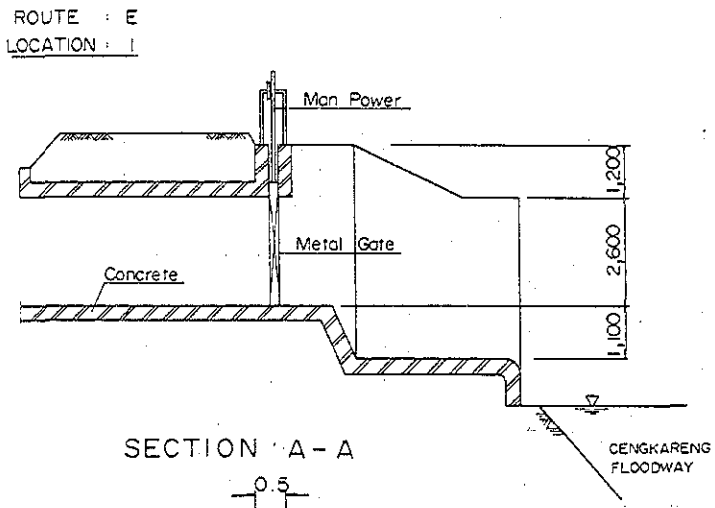


FIG. 1.3.11 PROFILE AND CROSS SECTION OF PROPOSED NEW CHANNEL OF BASIN (A)

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







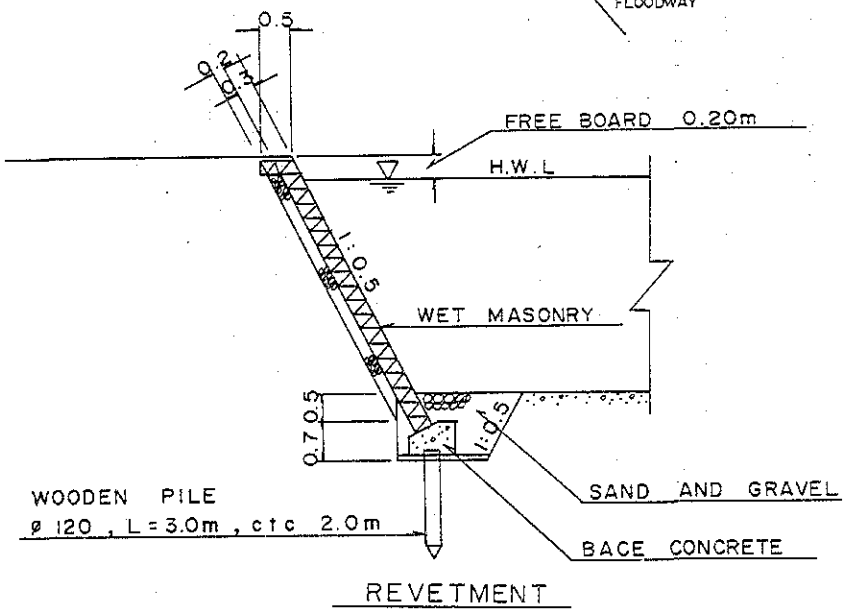
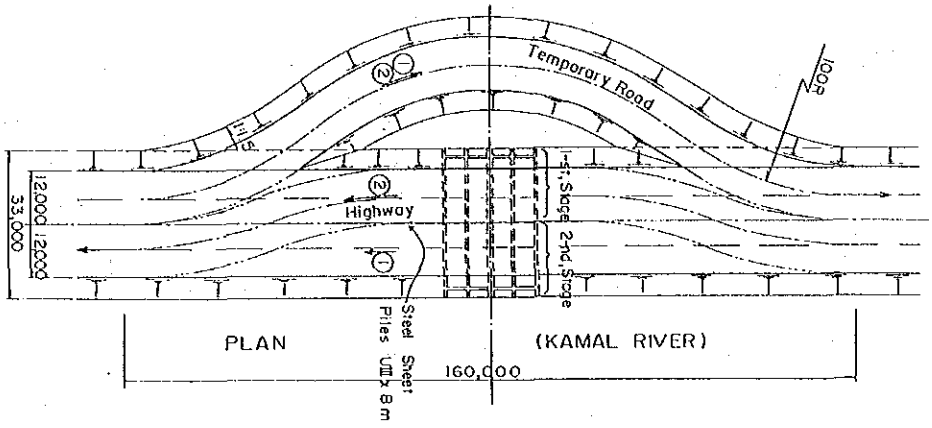
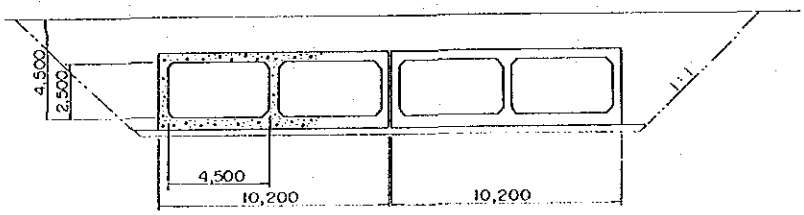


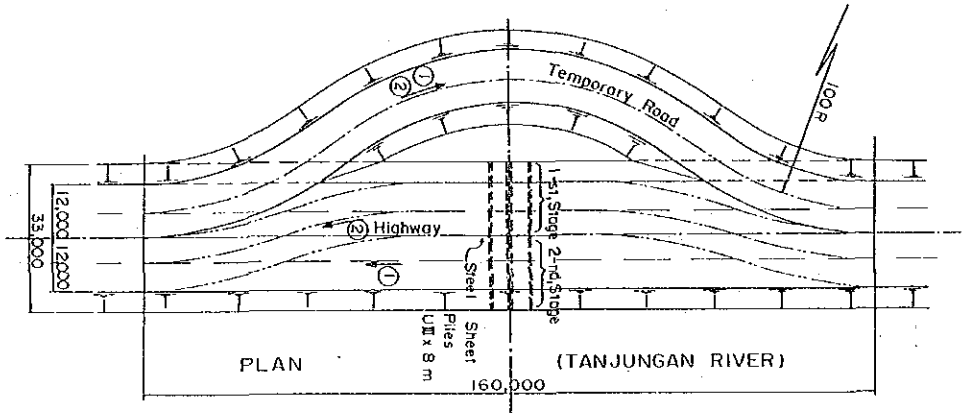
FIG. 1.3.12 STRUCRURE OF SLUICE GATE AND REVETMENT

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



① : traffic lanes for the 1-st, stage
② : traffic lanes for the 2-nd, stage





① : traffic lanes for the 1-st, stage
② : traffic lanes for the 2-nd, stage

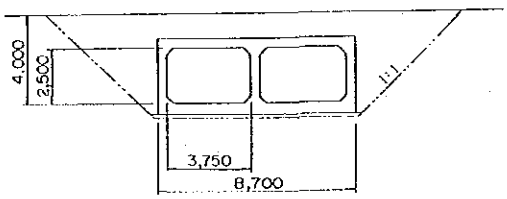


FIG. 1.3.13 STRUCTURE OF HIGHWAY CROSSING

Chapter 4 COST ESTIMATION AND IMPLEMENTATION SCHEDULE

4.1 Basis of Cost Estimation

The estimation of the project cost, consisting of direct construction cost, land acquisition and house resettlement compensation costs, engineering service cost, government administration cost, physical contingency and price escalation was carried out based on the following conditions.

(1) The estimates are made on the assumption that all construction works will be contracted to general contractors.

(2) All base costs are expressed under the economic conditions that prevailed in July, 1990.

(3) Engineering service cost is assumed at 10.0% of the direct construction cost.

(4) Government administration cost is assumed at 1.5% of the total cost of direct construction, and land acquisition and house resettlement compensation.

(5) A physical contingency is assumed to be 10.0% of the direct construction cost.

(6) Annual price escalation for the project cost is assumed to be 6.0%.

4.2 Unit Construction Cost

The unit prices of labor, materials and equipment are determined based on the data collected from PU of DKI, JFCP and other agencies concerned. The unit prices of labor and construction materials and rental fee of equipment are shown in Table 1.4.1.

The estimated unit construction costs by work item or type of facilities are shown in Table 2.4.2.

The unit costs of land acquisition and house resettlement compensation are determined based on the information provided by PU of DKI, JFCP and other agencies.

The estimated unit costs are as follows.

(1) Land acquisition
- Residential area : 77,400 Rp./m^2
- Green area (undeveloped area) : 6,400 Rp./m^2

(2) House resettlement compensation : 51,700 Rp./m^2

4.3 Estimate Project Cost

The total project cost, consisting of direct construction cost, land acquisition and compensation cost, engineering service cost, government administration cost and physical contingency, amounts to Rp. 51,200 million at July, 1990 prices as given below.

(million Rp.)

Item	Cost
Direct Construction	19,880
Land Acquisition/Compensation	26,646
Engineering Service	1,988
Administration	698
Physical Contingency	1,988
Total	51,200

Its break-down by drainage basin and by construction works are given in Table 1.4.3.

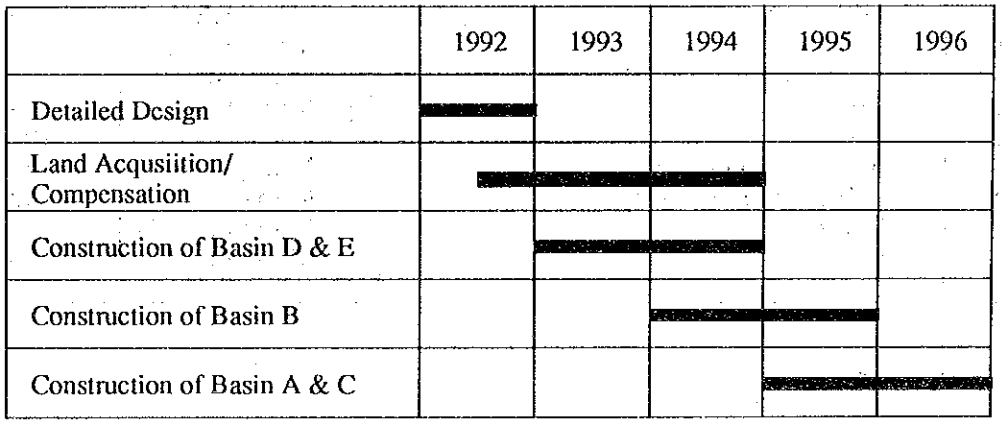
Details of the cost estimate of the direct construction cost, and land acquisition and compensation costs are shown in Table 1.4.4.

4.4 Operation and Maintenance Cost

The operation and maintenance cost at full operation stage of the facilities, after completion of the project, is assumed to be annually 0.5% (Rp. 99.4 million/year) of the direct construction cost at July 1990 price.

4.5 Implementation Schedule

The project will be completed within five (5) years from 1992 to 1996. The proposed implementation schedule is shown below.



The disbursement schedule of the project cost are shown below.

(million Rp.)

Year	1992	1993	1994	1995	1996	Total
Project Cost (1990 price)	7,000	14,000	17,000	8,000	5,200	51,200
Price Escalation	865	2,674	4,463	2,706	2,177	12,885
Total	7,865	16,674	21,463	10,706	7,377	64,085

Table 1.4.1 Labour Cost, Rental Cost of Equipment and Material Cost

Labour Cost

Item No.	Description	Unit	Unit Cost (Rp.)
1	Common labor	Man-day	3,500
2	Semi skilled labor	Man-day	4,000
3	Skilled labor	Man-day	5,000
4	Mason	Man-day	5,000
5	Plasterer	Man-day	5,500
6	Concrete worker	Man-day	5,500
7	Steel worker	Man-day	5,500
8	Carpenter	Man-day	5,500
9	Foreman	Man-day	8,000
10	Welder	Man-day	6,000
11	Electrician	Man-day	6,000
12	Plumber	Man-day	6,000
13	Operator	Man-day	10,000
14	Assistant Operator	Man-day	6,500
15	Driver (dump truck)	Man-day	6,000
16	Mechanic	Man-day	7,000
17	Surveyor	Man-day	8,000

Rental Cost of Equipment

Item No.	Description	Capacity	Unit Cost (Rp./day)
1	Concrete mixer	0.1 m^3	32,000
2	Concrete vibrator	dia. 40 mm	25,000
3	Water pump	dia. 75 mm	32,800
4	Excavator/backhoe	0.6 m^3	360,000
5	Bulldozer	11 ton	465,000
6	Bulldozer	15 ton	520,000
7	Crawler crane	2 ton	480,000
8	Dump truck	8 ton	122,000
9	Dump truck	2.4 ton	164,000
10	Vibro hammer	80 kg	710,000
11	Tamping rammer	3 m^3/min	34,000
12	Compressor	23 ton	425,000
13	Vibratory compactor	-	320,000
14	Generator set		95,000

(Continued)

Material Cost

Item No.	Description	Unit	Unit Cost (Rp.)
1	Gasoline	lit.	450
2	Diesel oil	lit.	245
3	Hydraulic oil	lit.	5,200
4	Lubricant oil	lit.	6,500
5	Grease	kg	7,750
6	Portland cement	bag	5,400
7	Sand for concrete	m^3	24,000
8	Sand for others	m^3	20,000
9	Sand gravels	m^3	21,000
10	Crushed stone for concrete	m^3	24,000
11	Broken stone	m^3	21,000
12	Brick	pc	80
13	Selected soil	m^3	2,750
14	Meranti Wood (Class III):		
	a. Plank	m^3	230,000
	b. Square	m^3	210,000
15	Plywood 4 x 8 t 9 mm	sheet	16,000
16	Plywood 4 x 8 t 12 mm	sheet	21,000
17	Dolken wood dia. 80 mm	pc	1,000
18	Reinforced steel bar	ton	800,000
19	Steel materials:		
	a. Sheet pile type II (48 kg/m)	kg	1,250
	b. Sheet pile type III (60 kg/m)	kg	1,250
	c. Sheet pile type VL (105 kg/m)	kg	1,250
	d. H Shape steel	kg	1,250
20	Concrete wire	kg	1,500
	Nails	kg	1,300
	Polyvinyl Chloride (PVC) Pipes:		
	a. Diameter 150 mm	m	19,850
	b. Diameter 200 mm	m	31,350
	c. Diameter 250 mm	m	48,350
	d. Diameter 300 mm	m	78,750
21	Reinforced Concrete (RC) Pipes (including rubber joint)		
	a. Diameter 350 mm	m	68,100
	b. Diameter 400 mm	m	75,100
	c. Diameter 450 mm	m	91,100
	d. Diameter 500 mm	m	100,850
	e. Diameter 600 mm	m	146,100
	f. Diameter 700 mm	m	170,000
	g. Diameter 800 mm	m	188,750
	h. Diameter 900 mm	m	247,900
	i. Diameter 1000 mm	m	292,000
	j. Diameter 1100 mm	m	343,300
	k. Diameter 1200 mm	m	399,500
	l. Diameter 1350 mm	m	521,250
	m. Diameter 1500 mm	m	686,200

Table 1.4.2 Unit Construction Cost

Works			Cost (Rp.)
1.	Works Masonry per 10 m long (63.3 m^2)		
	1) Excavation including transportation	3,600 Rp./m^3 x 40.4 m^3	145,440
	2) Backfilling with sand & gravel	11,647 Rp./m^3 x 35.7 m^3	415,798
	3) Backfilling with soil	1,892 Rp./m^3 x 2.0	3,784
	4) Wooden pile	0.17 m^3/pc x 272,536 Rp./m^3	46,331
	5) Foundation concrete		
	a) Concrete	108,775 Rp./m^3 x 2.7 m^3	29,369
	b) Plywood form	11,325 Rp./m^2 x 14.0 m^2	158,550
	c) Reinforcement	952,343 Rp./ton x 0.0945	89,996
	6) Masonry Works (t=30 cm)	29,342 Rp./m^2 x 71.5 m^2	2,097,953
	7) Wire Net	4,981 Rp./m^2 x 66.47 m^2	331,087
	8) Concrete Surfacing	108,775 x 3.98 m^3	432,925
	9) Direct Cost Total		3,751,233
	10) Preparatory Works	Direct cost x 25%	937,808
	11) Total		4,689,041
	Unit cost per m^2 = $\frac{4,689,041}{63.3}$ = 74,076 ≒ Rp. 74,100		
2.	Excavation		3,600/m^3
3.	Embankment		4,400/m^3
4.	Backfilling with sand & gravel		1,892/m^3
5.	Concrete		108,775/m^3
6.	Plywood Form		11,325/m^2
7.	Reinforcement		952,343/ton

Table 1.4.3 Break-down of Project Cost

Item	Cost (million Rp.)						Remarks
	Basin A	Basin B	Basin C	Basin D	Basin E	Total	
I Direct Construction	4,022.7	6,437.1	3,909.1	3,413.1	2,098.2	19,880.2	
Channel Excavation	399.6	824.4	212.4	129.6	123.1	1,689.1	
Embankment	114.4	105.6	85.4	99.8	61.6	466.8	
Revetment	2,852.9	3,919.9	3,267.8	2,741.7	1,696.9	14,479.2	
Bridge Improvement	-	388.0	49.4	163.2	14.1	614.7	
Highway Crossing	264.6	209.0	-	-	-	473.6	
Inspection Road	391.2	990.2	294.1	278.8	172.5	2,126.8	
Sluice gate	-	-	-	-	30.0	30.0	
Others	-	-	-	-	-	-	
II Land Acquisition/ Compensation	5,817.9	10,063.8	4,618.9	3,049.5	3,096.0	26,646.1	
Residential Area	5,580.5	9,458.3	4,288.0	3,049.5	3,096.0	25,472.3	
Green Area	237.4	341.8	-	-	-	579.2	
House Resettlement	-	263.7	330.9	-	-	594.6	
III Engineering Service	402.3	643.7	390.9	341.3	209.8	1,988.0	Ix10%
IV Administration	147.6	247.5	127.9	96.9	77.9	697.8	(I+II) x1.5%
Sub-total	10,390.5	17,392.1	9,046.8	6,900.8	5,481.9	49,212.1	
V Physical Contingency	402.3	643.7	390.9	341.3	209.8	1,988.0	Ix10%
Total	10,792.8	18,035.8	9,437.7	7,242.1	5,691.7	51,200.1	

Table 1.4.4 (1) Direct Construction and Land Acquisition/Compensation Costs for Drainage Basin (A)

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction				4,022.7
Channel Excavation	(m^3)	3,600	111,000	399.6
Embankment	(m^3)	4,400	26,000	114.4
Revetment	(m)		9,000	
	(m^2)	74,100	38,500	2,852.9
Bridge Improvement	(place)			
	(m^2)	881,800	-	-
Highway Crossing	(place)		1	
	(m^2)	881,800	300	264.6
Inspection Road	(m)		6,400	
	(m^2)	15,400	25,400	391.2
Sluice Gate	(place)	-	-	-
Others	(place)	-	-	-
Land Acquisition/Compensation				5,817.9
Residential Area	(m^2)	77,400	72,100	5,580.5
Green Area	(m^2)	6,400	37,100	237.4
House Resettlement	(m^2)	51,700	-	-

Note: Residential area includes future development area. Green area covers farmland, swamp and fish pond.

Table 1.4.4 (2) Direct Construction and Land Acquisition/Compensation Costs for Drainage Basin (B)

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction				6,437.1
Channel Excavation	(m^3)	3,600	229,000	824.4
Embankment	(m^3)	4,400	24,000	105.6
Revetment	(m)		12,500	
	(m^2)	74,100	52,900	3,919.9
Bridge Improvement	(place)		9	
	(m^2)	881,800	440	388.0
Highway Crossing	(place)		1	
	(m^2)	881,800	237	209.0
Inspection Road	(m)		16,000	
	(m^2)	15,400	64,300	990.2
Sluice Gate	(place)	-	-	-
Others				
Land Acquisition/Compensation				10,063.8
Residential Area	(m^2)	77,400	122,200	9,458.3
Green Area	(m^2)	6,400	53,400	341.8
House Resettlement	(m^2)	51,700	5,100	263.7

Note: Residential area includes future development area. Green area covers farmland, swamp and fish pond.

Table 1.4.4 (3) Direct Construction and Land Acquisition/Compensation Costs for Drainage Basin (C)

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction				3,909.1
Channel Excavation	(m^3)	3,600	59,000	212.4
Embankment	(m^3)	4,400	19,400	85.4
Revetment	(m)		10,500	
	(m^2)	74,100	44,100	3,267.8
Bridge Improvement	(place)		4	
	(m^2)	881,800	56	49.4
Highway Crossing	(place)			
	(m^2)	881,800	-	-
Inspection Road	(m)		4,800	
	(m^2)	15,400	19,100	294.1
Sluice Gate	(place)	-	-	-
Others				
Land Acquisition/Compensation				4,618.9
Residential Area	(m^2)	77,400	55,400	4,288.0
Green Area	(m^2)	6,400	-	-
House Resettlement	(m^2)	51,700	6,400	330.9

Note: Residential area includes future development area. Green area covers farmland, swamp and fish pond.

Table 1.4.4 (4) Direct Construction and Land Acquisition/Compensation Costs for Drainage Basin (D)

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction				3,413.1
Channel Excavation	(m^3)	3,600	36,000	129.6
Embankment	(m^3)	4,400	22,700	99.8
Revetment	(m)		8,600	
	(m^2)	74,100	37,000	2,741.7
Bridge Improvement	(place)		1	
	(m^2)	881,800	185	163.2
Highway Crossing	(place)			
	(m^2)	881,800	-	-
Inspection Road	(m)		4,500	
	(m^2)	15,400	18,100	278.8
Sluice Gate	(place)	-	-	-
Others				
Land Acquisition/Compensation				3,049.5
Residential Area	(m^2)	77,400	39,400	3,049.5
Green Area	(m^2)	6,400	-	-
House Resettlement	(m^2)	51,700	-	-

Note: Residential area includes future development area. Green area covers farmland, swamp and fish pond.

Table 1.4.4 (5) Direct Construction and Land Acquisition/Compensation Costs for Drainage Basin (E)

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction				2,098.2
Channel Excavation	(m^3)	3,600	34,200	123.1
Embankment	(m^3)	4,400	14,000	61.6
Revetment	(m)		5,400	
	(m^2)	74,100	22,900	1,696.9
Bridge Improvement	(place)		1	
	(m^2)	881,800	16	14.1
Highway Crossing	(place)			
	(m^2)	881,800	-	-
Inspection Road	(m)		2,800	
	(m^2)	15,400	11,200	172.5
Sluice Gate	(place)	-	1	30.0
Others				
Land Acquisition/Compensation				3,096.0
Residential Area	(m^2)	77,400	40,000	3,096.0
Green Area	(m^2)	6,400	-	-
House Resettlement	(m^2)	51,700	-	-

Note: Residential area includes future development area. Green area covers farmland, swamp and fish pond.

Chapter 5 PROJECT EVALUATION

5.1 Economic Benefits and Costs

The major benefit of the Cengkareng West Urban Drainage Project is the virtual removal of damages to be brought on by inundations in the Cengkareng West Urban Drainage area in the years to come. Those damages will be in the form of direct damages to properties such as houses, shops and factories, income losses due to the closure of commercial and industrial establishments, traffic damages, damages to infrastructure, etc.

Such damages on the annual average basis amounted to Rp. 1,262 million in 1988. They are projected to reach Rp. 7,085 million in the target year of 2010. The average annual flood damages in the intermediate years between 1988 and 2010 can be estimated by formulating a simple equation.

The growth rate of the damages is calculated at 8.2%. This high rate derives from the rapid growth of damageable properties to be expected from residential development in the Cengkareng West Urban Drainage area.

Once the Project is implemented, the annual average flood damages in the years to come will be reduced to nil. This forms the topmost benefit of the Project.

When an area is inundated, wastewater from houses, shops and other properties often spills out and mixes with flood water. This unhygienic situation sometimes leads to the breakout of epidemic, causing wide-spread human sufferings and incurring heavy medical costs. The realization of the Project will terminate or reduce the occurrence of such a disaster.

The fears, misgivings and inconvenience people experience in time of inundation cannot be neglected as intangible flood damages. These psychological burdens will be eliminated upon the implementation of the Project.

Flood prone areas tend to be avoided by households and businessmen because of the possible flood damages and discomfort they will bring on to

them. In the event the Project is carried out, they will be freed from such anxiety and as a result they will want to move in there. As a consequence, demand for land in the former flood prone areas will be enhanced eventually to be reflected in a higher land price.

Out of the four types of benefits described above, only the first one has been quantitatively analyzed due to the difficulties of quantification for other ones.

The total initial costs for the Project is calculated at Rp. 51,200 million. In conducting economic analysis those costs have to be recalculated in economic terms. Conversion rate of 80% was applied to labor cost taking account of the circumstances where unemployment rate was 9.37% in 1987 in the City of Jakarta. Also, land acquisition cost was excluded on the ground that it is difficult to determine the economic value of land, and also that the economic value of land in the "without project" situation will be sufficiently offset by the incremental economic value of land in the "with project" situation.

Eventually, initial costs in economic terms work out at Rp. 23,385 million (Refer to Table 1.5.1). They were distributed on yearly basis from 1992 to 1996 in accordance with the disbursement schedule as shown in Table 1.5.2. Annual O/M costs in economic terms are calculated at Rp. 91 million.

5.2 Project Evaluation

In making cost benefit streams, project life is assumed to be 50 years starting in 1992 and ending in 2041. Also, in calculating benefit cost ratio (B/C) and net present value (NPV), opportunity cost of capital (OCC) is assumed to be 10%.

Table 1.5.2 shows cost benefit streams over the project life period of 50 years. When those streams are accumulated year by year, the results are as shown in Table 1.5.3. When cumulative cost benefit streams are discounted at OCC, the results are as shown in Table 1.5.4.

It is clear from Table 1.5.4 that cumulative cost and benefit at present value over 50 years come to Rp. 17,689 million and Rp. 38,511 million, respectively. That is to say, cumulative cashflow at present value over the same period works out to Rp. 20,822 million. This is NPV. Also, when cumulative benefit is divided by cumulative cost, 2.18 is obtained. This is B/C. Table 1.5.5 shows such values of NPV and B/C.

The discount rate at which cumulative cost equals cumulative benefit is called economic internal rate of return (EIRR). As Table 1.5.6 shows, EIRR works out to 20.0%.

As already described, there are other important benefits not incorporated in the above economic analysis.

Taking all these into consideration, it can be concluded that the Cengkareng West Urban Drainage Project is economically feasible.

5.3 Environmental Assessment

5.3.1 Project Description

(1) General

The Project Area covers the north west low-lying area of Jakarta City with an area of 4,700 ha. It is encompassed by the administrative boundary of DKI, Jakarta to the west, Mookervart River to the south and Cengkareng Floodway to the east. The Area is undergoing a rapid land development to accommodate the increasing population.

The Project Area is drained by five (5) drainage systems of the Tanjungan River, Kamal River, Kali Gede/Kali Bor Channel, Saluran Cengkareng Channel and Padongkelan Channel. The above rivers and channels flood due to their insufficient flow capacities. The total potential flood area reaches 473 ha, out of which 273 ha is habitually inundated.

The above existing five (5) drainage systems will be improved to climinate the existing flood problems and further to cope with the increase in flood run-off due to the land developments in the future. The proposed drainage improvement works consists of excavation, embankment, bank protection and construction of related structures in the existing and new channels.

The main features of the proposed drainage channels are summarized below.

River/Channel	Length (km)	Gradient	Width (m)	Depth (m)
Tanjungar River	7.2	1 : 3,000	7.0 ~ 16.0	2.5
Kamal River	8.1	1 : 1,600 ~ 1 : 3,000	8.9 ~ 25.2	2.4
Kali Gede/Bor Channel	4.8	1 : 2,000	8.2 ~ 8.5	2.5 ~ 3.0
Saluran Cengkareng Channel	4.5	1 : 2,000	6.5 ~ 7.5	2.5
Padongkelan Channel	2.8	1 : 2,000	5.9 ~ 10.7	2.5
Total	27.4			

Location of the proposed drainage improvement works is shown in Fig. 1.5.1.

(2) Project Activities

(a) Pre-Construction Stage

Prior to construction of the drainage improvement works, 42 ha of land will be acquired and 230 houses with a population of 1,200 will be resettled.

(b) Construction Stage

The construction works will be carried out by local contractors which employ _____ people, and utilize local and

imported materials and equipment. The construction works will be completed within four (4) years from 1993 to 1996. The included major construction works are as follows.

Channel improvement length	:	27.5 km
- Existing channel	:	21 km
- New channel	:	6.5 km
Channel excavation	:	469,000 m^3
Embankment	:	106,000 m^3
Revetment works	:	46 km, 195,000 m^2
Bridge improvement	:	15 places, 700 m^2
Highway crossing	:	2 places, 360 m^2
Inspection road	:	35 km, 138,000 m^2
Sluice gate improvement	:	1 place

The embankment will mostly be constructed by using the excavated soils. Most of the surplus excavated soils will be dumped within the Project Area for urban land development. No large borrow pit and spoil bank is required.

(c) Operation Stage

After completion of the construction, the following operation and maintenance works will be carried out to sustain a satisfactory function of the drainage system.

- Periodical dredging of channel, removal of dumped garbage and other debris
- Repairing of revetment, embankment, inspection road and sluice gate
- Operation of sluice gate according to proper operation rule

(3) Related Activities

Garbage disposal is a related activity to the drainage project. People should be discouraged from disposing their garbages into the channels.

5.3.2 Original Environmental Conditions

(1) Socio-Economic Conditions

(a) Population

The Project Area covers eight (8) Kelurahans. The total population of the Area was 0.263 million in 1988. It is expected to increase to 0.456 million in 2010.

(b) Income Level

The existing average monthly income per capita of the Project Area ranges from Rp.30,409 in Kel. Kamal, Kel. Tegal Alur and Kel. Pegadungan to Rp.44,415 in Kamal Muara with an average of Rp. 34,730.

(2) Physical Conditions

(a) Topography and Geology

The Project Area is low-lying and flat. Its ground elevation is in the range of P.P. 1.0 m and P.P. 5.0 m. The whole Project Area is covered by alluvial soils.

Note: P.P. (Priok Pile) means the tidal gauging station located at Tanjung Priok harbour.

(b) Land Use

In the Project Area, green area including farm land swamp and other open spaces is still prevailing at present. However, this area is undergoing to a rapid land development. The urban land use ratio will increase from 50% in 1990 to 75% in 2005. The existing and future land uses are estimated as follows.

Land Use	Existing (1990)	Future (2005)
Residential	1,410 ha (30%)	2,350 (50%)
Commercial & Institutional	705 (15)	705 (15)
Industrial	235 (5)	470 (10)
Green	2,350 (50)	1,175 (25)
Total	4,700 (100)	4,700 (100)

(3) Water Resources

(a) Surface Water

The following five (5) major rivers and channels and one (1) irrigation canal run through the Project Area. Their salient features are as follows.

	Length (km)	Width (m)	Gradient	Channel/ Water Use	Water Pollution
Tanjungan River	3.2	2-5	1:3,000	Drainage	Mild
Kamal River	11.8	3-18	1:2,000~ 1:3,000	Drainage, Irrigation	Mild
Kali Gede/Kali Bor Channel	4.8	2-4	1:2,000	Drainage	Mild
Saluran Cengkareng Channel	4.5	2-6	1:2,000	Drainage	Severe
Padongkelan Channel	1.1	2-5	1:2,000	Drainage	Severe
Maja Irrigation Canal	8.6	8-10	1:4,000	Irrigation	Mild

(b) Groundwater

Groundwater table in the Project Area lies 2~4 m below the ground surface. Groundwater of the whole Project Area is affected by saline water with more than cl^- 500 mg/l. It is also affected by organic pollution.

(c) Tide

Drainage of the Project Area is affected by tide of the Jakarta Bay. The tide level at Jakarta Bay is shown below.

Spring High Tide (High High Water)	:	P.P. + 1.15 m
Mean Sea Water	:	P.P. + 0.60 m
Spring Low Tide (Low Low Water)	:	P.P. + 0.00 m

The tide intrudes up to 2.0 km upstream in the Tanjungan River and 3.0 km upstream in the Kamal River at the time of spring high tide. However, Kali Gede/Kali Bor, Saluran Cengkareng and Padongkelan channels are not affected by tide.

(4) Biological Resources

There are no rare and protected flora and fauna.

(5) Climate

The climate of the Project Area is characterized by two (2) distinct seasons: rainy season (November - May) and dry season (June - October). The average annual rainfall is 1,700 mm, out of which 70% occurs in rainy season. The average monthly rainfall is 146 mm. The highest rainfall of 340 mm is recorded in January, while the lowest one of 50 mm occurs in August.

The temperature ranges from 23°C in January to 31°C in May with an average of 27°C.

(6) Related Infrastructures

(a) Road Network

The following roads pass through the Project Area.

- Toll Road to Air Port, Outer Ring Road (under Const.), Jl. Muara Kapuk, Jl. Tegal Alur, Jl. Kapuk Raya, Jl. Daan Mogot

Heavy traffic is limited to Jl. Daan Mogot and part of Jl. Muara Kapuk. However, Toll Road to Air Port allows a high speed traffic.

The proposed drainage channels cross the above roads at several locations.

(b) Municipal Water Supply

The Project Area is provided with no municipal water supply system.

5.3.3 Assessment of Environmental Impact

(1) Environmental Impact

The anticipated environmental impacts due to the project activities are mostly positive. The negative impacts are minor. The impacts in the pre-construction, construction and operation stages are listed in Table 1.5.7.

The anticipated negative impacts in the three (3) stages are described in more detail as follows.

(a) Pre-construction Stage

- Land and house losses due to load acquisition and house resettlement

(b) Construction Stage

- Vibration and noise pollution due to operation of construction equipment
- Traffic disturbance caused by transportation of soils and construction materials, and improvement works of the existing bridges and highway crossings

- Damages to road caused by transportation of soils and construction materials
- Dust caused by earth works
- Water pollution due to increased turbidity caused by river dredging and revetment works

(c) Operation Stage

No negative impacts are anticipated.

(2) Assessment and Management of Negative Impacts

(a) Pre-construction Stage

The total land acquisition area and number of house resettlement of the Project are not large and their sites are widely scattered over the whole Project Area. Hence, the required land acquisition and house resettlement in a particular community are small.

The environmental impacts on community life are considered minor. They can be easily managed by proper procedures and schedule of the land acquisition and house resettlement individually.

(b) Construction Stage

The total construction works of the Project are not large in quantity and their sites are widely dispersed across the Project Area. Accordingly, the volume of the construction works in a particular region is small. Moreover, most of the construction sites are located in rural area.

The environmental impacts due to the construction works are considered minor. Moreover, their periods are short. They can be easily managed by proper construction method and schedule as follows.

- Vibration and Noise Pollution

Pile driving is the typical construction works which may cause vibration and noise pollution. Pre-boring method will be adopted instead of conventional hammering method, if necessary, to minimize vibration and noise pollution.

Construction works which cause a serious noise and vibration, if any, may not be allowed in night time.

- Traffic Disturbance

The embankment will mostly be constructed by using the excavated soils of the channels. Most of the surplus excavated soils will be dumped within the Project Area for urban land development. Therfore, the required transportation activities for the construction works are considered not large. The anticipated traffic disturbance can be easily managed as decribed below.

Transportation of soils and construction materials, and improvement works of the existing bridges will be scheduled to avoid peak hours of daily traffic, as required. Heavy traffic roads will be avoided from the routes of project vehicle operation.

Traffic disturbance due to the construction works of the highway crossing will be minimized by construction of a temporary by-pass road.

- Damages to Road

Over-loading of project vehicles may not be allowed to minimize damages to road. Damages to road by project vehicles, if caused, will be immediately repaired.

- Dust Pollution

  Cleaning and water spraying of the roads in and/or around construction site will be enforced to minimize dust pollution.

- River Water Pollution

  River dredging and revetment works may make river water in the downstream muddy. Settling pond of sediments will be constructed at the construction site, if necessary, to minimize water pollution in the downstream.

The relative severeness of the above negative impacts are assessed by score method as shown below.

Negative Impact	Score
Vibration & Noise Pollution	2
Traffic Disturbance	1
Damages to Road	3
Dust Pollution	2
River Water Pollution	3

Note : Smaller number shows severer condition.

The negative impacts and their management measures are summarized in Table 1.5.8.

(c) Operation Stage

No negative impacts are anticipated.

5.3.4 Conclusion

The anticipated negative environmental impacts are considered minor. They can be easily managed by proper land acquisition & house resettlement procedures and schedule, and proper construction method and schedule.

Table 1.5.1 Economic Costs of Cengkareng West Urban Drainage Project

(Unit: Rp. Million)

Item	Financial Costs	Economic Costs
1. Direct Construction Cost	19,880.2	18,116.8
2. Land Acquisition and Compensation	26,646.1	594.6
1) Land Acquisition	26,051.5	0.0
2) Compensation	594.6	594.6
3. Engineering Services	1,988.0	1,988.0
4. Government Administration	697.8	697.8
5. Physical Contingency	1,988.0	1,988.0
Total	51,200.1	23,385.2
O/M Costs	99.4	90.6

Source: JICA

Table 1.5.2 Cost Benefit Streams - Cengkareng West Urban Drainage

IC=Initial Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

(Unit:Rp Million)

NO.	YEAR	IC	OM	CS	BF	CF
1	1992	1988	0	1988	0	-1988
2	1993	3215	0	3215	0	-3215
3	1994	5987	44	6031	1364	-4667
4	1995	7391	72	7463	2475	-4988
5	1996	4804	91	4895	3379	-1516
6	1997	0	91	91	3644	3553
7	1998	0	91	91	3909	3818
8	1999	0	91	91	4174	4083
9	2000	0	91	91	4438	4347
10	2001	0	91	91	4703	4612
11	2002	0	91	91	4968	4877
12	2003	0	91	91	5232	5141
13	2004	0	91	91	5497	5406
14	2005	0	91	91	5762	5671
15	2006	0	91	91	6026	5935
16	2007	0	91	91	6291	6200
17	2008	0	91	91	6556	6465
18	2009	0	91	91	6820	6729
19	2010	0	91	91	7085	6994
20	2011	0	91	91	7085	6994
21	2012	0	91	91	7085	6994
22	2013	0	91	91	7085	6994
23	2014	0	91	91	7085	6994
24	2015	0	91	91	7085	6994
25	2016	0	91	91	7085	6994
26	2017	0	91	91	7085	6994
27	2018	0	91	91	7085	6994
28	2019	0	91	91	7085	6994
29	2020	0	91	91	7085	6994
30	2021	0	91	91	7085	6994
31	2022	0	91	91	7085	6994
32	2023	0	91	91	7085	6994
33	2024	0	91	91	7085	6994
34	2025	0	91	91	7085	6994
35	2026	0	91	91	7085	6994
36	2027	0	91	91	7085	6994
37	2028	0	91	91	7085	6994
38	2029	0	91	91	7085	6994
39	2030	0	91	91	7085	6994
40	2031	0	91	91	7085	6994
41	2032	0	91	91	7085	6994
42	2033	0	91	91	7085	6994
43	2034	0	91	91	7085	6994
44	2035	0	91	91	7085	6994
45	2036	0	91	91	7085	6994
46	2037	0	91	91	7085	6994
47	2038	0	91	91	7085	6994
48	2039	0	91	91	7085	6994
49	2040	0	91	91	7085	6994
50	2041	0	91	91	7085	6994

Table 1.5.3 Cumulative Cost Benefit Streams - Cengkareng West Urban Drainage

BNFT=Benefits; COST=Costs: CSFL=Cash Flow (=BNFT-COST)
CM BNFT=Cumulative Benefits; CM COST=Cumulative Costs; CM CSFL=Cumulative Cash Flow

(Unit: Rp Million)

NO.	YEAR	COST	BNFT	CSFL	CM COST	CM BNFT	CM CSFL
1	1992	1,988	0	-1,988	1,988	0	-1,988
2	1993	3,215	0	-3,215	5,203	0	-5,203
3	1994	6,031	1,364	-4,667	11,234	1,364	-9,870
4	1995	7,463	2,475	-4,988	18,697	3,839	-14,858
5	1996	4,895	3,379	-1,516	23,592	7,218	-16,374
6	1997	91	3,644	3,553	23,683	10,862	-12,821
7	1998	91	3,909	3,818	23,774	14,771	-9,003
8	1999	91	4,174	4,083	23,865	18,945	-4,920
9	2000	91	4,438	4,347	23,956	23,383	-573
10	2001	91	4,703	4,612	24,047	28,086	4,039
11	2002	91	4,968	4,877	24,138	33,053	8,915
12	2003	91	5,232	5,141	24,229	38,285	14,057
13	2004	91	5,497	5,406	24,320	43,782	19,462
14	2005	91	5,762	5,671	24,411	49,544	25,133
15	2006	91	6,026	5,935	24,502	55,570	31,068
16	2007	91	6,291	6,200	24,593	61,861	37,268
17	2008	91	6,556	6,465	24,684	68,417	43,733
18	2009	91	6,820	6,729	24,775	75,237	50,462
19	2010	91	7,085	6,994	24,866	82,322	57,456
20	2011	91	7,085	6,994	24,957	89,407	64,450
21	2012	91	7,085	6,994	25,048	96,492	71,444
22	2013	91	7,085	6,994	25,139	103,577	78,438
23	2014	91	7,085	6,994	25,230	110,662	85,432
24	2015	91	7,085	6,994	25,321	117,747	92,426
25	2016	91	7,085	6,994	25,412	124,832	99,420
26	2017	91	7,085	6,994	25,503	131,917	106,414
27	2018	91	7,085	6,994	25,594	139,002	113,408
28	2019	91	7,085	6,994	25,685	146,087	120,402
29	2020	91	7,085	6,994	25,776	153,172	127,396
30	2021	91	7,085	6,994	25,867	160,257	134,390
31	2022	91	7,085	6,994	25,958	167,342	141,384
32	2023	91	7,085	6,994	26,049	174,427	148,378
33	2024	91	7,085	6,994	26,140	181,512	155,372
34	2025	91	7,085	6,994	26,231	188,597	162,366
35	2026	91	7,085	6,994	26,322	195,682	169,360
36	2027	91	7,085	6,994	26,413	202,767	176,354
37	2028	91	7,085	6,994	26,504	209,852	183,348
38	2029	91	7,085	6,994	26,595	216,937	190,342
39	2030	91	7,085	6,994	26,686	224,022	197,336
40	2031	91	7,085	6,994	26,777	231,107	204,330
41	2032	91	7,085	6,994	26,868	238,192	211,324
42	2033	91	7,085	6,994	26,959	245,277	218,318
43	2034	91	7,085	6,994	27,050	252,362	225,312
44	2035	91	7,085	6,994	27,141	259,447	232,306
45	2036	91	7,085	6,994	27,232	266,532	239,300
46	2037	91	7,085	6,994	27,323	273,617	246,294
47	2038	91	7,085	6,994	27,414	280,702	253,288
48	2039	91	7,085	6,994	27,505	287,787	260,282
49	2040	91	7,085	6,994	27,596	294,872	267,276
50	2041	91	7,085	6,994	27,687	301,957	274,270

Table 1.5.4 Cumulative Cost Benefit Streams at Discount Rate of 10% - Cengkareng West Urban Drainage

BNFT=Benefits; COST=Costs: CSFL=Cash Flow (=BNFT-COST)
CM BNFT=Cumulative Benefits; CM COST=Cumulative Costs; CM CSFL=Cumulative Cash Flow

(Unit: Rp Million)

NO.	YEAR	COST	BNFT	CSFL	CM COST	CM BNFT	CM CSFL
1	1992	1,807	0	-1,807	1,807	0	-1,807
2	1993	2,657	0	-2,657	4,464	0	-4,464
3	1994	4,531	1,025	-3,506	8,995	1,025	-7,970
4	1995	5,098	1,690	-3,407	14,093	2,715	-11,378
5	1996	3,039	2,098	-941	17,132	4,813	-12,319
6	1997	51	2,057	2,006	17,183	6,870	-10,313
7	1998	47	2,006	1,959	17,230	8,876	-8,354
8	1999	42	1,947	1,905	17,273	10,823	-6,449
9	2000	39	1,882	1,844	17,311	12,705	-4,606
10	2001	35	1,813	1,778	17,346	14,519	-2,828
11	2002	32	1,741	1,709	17,378	16,260	-1,118
12	2003	29	1,667	1,638	17,407	17,927	520
13	2004	26	1,592	1,566	17,434	19,519	2,086
14	2005	24	1,517	1,493	17,457	21,036	3,579
15	2006	22	1,443	1,421	17,479	22,479	5,000
16	2007	20	1,369	1,349	17,499	23,848	6,349
17	2008	18	1,297	1,279	17,517	25,145	7,628
18	2009	16	1,227	1,210	17,533	26,372	8,838
19	2010	15	1,158	1,144	17,548	27,530	9,982
20	2011	14	1,053	1,040	17,562	28,583	11,021
21	2012	12	957	945	17,574	29,541	11,967
22	2013	11	870	859	17,585	30,411	12,826
23	2014	10	791	781	17,595	31,202	13,607
24	2015	9	719	710	17,605	31,922	14,317
25	2016	8	654	646	17,613	32,576	14,962
26	2017	8	594	587	17,621	33,170	15,549
27	2018	7	540	533	17,628	33,710	16,083
28	2019	6	491	485	17,634	34,202	16,568
29	2020	6	447	441	17,640	34,648	17,009
30	2021	5	406	401	17,645	35,054	17,409
31	2022	5	369	364	17,650	35,424	17,774
32	2023	4	336	331	17,654	35,759	18,105
33	2024	4	305	301	17,658	36,064	18,406
34	2025	4	277	274	17,662	36,341	18,680
35	2026	3	252	249	17,665	36,594	18,929
36	2027	3	229	226	17,668	36,823	19,155
37	2028	3	208	206	17,670	37,031	19,361
38	2029	2	189	187	17,673	37,221	19,548
39	2030	2	172	170	17,675	37,393	19,718
40	2031	2	157	155	17,677	37,549	19,872
41	2032	2	142	140	17,679	37,692	20,013
42	2033	2	129	128	17,681	37,821	20,141
43	2034	2	118	116	17,682	37,939	20,257
44	2035	1	107	106	17,683	38,046	20,362
45	2036	1	97	96	17,685	38,143	20,458
46	2037	1	88	87	17,686	38,231	20,545
47	2038	1	80	79	17,687	38,311	20,625
48	2039	1	73	72	17,688	38,384	20,697
49	2040	1	66	66	17,689	38,451	20,762
50	2041	1	60	60	17,689	38,511	20,822

Table 1.5.5 Computation of NPV and B/C - Cengkareng West Urban Drainage

(Unit of NPV: Rp Million)

ITEM	NPV	B/C
VALUE	20,822	2.18

Table 1.5.6 Computation of EIRR - Cengkareng West Urban Drainage

DF=Discount Factor; CM BNFT=Cumulative Benefit;
CM COST=Cumulative Cost; NPV=Net Present Value;
B/C=Benefit Cost Ratio

(Unit: Rp Million)

DF	CM COST	CM BNFT	NPV	B/C
0	27,686	301,957	274,271	10.91
1	25,927	228,419	202,492	8.81
2	24,481	176,076	151,595	7.19
3	23,257	138,211	114,954	5.94
4	22,197	110,371	88,174	4.97
5	21,261	89,572	68,311	4.21
6	20,420	73,787	53,367	3.61
7	19,655	61,623	41,968	3.14
8	18,951	52,112	33,161	2.75
9	18,298	44,570	26,272	2.44
10	17,689	38,511	20,822	2.18
11	17,117	33,582	16,465	1.96
12	16,578	29,527	12,949	1.78
13	16,069	26,155	10,086	1.63
14	15,585	23,324	7,739	1.50
15	15,126	20,924	5,798	1.38
16	14,689	18,874	4,185	1.28
17	14,272	17,109	2,837	1.20
18	13,874	15,578	1,704	1.12
19	13,493	14,242	749	1.06
20	13,128	13,070	-58	1.00

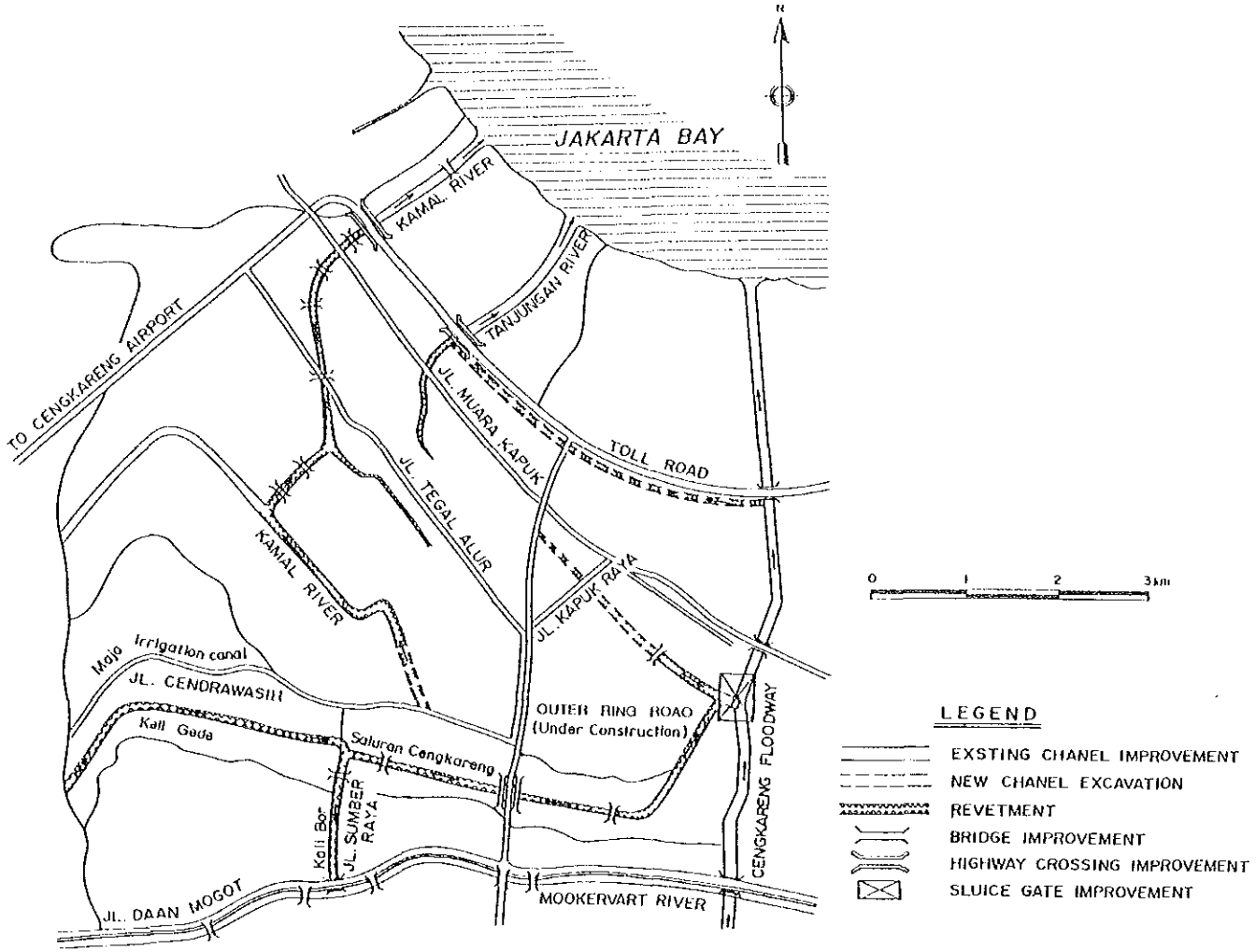
EIRR= 20.0

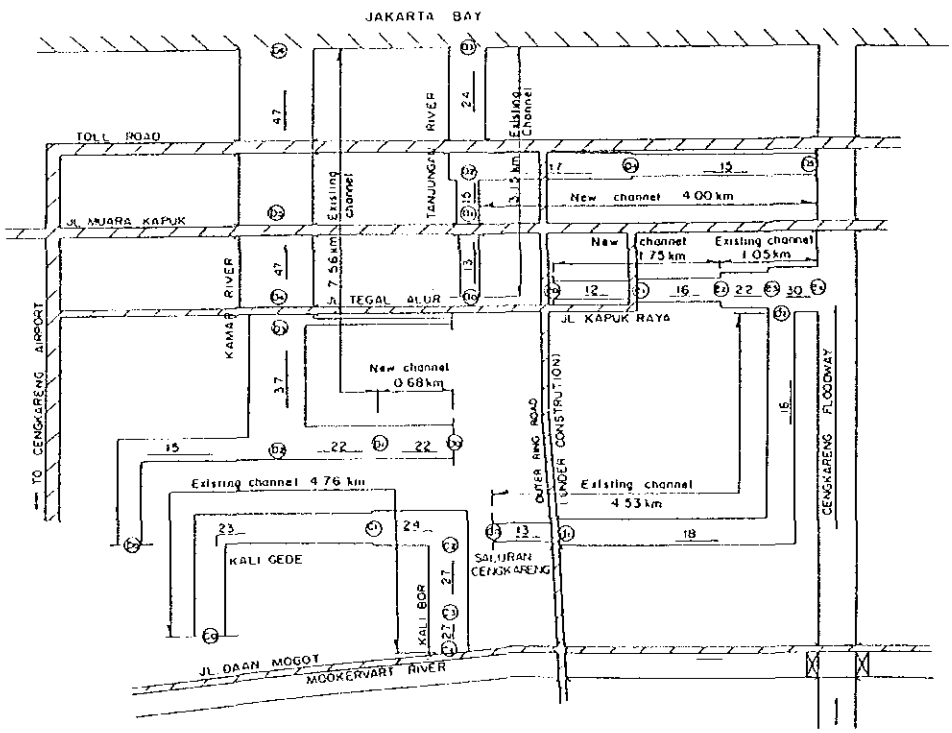
Table 1.5.7 Environmental Impacts

Environmental Component	I. Pre-const. Stage (Land Acquisition)	II. Const. Stage (Const. Works)	III. Operation Stage (O&M Works)
(1) Economic Condition		(+)	(+)
(2) Education			
(3) Income		(+)	
(4) Health			(+)
(5) Perception			
(6) Sanitary Condition			(+)
(7) Traffic Condition		(-)	(+)
(8) Esthetic Condition			(+)
(9) Soil Stability			
(10) Land Use	(-)		(+)
(11) River Water		(-)	
(12) Groundwater			
(13) Water Use			
(14) Road		(-)	
(15) Fauna & Flora			
(16) Odour			
(17) Noise		(-)	
(18) Vibration		(-)	
(19) Dust		(-)	
(20) Foam			

Table 1.5.8 Negative Impacts and Management Measures

Stage	Project Activities	Affected Objectives	Negative Impact	Management Measures
I. Pre-construction	Land Acquisition & House Resettlement	Community	Land & House Loss	Proper Land Acquisition Procedures & Schedule
II. Construction	Construction Works	Community	Noise, Vibration & Dust	Proper Construction Method & Schedule
		Traffic	Disturbance	Proper Construction Method & Schedule
		Road	Damage	Repairing
		River Water	Pollution	Proper Construction Method & Schedule
III. Operation	Operation & Maintenance Works	--	No Negative Impact	--





(DESIGN FLOOD DISCHARGE DISTRIBUTION OF PROPOSED CHANNEL)

FIG. 1.5.1 LOCATION OF PROPOSED CHANNEL IMPROVEMENT

I - 2
SEPAK RIVER IMPROVEMENT

I-2 SEPAK RIVER IMPROVEMENT

Chapter 1 PROJECT AREA

1.1 General

The Sepak River covers a drainage area of 43.4 km^2 at its downstream end where it joins the Cengkareng Floodway (See Fig. 2.1.1). The river system is composed of the main Sepak River, and the tributaries of Kembangan, Kreo and Ulujami.

The Sepak River basin is undergoing a rapid urbanization. The population of the basin will increase from 0.466 million in 1988 to 1.109 million in 2010.

The urban land area including residential, commercial & institutional and industrial uses is expected to increase from 3,227 ha or 74 % of the total area in 1990 to 3,915 ha or 90 % in 2005. The existing and future land use patterns of the basin are as follows.

Land Use	Existing	Future
Residential Area	3,194 ha	2,996 ha
Commercial & Institutional Area	21	881
Industrial Area	12	37
Green Area	1,113	426
Total	4,340	4,340

1.2 Existing Drainage System

Most of the Sepak River reaches have already been improved. Improvement of the lowermost reaches with a total length of 3.3 km is on-going. The D/D was completed by JFCP with financial assistance from OECF in 1987. The project includes the following major construction works.

- Channel improvement including excavation, embankment and bank protection : 3.3 km
- Construction of bridge : 2 places

- Construction of drainage culvert : 2 places

While, 1.0 km of the Kreo River, 0.5 km of the Sepak River and 0.6 km of the Kembangan River still remain unimproved.

Location of the on-going and unimproved river sections are shown in Fig. 2.1.1.

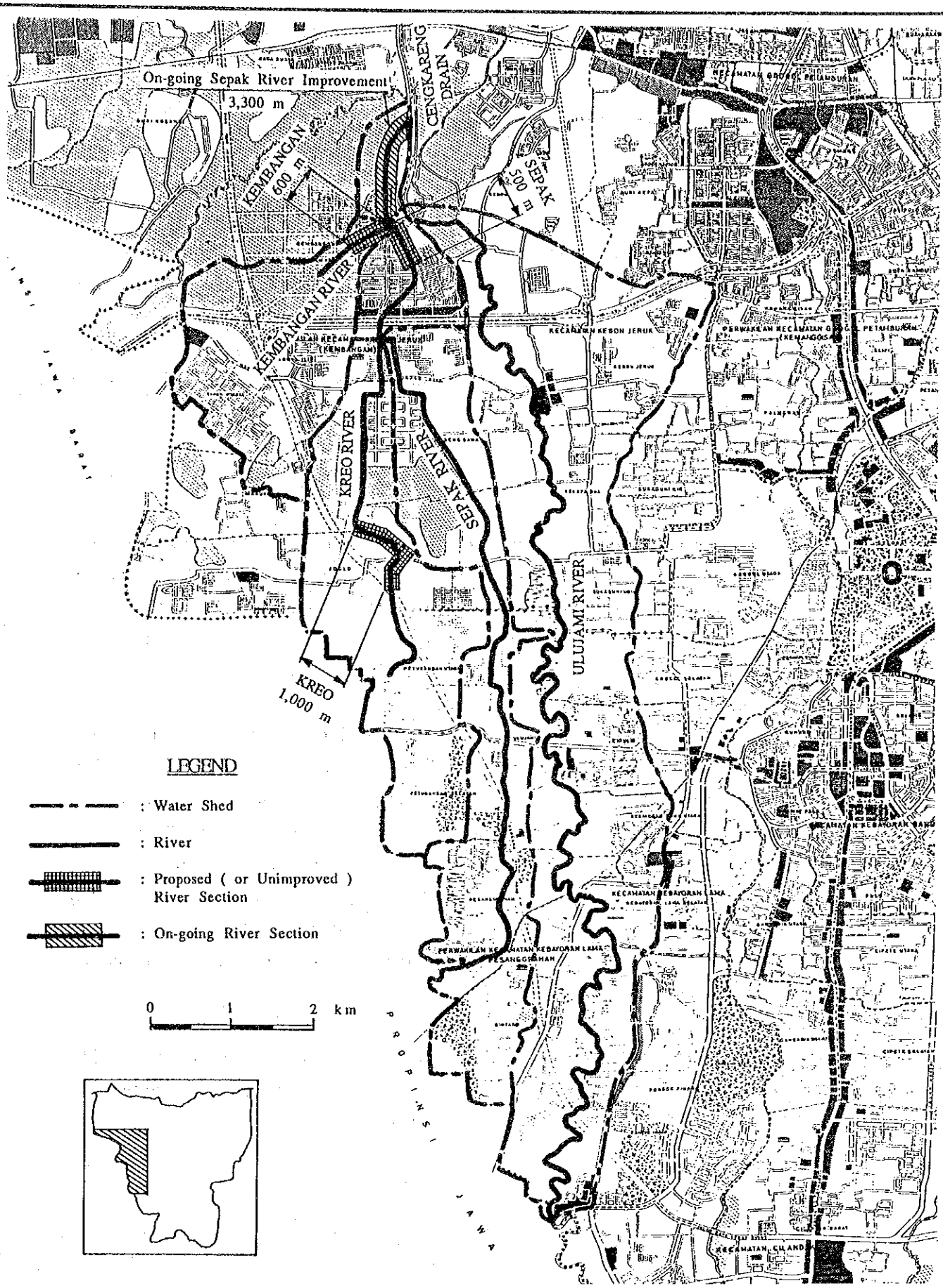


FIG. 2.1.1 LOCATION OF PROJECT AREA

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

Chapter 2 FLOOD AND FLOOD DAMAGES

2.1 Flood Conditions

There exists two (2) inundation areas. The total potential inundation area adds up 51.5 ha, while a total area of 42.9 ha is habitually inundated. The depth and duration of inundation in time of potential floods work out to 19 to 49 cm and 13 to 22 hours, respectively. Whereas the depth and duration of habitual inundation are 5 to 11 cm and one (1) hour, respectively (Refer to Fig. 2.2.1).

2.2. Flood Damages

The number of property by type and by inundation areas for 1988 and 2010 is shown in Table 2.2.1. The figures for 2010 were estimated based on the land use plan and economic forecast. Also, the number of vehicles by type and by inundation area for the said two years is presented in Table 2.2.2. The figures for 2010 are projected based on economic forecast.

As Table 2.2.3 shows average annual flood damages in terms of direct damages to properties amount to Rp. 93.6 million as of 1988. Likewise, income losses due to shop closure and damages to traffic amount to Rp. 0.3 million and Rp. 5.2 million, respectively. In the target year of 2010, direct damages to properties would reach Rp. 859.2 million. Similarly, income losses and traffic damages would grow to Rp. 1.8 million and Rp. 18.8 million, respectively. It is to be noted that flood damages are projected to multiply by three (3) to nine (9) times from 1988 to 2010, depending on the type of property.

As shown in Table 2.2.3 average annual flood damages add up to Rp. 119 million in 1988, which would multiply by 8.9 times to Rp. 1,056 million in 2010 if no urban drainage projects were implemented.

Table 2.2.1 Estimated Number of Properties in Inundation Areas
- Sepak River Improvement -

	Inundation Area No.	House	Shop	Factory
1	Year 1988			
	1	186	5	0
	2	258	6	0
	Total	444	11	0
2	Year 2010			
	1	609	11	0
	2	1,086	16	0
	Total	1,695	27	0

Sources : Statistik Wilayah 1988 and JICA

Table 2.2.2 Estimated Number of Vehicles on Road by Type by Inundation Area
- Sepak River Improvement -

	Inundation Area No.	Passanger Car	Bus	Truck	Motor Cycle	Total
1	Year 1988					
	1	98	33	42	187	360
	2	199	68	86	382	734
	Total	297	101	128	569	1,094
2	Year 2010					
	1	290	139	155	589	1,174
	2	591	284	316	1,202	2,394
	Total	881	424	471	1,791	3,568

Sources : Statistik Wilayah 1988 and JICA

Table 2.2.3 Summary of Estimated Average Annual Flood Damages ("Without Project" Case) - Sepak River Improvement

(Unit : Rp.)

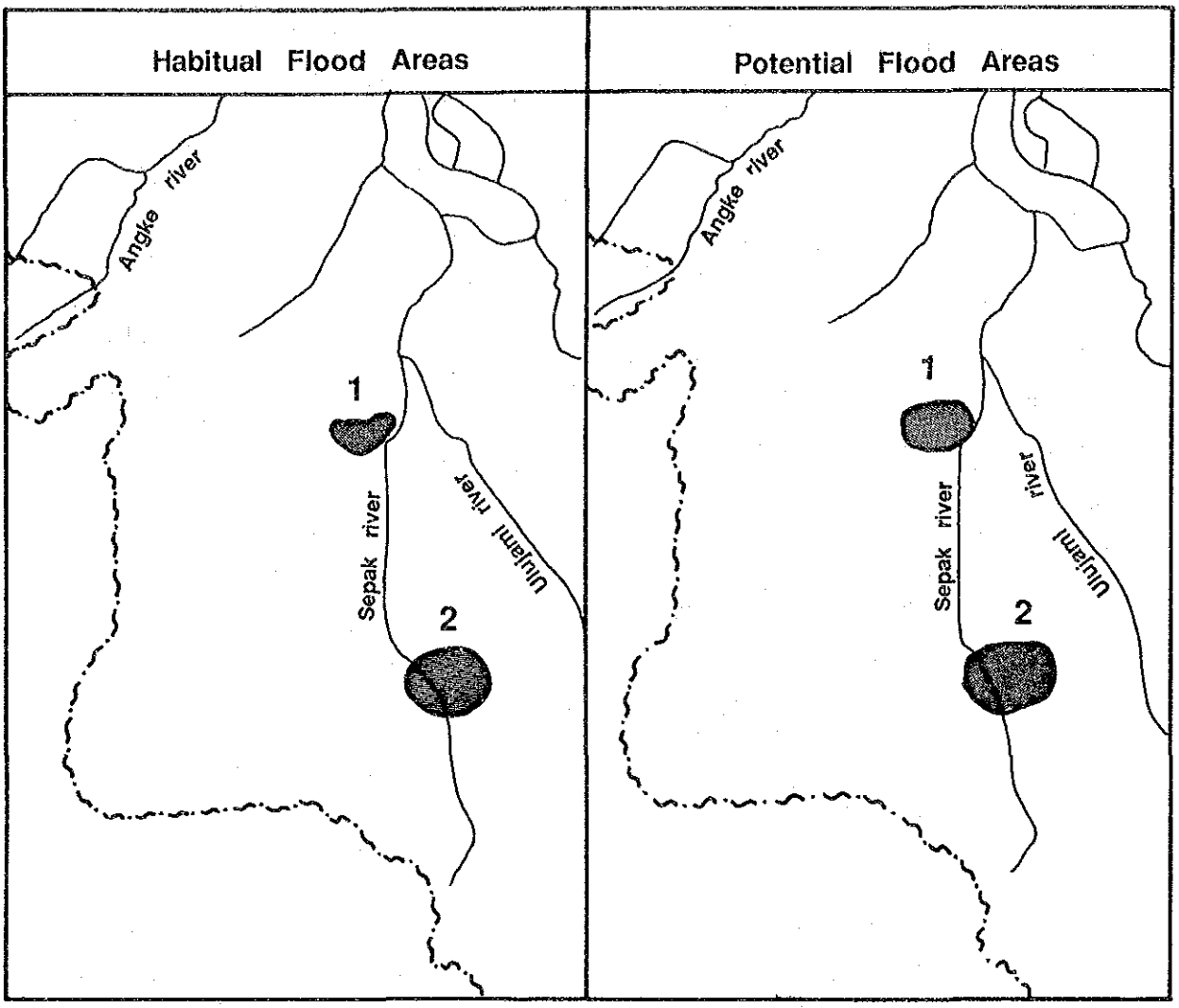
Item	1988	2010
1 Direct Damages to Property		
1) House	86,388,000	820,225,000
2) Shop	4,837,000	27,464,000
3) Factory	0	0
4) Other Specified Property 1/	2,375,000	11,507,000
Sub-Total	93,600,000	859,196,000
2. Indirect Damages		
1) Income Losses due to Shop Closure		
(1) Shop	295,000	1,718,000
(2) Factory	0	0
(3) Other Specified Property 2/	20,000	98,000
Sub-Total	315,000	1,816,000
2) Traffic Damages		
(1) Time Cost	1,552,000	5,553,000
(2) Incremental VOC	3,610,000	13,208,000
Sub-Total	5,162,000	18,761,000
Total (1.+2.)	99,077,000	879,773,000
3. Damages to Other Unspecified Property Including Infrastructure		
(1. + 2.) x 20 %	19,815,000	175,955,000
Grand Total (1.+2.+3.)	118,892,000	1,055,728,000

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



Habitual Flood Areas				Potential Flood Areas			
Location	Depth (cm)	Area (ha)	Duration (hr)	Location	Depth (cm)	Areas (ha)	Duration (hr)
1	5	14.7	1	2	49	18.4	22
2	11	28.2	1	3	19	33.1	13

FIG. 2.2.1 HABITUAL AND POTENTIAL INUNDATION AREA (SEPAK RIVER IMPROVEMENT)

Chapter 3 PROPOSED RIVER IMPROVEMENT

3.1 Objective River Section

The three (3) unimproved river sections mentioned in the previous Section 1.2 will be improved to meet increasing flood peaks due to the land development. For their location, ref. Fig. 2.1.1.

3.2 Design Flood Discharge

Design flood frequency is determined to be 10-year for the Kreo River, 10-year for the Sepak River and 5-year for the Kembangan River based on the guidelines established by the Government of Indonesia (Refer to II-1 Cengkareng West Urban Drainage, Section 3.1).

The design flood discharge of the objective three (3) river sections are estimated based on the calculation method described in II-1 Cengkareng West Urban Drainage, Section 3.1. The results are summarized below.

Item	Kreo River	Sepak River	Kembangan River
Catchment Area (km^2)	7.8	17.8	2.4
Design Frequency (year)	10	10	5
Design Rainfall Intensity (mm/hr)	33	31	48
Runoff Coefficient	0.521	0.488	0.625
Design Discharge (m^3/s)	35	70	20
Specific Design Discharge ($m^3/s/km^2$)	4.5	3.9	8.3

3.3 Proposed River Profile and Cross Section

The river profiles of the objective three (3) river sections are determined to smoothly connect with the respective upstream and downstream sections which are completed or on-going. The proposed river bed slope of the three (3) river sections are shown below.

River	Length (km)	Slope
Kreo River	1.0	1/540
Sepak River	0.5	1/667
Kembangan River	0.6	1/540

The river banks of the whole objective river sections are protected by revetment of wet masonry type. Inspection road with side ditch is provided along the river bank. The main dimensions of the proposed river cross section are summarized below.

River	Length (m)	Bottom Width (m)	Top Width	Depth (m)
Kreo River	1,000	7.20	10.10	2.90
Sepak River	500	10.60	13.50	2.90
Kembangan River	600	10.70	12.00	1.30

The proposed profiles and cross sections of the three (3) rivers are shown in Fig. 2.3.1 - Fig. 2.3.3. The proposed cross sections of bank protection, inspection road and side ditch of the three (3) rivers are shown in Fig. 2.3.4.

3.4 Proposed Construction Works and Land Acquisition

Major construction works of the proposed river improvement plan are channel excavation, embankment, revetment works, inspection road pavement and side drain works. Those are summarized below.

- Channel excavation : 33,000 m^3
- Embankment : 8,000 m^3
- Revetment works : 4,200 m, 14,500 m^2
- Inspection road pavement : 2,100 m, 6,300 m^2
- Side drain works : 4,200 m

The required land acquisition is 1.7 ha of green area.

The break-down of the construction works and land acquisition by river is shown in Table 2.3.1.

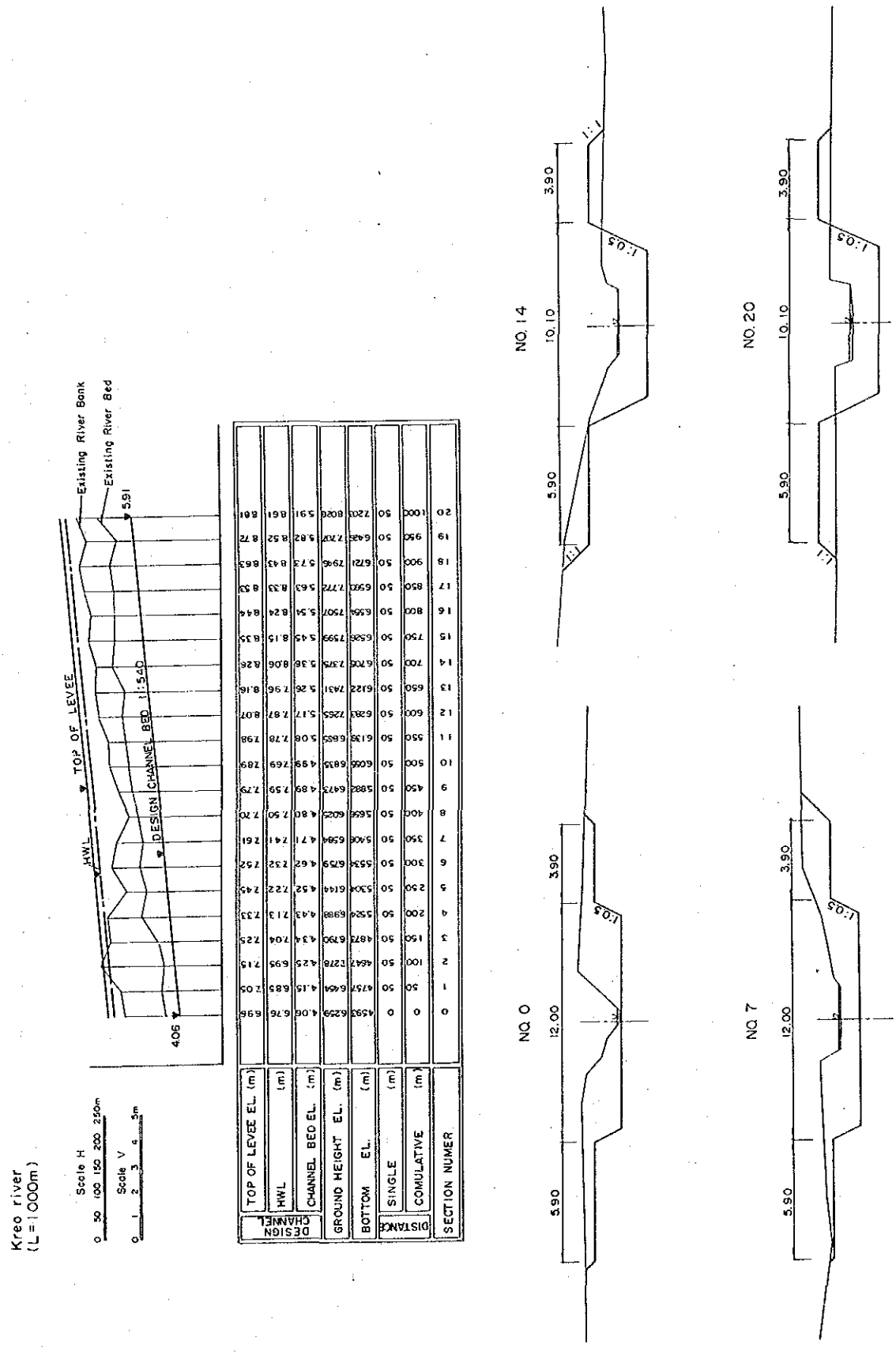


FIG. 2.3.1 PROFILE AND CROSS SECTION OF PROPOSED KREO RIVER

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

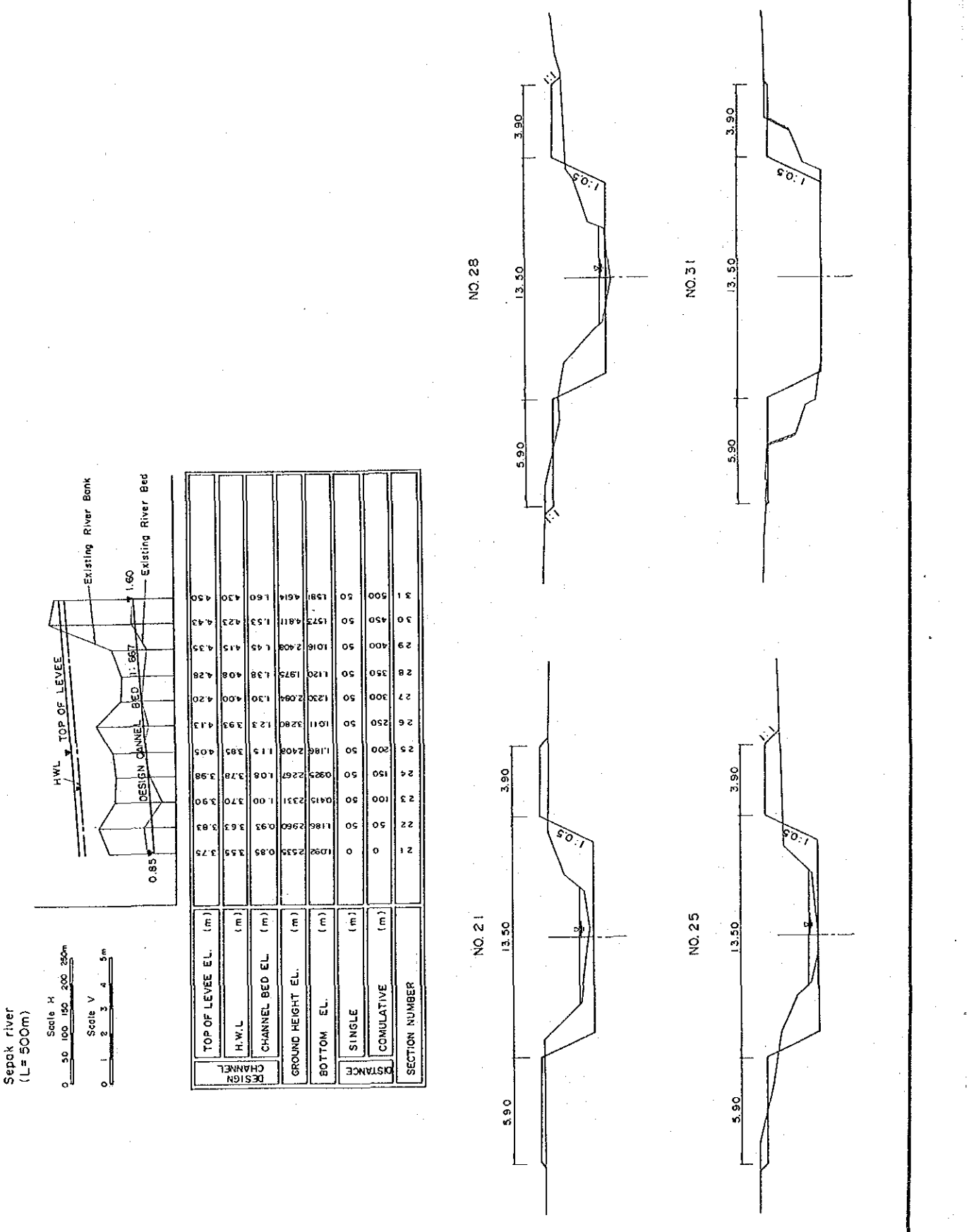


FIG. 2.3.2 PROFILE AND CROSS SECTION OF SEPAK RIVER

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

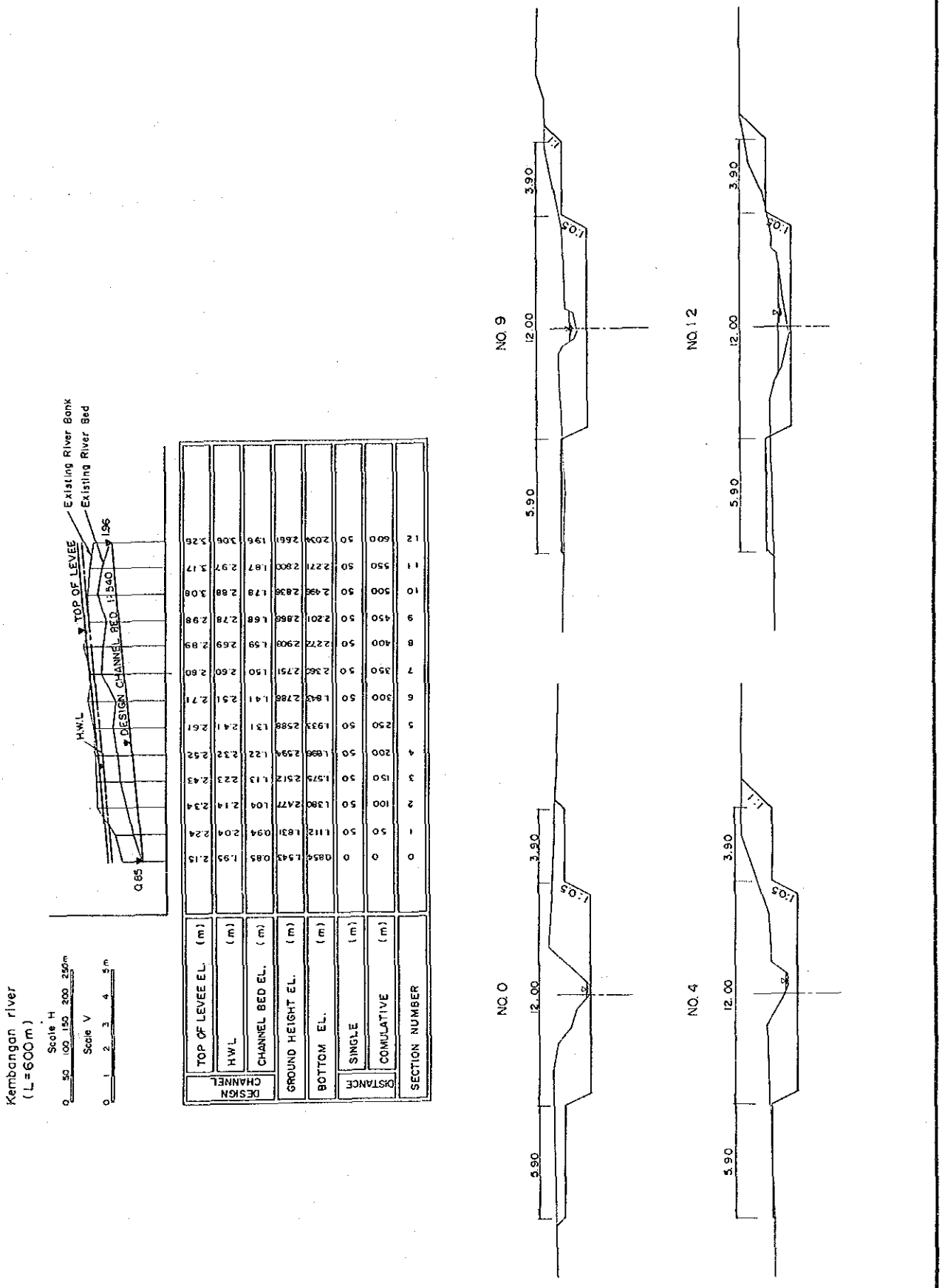


FIG. 2.3.3 PROFILE AND CROSS SECTION OF KEMBANGAN RIVER

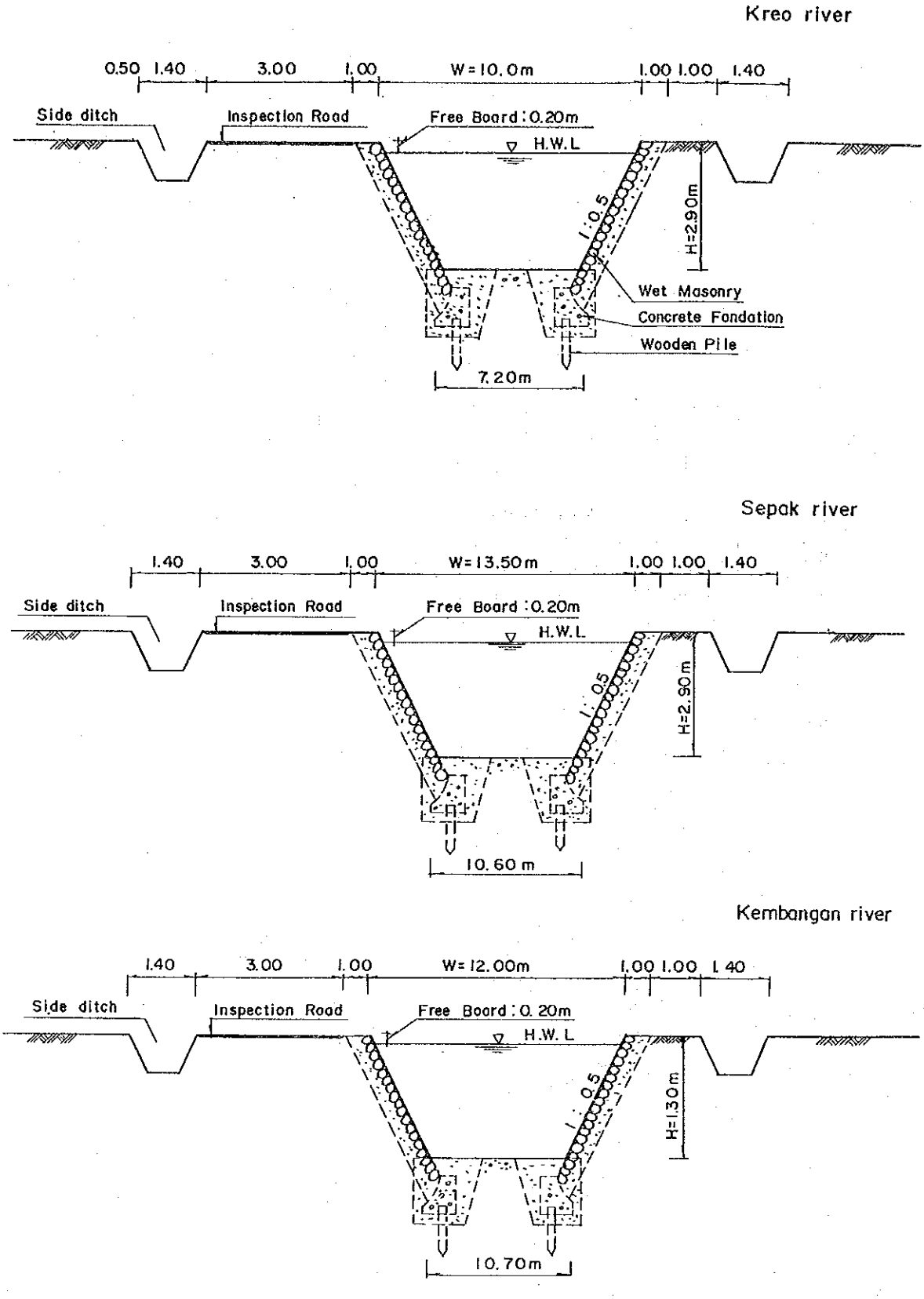


FIG. 2.3.4 CROSS SECTION OF BANK PROTECTION, INSPECTION ROAD AND SIDE DITCH

Chapter 4 COST ESTIMATE

The project costs were estimated in the same manner as II-1, Cengkareng West Urban Drainage, Chapter 4.

The total project cost amounts to Rp. 4,835 million at July, 1990 prices as given below.

Item	Cost
I. Direct Construction	2,976
II. Land Acquisition	1,200
III. Engineering Service: I x 10%	298
IV. Administration: (I + II) x 1.5%	63
V. Physical Contingency: I x 10%	298
Total	4,835

Its break-down by construction work is shown in Table 2.4.1.

The break-down of the direct construction and land acquisition costs by river is shown in Table 2.4.2.

Table 2.4.1 Break-down of Project Cost

Item	Cost (million Rp.)
Direct Cosntruction	2,976
Channel Excavation	120
Embankment	35
Revetment	1,292
Maintenance Road	97
Side Drain	1,432
Land Acquisition	1,200
Engineering Service	298
Administration	63
Physical Contingency	298
Total	4,835

Table 2.4.2 (1) Direct Construction and Land Acquisition Cost for Kreo River

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction Cost				
Channel Excavation	(m^3)	3,608	14,000	51
Embankment	(m^3)	4,436	5,000	22
Revetment	(m)		2,000	
	(m^2)	89,332	7,800	697
Maintenance Road	(m)		1,000	
	(m^2)	15,402	3,000	46
Side Drain	(m)	341,013	2,000	682
Total				1,498
Land Acquisition Cost				
Land Acquisition	(m^2)	70,560	8,000	565

Table 2.4.2 (2) Direct Construction and Land Acquisition Cost for Sepak River

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction Cost				
Channel Excavation	(m^3)	3,608	5,000	18
Embankment	(m^3)	4,436	2,000	9
Revetment	(m)		1,000	
	(m^2)	89,332	3,900	348
Maintenance Road	(m)		500	
	(m^2)	15,402	1,500	23
Side Drain	(m)	341,013	1,000	341
Total				739
Land Acquisition Cost				
Land Acquisition	(m^2)	70,560	4,000	282

Table 2.4.2 (3) Direct Construction and Land Acquisition Cost for Kembangan River

Item	Unit	Unit Cost (Rp.)	Quantity	Cost (million Rp.)
Direct Construction Cost				
Channel Excavation	(m^3)	3,608	14,000	51
Embankment	(m^3)	4,436	1,000	4
Revetment	(m)		1,200	
	(m^2)	89,332	2,760	247
Maintenance Road	(m)		600	
	(m^2)	15,402	1,800	28
Side Drain	(m)	341,013	1,200	409
Total				739
Land Acquisition Cost				
Land Acquisition	(m^2)	70,560	5,000	353

I - 3
BOJONG DRAINAGE IMPROVEMENT

I-3 BOJONG DRAINAGE IMPROVEMENT

Chapter 1 PROJECT AREA

1.1 General

The Project Area covers the whole Bojong housing area of 40.0 ha with a total population of 5,589. It is located in the low-lying area encompassed by Jl. Raya Kamal to the west, Angke River to the south, Cengkareng Floadway to the east and Mookervart River to the north.

Location of the Project Area is shown in Fig. 3.1.1.

1.2 Existing Drainage System

Storm water of the Bojong housing area is drained by pump station of 0.9 m^3/s capacity with a retarding basin of 29,000 m^3 storage capacity into a tributary of the Mookervard River.

The main features of the drainage system are shown below.

(1) Drainage Area : 40.0 ha

(2) Pump Station

Receiving River : Tributary of Mookervart River
H.W.L. of Receiving River : P.B.M.+3.40m
Pump : ø254 mmx0.15 m^3/sx47 HPx3 units (Electric Driving)
: ø254 mmx0.15 m^3/sx47 HPx3 units (Diesel Engine Driving)
: design head : 12 m

(3) Retarding Basin

Surface Area	:	14,500 m^2
Effective Storage Capacity	:	29,000 m^3
H.W.L	:	P.B.M.+1.56 m
N.W.L	:	P.B.M.-0.44 m

Spillway Elevation : P.B.M.+1.56 m
Structure : Earth Embankment

(4) Drainage Channel

Open Ditch : 4,250 m long
Pipe : 290 m long

The capacity of the existing system is insufficient. The existing drainage system was designed to meet floods of the original housing development area of 31.0 ha. However, the area has been further developed by 9.0 ha thereafter (See Fig. 3.1.2).

Layout of the existing drainage channel networks, pump station and retarding basin are shown in Fig. 3.1.3, Fig. 3.1.4 and Fig. 3.1.5 respectively.

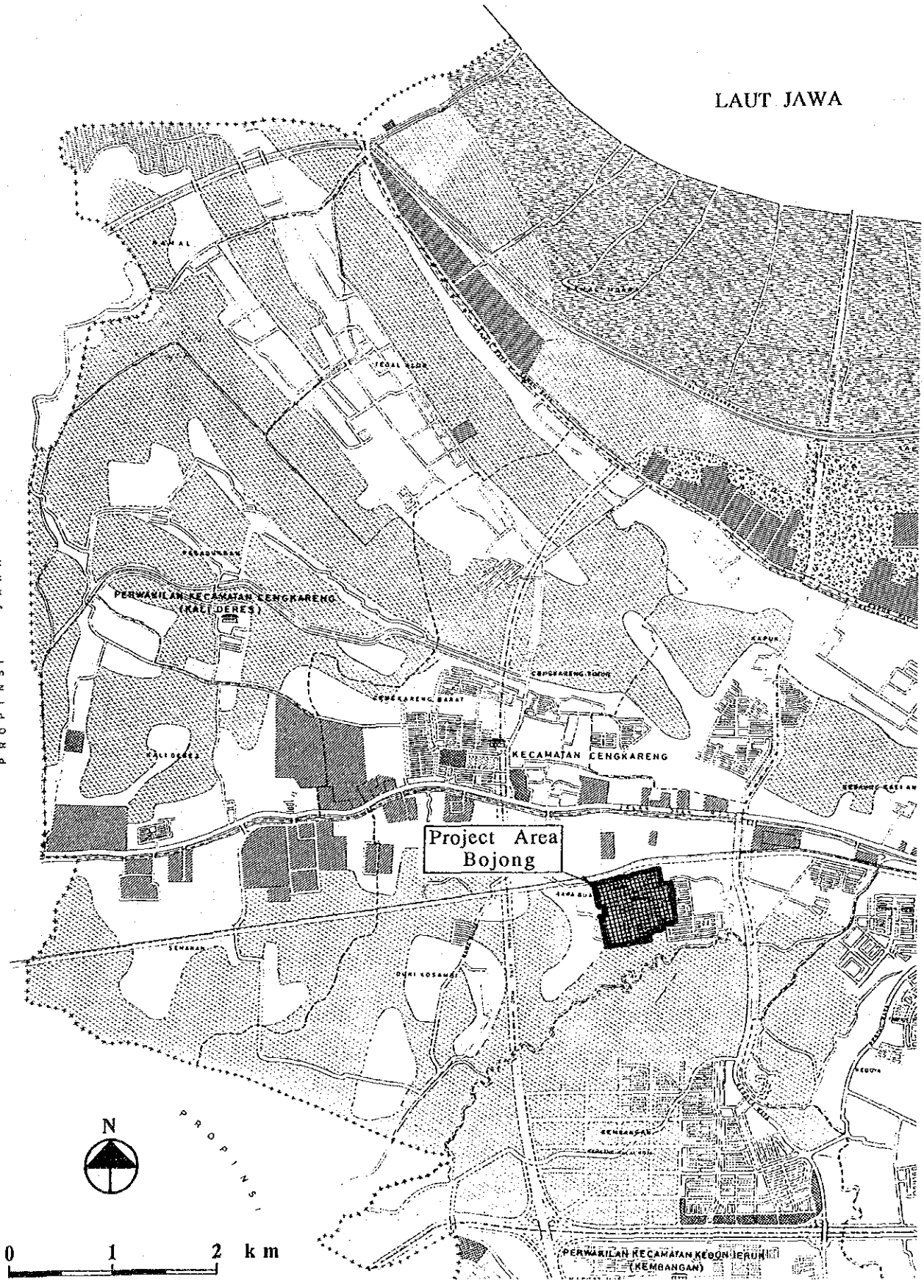
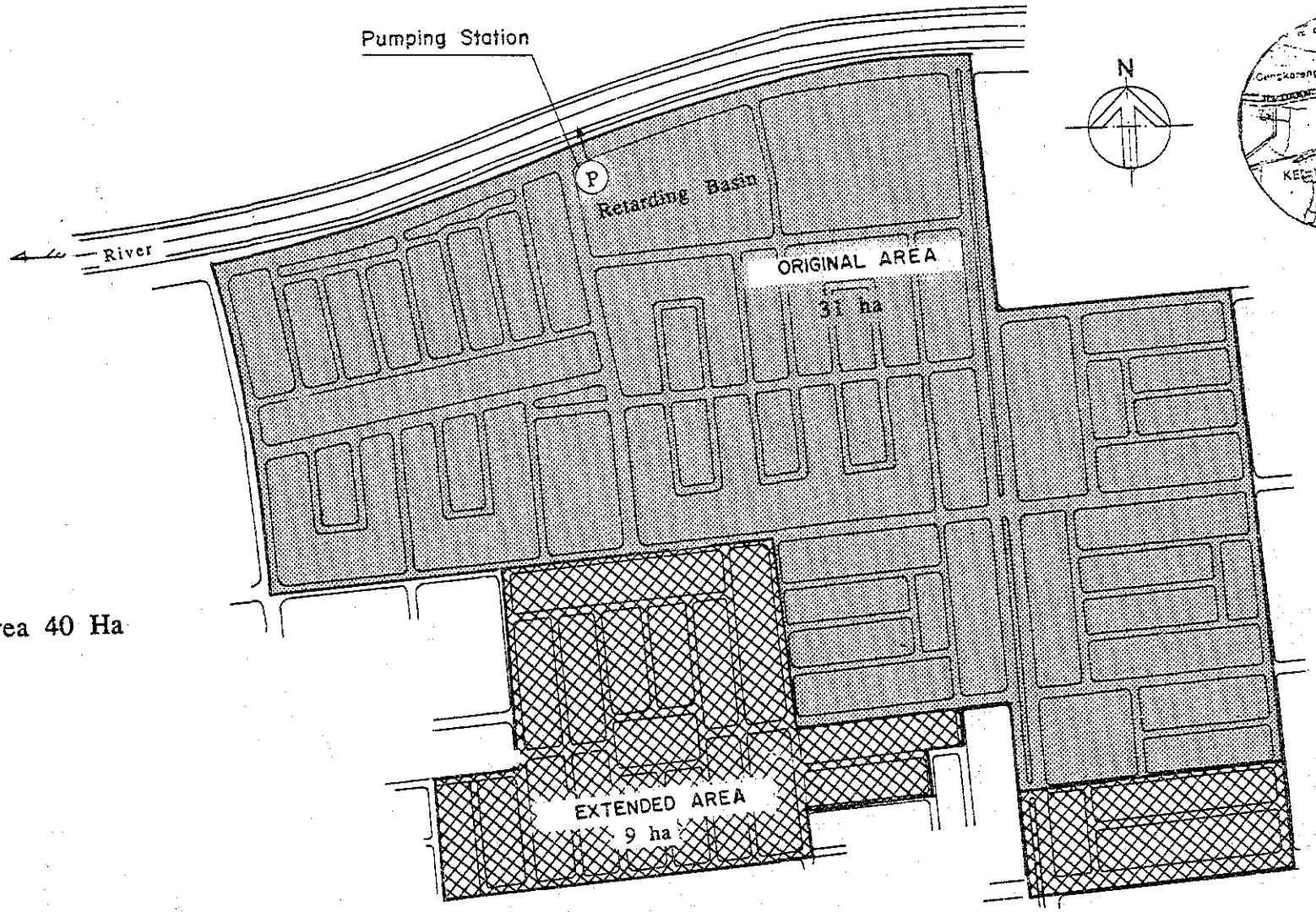


FIG. 3.1.1 LOCATION OF PROJECT AREA

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



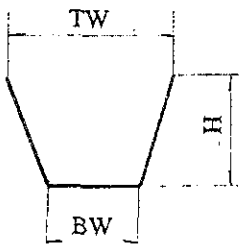
Project Area 40 Ha

FIG. 3.1.2 ORIGINAL AND EXTENDED HOUSING DEVELOPMENT AREA

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

JICA A.D 1991

Channel Route	Channel No.	Shape (m) BW	TW	H
I	1	0.20	0.45	0.56
	2	0.20	0.45	0.56
	3	0.50	1.44	1.22
	14	0.50	1.44	1.22
	15	1.10	1.20	1.10
	16	0.50	1.44	1.25
	17	0.50	1.44	1.25
	4	0.25	0.45	0.50
	6	0.40	1.10	1.10
	5	0.40	1.10	1.10
II	8	0.40	1.10	1.10
	9	0.20	0.48	0.50
	11	0.20	0.40	0.50
	12	ø 600		
	13	ø 600		
	7	0.40	1.10	1.10
	10	0.20	0.40	0.50
III	18	0.30	0.40	0.25
	19	0.60	1.30	1.30
	21	1.32	1.32	1.24
	23	0.22	0.44	0.40
	25	0.30	0.90	1.50
	20	0.50	0.65	0.60
	22	0.35	1.06	0.80
	24	0.35	0.79	0.40
	26	0.30	0.91	1.50
IV	27	0.60	1.50	1.00
	28	0.90	1.50	1.50
	30	0.90	1.50	1.50
	32	0.90	1.50	1.50
	29	0.35	0.77	0.60
	31	0.28	0.46	0.50



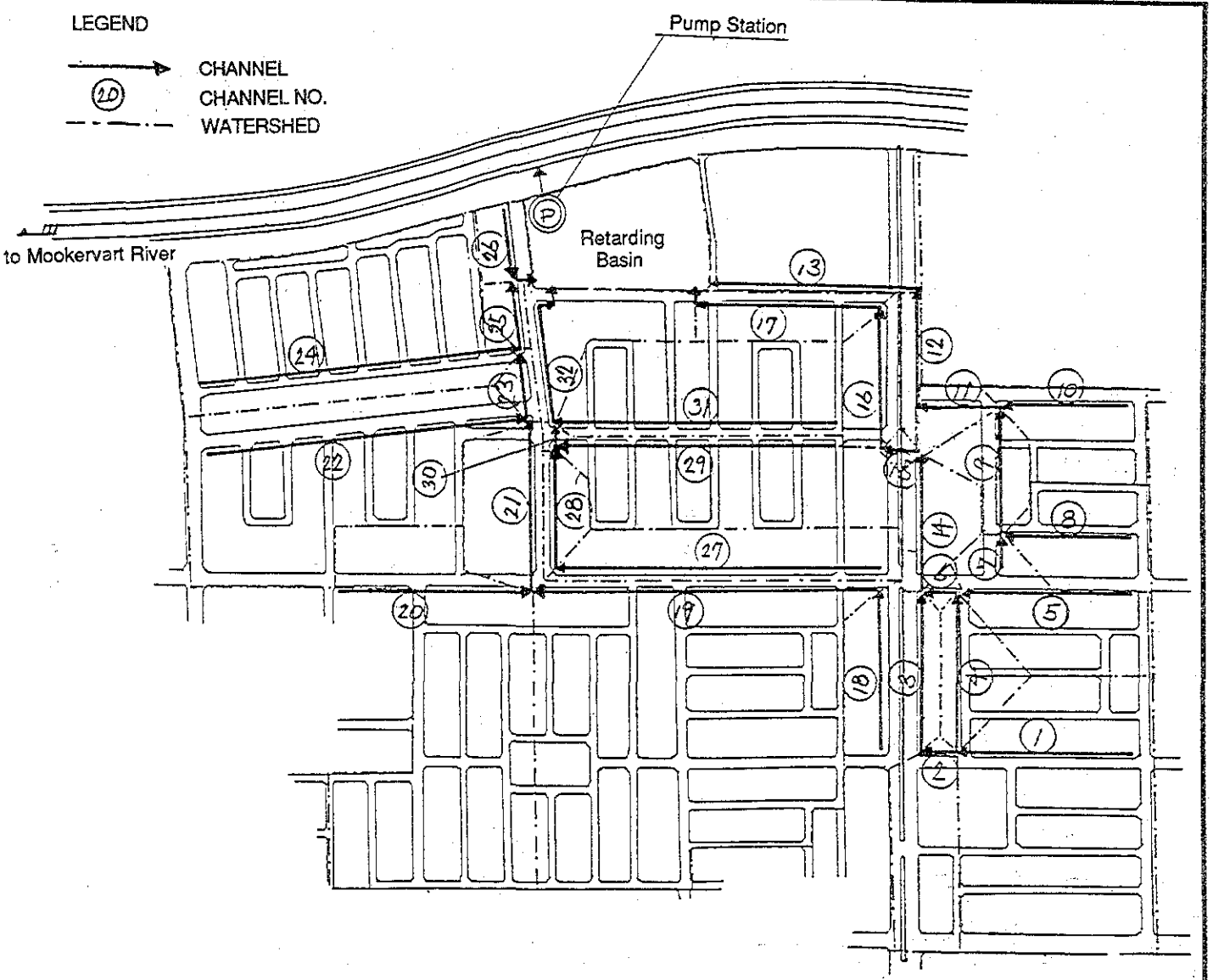
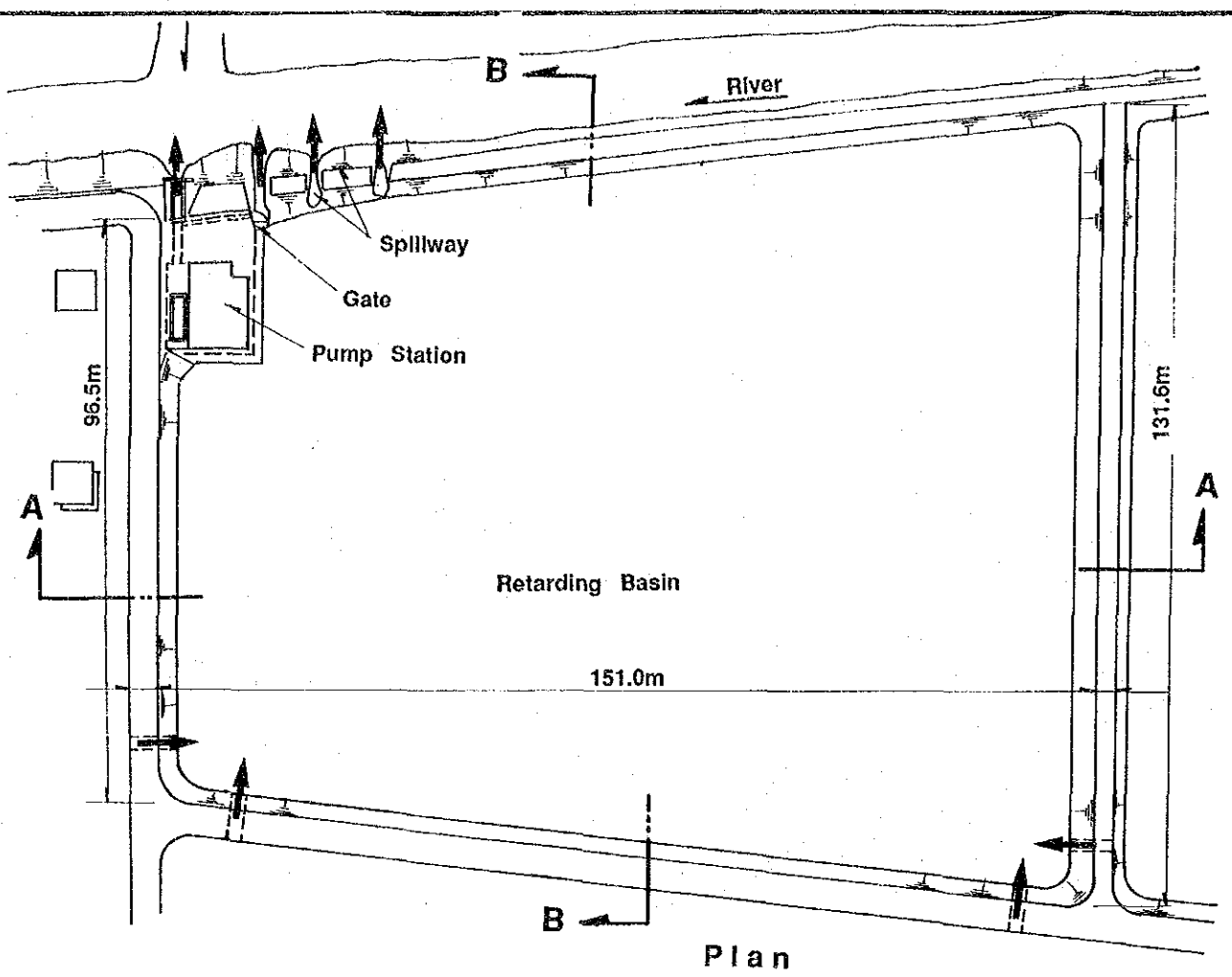
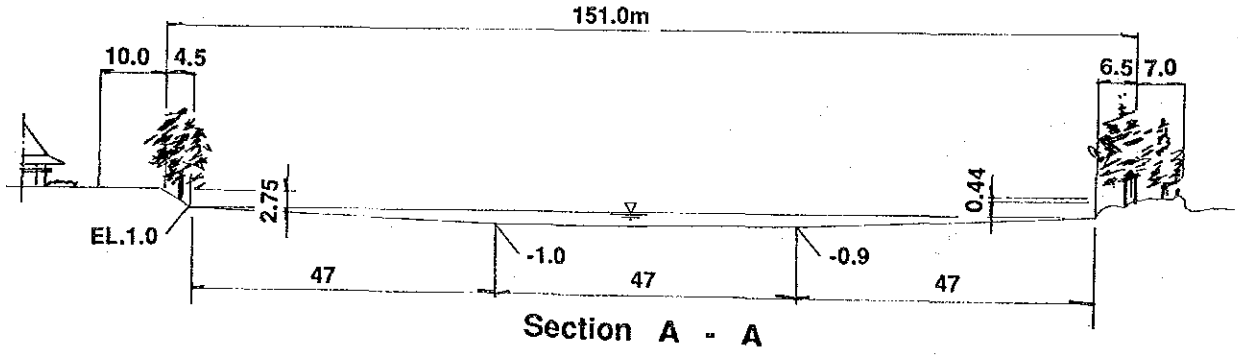


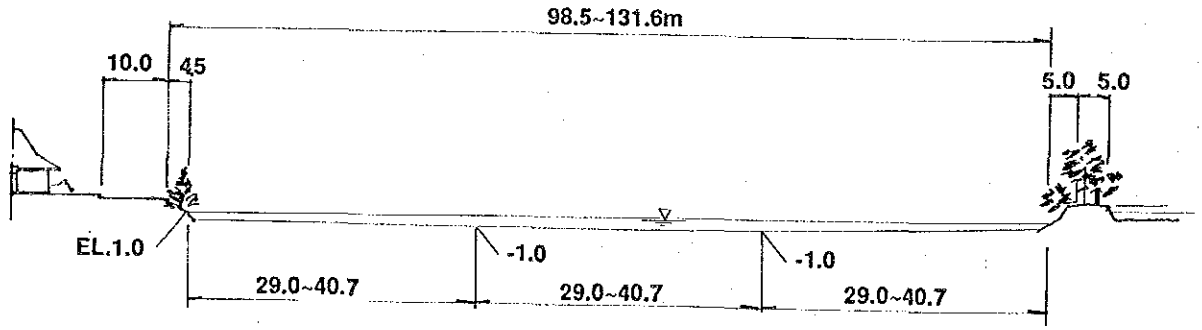
FIG. 3.1.3 EXISTING CHANNEL NETWORKS

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





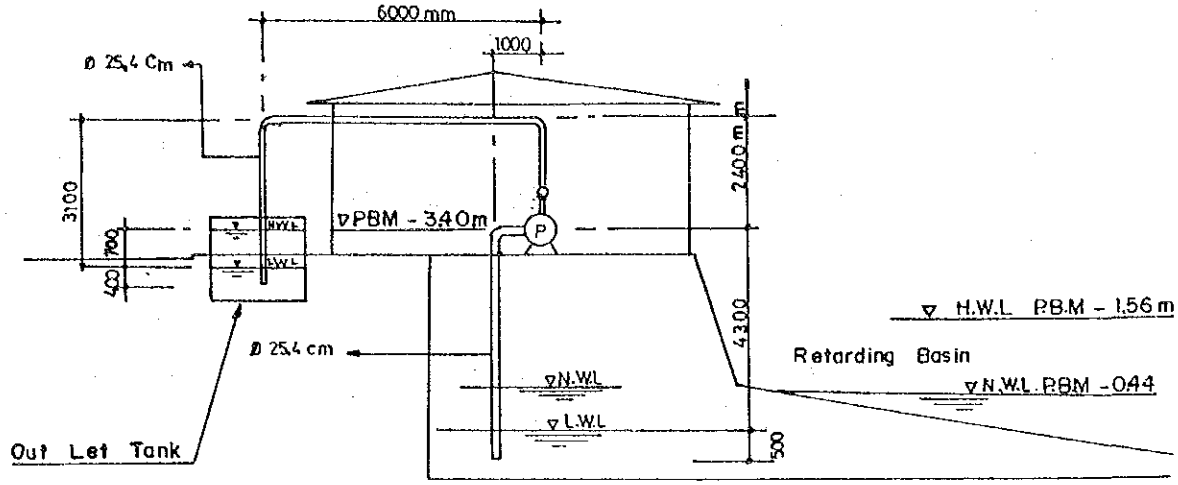
Section A - A



Section B - B

FIG. 3.1.4 EXISTING RETARDING BASIN

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



Existing Pump Ø 25.4 cm x0.15 m³/sec x 12mH x 47 HP x 6 Pumps

scale
0 1 2 3 4 5m

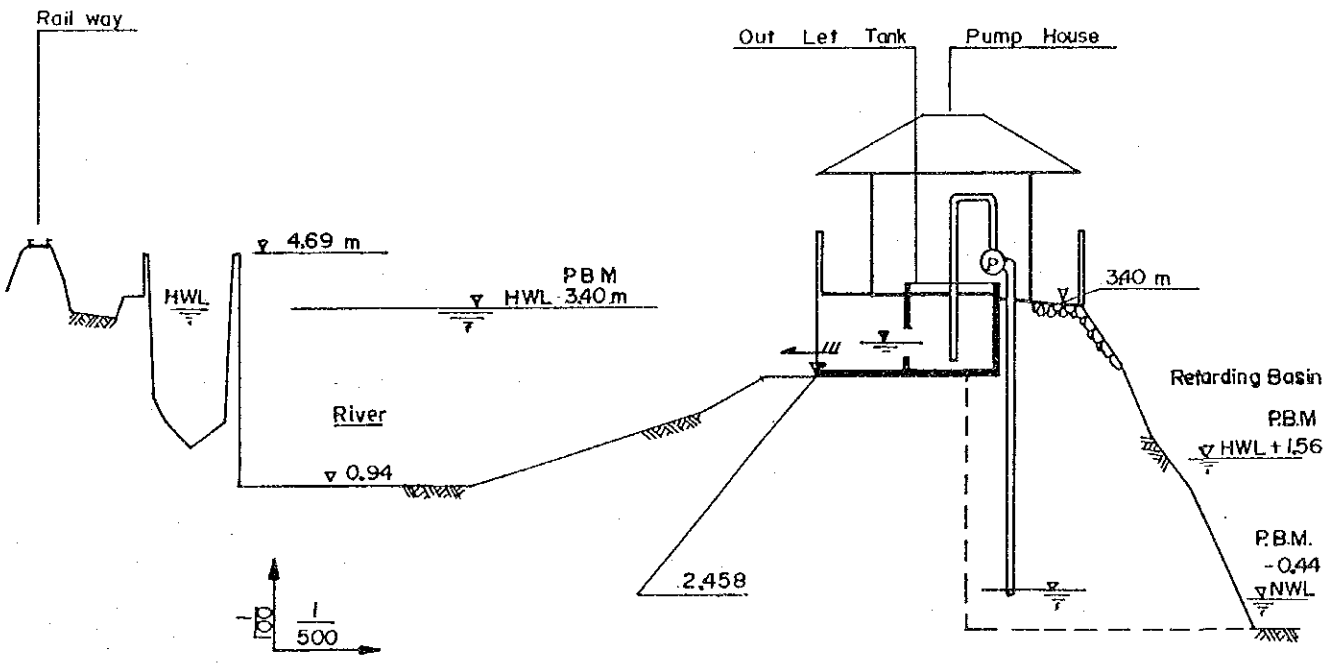


FIG. 3.1.5 EXISTING PUMP STATION

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

Chapter 2 FLOOD AND FLOOD DAMAGES

2.1 Flood Conditions

There exist seven (7) potential inundation areas, of which three (3) are habitually inundated. The total hectareage of the potential inundation areas sums up to 13.8 ha, of which 3.7 ha is subject to habitual inundation.

The depth of inundation in the potential inundation areas ranges from 50 cm to 75 cm, while the duration of inundation falls between 4 days and 5 days. Inundation depth and duration in the habitual inundation areas are 15 to 30 cm and 1.5 to 3 hours, respectively. (Refer to Fig. 3.2.1 and 3.2.2).

2.2 Flood Damages

The number of property by type and by inundation area for 1988 and 2010 is shown in Table 3.2.1. The figures for 2010 were estimated based on the land use plan and economic forecast. Also, the number of vehicles by type and by inundation area for the said two (2) years is presented in Table 3.2.2. The figures for 2010 are projected based on economic forecast.

As Table 3.2.3 shows, average annual flood damages in terms of direct damages to properties amount to Rp. 176 million as of 1988. Likewise, income losses due to shop closure and damages to traffic amount to Rp. 0.3 million and Rp. 7 million, respectively. In the target year of 2010, direct damages to properties would reach Rp. 877 million. Similarly, income losses and traffic damages would grow to Rp. 47 million and Rp. 26 million, respectively. It is to be noted that flood damages are projected to multiply by three (3) to 142 times from 1988 to 2010 depending on the type of property.

As shown in Table 3.2.4, average annual flood damages add up to Rp. 224 million in 1988, which would multiply by 5.4 times to Rp. 1,208 million in 2010 if no urban drainage projects were implemented.

Table 3.2.1 Estimated Number of Properties in Inundation Areas
- Bojong Drainage Improvement -

	Inundation Area No.	House	Shop	Factory
1	Year 1988			
	1	347	0	1
	2	243	0	1
	3	243	0	1
	4	660	0	2
	5	174	0	0
	6	208	0	1
	7	521	0	1
	Total	2,396	0	7
2	Year 2010			
	1	603	19	10
	2	422	13	7
	3	422	13	7
	4	1,145	36	18
	5	301	9	5
	6	362	11	6
	7	904	28	15
	Total	4,160	131	67

Sources : Statistik Wilayah 1988 and JICA

Table 3.2.2 Estimated Number of Vehicle on Road by Type and by Inundation Area
- Bojong Drainage Improvement -

	Inundation Area No.	Passenger Car	Bus	Truck	Motor Cycle	Total
1	Year 1988					
	1	60	20	26	115	220
	2	42	14	18	80	154
	3	42	14	18	80	154
	4	113	39	49	218	418
	5	30	10	13	57	110
	6	36	12	15	69	132
	7	89	30	39	172	330
	Total	412	140	178	790	1,519
2	Year 2010					
	1	177	85	95	360	718
	2	124	60	66	252	502
	3	124	60	66	252	502
	4	337	162	180	685	1,364
	5	89	43	47	180	359
	6	106	51	57	216	431
	7	266	128	142	541	1,077
	Total	1,224	589	654	2,486	4,953

Sources : Statistik Wilayah 1988 and JICA

Table 3.2.3 Average Annual Flood Damages by Inundation Area
- Bojong Drainage Improvement -

(Unit : Rp.)

	Inundation Area No.	Direct Damages to Properties *	Income Losses due to Shop Closure **	Damages to Traffic
1	Year 1988			
	1	0	331,000	1,039,000
	2	0	0	727,000
	3	0	0	727,000
	4	35,048,000	0	1,973,000
	5	2,073,000	0	519,000
	6	40,980,000	0	623,000
	7	98,247,000	0	1,558,000
	Total	176,348,000	331,000	7,167,000
2	Year 2010			
	1	0	4,312,000	3,775,000
	2	0	2,903,000	2,642,000
	3	0	3,018,000	2,642,000
	4	167,147,000	11,634,000	7,172,000
	5	10,698,000	2,790,000	1,887,000
	6	205,731,000	6,506,000	2,265,000
	7	493,332,000	15,932,000	5,662,000
	Total	876,908,000	47,096,000	26,047,000

Notes : * Related Properties : house, shop and factory
** Related Properties : shop and factory

Source : JICA

Table 3.2.4 Summary of Estimated Average Annual Flood Damages ("Without Project" Case) - Bojong Drainage Improvement

(Unit : Rp.)

Item		1988	2010
1	Direct Damages to Property		
	1) House	173,210,000	747,316,000
	2) Shop	0	47,581,000
	3) Factory	3,138,000	82,011,000
	4) Other Specified Property 1/	1,541,000	54,312,000
	Sub-Total	177,889,000	931,220,000
2.	Indirect Damages		
	1) Income Losses due to Shop Closure		
	(1) Shop	0	3,114,000
	(2) Factory	1,683,000	43,982,000
	(3) Other Specified Property 2/	113,000	2,694,000
	Sub-Total	1,796,000	49,790,000
	2) Traffic Damages		
	(1) Time Cost	2,155,000	7,710,000
	(2) Incremental VOC	5,012,000	18,336,000
	Sub-Total	7,167,000	26,046,000
	Total (1.+2.)	186,852,000	1,007,056,000
3.	Damages to Other Unspecified Property Including Infrastructure		
	(1. + 2.) x 20 %	37,370,000	201,411,000
	Grand Total (1.+2.+3.)	224,222,000	1,208,467,000

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

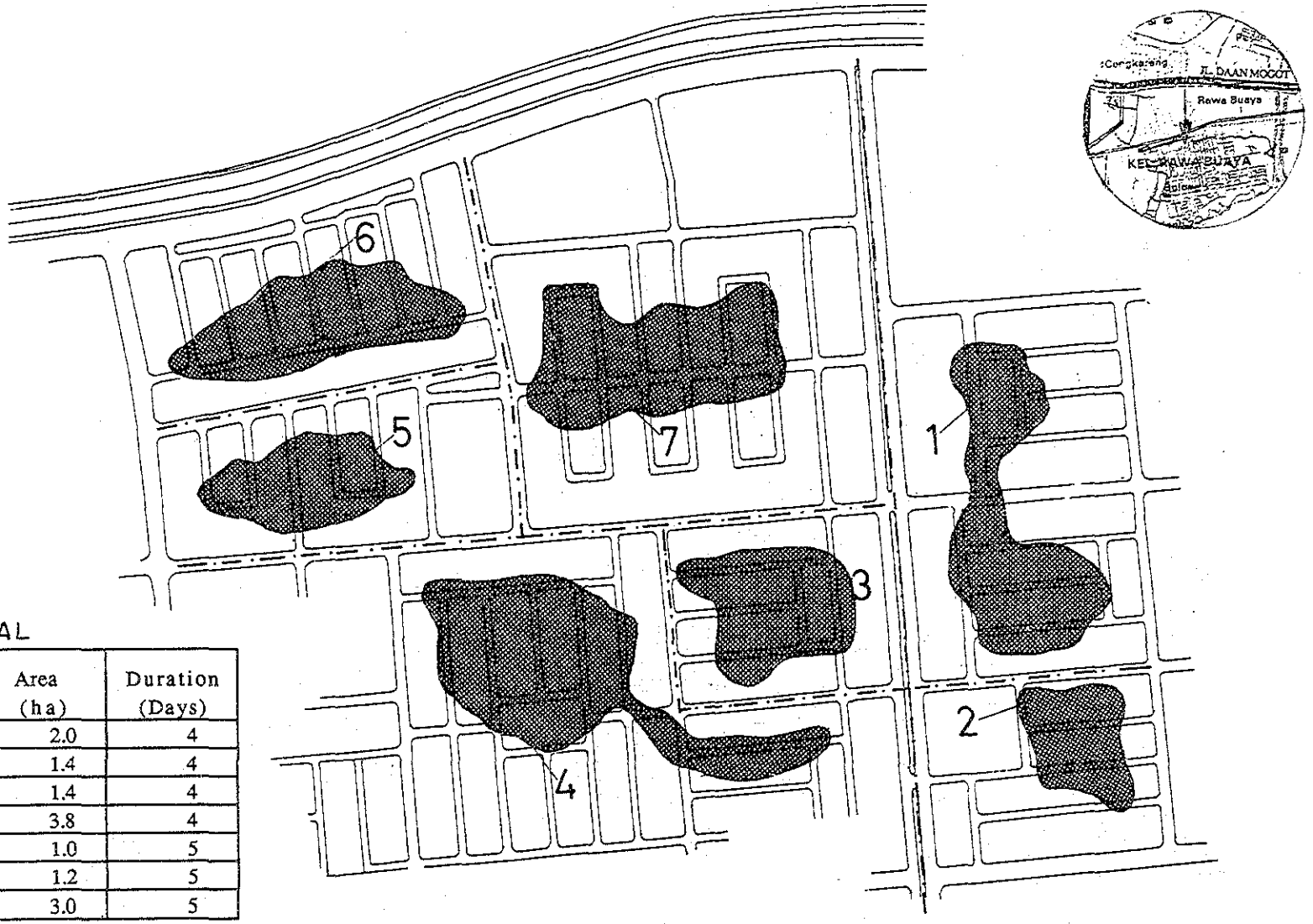
HABITUAL

Location	Depth (m)	Area (ha)	Duration (Hours)
4	0.15	0.76	1.5
6	0.3	1.4	3.0
7	0.3	1.5	3.0

FIG. 3.2.1 HABITUAL INUNDATION AREA (BOJONG DRAINAGE IMPROVEMENT)

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

JICA A.D 1991



POTENTIAL

Location	Depth (m)	Area (ha)	Duration (Days)
1	0.55	2.0	4
2	0.5	1.4	4
3	0.55	1.4	4
4	0.5	3.8	4
5	0.7	1.0	5
6	0.75	1.2	5
7	0.7	3.0	5

FIG. 3.2.2 POTENTIAL INUNDATION AREA (BOJONG DRAINAGE IMPROVEMENT)

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

Chapter 3 DRAINAGE IMPROVEMENT PLAN

3.1 Assessment of Existing Drainage Capacity

The existing flood problems are considered to be due to either one or both of the following causes.

(1) Insufficient drainage capacity of the pump station
(2) Insufficient flow capacity of the drainage channel

The existing capacity of the pump station and drainage channel are assessed to identify the cause of the existing flood problems.

3.1.1 Pump Station

(1) Design Flood Hydrograph

The existing pump station drains an area of 40 ha. Hence, design flood frequency of two (2) years is applied in this assessment study (Refer to II-1, Cengkareng West Urban Drainage, Chapter 3).

The design flood hydrograph was estimated by the Unit Hydrograph Method based on the design point rainfall mass curve proposed in the 1973 Master Plan. The estimated design flood hydrograph with a 2-year return period is shown in Fig. 3.3.1.

(2) Capacity of Retarding Basin

The storage capacity of 29,000 m^3 between N.W.L (P.B.M - 0.44 m) and H.W.L (P.B.M + 1.56 m) is available for regulation of the flood water.

The required capacity of the retarding basin is estimated to be 12,000 m^3 based on the mass curve calculation shown in Fig. 3.3.2.

The existing retarding basin has sufficient capacity to meet the design floods with a 2-year return period. Improvement of the existing pump station is not required.

3.1.2 Drainage Channel

The design flood discharge with 2-year return period was estimated by the Rational Formula (Refer to II-1 Cengkareng West Urban Drainage, Chapter 3). In this calculation, run-off coefficient and concentration time were assumed as $f = 0.5$ and $Tc = 21$ minutes respectively.

The flow capacity of the existing drainage channel was estimated by the Manning's Formula. Manning's roughness coefficient was assumed as $n = 0.014$ for concrete channel.

The flow capacity of the existing channel is compared with its design flood discharge as shown in Table 3.3.1. The existing flow capacity is insufficient for 12 channel sections with a total length of 1,850 m.

The existing flood problems are attributed to insufficient flow capacity of the existing channel. Improvement of the existing channel is required.

3.2 Proposed Channel Improvement Plan

Twelve (12) channel sections with an insufficient flow capacity and one (1) related channel section will be improved to meet the design flood discharge. The total channel improvement length is 1,995 m. The main features of the respective sections of the proposed channel are shown in Table 3.3.2. The profiles of proposed channel are shown in Fig. 3.3.3. The structures of proposed open channel and pipes are shown in Fig. 3.3.4.

Table 3.3.1 Existing Flow Capacity of Drainage Channel

Channel Route	Channel No.	Shape (m)	Channel Length (m)	Catchment Area (ha)	Existing Channel Capacity (m^3/sec)	Design Discharge (m^3/sec)	Shortage of Capacity (m^3/sec)
I	1	0.2 / 0.45 / 0.56	145	3.22	0.16	0.41	-0.25
	2	0.2 / 0.45 / 0.56	45	0.95	0.27	0.52	-0.25
	3	0.5 / 1.44 / 1.22	157	0.39	0.99	0.53	0
	14	0.5 / 1.44 / 1.22	112	0.53	1.09	0.68	0
	15	1.10 / 1.20 / 1.10	20	0.06	2.13	0.68	0
	16	0.5 / 1.44 / 1.25	130	0.51	2.50	0.74	0
	17	0.5 / 1.44 / 1.25	190	0.59	0.46	0.75	-0.29
	4	0.25 / 0.45 / 0.5	152	0.54	0.14	0.07	0
	6	0.40 / 1.10 / 1.10	45	0.06	1.10	0.19	0
	5	0.40 / 1.10 / 1.10	145	0.89	2.07	0.11	0
II	8	0.40 / 1.10 / 1.10	120	0.88	1.46	0.11	0
	9	0.2 / 0.48 / 0.50	110	0.45	0.06	0.20	-0.14
	11	0.2 / 0.40 / 0.50	60	0.21	0.29	0.31	-0.02
	12	φ600	110	0.19	0.36	0.32	0
	13	φ600	180	2.07	0.31	0.52	-0.21
	7	0.40 / 1.10 / 1.10	30	0.25	3.16	0.03	0
	10	0.2 / 0.40 / 0.50	120	0.84	0.22	0.11	0
III	18	0.3 / 0.40 / 0.25	152	0.64	0.08	0.08	0
	19	0.6 / 1.30 / 1.30	300	6.00	2.05	0.74	0
	21	1.32 / 1.32 / 1.24	145	0.78	1.89	1.19	0
	23	0.22 / 0.44 / 0.40	50	0.13	0.13	1.49	-0.94
	25	0.3 / 0.90 / 1.50	60	0.13	0.46	1.82	-1.36
	20	0.5 / 0.65 / 0.60	110	3.87	0.33	0.51	-0.18
	22	0.35 / 1.06 / 0.80	300	3.04	0.44	0.36	0
	24	0.35 / 0.79 / 0.40	300	3.45	0.28	0.41	-0.13
	26	0.3 / 0.9 / 1.5	75	0.27	1.53	0.04	0
IV	27	0.6 / 0.9 / 1.0	300	1.18	0.93	0.14	0
	28	0.9 / 1.5 / 1.5	110	0.41	1.52	0.18	0
	30	0.9 / 1.5 / 1.5	45	0.07	2.74	0.39	0
	32	0.9 / 1.5 / 1.5	120	0.77	4.98	0.64	0
	29	0.35 / 0.77 / 0.66	300	1.85	0.21	0.22	-0.01
	31	0.28 / 0.46 / 0.50	300	1.74	0.08	0.21	-0.13

For Channel No., refer to Fig. 3.1.3.

Table 3.3.2 Main Features of Proposed Channel

Channel Route	Channel No.	Length (m)	Design Discharge (m3/s)	Slope (1/1000)	Top Width (m)	Bottom Width (m)	Depth (m)
I	1	145	0.41	2.0	0.50	0.50	1.00
	2	45	0.52	2.0	0.50	0.50	1.00
	17	190	0.75	0.3	1.44	0.50	1.25
II	9	110	0.20	4.0	0.50	0.50	0.50
	11	60	0.31	4.0	0.50	0.50	0.50
	13	180	0.52	3.0	φ0.7		
III	23	50	1.49	2.0	1.32	1.00	1.24
	25	60	1.82	2.0	1.32	1.00	1.24
	20	110	0.51	4.0	0.65	0.50	0.60
	24	300	0.41	3.9	0.79	0.40	0.50
	21	145	1.19	2.0	1.32	1.00	1.24
IV	29	300	0.22	0.5	0.77	0.77	0.68
	31	300	0.21	0.5	0.77	0.77	0.68

For Channel No., refer to Fig. 3.1.3.

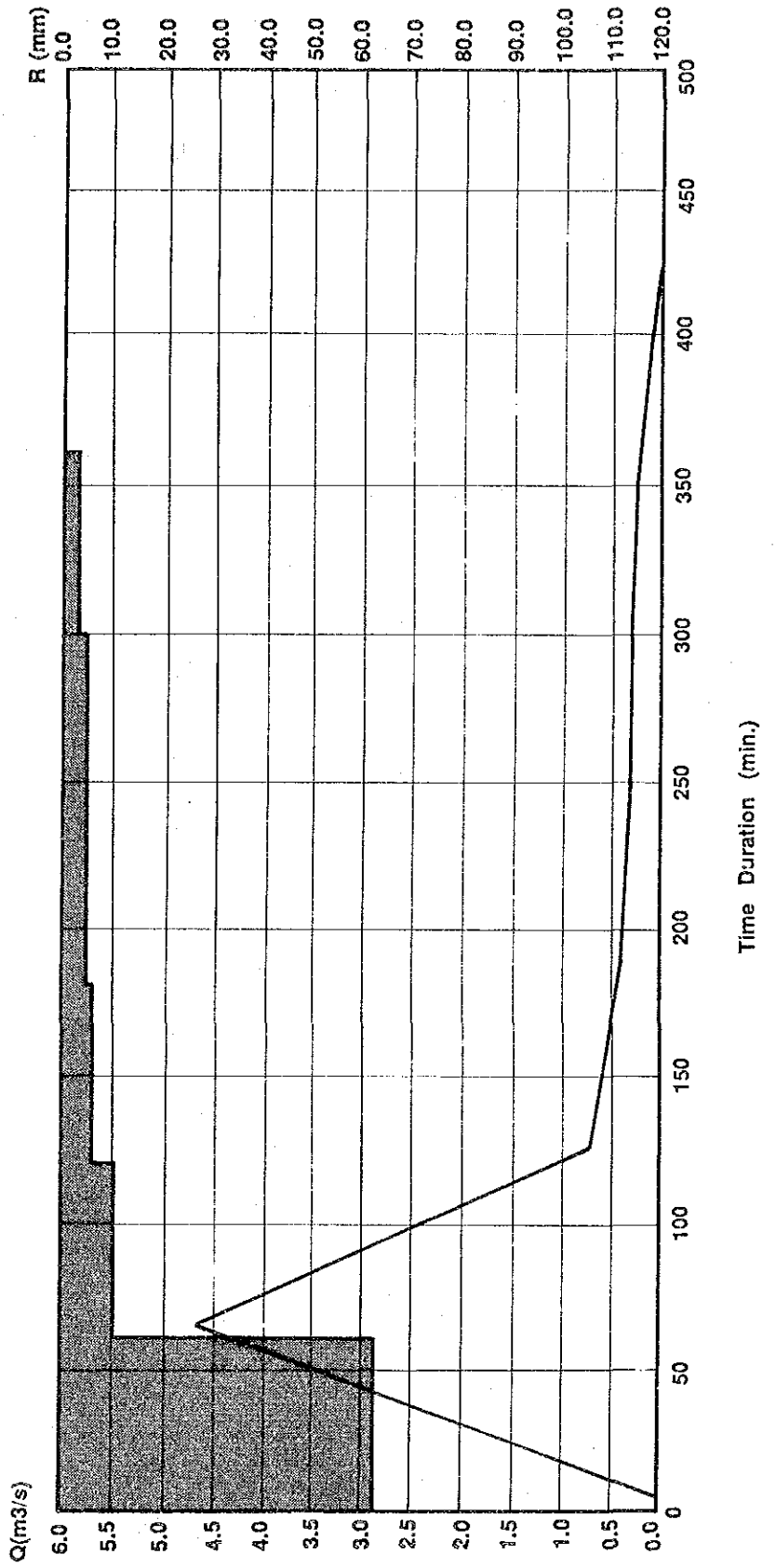


FIG. 3.3.1 DESIGN FLOOD RUNOFF HYDROGRAPH AT BOJONG AREA

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

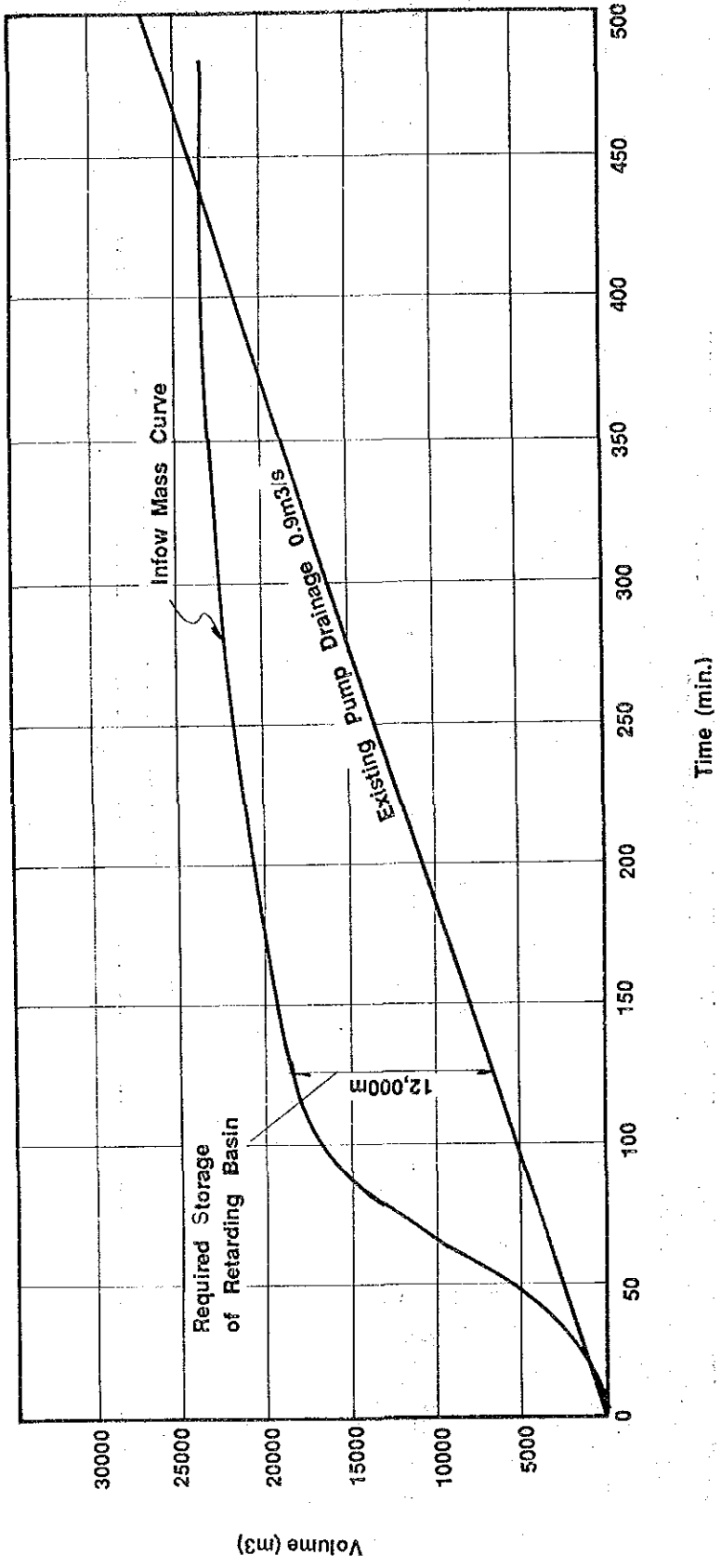
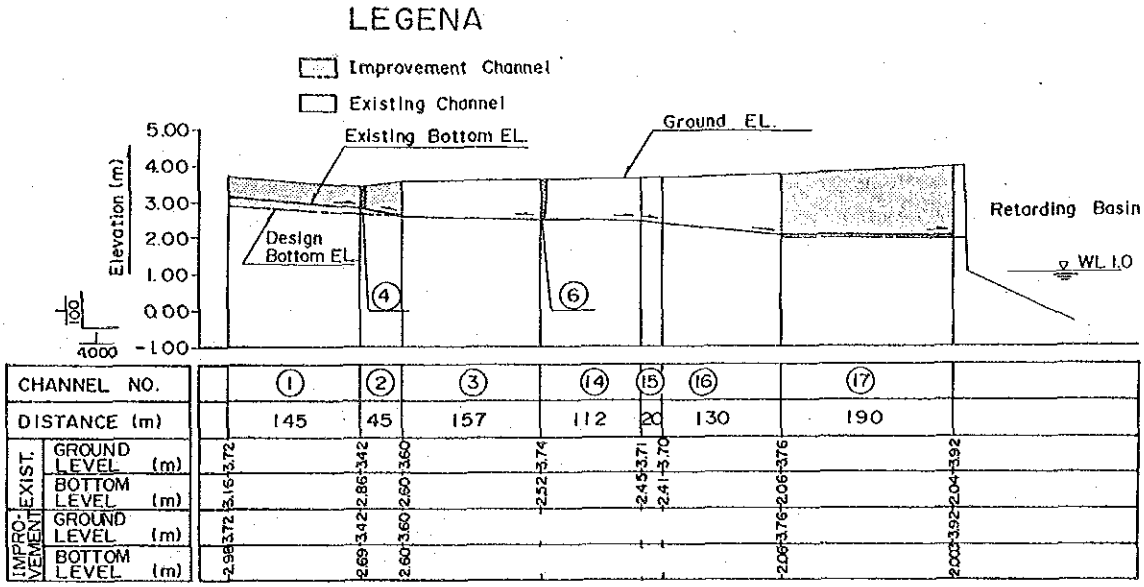


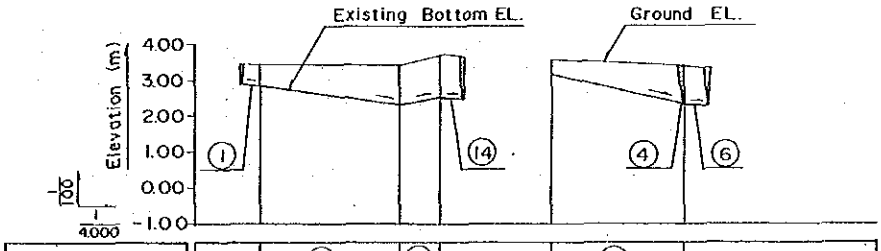
FIG. 3.3.2 MASS CURVE CALCULATION OF PUMP DRAINAGE

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



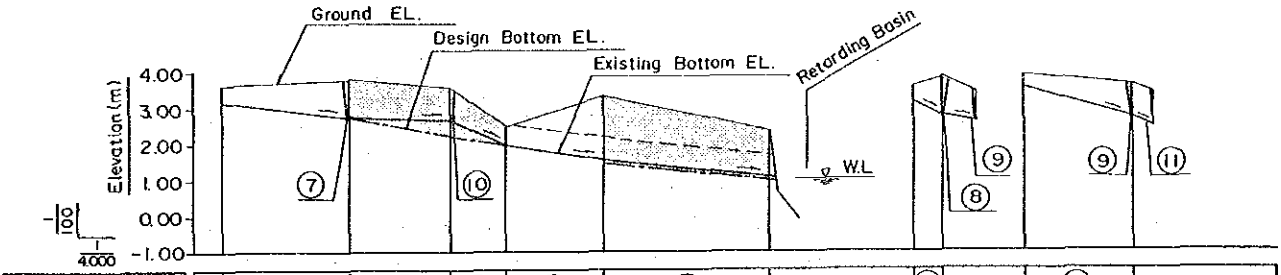
CHANNEL NO.		①	②	③	⑭	⑮	⑯	⑰
DISTANCE (m)		145	45	157	112	20	130	190
EXIST.	GROUND LEVEL (m)	3.72 3.16 3.72	3.42 2.86 3.42	3.60 2.60 3.60	3.74 2.52 3.74	3.71 2.45 3.71	3.70 2.41 3.70	3.76 2.06 3.76	3.92 2.04 3.92
	BOTTOM LEVEL (m)								
IMPROVEMENT	GROUND LEVEL (m)	3.72 2.98 3.72	3.42 2.69 3.42	3.60 2.60 3.60				3.76 2.06 3.76	3.92 2.00 3.92
	BOTTOM LEVEL (m)								

I



CHANNEL NO.		④	⑥	⑤
DISTANCE (m)		152	45	145
EXIST.	GROUND LEVEL (m)	3.42 2.86 3.42	3.41 2.31 3.41	3.74 2.52 3.74	3.57 3.16 3.57	3.41 2.31 3.41
	BOTTOM LEVEL (m)					
IMPROVEMENT	GROUND LEVEL (m)					
	BOTTOM LEVEL (m)					

I (Continued)



CHANNEL NO.		⑧	⑨	⑪	⑫	⑬	⑦	⑩
DISTANCE (m)		120	110	60	110	180	30	120
EXIST.	GROUND LEVEL (m)	3.63 3.14 3.63	3.83 2.73 3.83	3.60 2.70 3.60	2.49 1.99 2.49	3.30 1.55 3.30	3.57 3.16 3.57	3.83 2.73 3.83	3.87 3.52 3.87	3.60 2.70 3.60
	BOTTOM LEVEL (m)									
IMPROVEMENT	GROUND LEVEL (m)		3.83 2.73 3.83	3.60 2.29 3.60	2.49 1.99 2.49	3.30 1.45 3.30	2.39 0.94 2.39			
	BOTTOM LEVEL (m)									

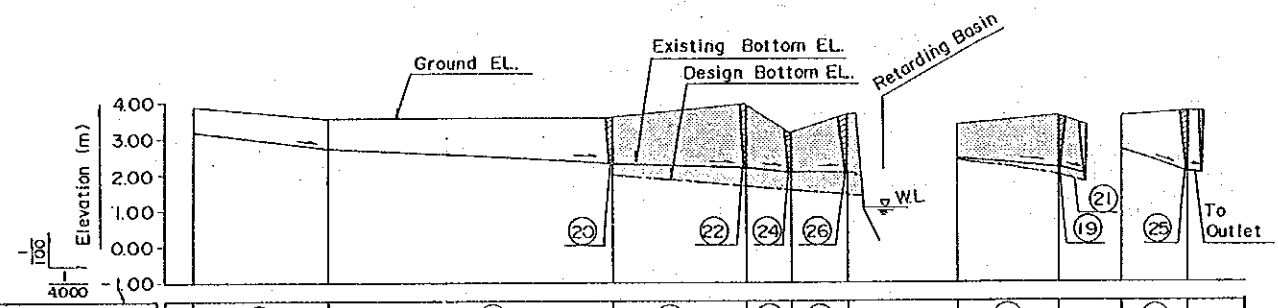
II

FIG. 3.3.3(1) PROFILE OF PROPOSED CHANNEL (CHANNEL ROUTE I & II)

LEGEND

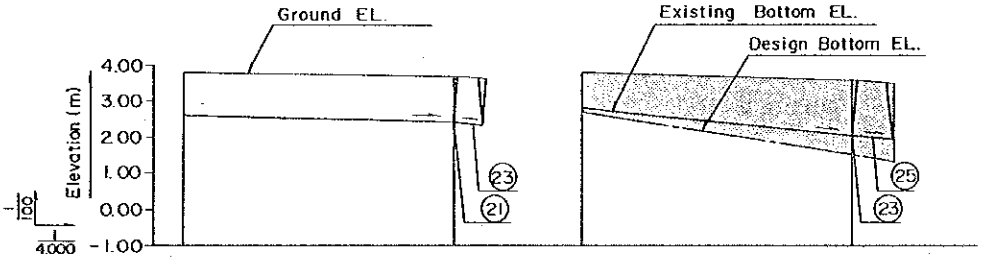
Improvement Channel

Existing Channel



CHANNEL NO.		⑱	⑲	㉑	㉓	㉕	⑳	㉖
DISTANCE (m)		152	300	145	50	60	110	75
EXIST.	GROUND LEVEL (m)	3.17–3.90	2.76–3.56	2.30–3.60	2.18–3.96	2.04–3.12	2.40–3.31	2.67–3.59
	BOTTOM LEVEL (m)							
IMPROVEMENT	GROUND LEVEL (m)			1.96–3.60	1.67–3.96	1.57–3.12	1.45–3.72	2.40–3.31
	BOTTOM LEVEL (m)							1.96–3.60

III



CHANNEL NO.		㉒	㉔
DISTANCE (m)		300	300
EXIST.	GROUND LEVEL (m)	2.61–3.83	2.41–3.70
	BOTTOM LEVEL (m)		
IMPROVEMENT	GROUND LEVEL (m)		2.73–3.81
	BOTTOM LEVEL (m)		2.83–3.81
			1.57–3.62
			2.04–3.62

III (Continued)

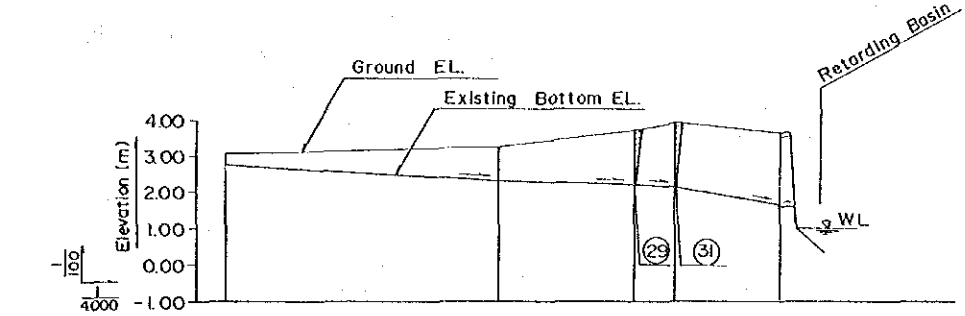
FIG. 3.3.3(2) PROFILE OF PROPOSED CHANNEL (CHANNEL ROUTE III)

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

LEGEND

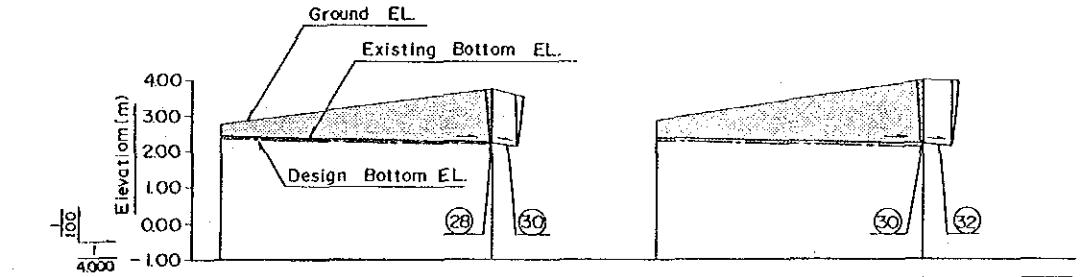
Improvement Channel

Existing Channel



CHANNEL NO		(27)	(28)	(30)	(32)
DISTANCE (m)		300	110	45	120
EXIST.	GROUND LEVEL (m)	2.78-3.07	2.30-3.30	2.24-3.74	2.18-3.96
	BOTTOM LEVEL (m)				1.67-3.67
IMPROVEMENT	GROUND LEVEL (m)				
	BOTTOM LEVEL (m)				

IV



CHANNEL NO		(29)	(31)	
DISTANCE (m)		300	300	
EXIST.	GROUND LEVEL (m)	2.78-2.78	2.83-3.74	3.95-3.95
	BOTTOM LEVEL (m)	2.40-2.40	2.24-3.74	2.32-2.83
IMPROVEMENT	GROUND LEVEL (m)	2.40-2.78	2.24-3.74	2.32-2.83
	BOTTOM LEVEL (m)	2.40-2.78	2.24-3.74	2.32-2.83

IV (Continued)

FIG. 3.3.3(3) PROFILE OF PROPOSED CHANNEL (CHANNEL ROUTE IV)

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

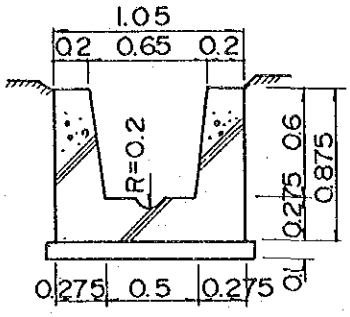
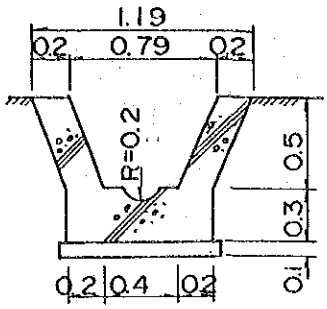
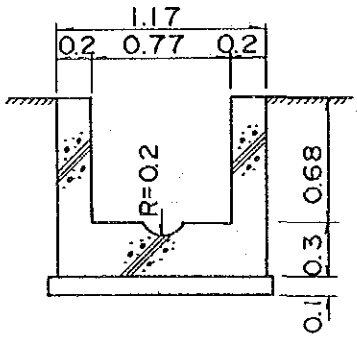
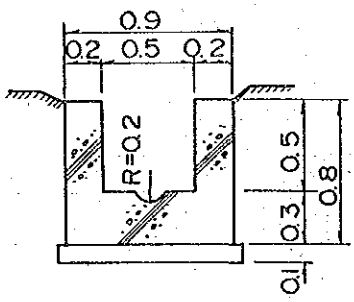
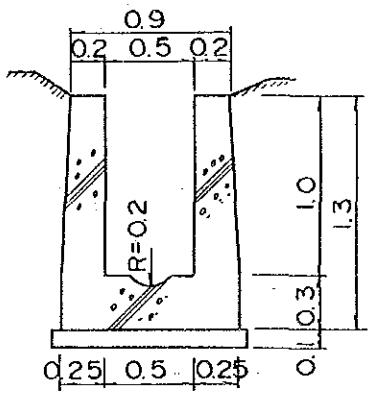
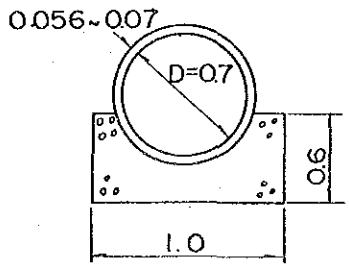
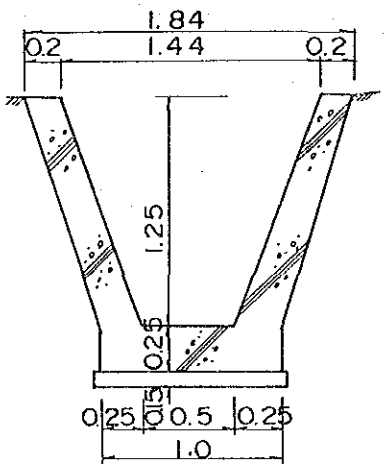
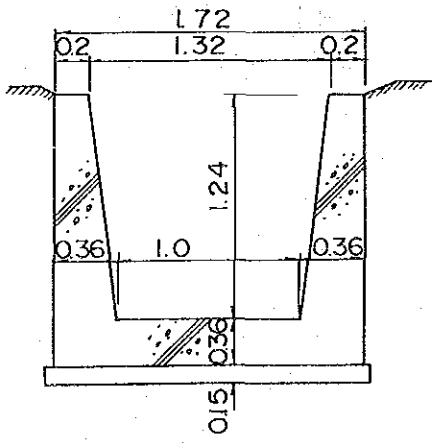
CHANNEL NO	Channel	CHANNEL NO	Channel & Pipe
(20)		(24)	
(29) (30)		(9) (11)	
(1) (2)		(13)	
(17)		(21) (23) (25)	

FIG. 3.3.4 STRUCTURE OF PROPOSED OPEN CHANNEL AND PIPE

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

JICA A.D 1991

Chapter 4 COST ESTIMATE

The project costs were estimated in the same manner of II-1, Cengkareng West Urban Drainage, Chapter 4.

The total project cost amounts to Rp. 549 million at July, 1990 prices as given below.

(million Rp.)

Item	Cost
I. Direct Construction	430
II. Land Acquisition	26
III. Engineering Service: I x 10%	43
IV. Administration: (I + II) x 1.5%	7
V. Physical Contingency: I x 10%	43
Total	549

Break-down of the direct construction and land acquisition costs are shown in Table 3.4.1.