

retaining wall of Semarang and Baru rivers. On the other hand, the inner design low water level (LWL) and HWL of the pumping stations shall meet the requirements of the proposed retarding ponds, which are described in the next section.

The design and maximum static head of the pump equipment are calculated as follows:

Design Static Head = HWL of Semarang Harbor - LWL of Retarding Pond

Maximum Static Head = HHWL of Semarang Harbor - LWL of Retarding Pond

Table VI.7.3 shows the hydraulic requirements of the proposed three pumping stations.

Proposed Retarding Pond

Each pumping station is proposed to be provided with retarding pond at the inner side to reduce the required pump capacity and to economize on total pump drainage cost.

The design HWL of the retarding pond during pump operation is proposed to be 0.2 m above MSL in Jakarta Harbor to maintain gravity drainage in the lowest residential area of 0.6 m above MSL in Jakarta Harbor, because the required hydraulic head loss is assumed to be 0.4 m.

On the other hand, the design LWL, which is the same as the bottom elevation of the retarding pond, is related with the design HWL, the required storage volume and area of the retarding pond. Their relationship is as follows:

$$A = \frac{S}{HWL - LWL}$$

where, A : Required area of retarding pond (m²)

S : Required storage volume of retarding pond (m³)

HWL : Design high water level of retarding pond (m above MSL)

LWL : Design low water level of retarding pond (m above MSL)

The proposed hydraulic requirement of each retarding pond is shown below.

Drainage Area	Retarding Pond			
	HWL	LWL	Area (ha)	Storage Capacity (m ³)
Bandarharjo West	0.20	-1.80	0.84	16,700
Asin River Basin	0.20	-2.80	2.67	80,000
Bandarharjo East	0.20	-2.80	0.93	28,000

Note: Datum line of HWL and LWL is MSL in Jakarta Harbor.

7.6.2 Proposed Channel Improvement Plan

The channel improvement plans are prepared for the following primary and secondary channels:

Semarang River, 6.9 km

Asin River, 1.3 km

Baru River, 0.8 km

Secondary Channel of Bandarharjo West, 0.8 km

Secondary Channel of Bandarharjo East, 0.7 km

(1) Design Discharge

As shown in Fig. VI.7.7, the above drainage areas are divided into several sub-drainage areas based on the existing topographic condition, road and drain networks. The design discharge of a 5-year return period flood for the objective channel improvements is calculated by the Modified Rational Formula as mentioned in Subsection 6.1.6 of the Master Plan study.

The proposed design discharge for each channel improvement are shown in Table VI.7.4 and Fig. VI.7.7.

(2) Semarang River Improvement

The proposed Semarang River improvement works consist of:

- (a) Dredging from the river mouth to Jl. Pandanaran crossing of 6.9 km long;
- (b) Raising of earth dike (Type A, L=2.35km) and retaining wall (Type D, L=0.50km) including rehabilitation of inspection road between North Ring Road bridge and the national railway bridge; and
- (c) Shifting of the river channel (Type A with bank protection, l=0.50 km) to obtain the suitable construction space for Asin pumping station with retarding pond.

The planning concepts for longitudinal and cross sections of the channels to be improved are as follows:

- (a) Since the design discharge of a 5-year return period flood is almost the same as the previous one in Semarang River Drainage Project, the riverbed elevation and slope are planned to apply the previous proposal as shown in Figs. VI.4.5. and VI.5.3.
- (b) The existing insufficient cross sections due to sedimentation are only dredged to the design sections without any widening of the river and reconstruction of the retaining wall.
- (c) Top elevation of earth dike and retaining wall for the tidal protection section is to be set higher than 1.2 m above MSL in Jakarta Habar.
- (d) For the shifting channel section of 0.5 km along the proposed retarding pond, a bank protection facility (revetment) should be considered in order to prevent scouring and infiltration of the proposed retarding pond.

The proposed channel improvement plans of Semarang River are shown in Table VI.7.5 and Fig. VI.7.8.

(3) Asin River Improvement

The proposed Asin River improvement consists of the following two (2) works:

- (a) Channel improvement of 1.30 km from the confluence with Semarang River to the uppermost stretch of Asin River; and
- (b) Reconstruction of Jl. Brotojoyo (III) Bridge.

During the development of Tanah Mas Estate, Asin River of 1.20 km between the confluence with Semarang River and Jl. Brotojoyo (III) Bridge was improved with the rectangular lined channel type. Even if the existing channel width of almost 20 m is sufficient for the requirement, excavation of channel bed is necessary including the reconstruction of retaining wall. The uppermost channel of 100 m is required to have a large scale improvement by widening and deepening including the construction of retaining wall, because the existing cross section is insufficient for the future requirement. As the channel widening, reconstruction of the existing Jl. Brotojoyo (III) Bridge is required. Table VI.7.5 and Fig. VI.7.9 show the proposed channel improvement plans of Asin River.

(4) Baru River Improvement

The proposed Baru River improvement works consist of:

- (a) Channel improvement of Semarang River diversion of $6.0 \text{ m}^3/\text{s}$ including raising of retaining wall and rehabilitation of inspection road; and

- (b) Reconstruction of the existing control gate structure.

As mentioned in Subsection 7.5.2, Baru River is proposed to be divided into two (2) cross sections, diversion channel and retarding pond, by the construction of a partition concrete retaining wall of 600 m long. According to the hydraulic design of diversion channel shown in Table VI.7.5, a rectangular lined channel with a width of 5.0 m and a depth of 2.0 m is applied to the proposed diversion channel.

The Baru River improvement works consist of the following two (2) sections:

- (a) The diversion channel: rectangular lined channel (width = 5.0 m, depth = 2.0 m, length = 650 m); and
- (b) The existing channel improvement of 150 m from the proposed pumping station to the North Ring Road bridge.

In addition, the existing control gate located at the uppermost stretch of Baru River is proposed to be reconstructed because of its inoperative condition.

Table VI.7.5 and Fig. VI.7.10 show the proposed channel improvement plan of Baru River.

(5) Secondary Channel Improvement

Secondary channel improvement works are proposed for two (2) drainage areas, Bandargarjo East and Bandarharjo West, to

connect the existing secondary channel with the proposed retarding ponds.

The existing small drainage channel of about 3.0 m in width, 0.8 m in depth and 800 m in length, which is located at the swamp or unfunctional fishpond in the northern part of Bandarharjo West Area, is planned to be improved to the rectangular channel lined channel with stone masonry (width: 3.0 m, depth: 1.8 m, bed slope: $i = 1/2,000$).

For the Bandarharjo East Area, a new secondary channel 3.0 m in width, 2.0 m in depth and 700 m in length is proposed to be constructed along Jl. Kapt. Laut Wiratmo, to connect the outlet of the existing secondary channel with the proposed retarding pond.

Table VI.7.5 and Fig.VI.7.11 show the proposed secondary channel improvement plan.

The proposed urban drainage works summarized in Table VI.7.6 and Fig. VI.7.4.

TABLES

Table VI.3.1 POPULATION AND BUILT-UP AREA OF THE URBAN DRAINAGE STUDY AREA IN 1990 AND 2015

Name of Kecamatan	Area (km ²)	Population				Built-up Area			
		1990		2015		1990		2015	
		No.	Density (No/km ²)	No.	Density (No/km ²)	Area (km ²)	Rate (%)	Area (km ²)	Rate (%)
Central Semarang	2.79	58,727	21,049	78,547	28,153	2.79	100.0	2.79	100.0
North Semarang	11.93	159,638	13,381	213,516	17,897	8.68	72.8	11.93	100.0
East Semarang	28.90	221,724	7,672	296,556	10,261	19.40	67.1	21.73	75.2
South Semarang	63.02	227,743	3,614	304,606	4,833	58.65	93.1	40.58	64.4
West Semarang	31.27	268,960	8,601	359,734	11,504	19.40	62.0	29.39	94.0
Genuk	60.35	160,362	2,657	214,484	3,554	51.95	86.1	55.34	91.7
Gunung Pati	51.46	46,362	901	62,009	1,205	7.42	14.4	5.09	9.9
Mijen	67.46	40,324	598	53,933	799	6.99	10.4	8.57	12.7
Tugu	56.48	65,390	1,158	87,459	1,548	10.87	19.2	42.47	75.2
Others	-	1,741	-	2,329	-	-	-	-	-
Total	373.66	1,250,971	3,348	1,673,173	4,478	186.15	49.8	217.89	58.3

Table VI.3.2 FLOOD CONDITION OF THE STUDY AREA

Name of Kecamatan	Area (km ²)	Flood Area (ha)	Flood Depth (m)	Duration (hr)
Mijen	67.46	30	0.5 - 4.0	1 - 4
Gunung Pati	51.46	-	-	-
South Semarang	63.02	181	0.1 - 3.0	1 - 168
Genuk	60.35	868	0.3 - 2.0	1 - 98
East Semarang	28.90	155	0.2 - 1.0	0.5 - 24
North Semarang	11.93	603	0.1 - 0.6	2 - 76
Central Semarang	2.79	37	0.2 - 0.75	0.5 - 48
West Semarang	31.27	438	0.1 - 2.0	0.5 - 48
Tugu	56.48	293	0.3 - 1.0	2 - 98
Total	373.66	2,605	-	-

Note : 1. Source : Perencanaan Induk Drainase, Kodia Dati II Semarang
(Master Plan of Drainage System, Semarang City)

Table VI.3.3 OBJECTIVE RIVERS AND THEIR DESIGN SCALE FOR URBAN DRAINAGE MASTER PLAN

Name of River	Drainage Area (km ²)	River Stretch (km)	Design Scale (year)	Remarks
A. Eastern Semarang Area				
1. Siringin	14.104	9.22	10	River mouth-Railway
2. Tenggang	28.660	9.20	10	River mouth-Jl. Majapahit
Sub-total	42.764	18.42	-	
B. Central Semarang Area				
1. Semarang	6.973	6.88	10	River mouth-Jl. Pandanaran
2. Banger	6.466	6.68	10	River mouth-Jl. Halmahera
3. Asin	4.252	1.30	5	Semarang R.-Jl. Brotojoyo II
4. Bulu	0.578	1.75	5	West Floodway- Weir
Sub-total	18.269	16.61	-	
C. Western Semarang Area				
1. Ronggolawe	2.213	3.25	5	West Floodway- Jl. Pamularsin
2. Karangayu	2.320	2.68	5	Ronggolawe-Jl. Pamularsin
3. Tawang	1.403	1.20	5	West floodway-PRPP Building
4. Silandak	1.426	0.85	5	Silandak-Jl. Siliwangi
Sub-total	7.362	7.98	-	
D. Kec. Tugu				
1. Tambakharjo	1.467	2.05	5	Silandak- National Road
2. Buntu	2.368	2.20	5	-do-
3. Bjumleng	1.858	2.70	5	-do-
4. Tugurejo	3.078	3.20	5	River mouth - National Road
5. Tapak	4.290	3.90	5	-do-
6. Boom Karanganyar	5.498	3.50	10	-do-
7. Randugarut	7.116	3.80	10	-do-
8. Mangkang Wetan	4.475	4.60	5	-do-
9. Mangkang Kulon	5.226	4.15	10	-do-
Sub-total	35.376	30.10	-	
Total				
	103.771	73.11	-	

Table VI.4.1(1/2) HYDRAULIC FEATURES OF MAJOR CHANNELS

RIVER	Station (km)	Channel Width B (m)	Water Depth H (m)	Flow Area A (m ²)	Woltted Perimeter P (m)	Hydraulic Radius R (m)	Roughness Coefficient n	Hydraulic Gradient I	Velocity V (m/s)	Discharge Q (m ³ /s)
Tegang River	0.00	39.1	1.8	44.61	39.7	1.12	0.031	0.000140	0.41	18.3
	0.50	49.5	1.9	42.54	41.9	1.02	0.031	0.000140	0.39	16.6
	1.00	20.1	1.8	23.22	20.4	1.14	0.031	0.000140	0.42	9.8
	1.50	39.2	1.7	23.47	39.6	0.59	0.031	0.000140	0.27	6.3
	2.00	17.7	1.9	17.63	17.7	1.00	0.031	0.000140	0.38	6.7
	2.50	12.9	2.4	18.65	13.6	1.37	0.031	0.000500	0.69	16.6
	3.00	9.0	1.9	10.19	9.9	1.03	0.031	0.000500	0.74	7.5
	3.50	10.6	1.6	7.61	10.4	0.73	0.031	0.000500	0.58	4.4
	4.00	8.4	1.5	6.28	8.5	0.74	0.031	0.000500	0.59	3.7
	4.50	9.0	2.2	10.62	10.2	1.04	0.031	0.001330	1.21	12.9
	4.99	5.9	1.9	11.03	9.3	1.19	0.024	0.001330	1.71	18.9
	5.50	12.3	1.7	11.96	10.8	1.11	0.024	0.001330	1.63	19.5
	6.00	11.5	1.4	11.17	11.0	1.02	0.024	0.001570	1.67	18.7
	6.50	3.5	1.1	1.41	4.2	0.34	0.031	0.001570	0.62	0.9
	7.00	5.8	1.0	2.88	5.8	0.50	0.031	0.001570	0.81	2.3
	7.50	5.7	1.2	3.14	5.8	0.54	0.031	0.001570	0.85	2.7
	8.00	6.8	1.2	3.91	6.2	0.63	0.031	0.001570	0.94	3.7
	8.50	6.2	1.0	2.80	5.6	0.50	0.031	0.001570	0.81	2.3
	9.00	6.1	1.2	2.86	5.9	0.48	0.031	0.001570	0.78	2.2
9.50	7.2	0.8	3.35	7.0	0.48	0.024	0.001570	1.01	3.4	
AVERAGE		14.3	1.6	12.97	14.2	0.89	0.030	0.000963	0.84	8.9
Siringin River	0.00	45.5	2.7	60.13	39.2	1.53	0.031	0.000360	0.81	48.7
	0.50	28.0	2.0	33.90	26.6	1.27	0.031	0.000360	0.72	24.4
	1.00	40.2	1.3	22.65	39.8	0.57	0.031	0.000360	0.42	9.5
	1.50	13.5	1.4	13.92	14.0	0.99	0.031	0.000360	0.61	8.5
	2.00	11.8	1.6	10.19	10.5	0.97	0.031	0.000360	0.60	6.1
	2.50	10.0	1.5	8.48	9.6	0.88	0.031	0.000360	0.56	4.7
	3.00	6.6	1.8	6.36	8.7	0.73	0.031	0.000360	0.50	3.2
	3.567	3.0	1.0	2.58	4.5	0.57	0.024	0.000513	0.65	1.7
	4.00	7.3	1.1	5.15	7.3	0.71	0.031	0.000513	0.58	3.0
	4.50	7.2	1.0	3.14	6.5	0.48	0.031	0.000513	0.45	1.4
	5.00	6.5	1.3	4.09	6.3	0.65	0.031	0.000513	0.55	2.2
	5.50	6.5	1.8	5.31	7.8	0.68	0.031	0.000513	0.56	3.0
	6.00	6.8	1.4	6.05	7.3	0.83	0.031	0.001110	0.95	5.7
	6.50	5.0	1.1	3.17	5.3	0.60	0.024	0.001110	0.99	3.1
	7.00	1.8	1.1	1.93	3.9	0.49	0.024	0.001110	0.86	1.7
	7.50	3.7	1.1	2.42	4.2	0.58	0.031	0.001110	0.75	1.8
	8.00	3.8	0.7	1.30	3.1	0.42	0.031	0.001110	0.60	0.8
	8.50	3.6	0.7	1.40	3.7	0.38	0.031	0.001110	0.56	0.8
	AVERAGE		10.5	1.2	10.11	10.4	0.67	0.027	0.000587	0.62
Semarang River	0.00	52.0	1.9	44.86	46.3	0.97	0.031	0.000209	0.46	20.6
	0.31	66.0	2.1	63.10	56.7	1.11	0.031	0.000209	0.50	31.6
	0.50	48.0	1.6	47.79	40.7	1.17	0.031	0.000209	0.52	24.9
	1.00	37.5	2.1	44.57	33.9	1.31	0.031	0.000209	0.56	25.0
	1.26	20.0	1.8	28.48	21.7	1.31	0.024	0.000209	0.72	20.5
	1.50	34.5	2.2	47.14	30.6	1.54	0.031	0.000209	0.62	29.2
	1.74	19.0	1.9	27.65	21.2	1.30	0.024	0.000209	0.72	19.9
	2.00	34.0	1.9	40.53	29.9	1.36	0.031	0.000209	0.57	23.1
	2.36	19.0	1.6	12.03	11.8	1.02	0.024	0.000209	0.61	7.3
	2.50	25.5	2.1	39.73	27.9	1.42	0.024	0.000209	0.76	30.2
	2.85	24.0	1.5	29.20	36.1	0.81	0.024	0.000643	0.92	26.9
	3.11	22.6	1.5	21.51	24.7	0.87	0.024	0.000643	0.96	20.6
	3.45	19.7	0.8	10.66	20.3	0.53	0.024	0.000643	0.69	7.4
	3.93	18.0	1.8	22.90	20.5	1.12	0.024	0.000643	1.14	26.1
	4.34	18.1	1.6	25.12	20.6	1.22	0.024	0.000643	1.21	30.4
	4.47	10.8	1.8	16.99	13.5	1.26	0.024	0.000761	1.34	22.8
	5.00	12.7	1.7	19.86	15.4	1.29	0.024	0.000761	1.36	27.0
	5.51	9.0	1.7	14.55	12.0	1.21	0.024	0.000761	1.31	19.1
	5.97	4.3	1.4	4.83	9.4	0.51	0.020	0.000761	0.88	4.3
6.39	7.9	0.7	4.91	8.7	0.56	0.024	0.000761	0.78	3.8	
6.87	2.2	1.6	3.37	5.2	0.65	0.024	0.000761	0.86	2.9	
6.87	5.7	1.6	7.87	8.2	0.96	0.024	0.000761	1.12	8.8	
AVERAGE		23.2	1.7	26.26	23.4	1.12	0.026	0.000483	0.85	19.7
Banger River	0.00	53.5	1.1	40.71	53.0	0.77	0.031	0.000174	0.36	14.7
	0.50	43.5	1.1	26.79	40.3	0.66	0.031	0.000174	0.32	8.6
	1.00	43.5	1.5	41.41	40.9	1.01	0.031	0.000174	0.43	17.8
	1.49	43.8	1.6	35.12	33.4	1.05	0.031	0.000174	0.44	15.5
	2.00	11.7	1.2	6.62	11.7	0.57	0.031	0.000322	0.40	2.6
	2.50	8.8	1.0	7.58	10.3	0.74	0.024	0.000322	0.61	4.6
	2.99	7.2	1.2	7.21	8.5	0.85	0.024	0.000322	0.67	4.8
	3.49	7.7	1.0	5.12	8.7	0.59	0.024	0.000510	0.66	3.4
	3.90	7.7	1.0	5.75	8.4	0.68	0.024	0.000510	0.73	4.2
	4.46	7.1	1.0	6.42	8.7	0.74	0.024	0.000510	0.77	4.9
	4.99	3.5	0.8	2.78	5.1	0.55	0.024	0.000510	0.63	1.8
	5.60	2.7	1.0	2.32	4.3	0.54	0.024	0.000634	0.70	1.6
	6.00	7.9	1.5	9.43	9.1	1.04	0.024	0.000634	1.08	10.2
6.57	5.2	1.5	4.10	5.5	0.75	0.024	0.000634	0.87	3.6	
AVERAGE		14.1	1.0	11.84	14.6	0.81	0.027	0.000330	0.54	6.1

Table VI.4.1(2/2) HYDRAULIC FEATURES OF MAJOR CHANNELS

RIVER	Station (km)	Channel Width B (m)	Water Depth H (m)	Flow Area A (m ²)	Wetted Perimeter P (m)	Hydraulic Radius R (m)	Roughness Coefficient n	Hydraulic Gradient I	Velocity V (m/s)	Discharge Q (m ³ /s)
Asin Channel	0.00	35.0	1.6	36.79	32.1	1.15	0.024	0.000550	1.07	39.4
	0.50	14.1	2.1	19.07	15.6	1.22	0.024	0.000550	1.12	21.4
	1.00	21.5	1.9	27.61	22.0	1.26	0.024	0.000550	1.14	31.5
	1.30	3.9	0.9	2.76	4.9	0.56	0.024	0.001250	1.00	2.8
	1.50	4.5	1.0	2.57	5.6	0.46	0.031	0.001250	0.68	1.7
	2.00	1.4	0.7	0.84	2.5	0.34	0.024	0.001250	0.72	0.6
	2.50	1.3	0.9	1.05	3.0	0.35	0.024	0.001250	0.07	0.1
	3.00	2.3	0.8	1.00	3.2	0.31	0.024	0.001250	0.07	0.1
	3.09	2.9	1.3	2.73	4.7	0.58	0.024	0.001250	0.10	0.3
	3.30	2.2	1.0	1.98	3.8	0.52	0.024	0.001250	0.10	0.2
	3.50	2.3	0.7	1.27	3.4	0.37	0.024	0.001250	0.08	0.1
AVERAGE		8.3	1.2	8.88	9.2	0.65	0.025	0.001059	0.56	5.0
Bulu Channel	0.00	3.5	1.9	4.52	6.6	0.68	0.024	0.003800	1.99	9.0
	0.00	2.0	1.3	2.39	6.8	0.35	0.020	0.003800	1.53	3.7
	0.34	4.7	1.8	6.58	7.0	0.94	0.024	0.003800	2.46	16.2
	0.34	2.8	0.7	1.59	7.4	0.21	0.020	0.003800	1.09	1.7
	0.50	2.8	1.1	2.49	4.2	0.59	0.024	0.003800	1.81	4.5
	0.54	2.9	0.9	2.23	4.4	0.51	0.024	0.003800	1.64	3.7
	0.81	2.0	0.9	1.65	3.6	0.46	0.024	0.003800	1.53	2.5
	1.00	2.5	0.6	1.10	3.3	0.33	0.024	0.000830	0.57	0.6
	1.50	1.8	0.6	1.00	2.8	0.36	0.024	0.000830	0.61	0.6
	1.73	4.1	2.1	7.64	11.4	0.67	0.024	0.000830	0.92	7.0
	AVERAGE		3.4	1.2	3.64	6.1	0.52	0.023	0.002741	1.34
Ronggolawe River	0.00	4.0	1.4	4.88	6.1	0.80	0.024	0.000500	0.80	3.9
	0.50	3.8	0.9	2.91	5.2	0.56	0.024	0.000500	0.63	1.8
	0.69	9.0	0.9	4.62	12.2	0.38	0.024	0.000500	0.49	2.3
	0.75	9.8	1.7	14.26	12.0	1.19	0.031	0.000500	0.81	11.6
	1.00	5.2	1.0	4.33	6.4	0.68	0.024	0.000500	0.72	3.1
	1.30	5.0	0.7	2.31	13.7	0.17	0.020	0.000500	0.34	0.8
	1.50	7.9	1.5	7.07	9.1	0.78	0.031	0.000500	0.61	4.3
	2.00	4.9	1.7	6.40	6.9	0.93	0.024	0.001440	1.51	9.7
	2.17	3.4	1.1	3.50	5.5	0.64	0.020	0.001440	1.41	4.9
	2.50	4.8	1.2	5.16	6.6	0.78	0.024	0.001440	1.34	6.9
	2.86	12.2	2.2	11.39	10.9	1.04	0.031	0.001440	1.26	14.4
AVERAGE		6.4	1.3	6.10	8.6	0.72	0.025	0.000842	0.90	5.5
Kalangayu River	0.00	4.8	1.5	5.48	6.5	0.84	0.024	0.000270	0.61	3.3
	0.54	4.8	1.3	5.44	6.6	0.82	0.024	0.000270	0.60	3.3
	1.00	3.3	1.0	3.06	4.9	0.62	0.024	0.000270	0.50	1.5
	1.50	7.5	1.6	8.00	8.4	0.95	0.024	0.000270	0.66	5.3
	1.78	5.1	1.2	4.75	11.6	0.41	0.020	0.000270	0.45	2.1
	2.00	7.0	1.6	8.70	8.8	0.99	0.024	0.000270	0.68	5.9
	2.26	11.5	2.1	20.10	18.8	1.07	0.024	0.000270	0.72	14.5
	2.50	4.7	1.8	6.60	6.8	0.97	0.024	0.004600	2.77	18.3
	2.76	4.9	2.6	11.50	9.1	1.26	0.024	0.004600	3.30	38.0
	AVERAGE		6.6	1.7	8.30	9.2	0.88	0.024	0.001216	1.13
TM 1	0.00	11.5	2.1	19.46	14.3	1.36	0.024	0.000670	1.32	25.7
	0.56	3.6	1.3	4.09	8.0	0.51	0.024	0.000670	0.69	2.8
	1.10	8.0	1.5	10.22	9.9	1.03	0.024	0.000670	1.10	11.2
	1.20	8.0	1.6	8.42	8.6	0.98	0.024	0.000670	1.06	8.9
	AVERAGE		7.8	1.6	10.55	10.2	0.97	0.024	0.000670	1.04
TM 2	0.00	20.0	1.8	30.89	22.5	1.37	0.024	0.000310	0.90	27.8
	0.50	22.5	1.4	25.67	21.9	1.17	0.024	0.000310	0.81	20.8
	0.95	9.0	2.1	12.74	11.0	1.16	0.031	0.000310	0.63	8.0
	1.50	10.7	2.1	18.23	12.6	1.45	0.024	0.000310	0.84	17.1
	1.60	10.7	2.0	17.71	13.2	1.34	0.024	0.000310	0.89	15.8
AVERAGE		13.2	1.9	18.59	14.7	1.28	0.026	0.000310	0.82	15.2
TM 3	0.00	7.2	1.9	6.15	7.4	0.83	0.031	0.002080	1.30	8.0
	0.50	5.5	1.4	3.96	5.5	0.72	0.031	0.002080	1.18	4.7
	0.77	6.5	0.9	5.68	8.1	0.70	0.024	0.002080	1.50	8.5
	0.77	5.9	0.9	5.17	10.8	0.48	0.024	0.002080	1.16	6.0
	AVERAGE		6.3	1.3	5.24	8.0	0.68	0.028	0.002080	1.29

Table VI.4.2 DISCHARGE CAPACITY AT BOTTLENECK OF PRIMARY CHANNEL

Name	River	Station (km)	Structure	Flow Area (m ²)	Velocity (m/s)	Discharge capa (m ³ /s)
Sr- 1	Siringin	2.87	Bridge	8.96	0.50	4.48
Sr- 2	-do-	5.50	-do-	6.58	0.56	3.68
Te- 1	Tenggang	1.90	-do-	21.92	0.38	8.33
Te- 2	-do-	2.20	-do-	10.14	0.38	3.85
Te- 3	-do-	2.65	-do-	13.30	0.89	11.84
Te- 4	-do-	7.12	Box Culvert	4.80	0.81	3.89
Te- 5 (Up)	-do-	9.20	-do-	6.46	1.01	6.52
Te- 5 (Center)	-do-	9.20	Pipe Culvert	1.57	1.01	1.59
Te- 5 (Down)	-do-	9.20	-do-	6.38	1.01	6.44
Sm- 1	Semarang	1.26	Bridge	48.63	0.72	35.01
Sm- 2	-do-	1.74	-do-	37.80	0.57	21.55
Sm- 3	-do-	2.36	-do-	37.80	0.51	19.28
Sm- 4	-do-	2.85	-do-	20.68	0.92	19.03
Sm- 5	-do-	3.11	-do-	32.20	0.96	30.91
Sm- 6	-do-	5.97	Box Culvert	5.54	0.88	4.88
Sm- 7	-do-	6.88	-do-	3.18	1.12	3.56
Sm- 8 (Up)	-do-	7.75	Bridge	6.40	1.12	7.17
Sm- 8 (Down)	-do-	7.75	Pipe Culvert	1.97	1.12	2.21
As- 1	Asin	1.18	Bridge	7.14	1.00	7.14
As- 2	-do-	1.30	-do-	2.88	1.11	3.20
As- 3	-do-	3.09	-do-	4.43	0.10	0.44
Ba- 1	Banger	2.17	Bridge	10.38	0.40	4.15
Ba- 2	-do-	2.65	-do-	9.70	0.61	5.59
Ba- 3	-do-	3.90	-do-	11.63	0.66	7.68
Ba- 4	-do-	4.45	-do-	8.40	0.77	6.47
Ba- 5 (Up)	-do-	5.60	Box Culvert	2.97	0.70	2.08
Ba- 5 (Down)	-do-	5.60	-do-	3.60	0.70	2.52
Ba- 6	-do-	6.57	Pipe Culvert	0.90	0.87	0.78
Ka- 1	Karangayu	0.00	-do-	3.03	0.61	1.85
Ka- 2	-do-	0.69	Box Culvert	8.73	0.55	4.80
Ka- 3	-do-	1.80	Pipe Culvert	3.39	0.45	1.53
Ka- 4	-do-	2.20	Box Culvert	3.62	0.68	2.46
Ro- 1 (Down)	Ronggolawe	0.00	-do-	4.90	0.70	3.43
Ro- 1 (Up)	-do-	0.00	-do-	3.93	0.80	3.14
Ro- 2	-do-	1.08	Box Culvert	5.36	1.00	5.36
Ro- 3	-do-	1.78	Box/Pipe Culv.	4.79	0.61	2.92
Ro- 4	-do-	2.26	Bridge	16.77	1.41	23.65

Note: Location of bottlenecks are shown in Fig.VI.4.3.

Table VI.4.3 REQUIRED DREDGING VOLUME OF SEMARANG RIVER

Station	Distance (m)	Area (m ²)	Average (m ²)	Volume (m ³)	Accumulated Volume (m ³)	Remarks
0.00	0	38.8	0.00	0	0	
0.31	310	31.8	35.30	10,943	10,943	North Ring Road Brd.
0.50	190	36.2	34.00	6,460	17,403	
1.00	500	16.2	26.20	13,100	30,503	
1.26	260	15.0	15.60	4,056	34,559	
1.50	240	8.8	11.90	2,856	37,415	
1.74	240	14.8	11.80	2,832	40,247	B Lama St. Brd.
2.00	260	14.8	14.80	3,848	44,095	
2.36	360	12.8	13.80	4,968	49,063	Yos S. St. Brd.
2.50	140	14.2	13.50	1,890	50,953	
2.85	350	12.9	13.55	4,743	55,696	Railway Brd.
3.00	150	19.1	16.00	2,400	58,096	
3.11	110	13.2	16.15	1,777	59,873	Pemuda St. Brd.
3.45	340	19.1	16.15	5,491	65,364	A Salim St. Brd.
3.50	50	10.1	14.60	730	66,094	
3.77	270	12.2	11.15	3,011	69,105	Lombok St. Brd.
3.95	160	14.2	13.20	2,112	71,217	Pekojan St. Brd.
4.00	70	11.1	12.65	886	72,103	
4.34	340	8.4	9.75	3,315	75,418	Pinggir St. Brd.
4.48	140	5.6	7.00	980	76,398	Ki MS St. Brd.
4.50	20	6.1	5.85	117	76,515	
4.70	200	5.6	5.85	1,170	77,685	Sebander St. Brd.
5.00	300	5.8	5.70	1,710	79,395	
5.14	140	0.0	2.90	406	79,801	W Gandul St. Brd.
5.50	360	0.0	0.00	0	79,801	G Mada St. Brd.
5.97	470	4.4	2.20	1,034	80,835	Thamrin St. Brd.
6.00	30	5.6	5.00	150	80,985	
6.39	390	8.4	7.00	2,730	83,715	Pekunden St. Brd.
6.50	110	6.0	7.20	792	84,507	
6.88	380	8.6	7.30	2,774	87,281	Pandanaran St. Culv.

Table VI.5.1 LENGTH AND COST OF SEMARANG RIVER IMPROVEMENTS BY FISCAL YEAR

No.	Fiscal Year	Financial Source	Improvement Length (m)	Improvement Cost (x 10 ³ Rp.)	Construction Period
1	1985/1986	APBN	680.7	129,568	1/10/86 to 6/8/86
2	"	IBRD	3,054.8	821,959	5/2/85 to 2/25/87
3	1986/1987	APBN	128.0	92,097	8/11/86 to 1/8/87
4	1987/1988	IBRD	885.0	1,042,956	3/11/87 to 1/5/88
5	"	IBRD	465.0	351,400	10/12/87 to 2/8/88
6	"	APBD TK-II	250.0	197,669	10/29/87 to 2/26/87
7	1989/1990	IBRD	1,032.5	968,997	8/30/87 to ?
8	"	IBRD	922.5	782,774	-
9	"	APBD TK-II	379.6	485,092	8/19/89 to ?
10	"	APBN	50.0	41,103	-
Total		-	7,848.1	4,913,615	

- Note: 1. IBRD: International Bank for Reconstruction and Development
 2. APBN:
 3. APBD TK-II:
 4. Final report of Implementation of Semarang Drainage Improvement Project : Urban V

Table VI.5.2 EXECUTED DRAINAGE IMPROVEMENT WORKS BY FISCAL YEAR

Fiscal Year	Channel Improvement (m)				Bridge Improvement (place)	Pump Rehabilitation (place)	Others
	Primary	Secondary	Tertiary	Total			
1984/1985	-	3,687.4	2,670.7	6,358.1	-	-	House compensation 163 houses
1985/1986	3,735.5	21,571.0	4,612.7	29,919.2	4	-	-
1986/1987	128.0	1,308.0	699.0	2,135.0	1	-	Land compensation 8,720 m ²
1987/1988	1,600.0	7,194.0	475.0	9,269.0	1	1	-
1988/1989	-	1,048.0	-	1,048.0	3	-	Excavation: 192,446 m ³ Equipment: 7 units
1989/1990	2,384.6	306.0	-	2,690.6	4	1	-
Total	7,848.1	35,114.4	8,457.4	51,419.9	13	2	-

Note: 1. Source : Final report of Implementation of Semarang Drainage Improvement Project :
Urban V

Table VI.5.3 COST OF SEMARANG DRAINAGE IMPROVEMENT PROJECT BY FISCAL YEAR AND FINANCIAL SOURCE

(unit : 1,000 Rp)

Fiscal Year	IBRD	APBD TK-I	APBD TK-II	APBN	Total
1984/1985	(6) 388,112	(2) 101,159	(2) 604,770	-	(10) 1,094,041
1985/1986	(9) 1,723,062	(3) 124,698	(1) 101,997	(3) 442,250	(16) 2,392,007
1986/1987	(2) 280,589	(3) 174,482	(1) 14,600	(2) 255,801	(8) 725,472
1987/1988	(4) 1,952,505	(3) 187,316	(3) 226,442	(1) 153,737	(11) 2,520,000
1988/1989	(11) 2,134,673	-	(2) 188,495	(5) 268,941	(18) 2,592,109
1989/1990	(3) 2,126,677	(1) 232,149	(3) 684,174	(3) 385,888	(10) 3,428,888
Total	(35) 8,605,618	(12) 819,804	(12) 1,820,478	(11) 1,506,617	(73) 12,752,517

Note : 1. The figures in parenthesis mean number of project package.
 2. Source : Final report of Implementation of Semarang Drainage Improvement Project : Urban V

Table VI.5.4 INVESTMENT PROGRAM FOR SEMARANG URBAN DEVELOPMENT PROJECT

Area	Proposed Project	Cost (Million Rp. in 1990/1991 price)					Total
		1991/1992	1992/1993	1993/1994	1994/1995	1995/1996	
Western Semarang	Channel improvement including railway bridge construction (R=4,692m)		329	1146.4	1108.2	349.7	2,933.3
West Floodway	Railway bridge, channel improvement of Ronggolawe and Karangayu Rivers, channel improvement of Bulu River (l=2,040m)	235.3	470.5	1,281.2	459.0		2,446.0
Central Semarang	Tide gate of Semarang River and channel improvement of Banger River (l=3,141m)	599.3	2,420.3	4,858.7	4,076.9	1,047.5	13,002.7
Eastern Semarang	Channel improvement of Tenggang and Siringin Rivers (l=10,520m)		573.0	6,346.8	8,978.5	5,721.9	21,620.2
-	Rehabilitation of secondary and tertiary drain including Tumpang channel (l=810m)		456.8	1,028.1			1,484.9
-	O/M support						
-	Master plan revision			1,364.0	1,131.3	1,131.4	3,626.7
-	Administration cost	93.2	255.0	961.5	921.2	495.0	2,725.9
-	Engineering cost		220.7	1,353.6	1,778.5	990.0	4,342.8
-	Tax		206.0	1,263.3	1,659.9	924.0	4,053.2
		1,647.2	4,931.3	19,603.6	20,113.5	10,659.5	56,955.1

Table VI.5.5 IMPLEMENTATION SCHEDULE OF SEMARANG URBAN DEVELOPMENT PROGRAM

Project Component	Cost (Million Rp.)	Responsible By	Year 1 '93 - '94	Year 2 '94 - '95	Year 3 '95 - '96	Year 4 '96 - '97	Year 5 '97 - '98	Remarks
A. Stage III Proposed								
1. PUAD A Yani System	1,148.8	TK II						
2. Pamularsin A Rachman Saleh Drain	953.7	TK II						
3. Ronggolawe & Karangayu Drain	330.0	TK II						
4. Bulu Drainage	1,693.0	TK II						
5. Semarang R. Tidal Gate	3,512.3	Central G.						
6. Banger R. Improvement I	2,739.4	Central G.						
7. Banger R. Improvement II	2,637.8	Central G.						
8. Banger R. Improvement III	3,795.0	Central G.						
9. Tenggang R. System	8,757.4	Central G.						
10. Kaligawe Secondary System	2,112.0	Central G.						
11. Siringin R.	5,599.7	Central G.						
12. Secondary/Tertiary Rehabilitation	830.6	TK II						
13. Tumpang R. Rehabilitation	519.3	TK II						
14. Equipment of O&M	2,057.0	Central G.						
15. O & M support	1,030.0	TK I						
16. Technical Assistance of O & M	1,224.0	Central G.						
Sub-total	38,940.0							
B. Additional Proposed								
1. Tenggang R. Hulu	1,365.9	Central G.						
2. Jl. Sriwijaya Drain	360.0	Central G.						
3. Kp. River and Mataram Drain	360.0	Central G.						
4. Simpang Lima Drain	270.0	TK I						
5. Jl. Thamrin Bridge	247.5	TK II						
6. Silandak R.	375.0	TK I						
7. Siangker R.	385.0	TK I						
8. Periodic Maintenance of Channel	7,885.9	TK II						
9. Drainage Channel Improvement	525.0	TK II						
Sub-total	11,774.3							
Total	50,714.3							

Source : Medium Term Investment Program (PJM) Semarang; November 1992

Table VI.6.1(1/4) Construction Cost Comparison of Tenggang River Improvement Alternatives

Item	(1-A)			(1-B)			(1-C)			Remarks
	Quantity	Unit	Cost	Quantity	Unit	Cost	Quantity	Unit	Cost	
1. Channel Improvement										
(1) Channel (Type-A)	2,100	m	1,661	4,350	m	2,375	4,350	m	2,505	
(2) Channel (Type-C)	6,400	m	8,922	6,400	m	8,288	6,400	m	8,378	
Sub-total			10,583			10,663			10,883	
2. Related Structures										
(1) Railway Bridge	30	m	540	29	m	522	15	m	270	
(2) Road Bridge	794	m ²	1,215	824	m ²	1,261	758	m ²	1,160	
(3) Inspection Road	51,000	m ²	270	64,500	m ²	342	64,500	m ²	342	
Sub-total			2,025			2,125			1,772	
3. Land Acquisition	253,000	m ²	5,060	326,000	m ²	6,520	343,000	m ²	6,860	
4. House Compensation	248	Unit	1,736	214	Unit	1,498	144	Unit	1,008	
Total Cost			19,404			20,806			20,523	

Table VI.6.1(2/4) Construction Cost Comparison of Semarang River Improvement Alternatives

Item	(2-A)			(2-B)			Remarks
	Quantity	Unit	Cost	Quantity	Unit	Cost	
1. Channel Improvement							
(1) Channel (Type-B)	2,360	m	2,072	2,360	m	2,093	
2. Related Structures							
(1) Pump Station	14	m ³ /s	20,738	7	m ³ /s	12,919	
(2) Road Bridge	311	m ²	476	311	m ²	476	
(3) Inspection Road	14,160	m ²	75	14,160	m ²	75	
Sub-total			21,289			13,470	
3. Land Acquisition	105,150	m ²	352	40,900	m ²	250	
4. House Compensation	0	Unit	0	150	Unit	1,050	
Total Cost			23,713			16,863	

Table VI.6.1(3/4) Construction Cost Comparison of Banger River Improvement Alternatives

Item	(Mill.Rp.)						Remarks
	(3-A)			(3-B)			
	Quantity	Unit	Cost	Quantity	Unit	Cost	
1. Channel Improvement							
(1) Channel (Type-D)	1,550	m	2,382	2,580	m	4,045	
(2) Channel (Type-G)	780	m	955	-	m	0	
Sub-total			3,337			4,045	
2. Related Structures							
(1) Inspection Road	9,300	m2	50	15,500	m2	82	
3. Land Acquisition	15,500	m2	310	29,800	m2	596	
4. House Compensation	130	Unit	910	215	Unit	1,505	
Total Cost			4,607			6,228	

Table VI.6.1(4/4) Construction Cost Comparison of Bulu River Improvement Alternatives

Item	(Mill.Rp.)						Remarks
	(4-A)			(4-B)			
	Quantity	Unit	Cost	Quantity	Unit	Cost	
1. Channel Improvement							
(1) Channel (Type-C)	275	m	224	275	m	227	
(1) Channel (Type-G)	-	m	-	200	m	173	
Sub-total			224			400	
2. Related Structures							
(1) Pump Station	1	L.S.	420	-	L.S.	0	
(2) Inspection Road	1,650	m2	9	1,650	m2	9	
Sub-total			429			9	
3. Land Acquisition	4,972	m2	99	3,300	m2	66	
4. House Compensation	36	Unit	252	30	Unit	210	
Total Cost			1,004			685	

Table VI.6.2 (1/2) Design Discharge

Channel No.	Drainage Area (km ²)	Velocity (m/s)	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Run-off Coefficient	Areal Reduction Factor	Design Discharge (m ³ /s)	
(Eastern Semarang Area)								
Siringin	Sr-9	14.10	0.60	231	36.37	0.71	0.92	74.36
	Sr-8	12.30	0.60	189	42.26	0.70	0.92	74.55
	Sr-6	7.14	0.75	151	49.98	0.65	0.95	48.82
	Sr-5	5.49	0.75	103	67.97	0.61	0.96	48.07
	Sr-3	3.19	1.00	83	76.63	0.61	0.97	32.49
	Sr-2	2.04	1.00	55	95.63	0.66	0.98	27.96
Tenggang	Te-14	18.24	0.75	208	39.41	0.56	0.90	79.60
	Te-13	10.42	0.60	178	44.20	0.60	0.93	57.00
	Te-11	14.07	1.25	158	48.45	0.53	0.92	73.89
	Te-6	1.12	1.25	49	101.77	0.67	0.99	19.94
	Te-5	12.99	1.00	128	56.65	0.53	0.92	79.00
	Te-3	6.28	1.25	104	67.55	0.51	0.95	45.98
	Te-2	3.99	1.25	83	76.38	0.52	0.97	33.97
(Central Semarang Area)								
Semarang	A-A'	11.23	0.50	175	44.91	0.63	-	58.80
	A-B	11.23	0.50	164	47.00	0.63	-	62.10
	Sm-8	6.39	0.50	161	47.80	0.62	-	29.97
	Sm-7	6.39	0.50	136	54.12	0.62	-	35.52
	Sm-6	6.39	0.50	122	58.57	0.62	-	39.43
	Sm-5	6.19	0.75	119	62.60	0.62	-	47.12
	Sm-4	5.69	0.75	105	67.07	0.60	-	44.57
	Sm-3	1.60	1.00	61	90.48	0.62	-	19.81
	Sm-2	1.09	1.00	44	107.56	0.60	-	15.66
Sm-1	0.22	1.25	25	143.76	0.65	-	4.55	
Asin	As-2	4.25	0.50	112	64.82	0.65	-	39.81
Banger	Ba-8	6.47	0.50	178	44.26	0.65	-	41.46
	Ba-7	6.17	0.60	137	53.74	0.65	-	47.46
	Ba-6	5.02	0.60	125	57.77	0.66	-	42.34
	Ba-5	4.22	0.60	100	68.91	0.66	-	42.54
	Ba-4	2.99	0.75	77	79.48	0.66	-	34.83
	Ba-3	2.20	0.75	69	84.39	0.65	-	27.01
	Ba-2	1.19	1.00	52	98.47	0.65	-	16.96
Bulu	Bu-4	0.58	1.25	38	104.95	0.64	1.00	8.56
	Bu-3	0.33	1.25	35	110.74	0.64	1.00	5.20
	Bu-2	0.23	1.25	28	123.87	0.60	1.00	3.71
	Bu-1	0.12	1.25	22	140.01	0.60	1.00	2.22
(Western Semarang Area)								
Ronggolawe	Rg-5	4.53	0.60	117	56.11	0.56	0.97	30.53
	Rg-4	1.75	0.60	73	73.65	0.57	0.99	15.98
	Rg-3	1.39	1.50	37	107.48	0.60	0.99	19.82
	Rg-2	1.05	1.50	31	117.25	0.60	0.99	16.27
Karangayu	Kr-4	2.23	0.50	91	64.98	0.57	0.98	18.62
	Kr-3	1.39	1.25	41	101.57	0.60	0.99	18.66
	Kr-2	1.04	1.25	36	109.08	0.60	0.99	14.94
Tawang	Twe-3	1.40	1.00	46	94.95	0.49	0.99	14.37
	Twe-2	0.67	1.00	31	118.25	0.33	0.99	5.79
Silandak	Sl-2	1.42	1.25	41	100.77	0.67	0.99	21.148

Table VI.6.2 (2/2) Design Discharge

Channel No.		Drainage Area (km ²)	Velocity (m/s)	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Run-off Coefficient	Areal Reduction Factor	Design Discharge (m ³ /s)
(Kec.Tugu Area)								
Tambak-harjo	Tam-2	1.47	0.50	67	77.39	0.63	0.99	15.59
	Tam-1	0.08	0.50	25	131.28	0.56	0.99	12.79
Buntu	Bun-3	2.37	0.50	106	59.39	0.69	0.98	21.10
	Bun-2	1.76	0.50	53	88.16	0.66	0.99	22.32
Jumbleng	Jum-3	1.86	0.50	89	65.51	0.60	0.98	15.87
	Jum-2	1.09	0.50	56	85.21	0.75	0.99	15.41
	Jum-1	0.45	1.50	23	137.60	0.80	1.60	10.87
Tugurejo	Tug-3	3.08	0.50	122	54.89	0.59	0.98	21.52
	Tug-2	2.09	0.50	78	70.65	0.72	0.98	23.35
	Tug-1	1.11	0.50	35	110.18	0.80	0.99	21.52
Tapak	Tap-4	4.29	0.50	154	43.98	0.63	0.97	25.63
	Tap-3	3.32	0.50	111	58.01	0.73	0.97	30.39
	Tap-2	2.27	0.50	74	73.03	0.77	0.98	27.96
Boom karanganyar	Boka-3	5.50	0.50	131	55.60	0.61	0.96	39.62
	Boka-2	3.76	0.50	74	81.08	0.75	0.97	49.37
Randugarut	Ran-3	7.12	0.50	133	55.09	0.68	0.95	55.94
	Ran-2	4.43	0.50	73	82.09	0.80	0.97	62.40
	Ran-1	1.17	1.50	19	164.46	0.80	0.99	33.76
Mangkang Wetan	Mawe-3	4.48	0.50	158	43.05	0.71	0.97	29.32
	Mawe-2	2.20	0.50	85	67.44	0.80	0.98	25.92
	Mawe-1	0.73	1.50	20	146.76	0.80	0.99	19.15
Mangkang Kulon	Maku-3	5.23	0.50	144	51.75	0.79	0.96	45.40
	Maku-2	3.14	0.50	83	76.49	0.80	0.97	41.56
	Maku-1	0.85	1.50	19	164.46	0.80	0.99	24.76

Table VI.6.3 (1/2) Hydraulic Design of Channel Improvement

Channel No.	Design Discharge (m ³ /s)	Section			Roughness Coefficient	Bed Slope I (%)	Velocity (m/s)	Discharge Capacity (m ³ /s)	
		Bottom Wid (m)	Upper Wid. (m)	Height (m)					
(Eastern Semarang Area)									
Siringin	Sr-9	74.36	40.00	50.40	2.60	0.031	0.0143	0.67	78.45
	Sr-8	74.55	40.00	50.40	2.60	0.031	0.0143	0.67	78.45
	Sr-6	48.82	13.00	14.60	2.40	0.024	0.0588	1.51	50.13
	Sr-5	48.07	13.00	14.60	2.40	0.024	0.0588	1.51	50.13
	Sr-3	32.49	9.00	17.00	2.00	0.031	0.1176	1.42	36.83
	Sr-2	27.96	9.00	17.00	2.00	0.031	0.1176	1.42	36.83
Tenggang	Te-14	79.60	49.00	59.40	2.60	0.031	0.0133	0.65	91.99
	Te-13	57.00	33.00	43.40	2.60	0.031	0.0133	0.63	62.98
	Te-11	73.89	21.00	22.73	2.60	0.024	0.0435	1.45	82.22
	Te-6	30.88	10.00	11.60	2.40	0.024	0.0435	1.25	32.35
	Te-5	79.00	13.50	13.50	2.60	0.024	0.1333	2.32	81.25
	Te-3	45.98	8.50	10.10	2.40	0.024	0.1333	2.12	47.33
Baru	Te-2	33.97	7.50	8.97	2.20	0.024	0.1333	1.99	35.98
(Central Semarang Area)									
Semarang	A-A'	58.50	29.20	39.60	2.60	0.024	0.0100	0.70	62.86
	A'-B	62.10	29.20	39.60	2.60	0.024	0.0100	0.70	62.86
	Sm-8	29.97	18.80	29.20	2.60	0.024	0.0100	0.67	41.97
	Sm-7	35.52	18.80	29.20	2.60	0.024	0.0100	0.67	41.97
	Sm-6	39.43	20.00	20.00	2.50	0.024	0.0256	1.06	52.91
	Sm-5	47.12	20.00	20.00	2.50	0.024	0.0256	1.06	52.91
	Sm-4	44.57	18.00	18.00	2.50	0.024	0.0256	1.04	46.93
	Sm-3	19.81	13.00	13.00	1.90	0.024	0.0500	1.21	29.76
	Sm-2	15.66	8.00	8.00	1.90	0.024	0.0500	1.10	16.77
Baru	Sm-1	4.55	8.00	8.00	1.90	0.024	0.0500	1.10	16.77
Baru	D-K	6.00	5.50	5.00	2.00	0.024	0.0200	0.65	7.15
Asin	As-2	39.81	18.27	20.00	2.60	0.024	0.0143	0.82	40.58
Banger	Ba-8	41.46	28.80	39.20	2.60	0.031	0.0100	0.54	48.64
	Ba-7	47.46	28.80	39.20	2.60	0.031	0.0100	0.54	48.64
	Ba-6	42.34	23.27	25.00	2.60	0.024	0.0100	0.54	44.92
	Ba-5	42.54	18.40	20.00	2.40	0.024	0.0200	0.92	42.59
	Ba-4	34.83	13.47	15.00	2.30	0.024	0.0333	1.12	36.66
	Ba-3	27.01	10.47	12.00	2.30	0.024	0.0333	1.08	27.84
	Ba-2	16.96	6.60	8.00	2.10	0.024	0.0500	1.16	17.79
Bulu	Bu-4	8.56	3.50	4.50	1.50	0.024	0.1429	1.50	8.82
	Bu-3	5.20	2.20	3.20	1.50	0.024	0.1429	1.32	5.29
	Bu-2	3.71	1.73	2.60	1.30	0.024	0.2000	1.38	3.86
	Bu-1	2.22	1.13	2.00	1.30	0.024	0.2000	1.25	2.47
(Western Semarang Area)									
Ronggolawe	Rg-5	30.53	16.00	17.40	2.10	0.024	0.0250	0.95	33.13
	Rg-4	15.98	9.00	10.33	2.00	0.024	0.0250	0.85	16.41
	Rg-3	19.82	3.50	4.83	2.00	0.024	0.4000	2.77	23.11
	Rg-2	16.27	3.00	4.33	2.00	0.024	0.4000	2.66	19.53
Karangayu	Kr-4	18.62	10.50	11.38	2.00	0.024	0.0250	0.87	19.43
	Kr-3	18.66	4.00	5.33	2.00	0.024	0.2000	2.03	18.93
	Kr-2	14.94	3.50	4.83	2.00	0.024	0.2000	1.96	16.34
Tawang	Twe-3	14.37	7.50	8.90	2.10	0.024	0.0250	0.84	14.49
	Twe-2	5.79	3.00	4.33	2.00	0.024	0.0500	0.94	6.90
Silandak	Sl-2	21.15	7.00	8.00	1.50	0.024	0.2000	1.99	22.43

Table VI.6.3 (2/2)

Hydraulic Design of Channel Improvement

Channel		Desgn Discharge (m ³ /s)	Section			Roughness Coefficient	Bed Slope I (%)	Velocity (m/s)	Discharge Capacity (m ³ /s)
No.			Bottom Wid. (m)	Upper Wid. (m)	Height (m)				
(Kec.Tugu Area)									
Tambak- harjo	Tam-2	15.59	10.00	18.00	2.00	0.031	0.0200	0.59	16.57
	Tam-1	12.79	4.00	5.33	2.00	0.024	0.1000	1.43	13.39
Buntu	Bun-3	21.10	15.00	23.00	2.00	0.031	0.0200	0.62	23.59
	Bun-2	22.32	6.50	7.83	2.00	0.024	0.1000	1.60	22.92
Jumbleng	Jum-3	15.87	10.00	18.00	2.00	0.031	0.0200	0.59	16.57
	Jum-2	15.41	10.00	18.00	2.00	0.031	0.0200	0.59	16.57
	Jum-1	10.87	10.00	18.00	2.00	0.031	0.0200	0.59	16.57
Tugurejo	Tug-3	21.52	9.00	19.40	2.60	0.031	0.0200	0.67	24.83
	Tug-2	23.35	9.00	19.40	2.60	0.031	0.0200	0.67	24.83
	Tug-1	21.52	6.00	7.40	2.10	0.024	0.1000	1.61	22.63
Tapak	Tap-4	25.63	12.00	22.40	2.60	0.031	0.0200	0.70	31.22
	Tap-3	30.39	12.00	22.40	2.60	0.031	0.0200	0.70	31.22
	Tap-2	27.96	6.50	8.03	2.30	0.024	0.1000	1.71	28.50
Boom ka- ranganyar	Boka-3	39.62	21.00	31.40	2.60	0.031	0.0200	0.75	50.76
	Boka-2	49.37	21.00	31.40	2.60	0.031	0.0200	0.75	50.76
Randugarut	Ran-3	55.94	27.00	37.40	2.60	0.031	0.0200	0.76	63.96
	Ran-2	62.40	27.00	37.40	2.60	0.031	0.0200	0.76	63.96
	Ran-1	33.76	27.00	37.40	2.60	0.031	0.0200	0.76	63.96
Mangkang Wetan	Mawe-3	29.32	12.00	22.40	2.60	0.031	0.0200	0.70	31.22
	Mawe-2	25.92	10.00	20.40	2.60	0.031	0.0200	0.68	26.95
	Mawe-1	19.15	10.00	20.40	2.60	0.031	0.0200	0.68	26.95
Mangkang Kulon	Maku-3	45.40	19.00	29.40	2.60	0.031	0.0200	0.74	46.39
	Maku-2	41.56	17.00	27.40	2.60	0.031	0.0200	0.73	42.03
	Maku-1	24.76	17.00	27.40	2.60	0.031	0.0200	0.73	42.03

Table VI.6.4(1/3) Proposed Channel Improvement Works
(Urban Drainage Structures)

Channel	Length (m)	Drainage Channel						Pump Station (place)	Gate Structure (place)	Bridge/Culvert		Inspection Road (m)
		Type-A (m)	Type-B (m)	Type-C (m)	Type-D (m)	Type-E (m)	Type-F (m)			Road (place)	Railway (place)	
(Eastern Semarang Area)												
Siringin	9,220	6,120	-	3,100	-	-	-	-	-	4	-	18,440
Tenggang	13,700	4,350	-	7,900	1,450	-	-	-	-	12	2	24,500
Total	22,920	10,470	0	11,000	1,450	0	0	0	0	16	2	42,940
(Central Semarang Area)												
Semarang	8,980	-	2,360	850	-	-	5,770	3	1	8	1	4,720
Asin	1,300	-	-	1,300	-	-	-	-	-	3	-	0
Banger	6,680	2,090	-	3,460	-	1,130	-	-	-	14	2	11,100
Bulu	1,750	-	-	1,750	-	-	-	-	-	5	-	3,500
Total	18,710	2,090	2,360	7,360	0	1,130	5,770	3	1	30	3	19,320
(Western Semarang Area)												
Ronggolawe	3,250	-	-	2,250	-	1,000	-	-	-	4	1	4,500
Karangayu	2,680	-	-	1,100	-	1,580	-	-	-	4	1	2,200
Tawang	1,200	-	-	-	-	1,200	-	-	-	3	-	0
Silandak	850	-	-	850	-	-	-	-	-	-	1	1,700
Total	7,980	0	0	4,200	0	3,780	0	0	0	11	3	8,400
(Kec.Tugu Area)												
Tambakharjo	1,550	1,250	-	300	-	-	-	-	-	1	1	3,100
Buntu	2,200	1,600	-	600	-	-	-	-	-	-	1	4,400
Jumbleng	2,700	2,000	-	700	-	-	-	-	-	-	1	5,400
Tugurejo	3,200	2,600	-	600	-	-	-	-	-	-	1	6,400
Tapak	3,900	2,400	-	1,500	-	-	-	-	-	-	1	7,800
Boom Karanganyar	3,100	3,100	-	-	-	-	-	-	-	-	1	6,200
Randugarut	3,800	3,400	-	400	-	-	-	-	-	-	1	7,600
Mangkang Wetan	4,600	4,150	-	450	-	-	-	-	-	1	1	9,200
Mangkang Kulon	4,150	3,750	-	400	-	-	-	-	-	1	1	8,300
Total	29,200	24,250	0	4,950	0	0	0	0	0	3	9	58,400

* Details of drainage channels are shown in Tables 6.3.4(2) and 6.3.4(3).

Table VI.6.4 (2/3)

Proposed Channel Improvement Works

Channel No.	Required Hydraulic Section WbxWuxH (mxm x m)	Drainage Channel						Land Acquisition (m ²)	
		Type-A (m)	Type-B (m)	Type-C (m)	Type-D (m)	Type-E (m)	Type-F (m)		
(Eastern Semarang Area)									
Siringin	Sr-9	40.0x50.4x2.6	1,500	-	-	-	-	-	54,900
	Sr-8	40.0x50.4x2.6	1,370	-	-	-	-	-	69,185
	Sr-6	13.0x14.6x2.4	-	-	2,200	-	-	-	43,692
	Sr-5	13.0x14.6x2.4	-	-	900	-	-	-	17,154
	Sr-3	9.0x17.0x2.0	1,650	-	-	-	-	-	40,095
	Sr-2	9.0x16.2x1.8	1,600	-	-	-	-	-	43,200
	Sub-total		6,120	0	3,100	0	0	0	268,226
Tenggang	Te-14	49.0x59.4x2.6	2,250	-	-	-	-	-	40,530
	Te-13	33.0x43.4x2.6	2,100	-	-	-	-	-	172,800
	Te-11	21.0x22.7x2.6	-	-	2,250	-	-	-	67,410
	Te-6	6.5x8.1x2.4	-	-	2,550	-	-	-	16,218
	Te-5	13.5x13.5x2.6	-	-	-	1,450	-	-	21,315
	Te-3	8.5x10.1x2.4	-	-	1,550	-	-	-	11,408
	Te-2	7.5x9.0x2.2	-	-	1,550	-	-	-	23,653
	Sub-total		4,350	0	7,900	1,450	0	0	353,334
Total		10,470	0	11,000	1,450	0	0	621,560	
(Central Semarang Area)									
Semarang	A-A'	29.2x37.0x2.6	-	310	-	-	-	-	0
	A-B	29.2x37.0x2.6	-	310	-	-	-	-	899
	Sm-8	18.8x26.6x2.6	-	1,120	-	-	-	-	112
	Sm-7	18.8x26.6x2.6	-	620	-	-	-	-	3,410
	Sm-6	20.0x20.0x2.5	-	-	-	-	-	150	-
	Sm-5	20.0x20.0x2.5	-	-	-	-	-	600	-
	Sm-4	18.0x18.0x2.5	-	-	-	-	-	1,370	-
	Sm-3	13.0x13.0x1.9	-	-	-	-	-	1,020	-
	Sm-2	8.0x8.0x1.9	-	-	-	-	-	1,380	-
	Sm-1	3.4x4.0x0.9	-	-	850	-	-	-	-
	D-K	5.5x5.5x2.0	-	-	-	-	-	1,250	-
Sub-total		0	2,360	850	0	0	5,770	4,421	
Asin	As-2	16.3x18.0x2.6	0	0	1,300	0	0	0	-
Banger	Ba-8	28.8x39.2x2.6	1,400	-	-	-	-	-	840
	Ba-7	28.8x39.2x2.6	690	-	-	-	-	-	15,318
	Ba-6	23.3x25.0x2.6	-	-	560	-	-	-	11,906
	Ba-5	18.4x20.0x2.4	-	-	1,250	-	-	-	20,950
	Ba-4	13.5x15.0x2.3	-	-	-	-	550	-	-
	Ba-3	10.6x12.0x2.1	-	-	1,150	-	-	-	21,574
	Ba-2	6.6x8.0x2.1	-	-	500	-	580	-	6,880
Sub-total		2,090	0	3,460	0	1,130	0	77,468	
Bulu	Bu-4	3.5x4.5x1.5	-	-	275	-	-	-	3,289
	Bu-3	2.2x3.2x1.5	-	-	500	-	-	-	5,980
	Bu-2	1.7x2.6x1.3	-	-	450	-	-	-	5,562
	Bu-1	1.1x2.0x1.3	-	-	525	-	-	-	5,387
	Sub-total		0	0	1,750	0	0	0	20,218
Total		2,090	2,360	7,360	0	1,130	5,770	102,106	
(Western Semarang Area)									
Ronggolawe	Rg-5	16.0x17.4x2.1	-	-	450	-	500	-	6,147
	Rg-4	9.0x10.3x2.0	-	-	1,300	-	-	-	18,928
	Rg-3	3.5x4.8x2.0	-	-	-	-	500	-	-
	Rg-2	3.0x4.3x2.0	-	-	500	-	-	-	3,630
Sub-total		0	0	2,250	0	1,000	0	28,705	
Karangayu	Kr-4	10.5x11.8x2.0	-	-	800	-	700	-	13,248
	Kr-3	4.0x5.3x2.0	-	-	-	-	380	-	-
	Kr-2	3.5x4.8x2.0	-	-	300	-	500	-	2,178
	Sub-total		0	0	1,100	0	1,580	0	15,426
Tawang	Twe-3	7.5x8.9x2.1	-	-	930	-	-	-	-
	Twe-2	3.0x4.3x2.0	-	-	270	-	-	-	-
	Sub-total		0	0	1,200	0	0	0	0
Silandak	Si-2	7.0x8.0x1.5	0	0	850	0	0	0	14,671
Total		0	0	5,400	0	2,580	0	58,802	

Table VI.6.4 (3/3) Proposed Channel Improvement Works

Channel No.	Required Hydraulic Section WbxWuxH (mxxm)	Drainage Channel						Land Acquisition (m ²)	
		Type-A (m)	Type-B (m)	Type-C (m)	Type-D (m)	Type-E (m)	Type-F (m)		
(Kec.Tugu Area)									
Tambak-harjo	Tam-2	10.0x18.0x2.0	1,250	-	-	-	-	-	-
	Tam-1	4.0x5.3x2.0	-	-	300	-	-	-	-
	Sub-total		1,250	0	300	0	0	0	-
Buntu	Bun-3	15.0x23.0x2.0	1,600	-	-	-	-	-	-
	Bun-2	6.5x7.8x2.0	-	-	600	-	-	-	-
	Sub-total		1,600	0	600	0	0	0	-
Jumbleng	Jum-3	10.0x18.0x2.0	1,000	-	-	-	-	-	-
	Jum-2	10.0x18.0x2.0	1,000	-	-	-	-	-	-
	Jum-1	7.2x8.5x2.0	-	-	700	-	-	-	-
	Sub-total		2,000	0	700	0	0	0	-
Tugurejo	Tug-3	9.0x19.4x2.6	1,300	-	-	-	-	-	-
	Tug-2	9.0x19.4x2.6	1,300	-	-	-	-	-	-
	Tug-1	6.0x7.4x2.1	-	-	600	-	-	-	-
	Sub-total		2,600	0	600	0	0	0	-
Tapak	Tap-4	12.0x22.4x2.6	1,300	-	-	-	-	-	-
	Tap-3	12.0x22.4x2.6	1,100	-	-	-	-	-	-
	Tap-2	6.5x8.0x2.3	-	-	1,500	-	-	-	-
	Sub-total		2,400	0	1,500	0	0	0	-
Boom karanganyar	Boka-3	21.0x31.4x2.6	1,700	-	-	-	-	-	-
	Boka-2	21.0x31.4x2.6	1,400	-	-	-	-	-	-
	Sub-total		3,100	0	0	0	0	0	-
Randugarut	Ran-3	27.0x37.4x2.6	1,800	-	-	-	-	-	-
	Ran-2	27.0x37.4x2.6	1,600	-	-	-	-	-	-
	Ran-1	13.3x15.0x2.6	-	-	400	-	-	-	-
	Sub-total		3,400	0	400	0	0	0	-
Mangkang Wetan	Mawe-3	12.0x22.4x2.6	2,200	-	-	-	-	-	-
	Mawe-2	10.0x20.4x2.6	1,950	-	-	-	-	-	-
	Mawe-1	8.3x10.0x2.6	-	-	450	-	-	-	-
	Sub-total		4,150	0	450	0	0	0	-
Mangkang Kulon	Maku-3	19.0x29.4x2.6	1,850	-	-	-	-	-	-
	Maku-2	17.0x27.4x2.6	1,900	-	-	-	-	-	-
	Maku-1	10.3x12.0x2.6	-	-	400	-	-	-	-
	Sub-total		3,750	0	400	0	0	0	-
Total		24,250	0	4,950	0	0	0	-	

Table VI.6.5 PRESERVED AREA FOR FUTURE CHANNEL IMPROVEMENT IN EASTERN SEMARANG AND KEC. TUGU AREAS

Name of River	Width (m)	Length (m)	Area (x10 ³ m ²)
A : Eastern Semarang Area			
Siringin	26.2 - 60.4	9,220	336.1
Tenggang	19.0 - 69.4	9,200	482.7
Sub-total	19.0 - 69.4	18,420	818.8
B : Kec. Tugu Area			
Tambakharjo	15.3 - 28.0	2,050	39.6
Buntu	17.8 - 33.0	2,200	63.5
Jumbleng	18.5 - 28.0	2,700	69.0
Tugurejo	17.4 - 29.4	3,200	86.9
Tapak	18.0 - 32.4	3,900	104.8
Boom Karanganyar	41.4	3,500	128.3
Randugarut	25.0 - 47.4	3,800	171.2
Mangkang Wetan	20.0 - 32.4	4,600	139.6
Mangkang Kulon	22.0 - 39.4	4,150	152.8
Sub-total	15.3 - 47.4	30,100	955.7
Total	15.3 - 69.4	48,520	1,774.5

Table VI.7.1 COST COMPARISON OF ALTERNATIVES FOR PUMP DRAINAGE SYSTEM IN ASIN RIVER BASIN AREA

Item	Alt.1		Alt.2		Alt.3	
	Quantity	Unit Cost (Mill.Rp.)	Quantity	Unit Cost (Mill.Rp.)	Quantity	Unit Cost (Mill.Rp.)
I. Construction Base Cost		10,513		12,703		10,951
1. Preparatory Works		956		1,155		996
2. Pump Station		5,976		7,476		5,976
1) Pump Station (1)	1 L.S.	5,976	1 L.S.	5,976	1 L.S.	5,976
2) Pump Station (2)	0 L.S.	0	1 L.S.	1,500	0 L.S.	0
3. Gate Structure	1 L.S.	899	1 L.S.	899	1 L.S.	899
4. Retarding Pond		1,444		1,754		1,337
1) Excavation; Common	91,200 m3	666	91,400 m3	667	74,960 m3	547
2) Revetment; Type F	3,650 m2	715	5,160 m2	1,011	3,710 m2	727
3) Drain Ditch	1,050 m	63	1,270 m	76	1,060 m	63
5. Channel Improvement		369		369		838
1) Excavation; Common	12,000 m3	88	12,000 m3	88	36,300 m3	265
2) Embankment	2,500 m3	7	2,500 m3	7	6,300 m3	17
3) Revetment; Type D	2,080 m2	81	2,080 m2	81	5,510 m2	215
4) Revetment; Type E	1,390 m2	193	1,390 m2	193	2,450 m2	341
6. Miscellaneous Works		869		1,050		905
II. Compensation Cost		1,687		1,212		751
1. Land Acquisition		1,405		930		699
Residensial Area; Grade B	0.00 ha	0	0.00 ha	0	3.17 ha	634
Residensial Area; Grade A	2.81 ha	1,405	1.43 ha	715	0.13 ha	65
Paddy Land; Urban	0.00 ha	0	1.43 ha	215	0.00 ha	0
2. House Evacuation		282		282		52
Class C	94 pc	282	94 pc	282	0 pc	0
Class D	0 pc	0	0 pc	0	52 pc	52
Total		12,200		13,915		11,702

Table VI.7.2 COST COMPARISON OF ALTERNATIVES
FOR PUMP DRAINAGE SYSTEM IN BANDARHARJO EAST AREA

Item	Alt.1		Alt.2		Remarks
	Quantity	Unit Cost (Mill.Rp.)	Quantity	Unit Cost (Mill.Rp.)	
I. Construction Base Cost		6,046		7,401	
1. Preparatory Works		550		673	
2. Pump Station	1 L.S.	3,442	1 L.S.	3,442	
3. Gate Structure	1 L.S.	242	1 L.S.	242	
4. Retarding Pond		531		802	
1) Excavation; Common	31,750 m3	232	15,200 m3	111	
2) Revetment; Type F	1,527 m2	299	0 m2	0	
3) Retaining Wall	0 m	0	500 m	691	
5. Channel Improvement		781		1,630	
1) Open Channel; Type D	800 m	781	300 m	293	
2) Open Channel; Type G	0 m	0	500 m	1,337	
6. Miscellaneous Works		500		612	
II. Compensation Cost		1,156		84	
1. Land Acquisition					
Commercial Area; Grade B	1.39 ha	556	0.21 ha	84	
2. House Evacuation					
Warehouse	4 pc (11,800 m2)	600	0 pc	0	
Total		7,202		7,485	

Table VI.7.3 HYDRAULIC REQUIREMENTS OF PROPOSED PUMPING STATION AND RETARDING POND

Pumping Station No. *1	Drainage Area (Km ²)	Discharge Capacity (m ³ /s)	Design Water Level *2			Static Head		Retarding Pond		Remarks
			Outer H.W.L	L.W.L	Inner H.W.L	Design (m)	Max. (m)	Area (ha)	Storage Capa. (x1000m ³)	
P1	0.580	0.80	0.80	-0.40	0.20	-1.80	2.40	2.60	0.84	16.7
P2	4.252	5.70	0.80	-0.40	0.20	-2.80	3.40	3.60	2.67	80.0
P3	1.49	2.00	0.80	-0.40	0.20	-2.80	3.40	3.60	0.93	28.0

Note: *1 Drainage Area of each pumping station
 P1.. Bandarharjo West Drainage Area
 P2.. Asin River Basin Area
 P3.. Bandarharjo East Drainage Area
 *2 Jakarta System is adopted for Design Water Level.

Table VI.7.4 DESIGN DISCHARGE OF CHANNEL IMPROVEMENT

Channel No.	Drainage Area (km ²)	Velocity (m/s)	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Run-off Coefficient	Peak Discharge (m ³ /s)	Design Discharge (m ³ /s)
(Primary Channel)							
Semaran River							
A-A'	11.23	0.50	175	40.00	0.63	51.07	54.0
A-B	11.23	0.50	164	41.87	0.63	54.00	54.0
Sm-8	6.39	0.50	161	42.58	0.62	25.39	36.0
Sm-7	6.39	0.50	136	48.21	0.62	30.33	42.0
Sm-6	6.39	0.50	122	52.20	0.62	33.84	42.0
Sm-5	6.19	0.75	119	55.62	0.62	41.20	42.0
Sm-4	5.69	0.75	105	59.76	0.60	39.05	40.0
Sm-3	1.60	1.00	61	81.41	0.62	17.83	18.0
Sm-2	1.09	1.00	44	97.41	0.60	14.19	15.0
Asin River							
As-2	4.25	0.50	138	47.61	0.65	29.24	30.0
Baru River							
						6.00	6.0
(Secondary Channel)							
Bandarharjo West							
BW-1	0.58	0.50	82	77.06	0.67	6.61	7.0
Bandarharjo East							
BE-1	0.80	0.50	88	66.12	0.65	7.64	8.0
BE-2	0.69	0.50	98	62.19	0.83	7.91	8.0

Table VI.7.5 Hydraulic Design of Channel Improvement

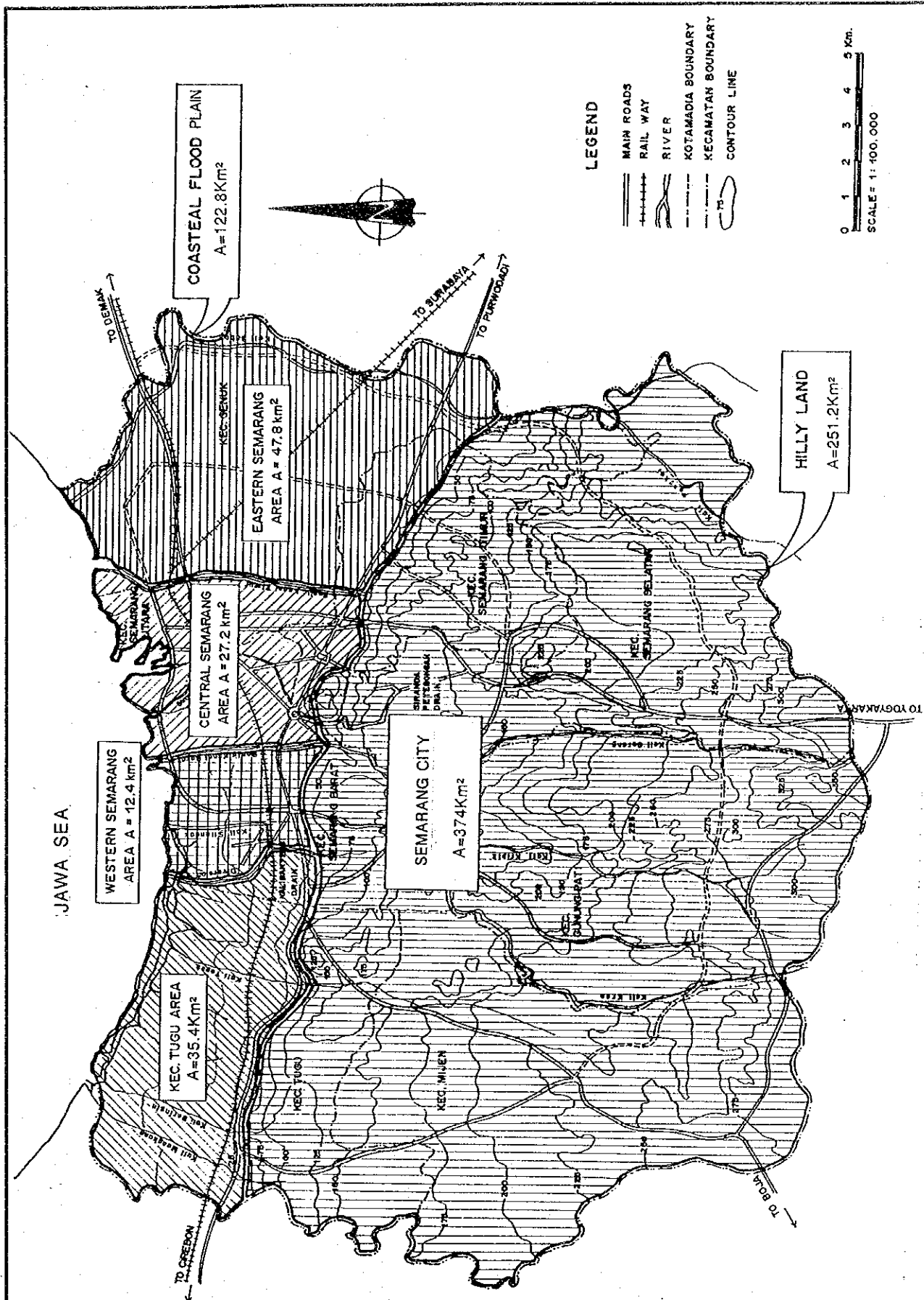
Channel No.	Design Discharge (m ³ /s)	Section			Roughness Coefficient	Bed Slope i (%)	Velocity (m/s)	Discharge Capacity (m ³ /s)
		Bottom Wid. (m)	Upper Wid. (m)	Height (m)				
(Primary Channel)								
Semarang River								
A-A'	54.00	34.00	42.40	2.59	0.031	0.0130	0.63	63.63
A-B	54.00	32.00	42.40	2.57	0.024	0.0130	0.80	76.58
Sm-8	36.00	25.00	34.88	2.47	0.031	0.0130	0.59	43.92
Sm-7	42.00	25.00	34.70	2.42	0.024	0.0130	0.76	54.75
Sm-6	42.00	25.00	25.00	2.41	0.024	0.0393	1.32	79.54
Sm-5	42.00	20.00	20.00	2.32	0.024	0.0393	1.29	74.95
Sm-4	40.00	20.00	20.00	1.98	0.024	0.0393	1.16	45.73
Sm-3	18.00	13.00	13.00	1.80	0.024	0.0590	1.27	29.77
Sm-2	15.00	9.00	9.00	1.57	0.024	0.0590	1.12	15.82
Asin River								
As-2	30.00	20.00	20.00	2.15	0.024	0.0143	0.73	31.35
Baru River								
	6.00	5.00	5.00	2.00	0.015	0.0100	0.72	7.15
(Secondary Channel)								
Bandarharjo West								
BW-1	7.00	3.00	3.00	1.80	0.015	0.0500	1.30	7.04
Bandarharjo East								
BE-1	8.00	3.00	3.00	2.00	0.015	0.0500	1.35	8.07
BE-2	8.00	3.00	3.00	2.00	0.015	0.0500	1.35	8.07

Table VI.7.6 PROPOSED URBAN DRAINAGE WORKS

Item	Unit	Bandarharjo	Asin River	Bandarharjo	Semarang	Baru	Total
		West	Basin	East	River	River	
1. Pumping Station	m ³ /s	0.80	5.70	2.00	-	-	8.50
2. Gate Structure	place	1	1	1	-	1	4
3. Retarding Basin	ha	0.84	2.67	0.93	-	-	4.44
4. Channel Improvement							
(1) Open Channel (Type-A)	m	-	-	-	2,350	-	2,350
(2) Open Channel (Type-D)	m	800	1,300	700	500	300	3,600
(3) Open Channel (Type-F)	m	-	-	-	4,020	-	4,020
(4) Open Channel (Type-G)	m	-	-	-	-	500	500
5. Related Structures							
(1) Revetment (Type-D)	m ²	-	-	-	9,529	-	9,529
(2) Revetment (Type-E)	m ²	-	-	-	2,840	-	2,840
(3) Bridge	place	-	1	-	-	-	1
(4) Inspection Road	m ²	3,246	20,050	5,600	25,500	6,400	60,796
6. Land Acquisition	m ²	13,680	16,600	2,100	18,550	-	50,930
7. House Evacuation	unit	-	30	-	52	-	82

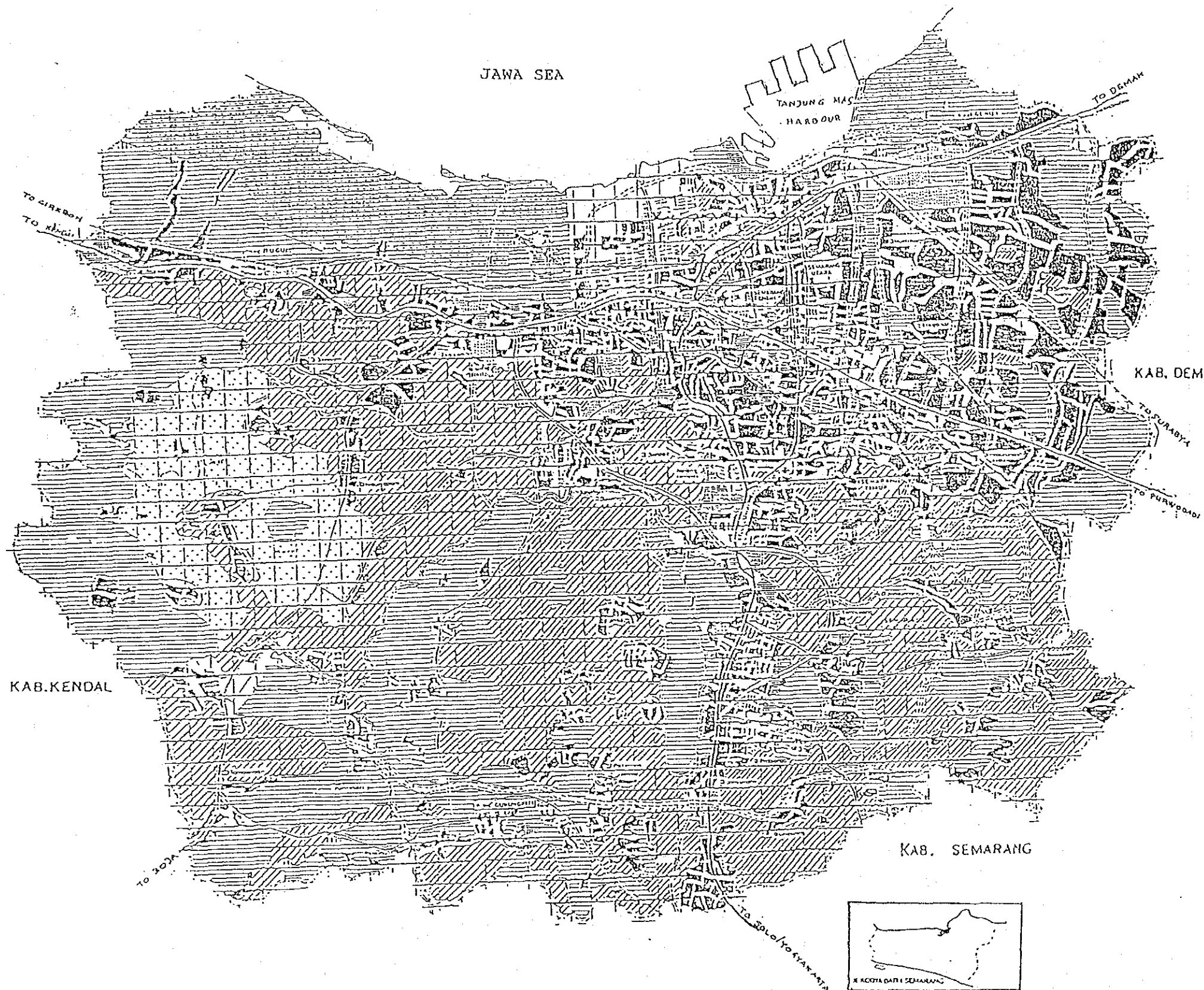
- Note :
1. Open Channel Type-A : Trapezoidal shape channel with 1:2 slope lined by sodding
 2. Open Channel Type-D : Rectangular channel lined by stone masonry
 3. Open Channel Type-F : Type D providing with concrete sheet pile for foot protection
 4. Open Channel Type-G : Rectangular channel lined by stone masonry and concrete retaining wall
 5. Open Channel Type-D : Cobble stone pitching supported by log foundation pile
 6. Open Channel Type-E : Cobble stone pitching supported by concrete sheet pile

FIGURES


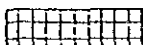
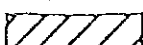
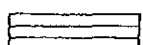
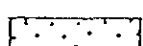
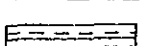

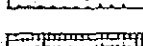
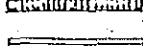
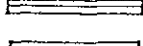
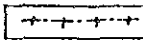
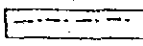
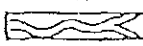
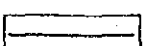
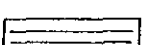
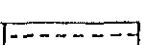



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Fig. VI.3.1
STUDY AREA FOR URBAN
DRAINAGE MASTER PLAN



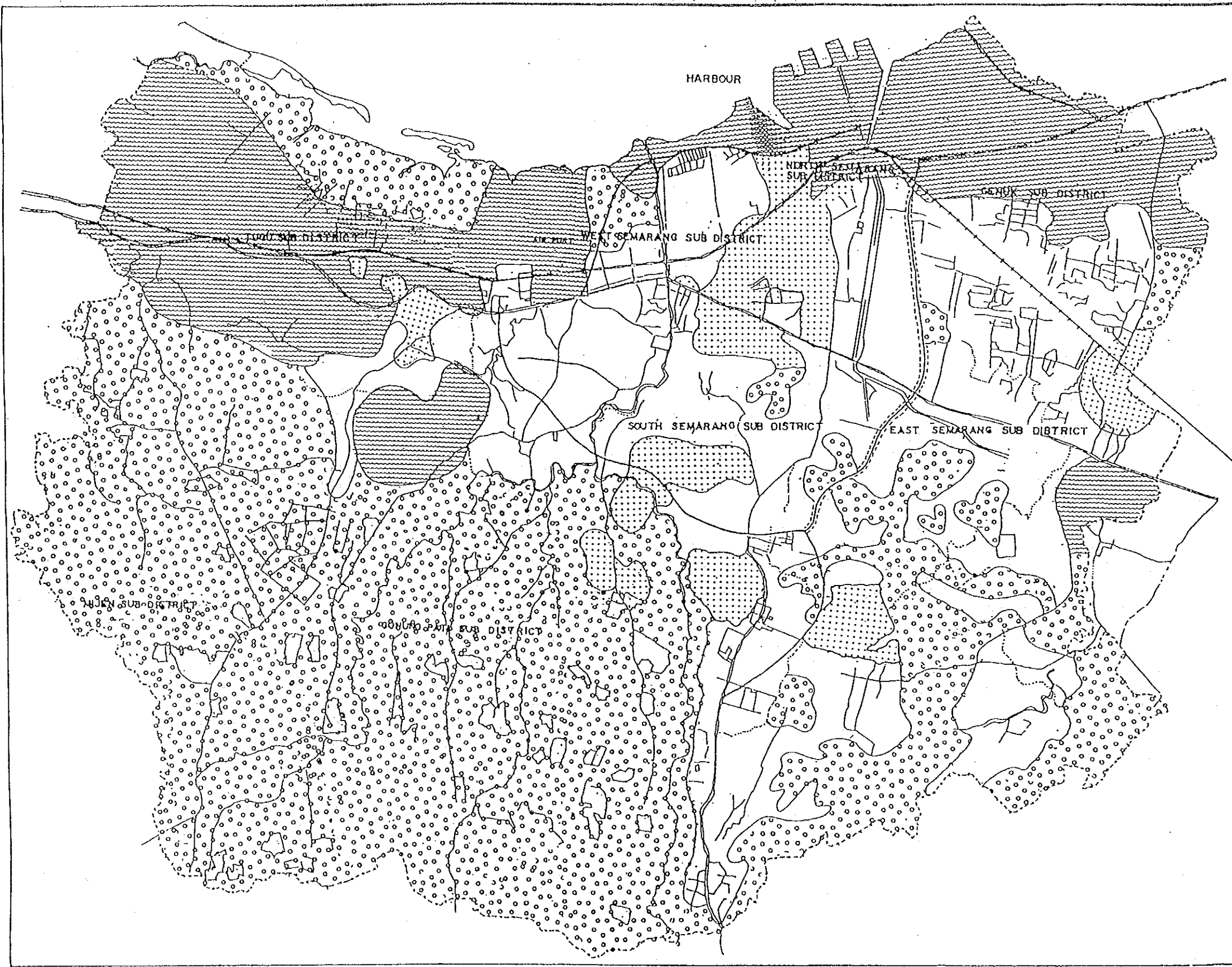
LEGEND

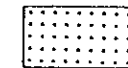
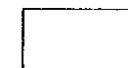
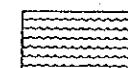
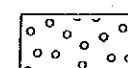
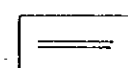
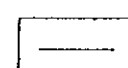
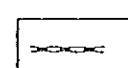
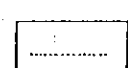
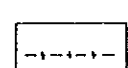
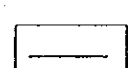
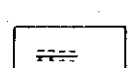
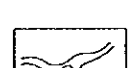
-  Settlement
-  Rice field
-  Cleared Land
-  Garden
-  Estate/Plantation
-  Brakish Dyke
-  Industry/Factory
-  Land for Services
-  Land for Employment
-  Allocated Land
-  Kotamadya boundary
-  Kecamatan boundary
-  River
-  Road
-  Tollroad
-  Proposed Tollroad
-  Railway



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Fig. VI. 3. 2
 PRESENT LAND USE IN SEMARANG CITY

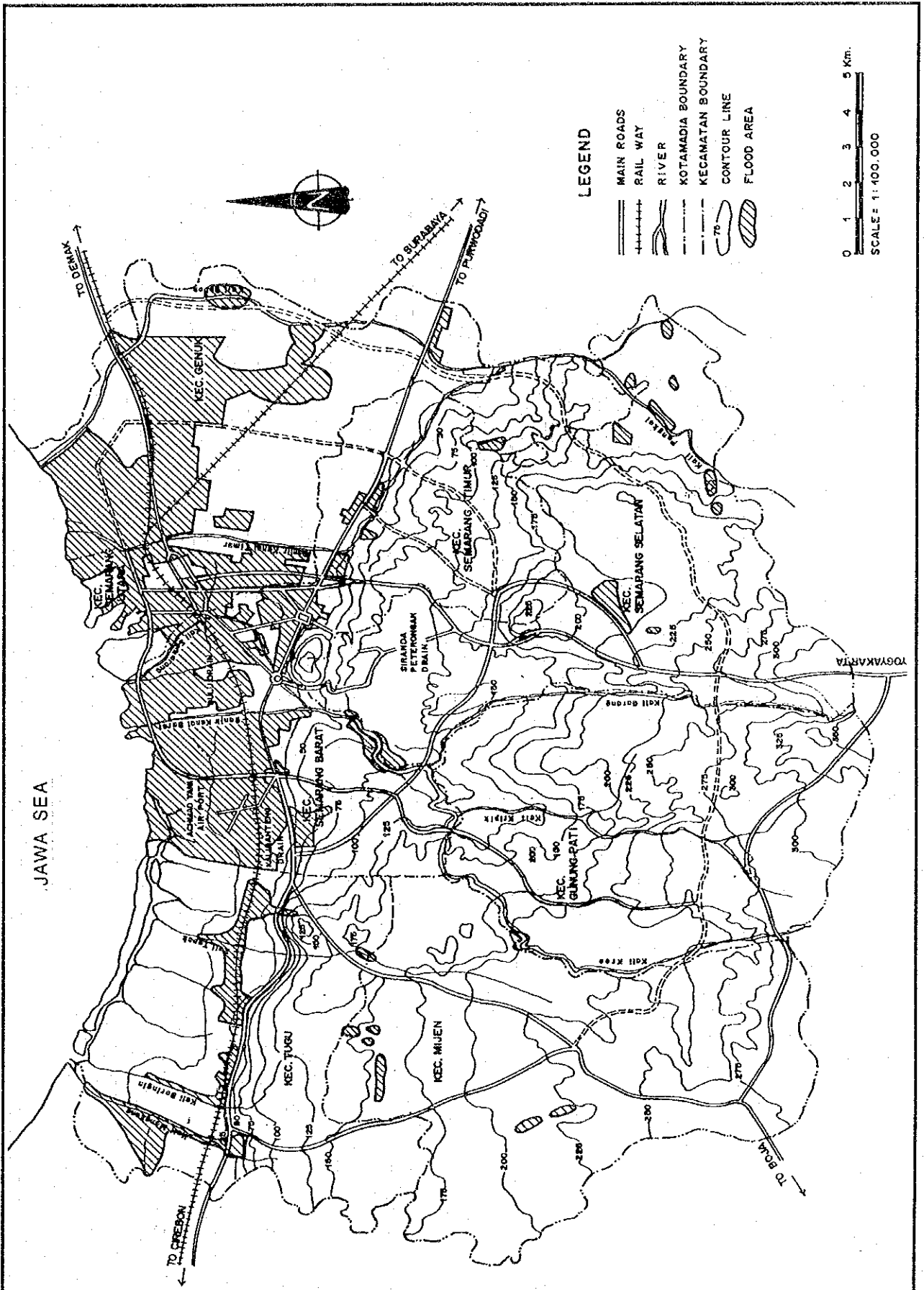


- LEGEND :**
-  BUSINESS AREA
 -  RESIDENTIAL AREA
 -  INDUSTRIAL AREA
 -  GREENZONE & OTHERS
 -  MAIN ROAD
 -  ROAD
 -  RAIL WAY
 -  SUB DISTRICT BOUNDARY
 -  DISTRICT BOUNDARY
 -  TOLL ROAD
 -  PROPOSED TOLL ROAD
 -  RIVER

Resource :
 Review on Spatial Planning of
 Metropolitan city, 1990 Directorate of
 City & Regional Planning, DG of Human
 Settlement, Min. of Public Work.

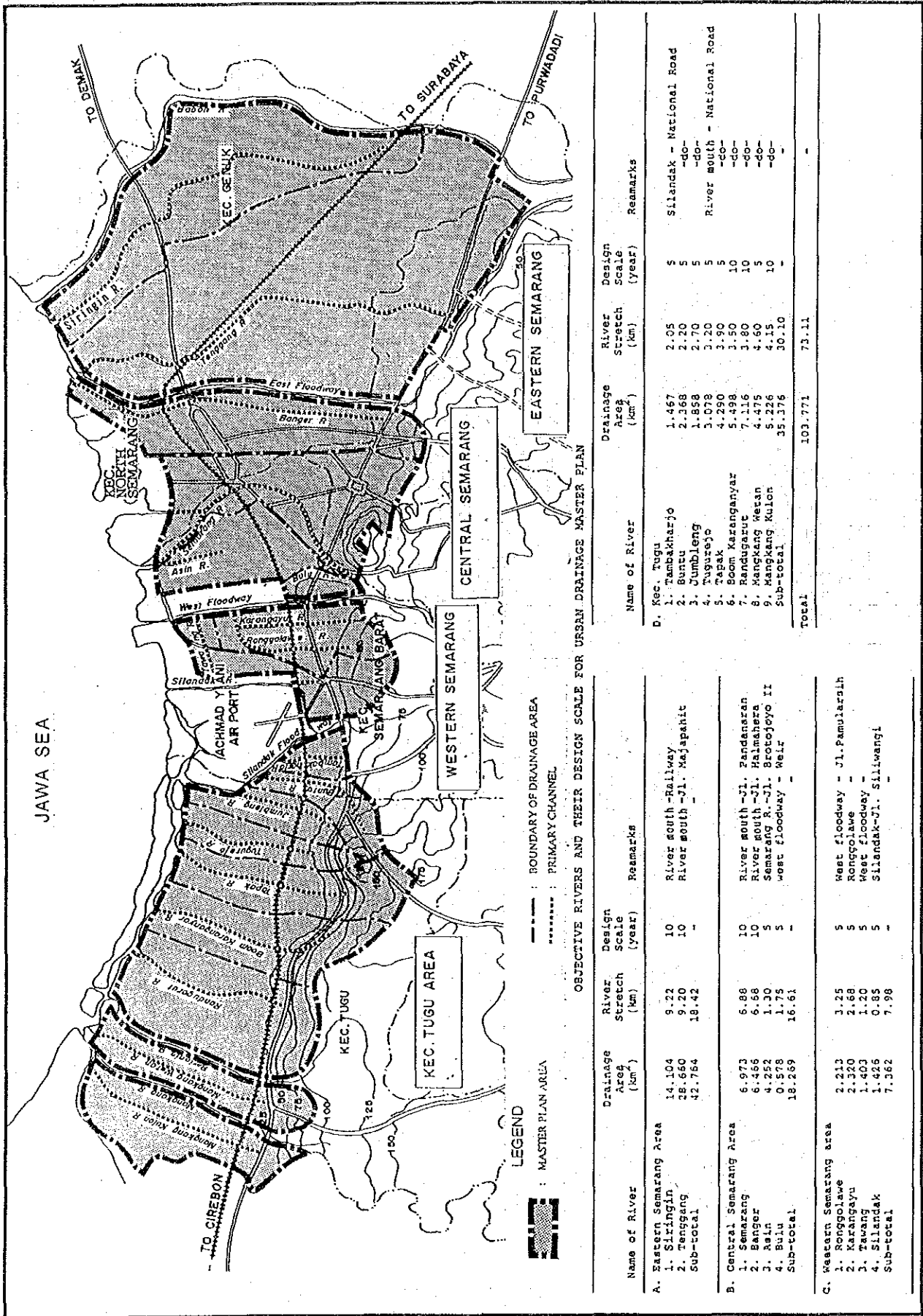
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Fig. VI. 3. 3
 FUTURE LAND USE PLAN IN SEMARANG CITY FOR THE
 YEAR OF 2015



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 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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Fig. VI 3.4
 FLOOD AREA IN
 SEMARANG CITY

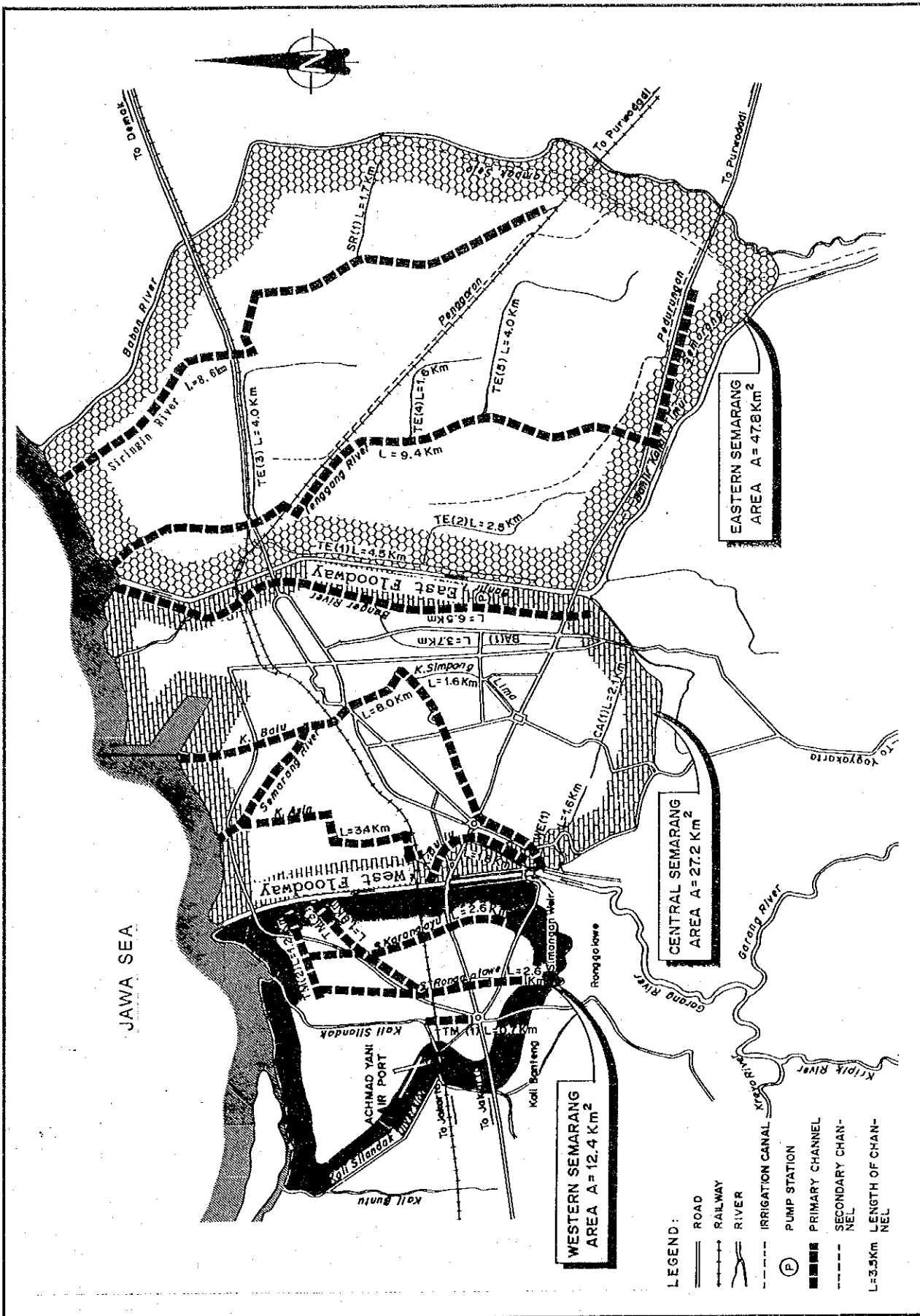


OBJECTIVE RIVERS AND THEIR DESIGN SCALE FOR URSAN DRAINAGE MASTER PLAN

Name of River	Drainage Area (km ²)	River Stretch (km)	Design Scale (Year)	Remarks
A. Eastern Semarang Area				
1. Sikringin	14.104	9.22	10	River south - Railway
2. Tenggang	28.660	9.20	10	River south - Jl. Majapahit
Sub-total	42.764	18.42	-	
B. Central Semarang Area				
1. Semarang	6.973	6.98	10	River mouth - Jl. Pandanaran
2. Ranger	6.456	6.88	10	River mouth - Jl. Raimandra
3. Asih	4.282	1.90	5	Semarang A. - Jl. Brotojoyo II
4. Bulu	0.578	1.75	5	West floodway - Weir
Sub-total	18.289	16.51	-	
C. Western Semarang area				
1. Ronggolawe	2.213	3.25	5	West floodway - Jl. Pamularsih
2. Karangayu	2.320	2.68	5	Ronggolawe -
3. Tawang	1.403	1.20	5	West floodway -
4. Silandak	1.426	0.85	5	Silandak - Jl. Siliwangi
Sub-total	7.362	7.98	-	
D. Eastern Semarang				
1. Tambakharjo	1.467	2.95	5	Silandak - National Road
2. Buntu	2.368	2.20	5	-do-
3. Jumbaleng	1.858	2.70	5	-do-
4. Tugurejo	3.073	3.20	5	River mouth - National Road
5. Takak	2.250	3.20	5	-do-
6. Soem Kazanganyar	3.498	1.50	10	-do-
7. Randugasut	7.116	3.60	10	-do-
8. Mangkang wetan	4.475	4.60	5	-do-
9. Mangkang Kulon	5.226	4.15	10	-do-
Sub-total	35.376	30.10	-	
Total	103.771	73.11	-	

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.3.5
 MASTER PLAN AREA AND OBJECTIVE PRIMARY CHANNEL

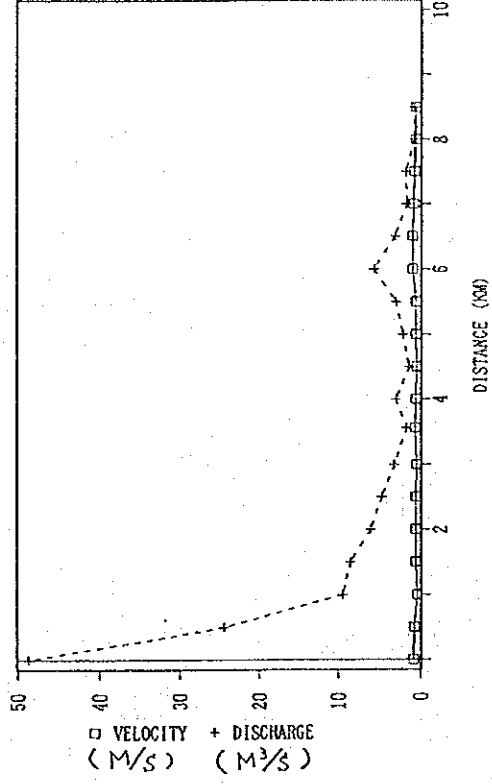
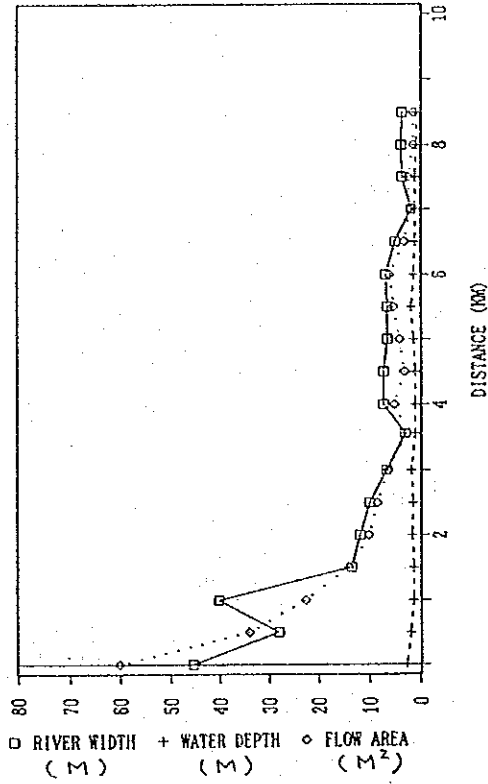


MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

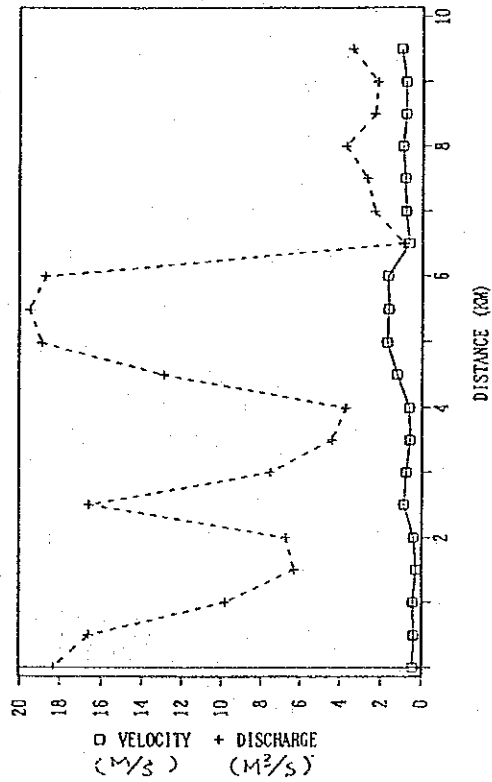
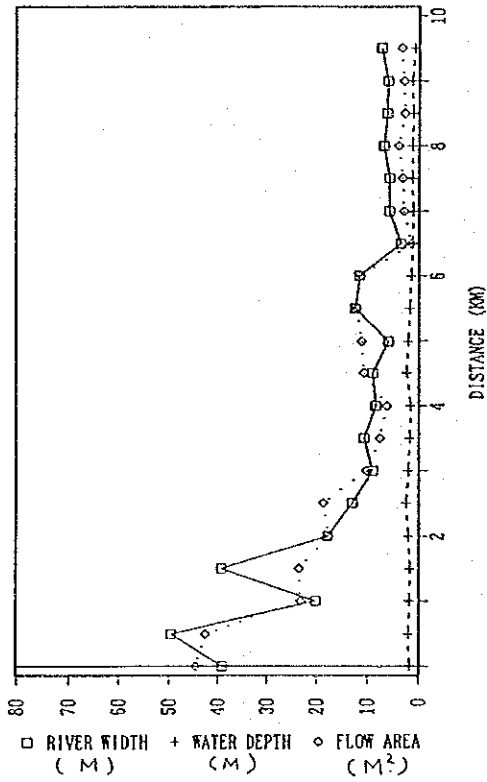
Fig. VI.4.1
EXISTING DRAINAGE SYSTEM IN CENTRAL,
EAST AND WEST SEMARANG

EAST SEMARANG AREA

SIRINGIN RIVER



TENGANG RIVER

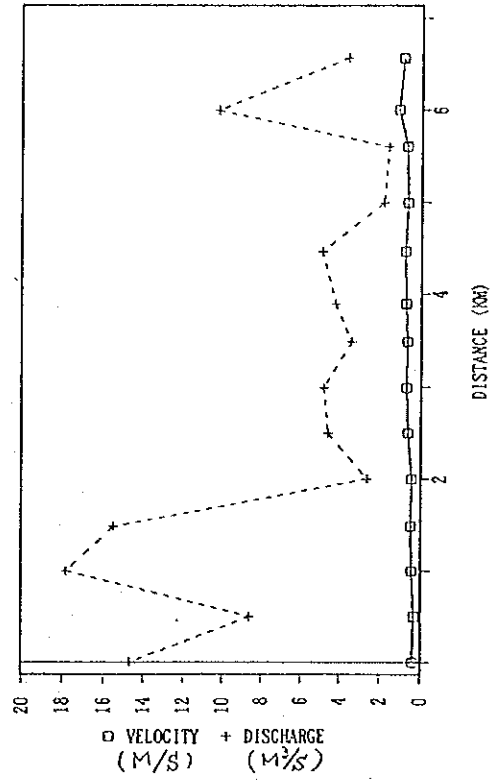
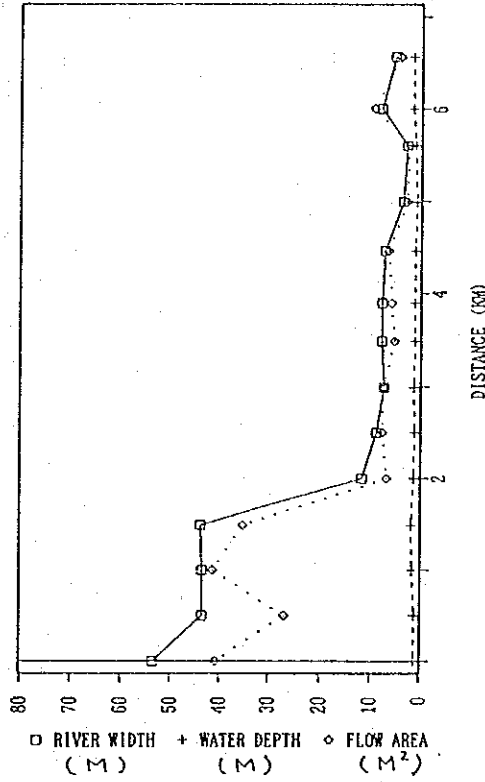


MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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Fig. VI.4.2 (1/3)
HYDRAULIC FEATURES OF TENGANG
AND SRINGIN RIVERS

CENTRAL SEMARANG AREA

BANGER RIVER



SEMARANG RIVER

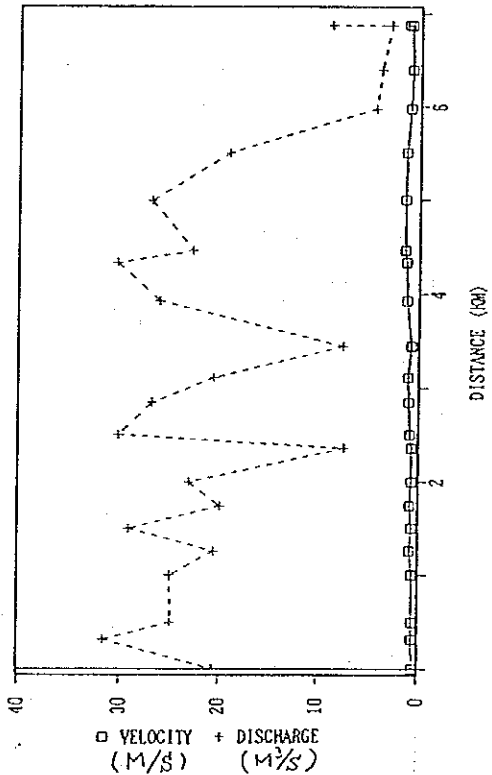
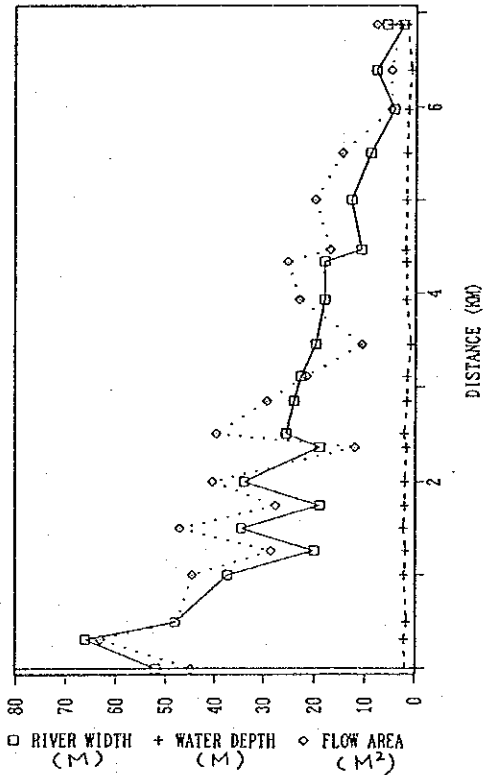
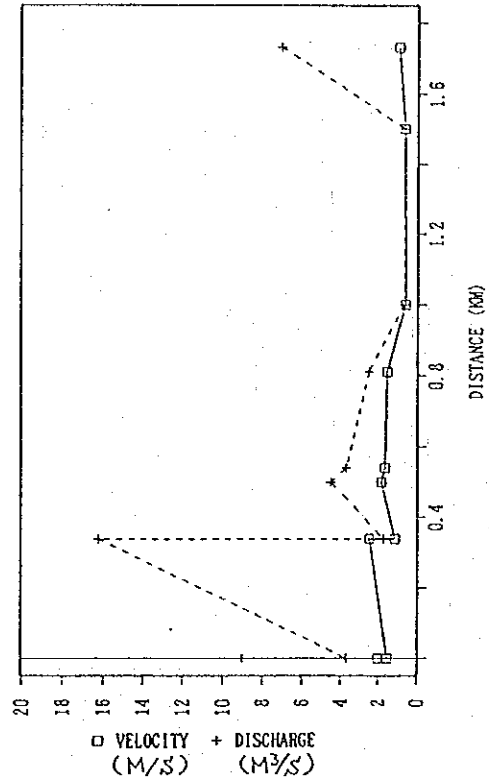
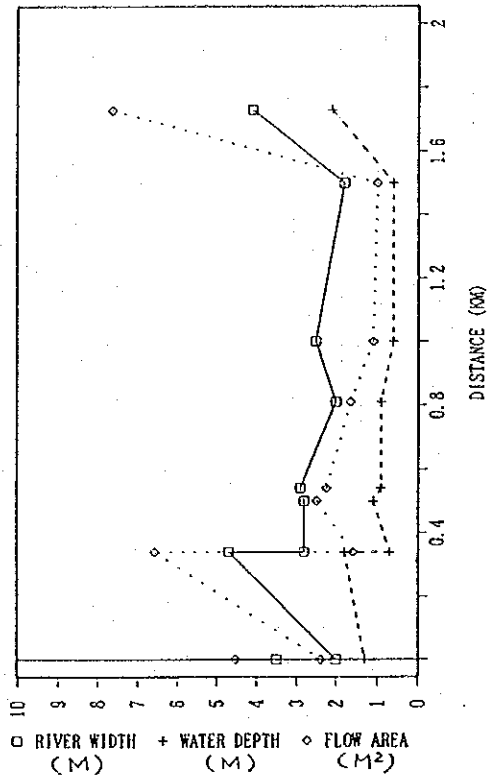


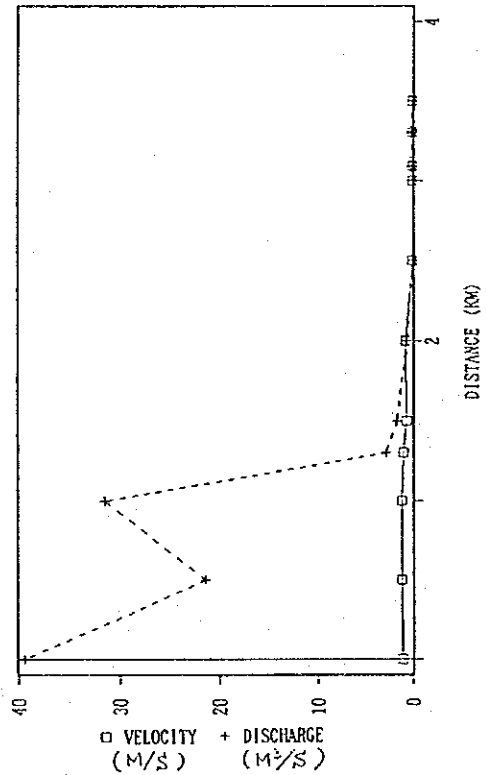
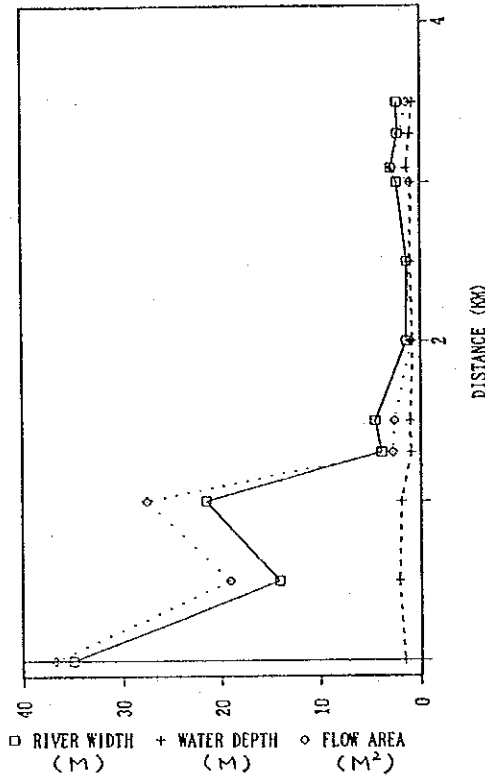
Fig. VI.4.2 (2/3)
 HYDRAULIC FEATURES OF SEMARANG
 AND BANGER RIVERS

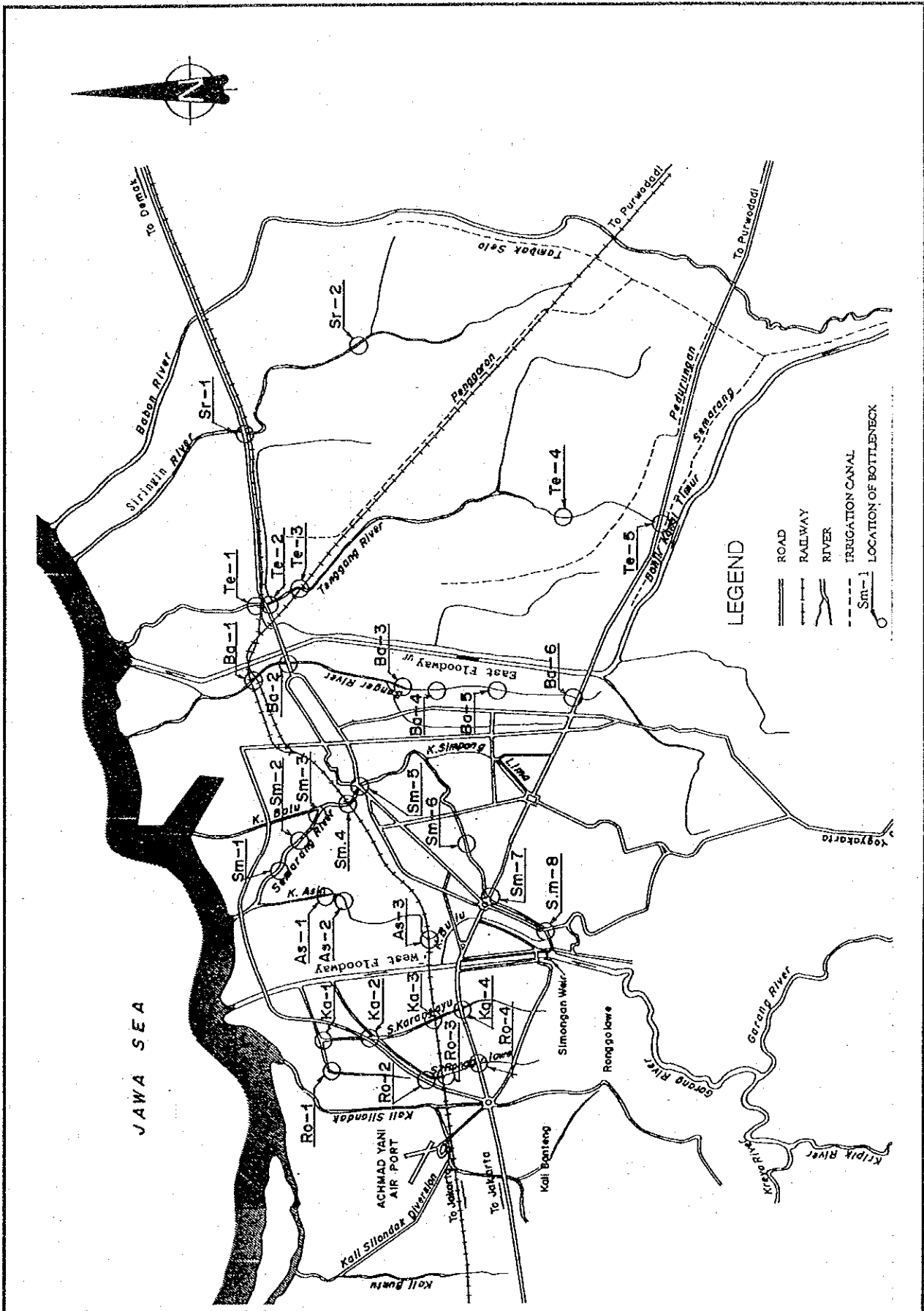
CENTRAL SEMARANG AREA

BULU RIVER



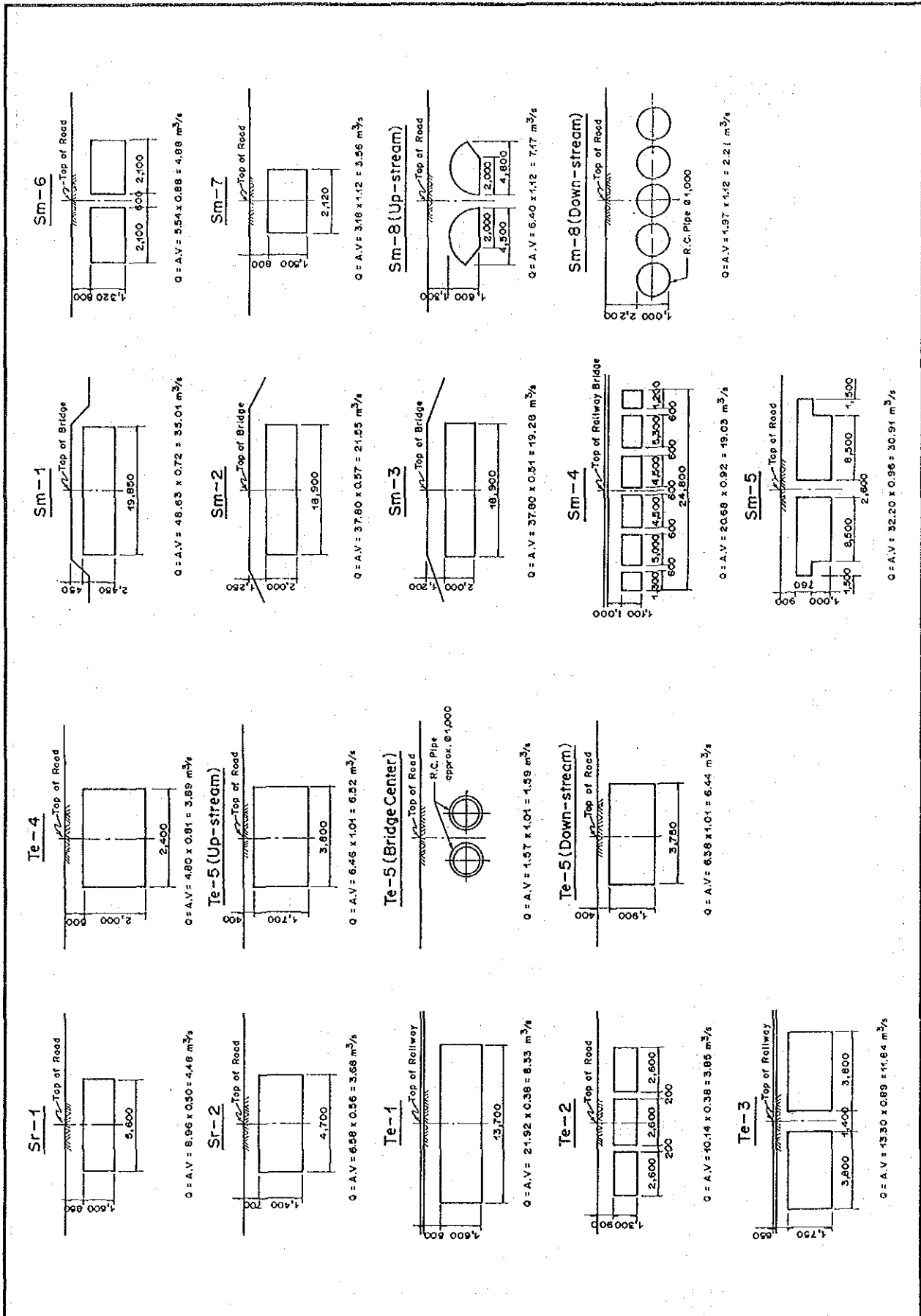
ASIN RIVER





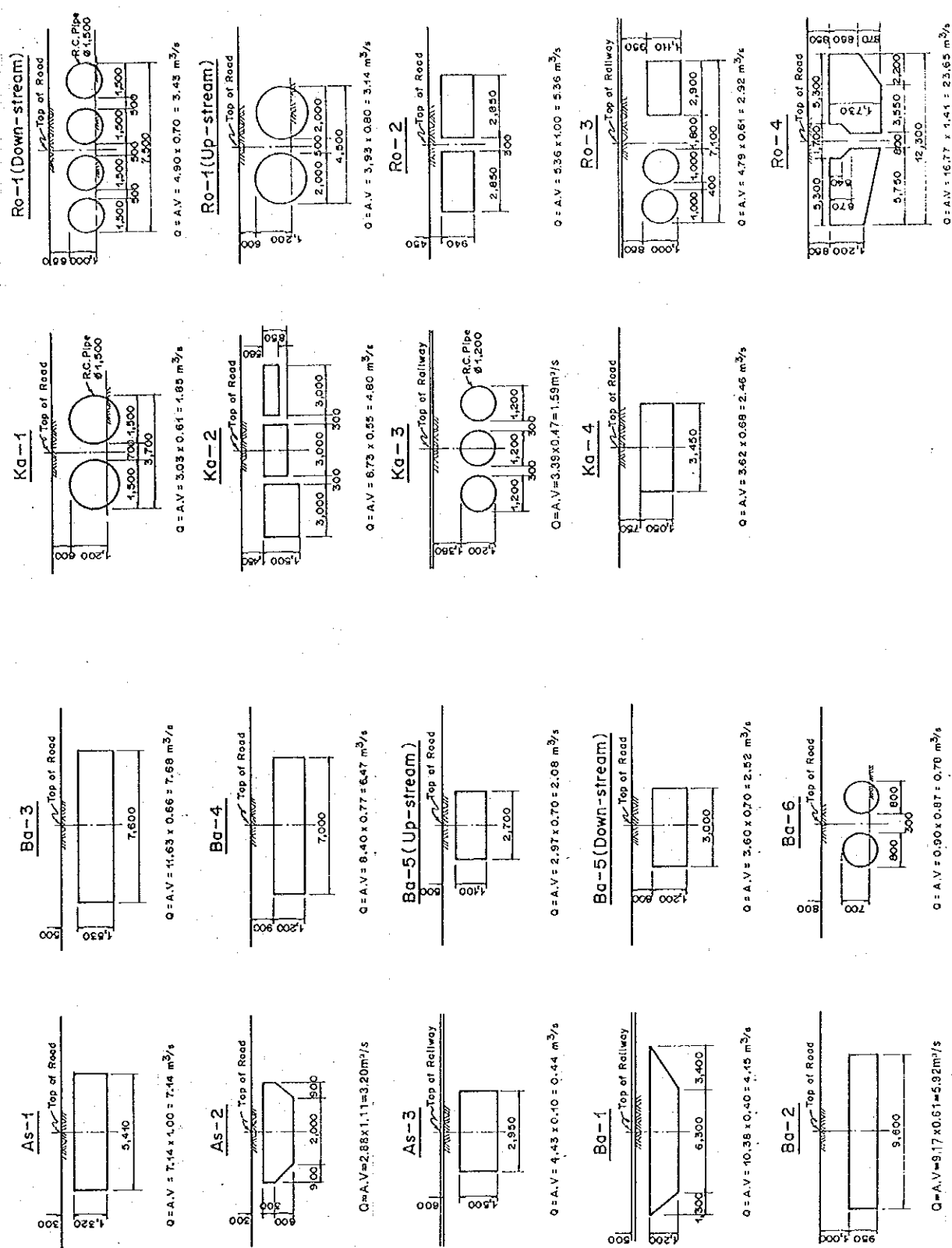
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
 FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.4.3
 LOCATIONS OF BOTTLENECK FOR
 PRIMARY CHANNEL



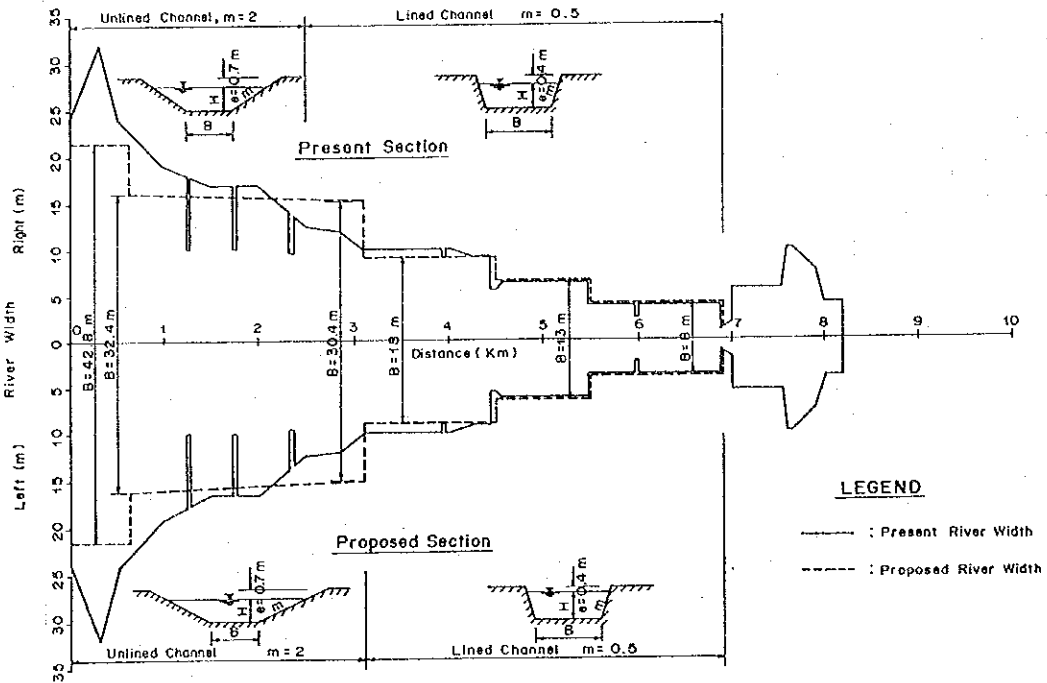
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
 FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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Fig. VI.4.4 (1/2)
 CROSS SECTIONS OF BOTTLENECK FOR
 PRIMARY CHANNEL

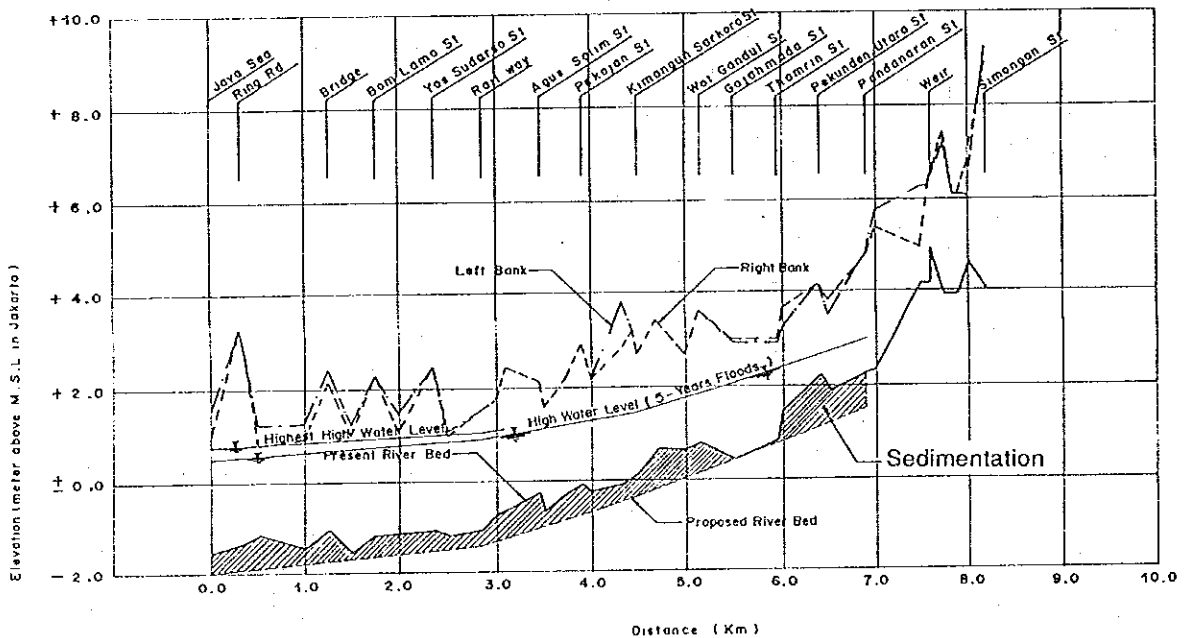


MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
 FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.4.4(2/2)
 CROSS SECTIONS OF BOTTLENECK FOR
 PRIMARY CHANNEL



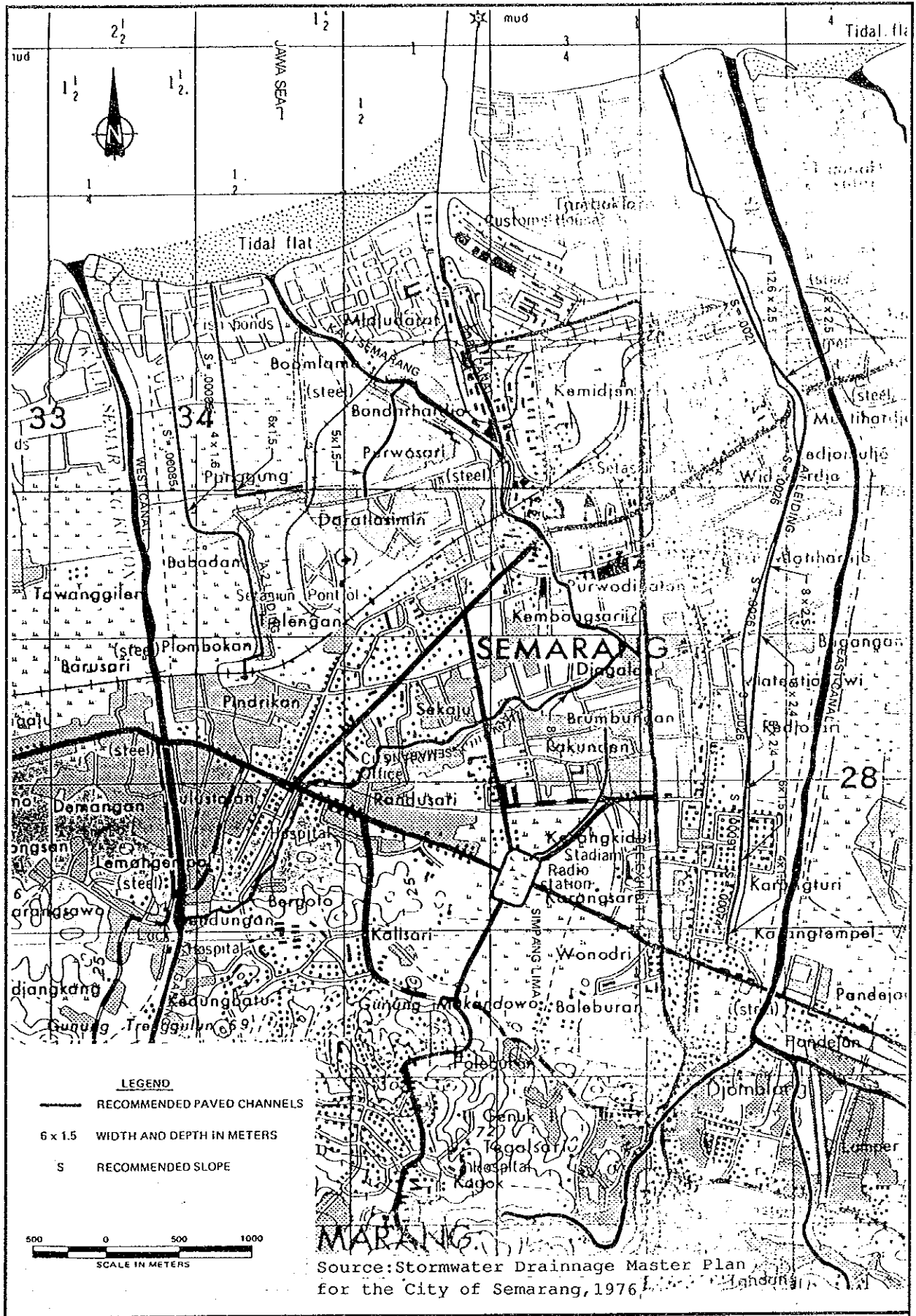
RIVER WIDTH AND CROSS SECTION



LONGITUDINAL SECTION

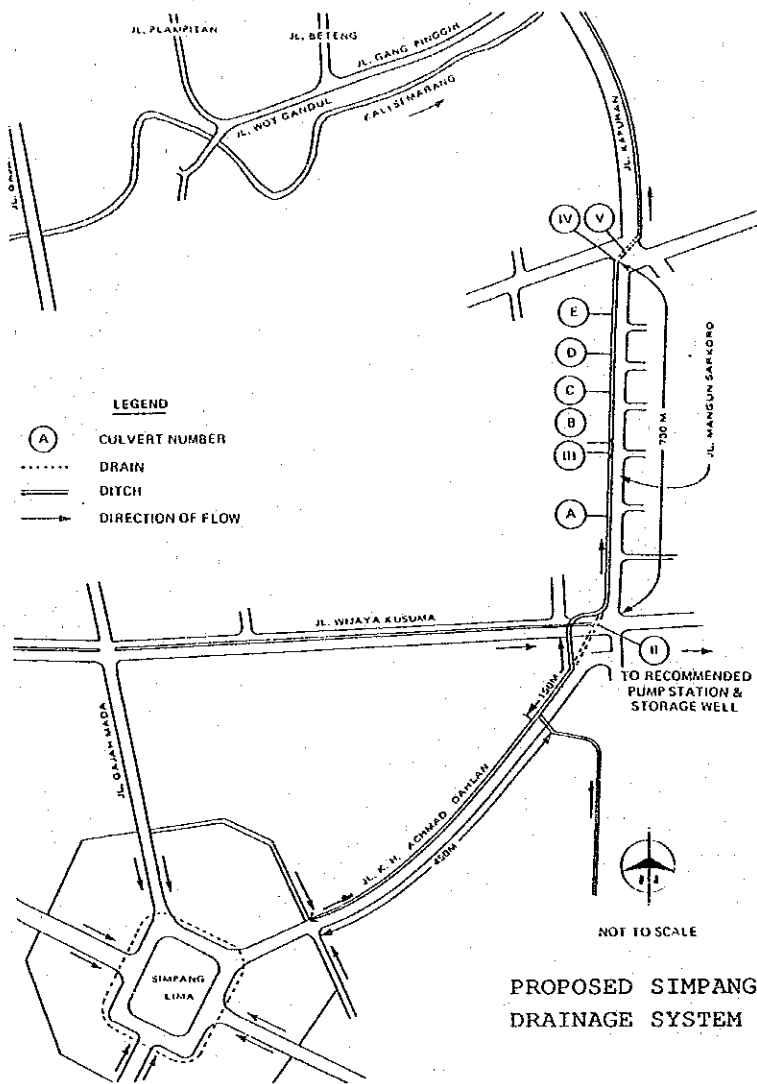
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.4.5
PROPOSED SEMARANG RIVER
IMPROVEMENT PLAN



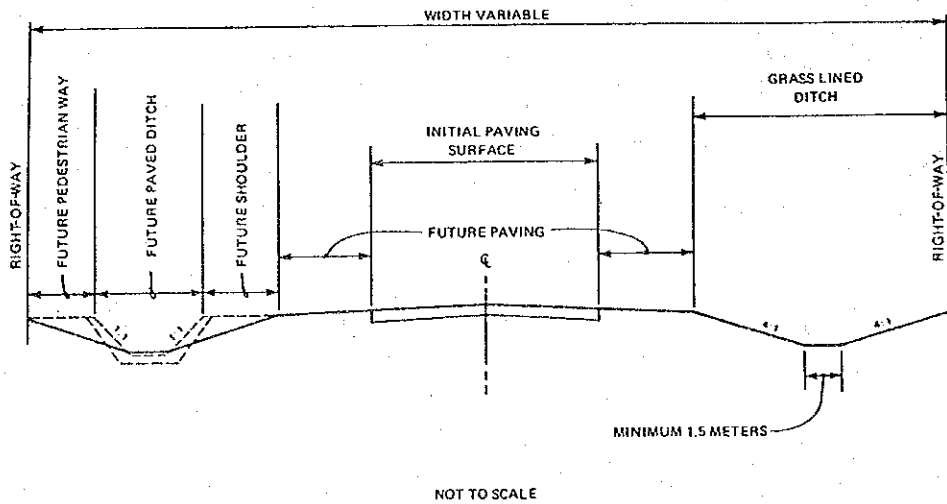
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.5.1
 RECOMMENDED IMPROVEMENTS FOR EXISTING CHANNELS IN PREVIOUS MASTER PLAN



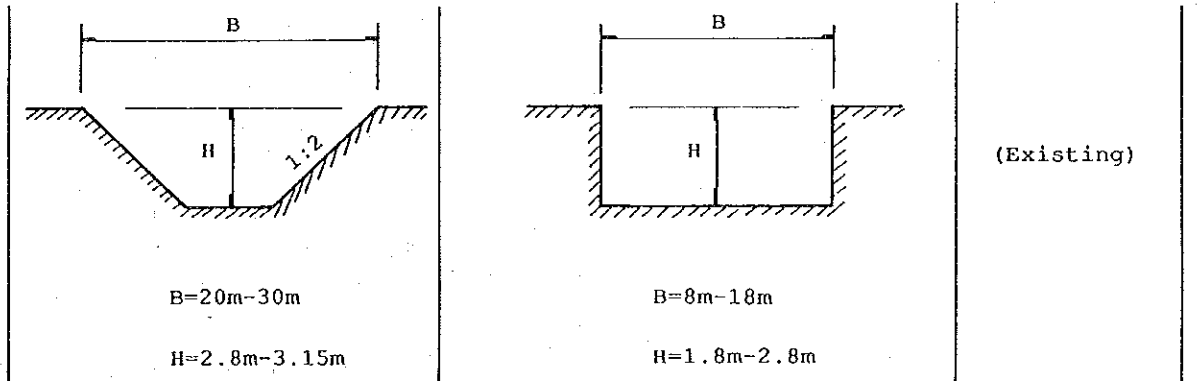
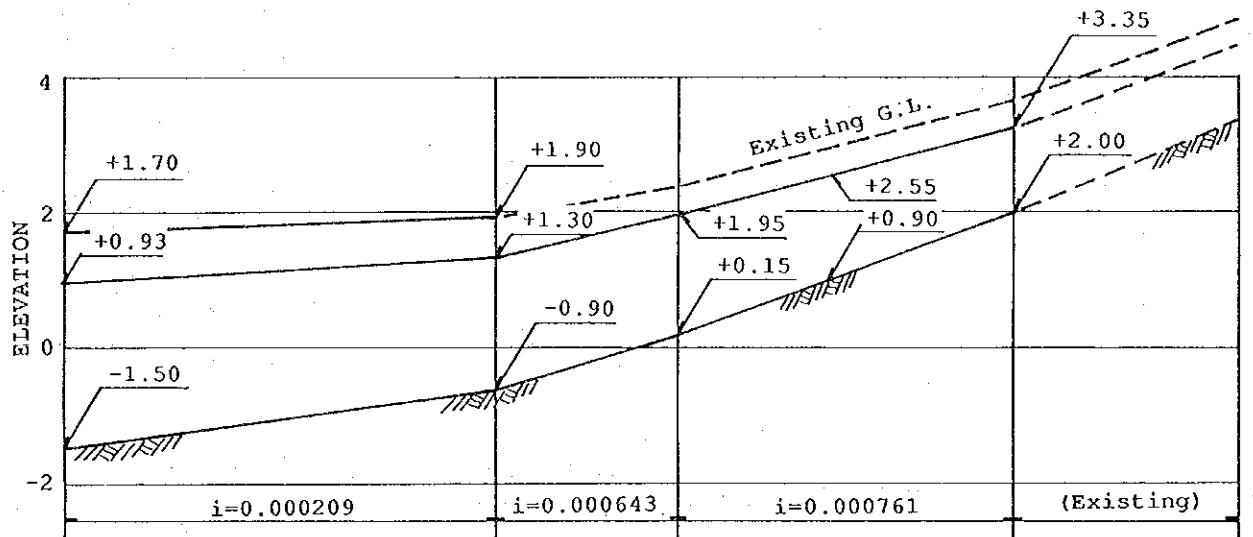
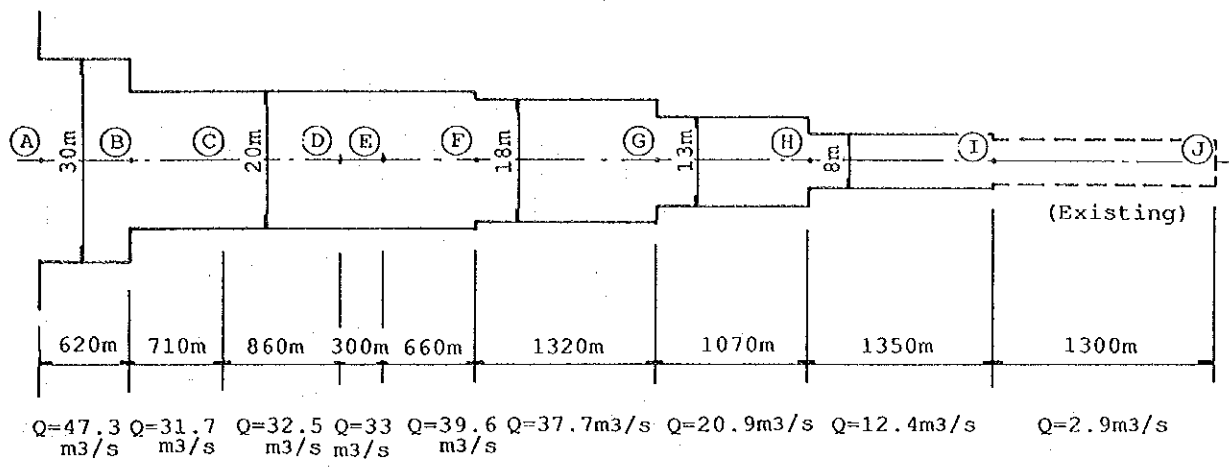
- LEGEND**
- (A) CULVERT NUMBER
 - DRAIN
 - DITCH
 - DIRECTION OF FLOW

PROPOSED SIMPANG LIMA DRAINAGE SYSTEM



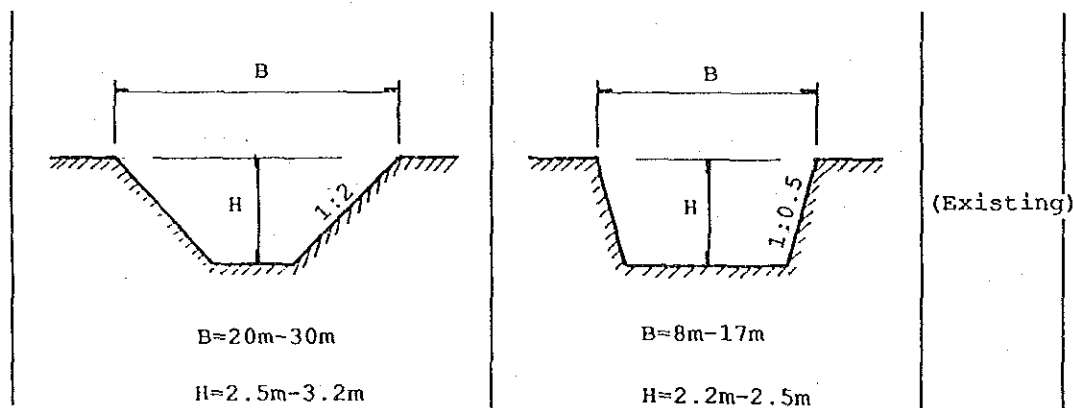
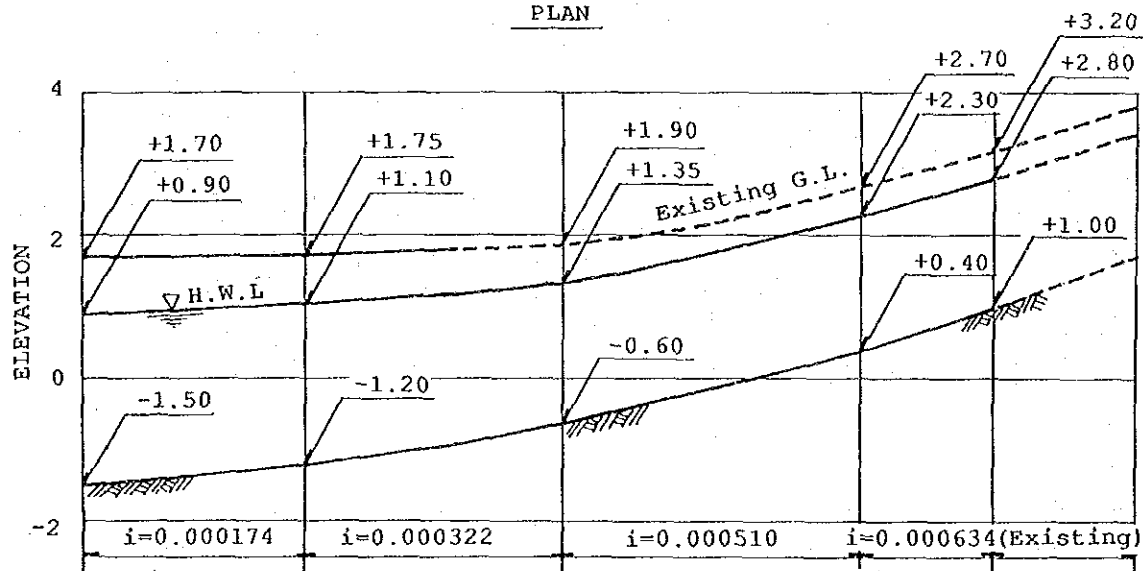
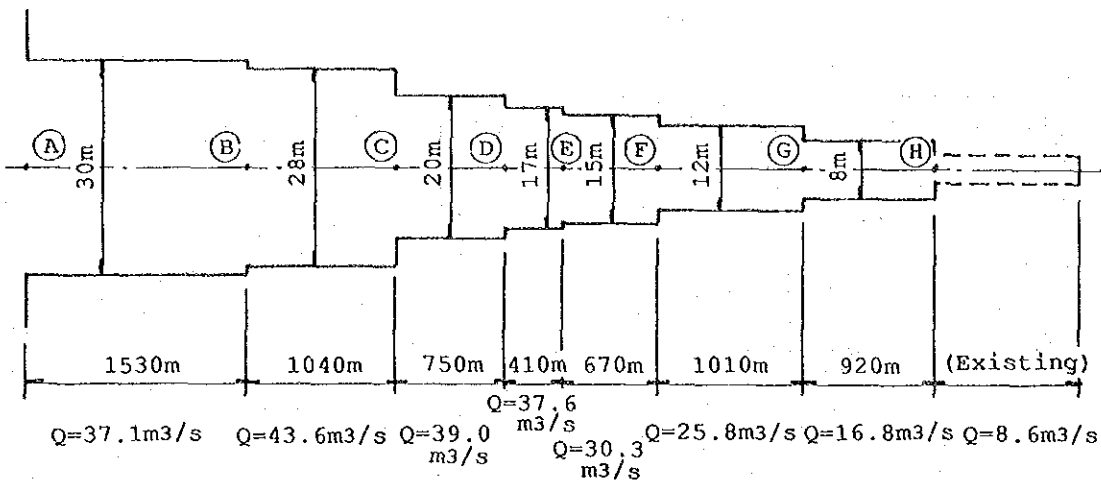
RECOMMENDED ROADWAY/DITCH SECTIONS

<p>MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS</p> <p>JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>Fig. VI.5.2 PROPOSED SIMPANG LIMA DRAINAGE SYSTEM, ROAD WAY/DITCH SECTIONS IN PREVIOUS MASTER PLAN</p>
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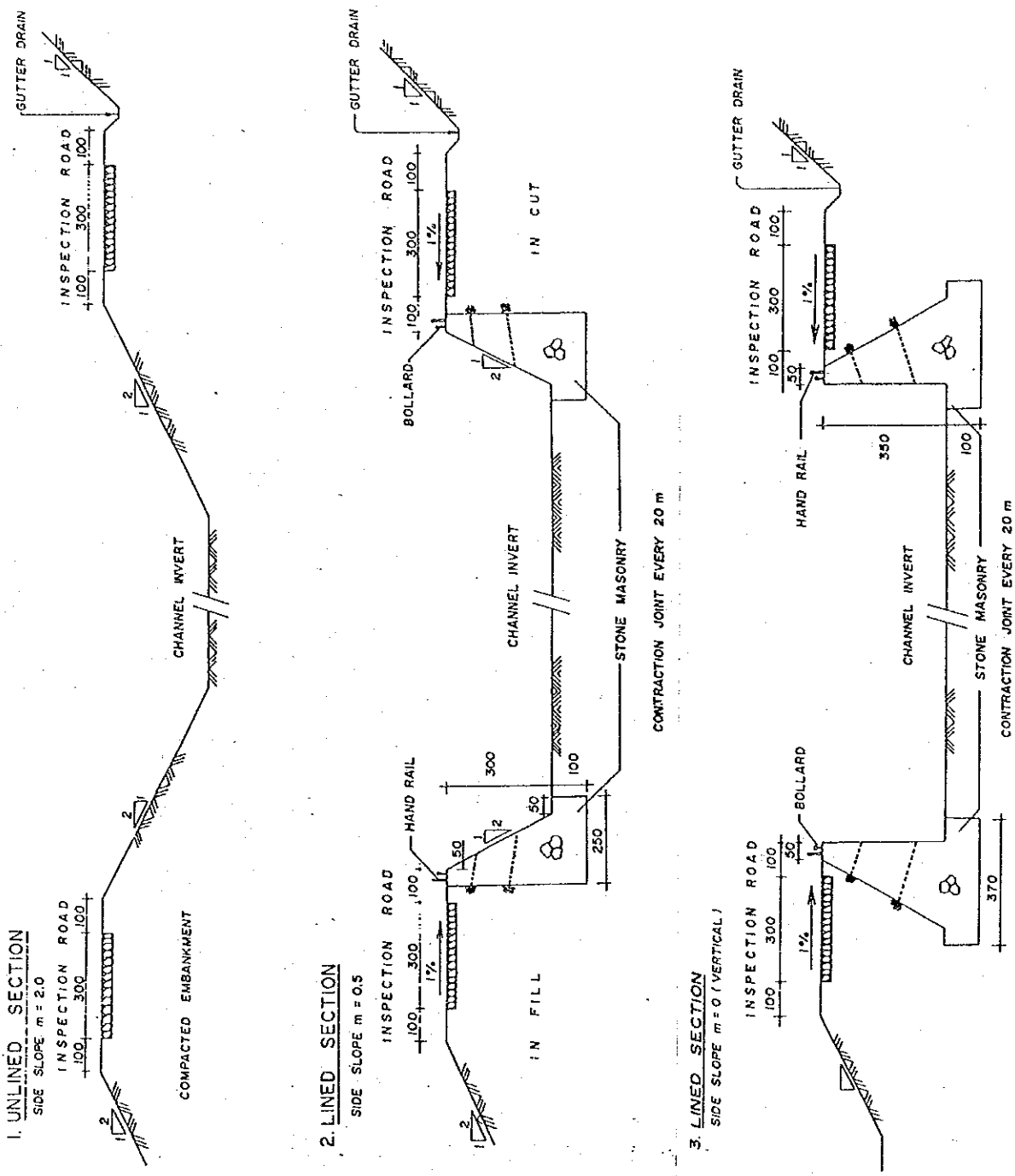
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.5.3
 SEMARANG RIVER IMPROVEMENT PLAN
 PROPOSED IN PREVIOUS MASTER PLAN



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.5.4
BANGEL RIVER IMPROVEMENT PLAN
PROPOSED IN PREVIOUS MASTER PLAN



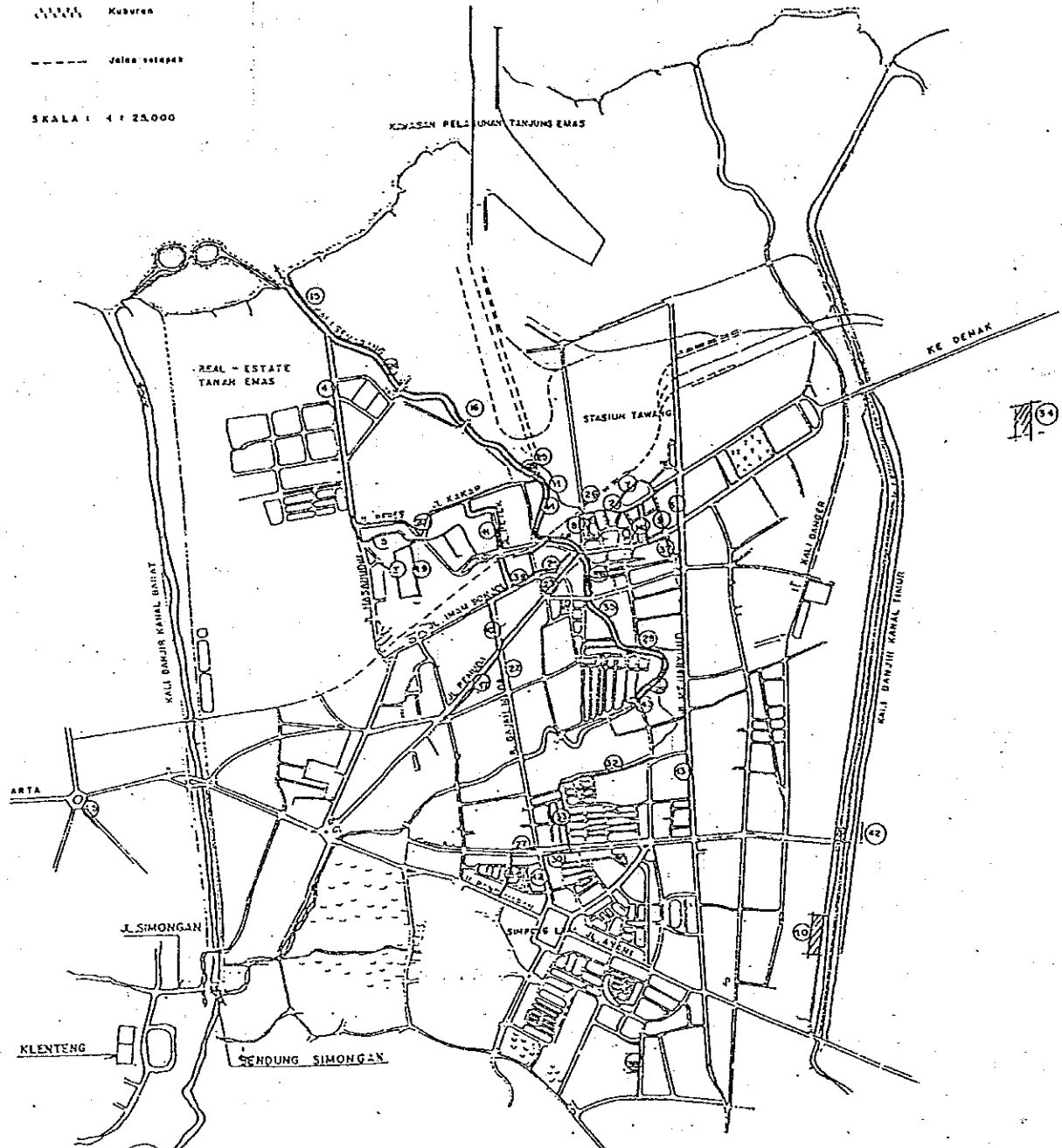
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.5.5
PROPOSED TYPICAL SECTIONS OF SEMARANG
AND BANGER RIVERS IN PREVIOUS MASTER PLAN

LEGEND

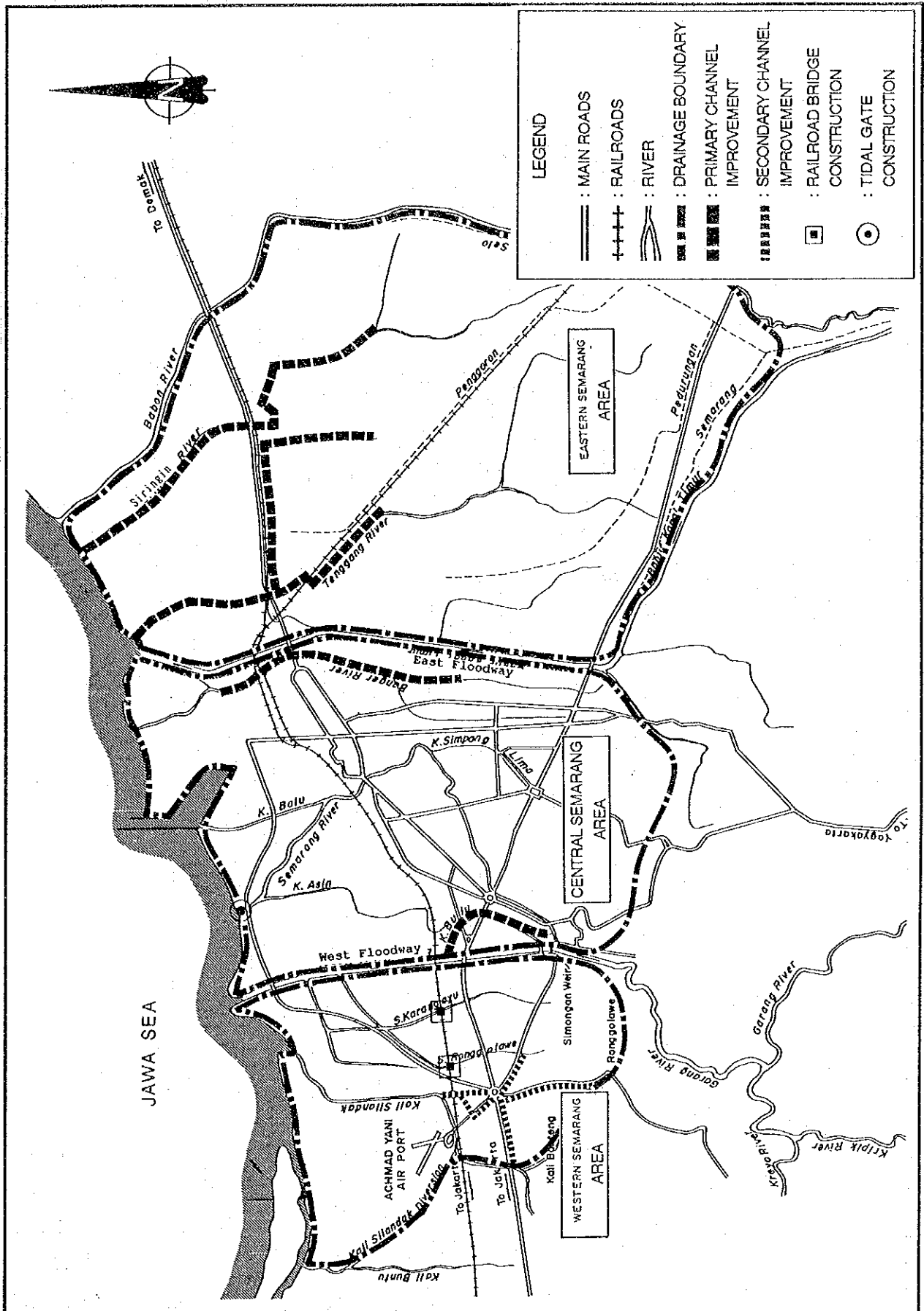
- Jalan KA
- Jalan Raya
- Sungai
- Jembatan
- Kuburan
- Kuasren
- Jalan setempat

SKALA : 1 : 25.000



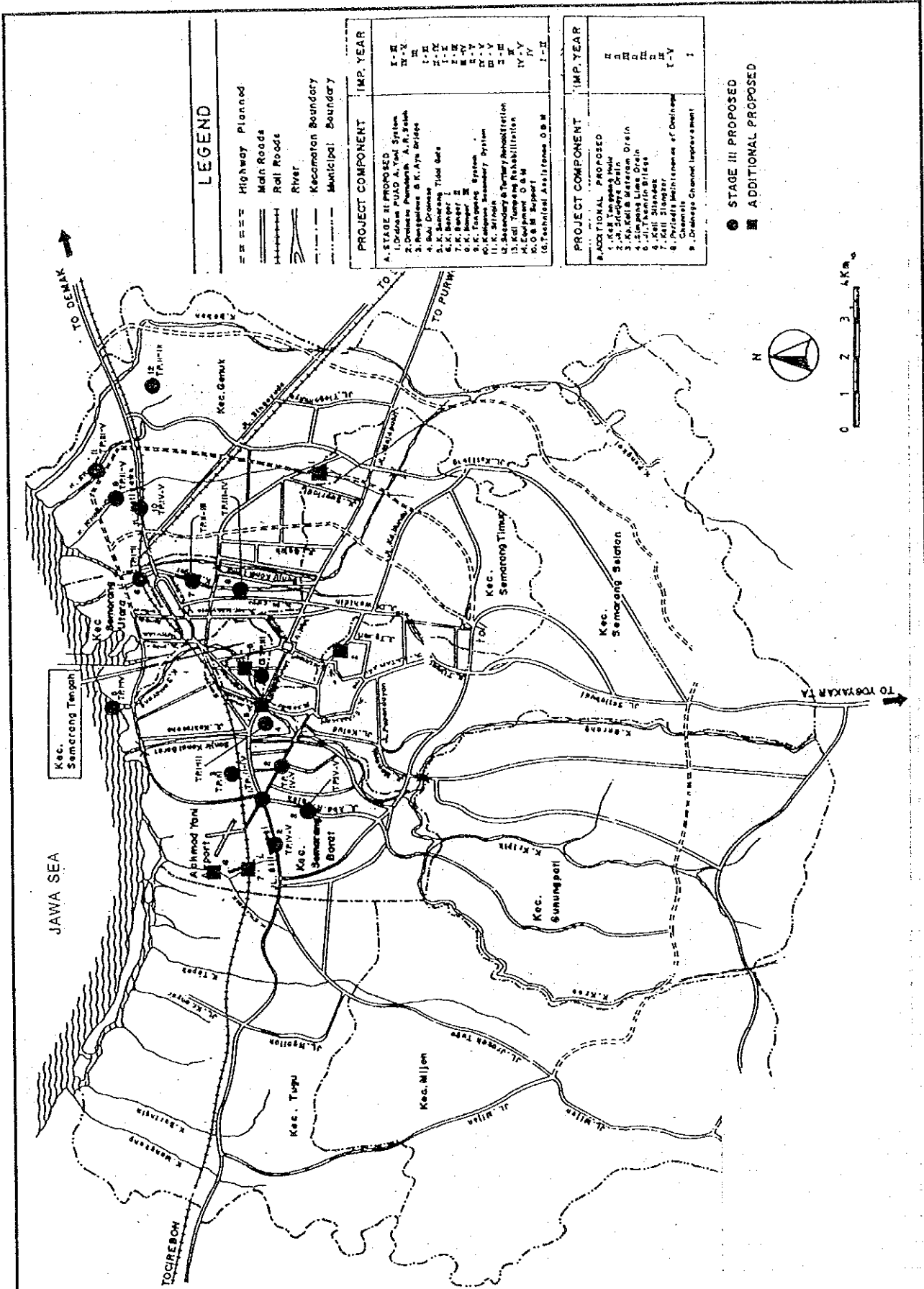
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
 FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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Fig. VI.5.6
 LOCATION OF PROJECT COMMITTED
 FUND IN URBAN V



MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
 FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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Fig. VI.5.7
 PROPOSED DRAINAGE IMPROVEMENT
 PROJECT OF SSUDP



LEGEND

- ==== Highway Planned
- ==== Main Roads
- ==== Rail Roads
- ==== River
- Kecamatan Boundary
- Municipal Boundary

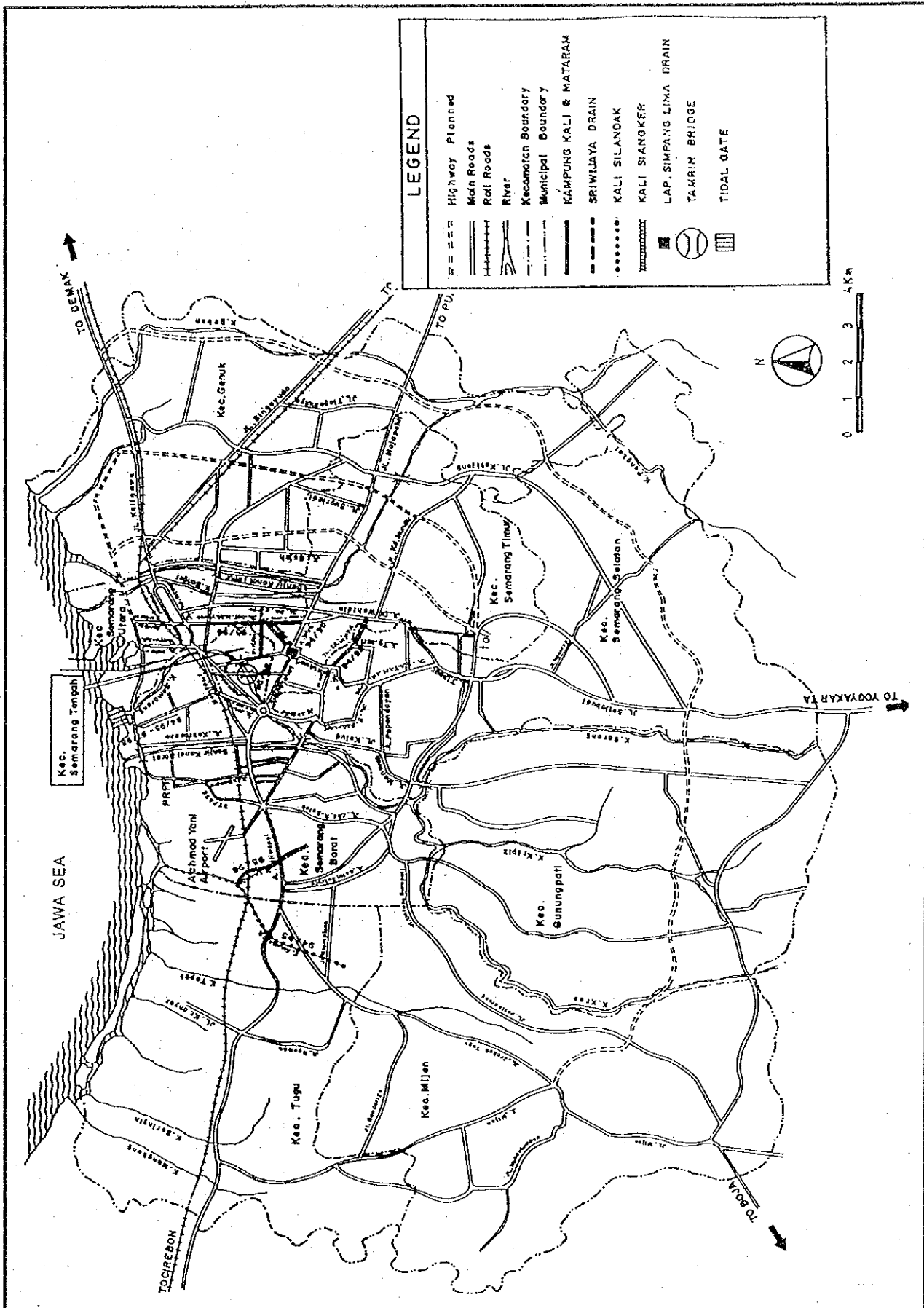
PROJECT COMPONENT	IMP. YEAR
A. STAGE II PROPOSED	I - II
1. Lodoan PUSD A. Yudi System	I - II
2. Drainase Pambanik A. R. Suk	I - II
3. Pengaliran & K. Aye Bridge	I - II
4. Subi Drainase	I - II
5. K. Semarang Tidal Gate	I - II
6. K. Banteng I	I - II
7. K. Banteng II	I - II
8. K. Banteng III	I - II
9. K. Tumpang System	I - II
10. K. Klaten Boundary System	I - II
11. K. Biring	I - II
12. Secondary & Tertiary Rehabilitation	I - II
13. K. Lingsar & K. Klaten	I - II
14. K. O.S.M Support	I - II
15. Technical Assistance O.S.M	I - II

PROJECT COMPONENT	IMP. YEAR
B. ADDITIONAL PROPOSED	I - II
1. K. Semarang Mulu	I - II
2. K. Srigir Drain	I - II
3. K. Srigir Drain	I - II
4. K. Srigir Drain	I - II
5. K. Srigir Drain	I - II
6. K. Srigir Drain	I - II
7. K. Srigir Drain	I - II
8. K. Srigir Drain	I - II
9. K. Srigir Drain	I - II
10. K. Srigir Drain	I - II

- STAGE III PROPOSED
- ADDITIONAL PROPOSED

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.5.8 (1/2)
 LOCATION OF DRAINAGE PROJECT IN SEMARANG OF SSUDP



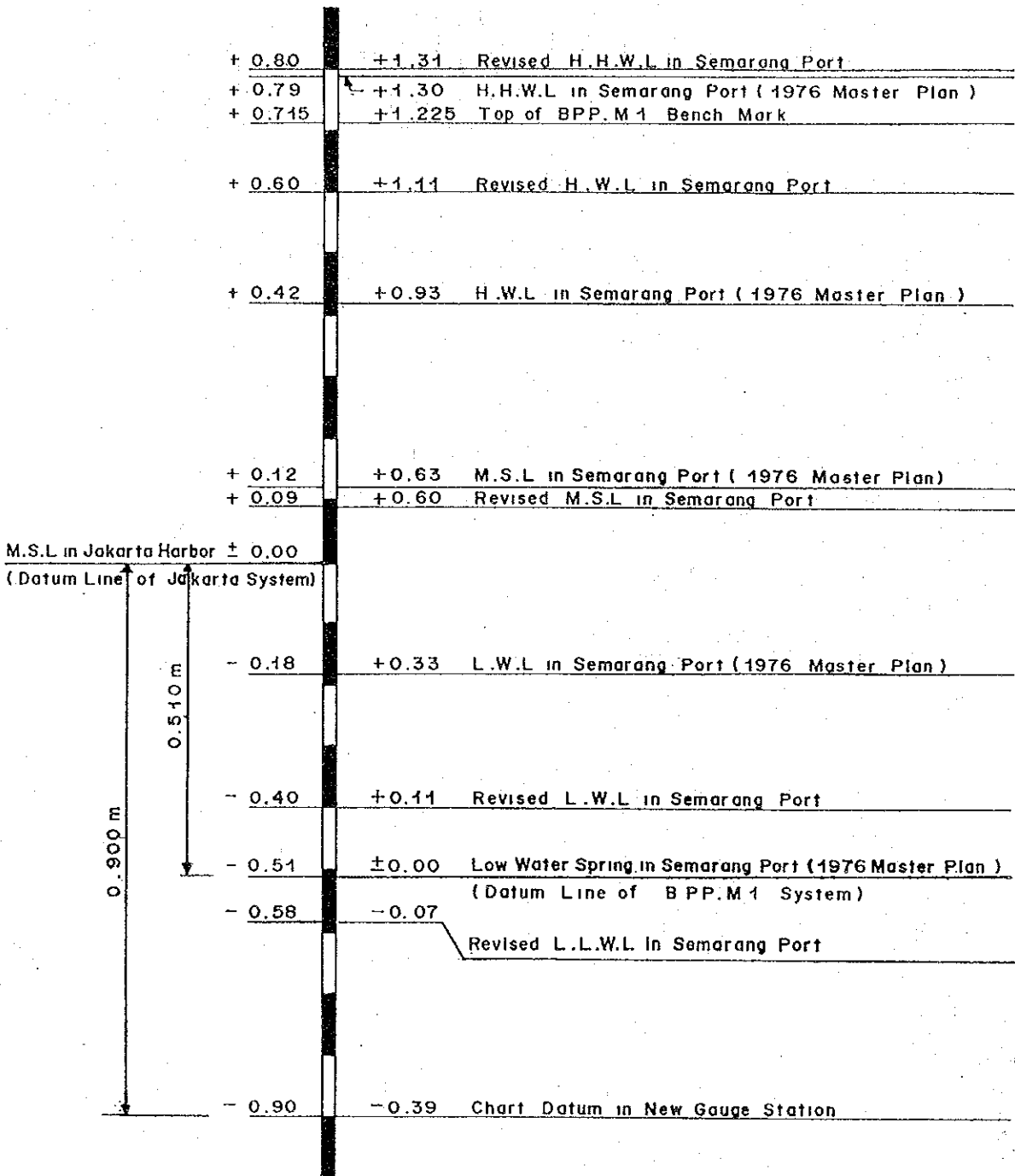
MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
 FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
 URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. VI.5.8(2/2)
 LOCATION OF DRAINAGE PROJECT IN
 SEMARANG OF SSUDP

Design Tide Level

Jakarta System

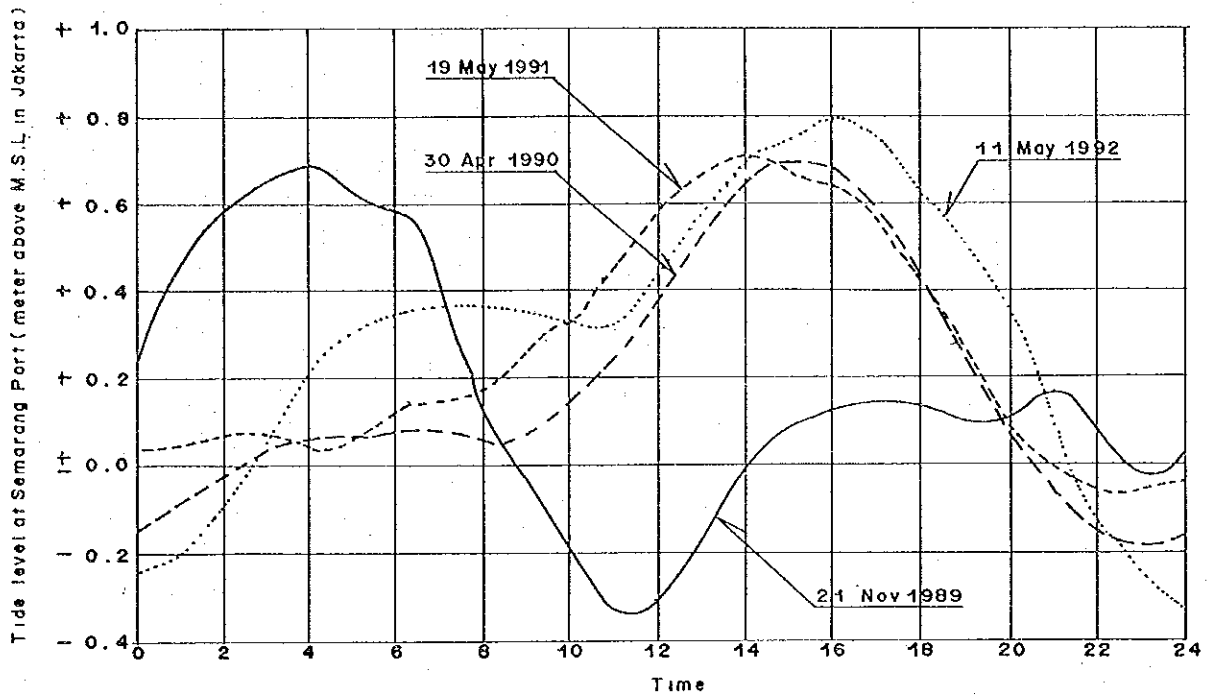
BPP M 1 System



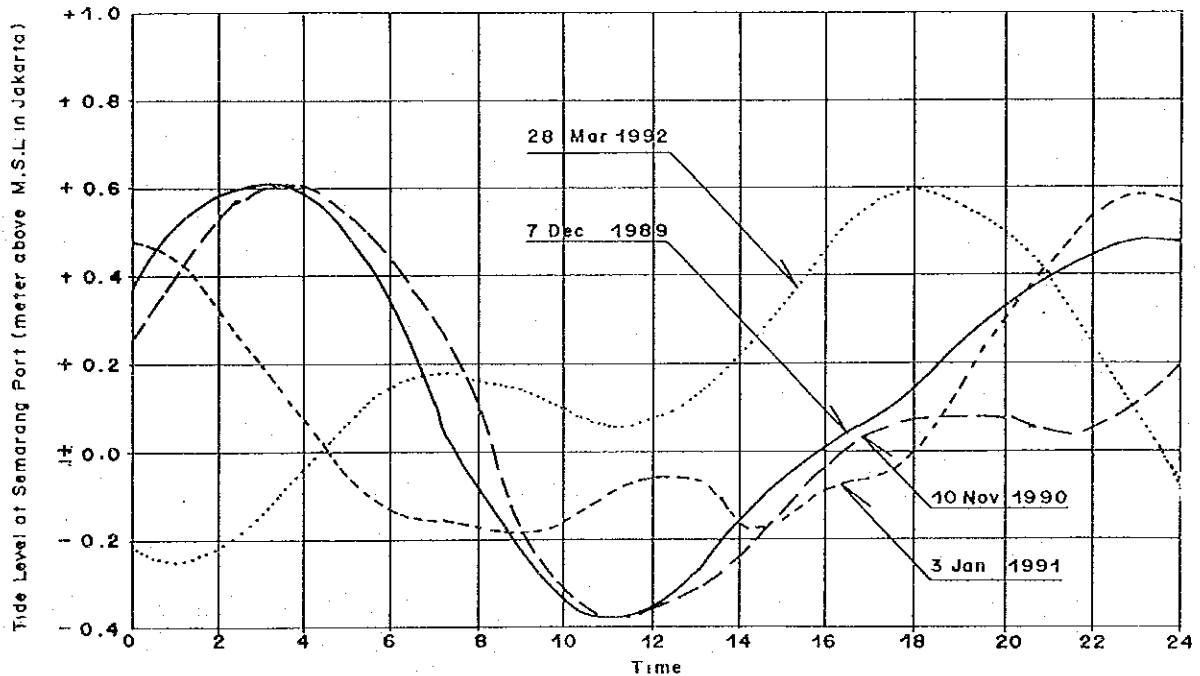
Jakarta System = BPP.M 1 System - 0.510 m

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

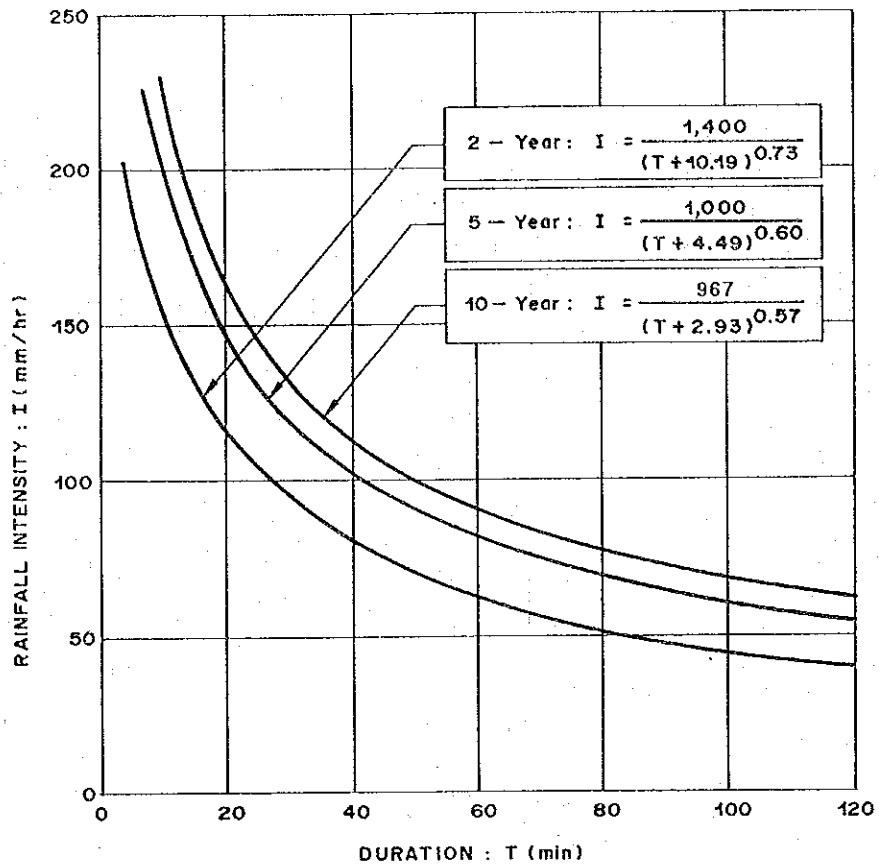
Fig. VI.6.1
TIDAL LEVEL AT SEMARANG HARBOR



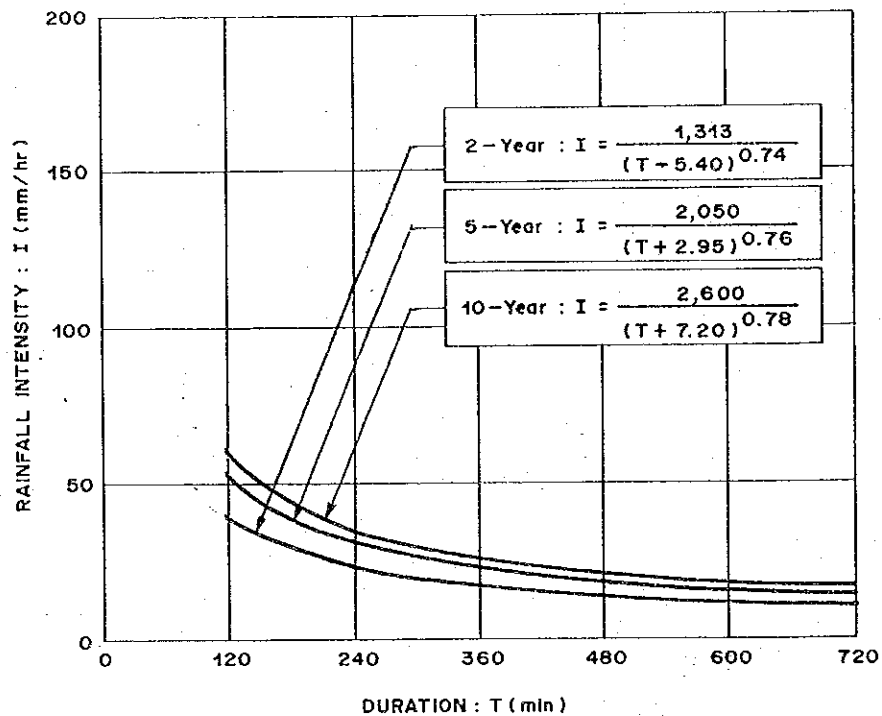
TYPICAL TIDAL VARIATION OF H.H.W.L.



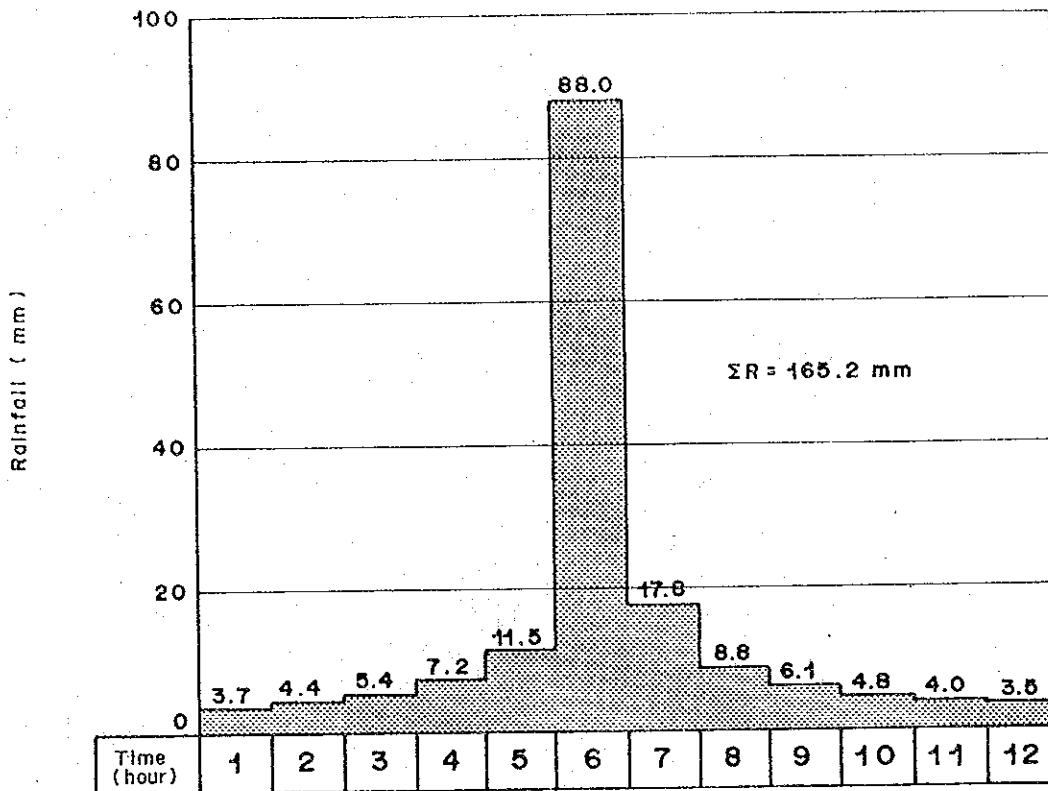
TYPICAL TIDAL VARIATION OF M. H. W. L.



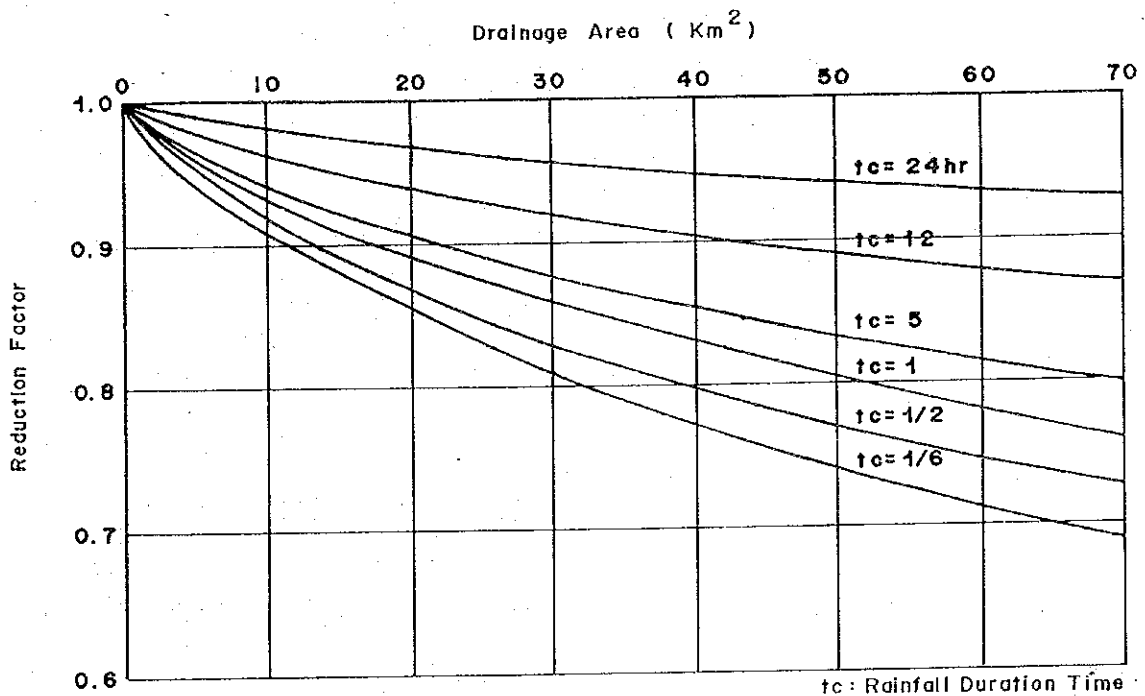
CASE 1 : SHORT DURATION TIME ($T \leq 2$ hr)



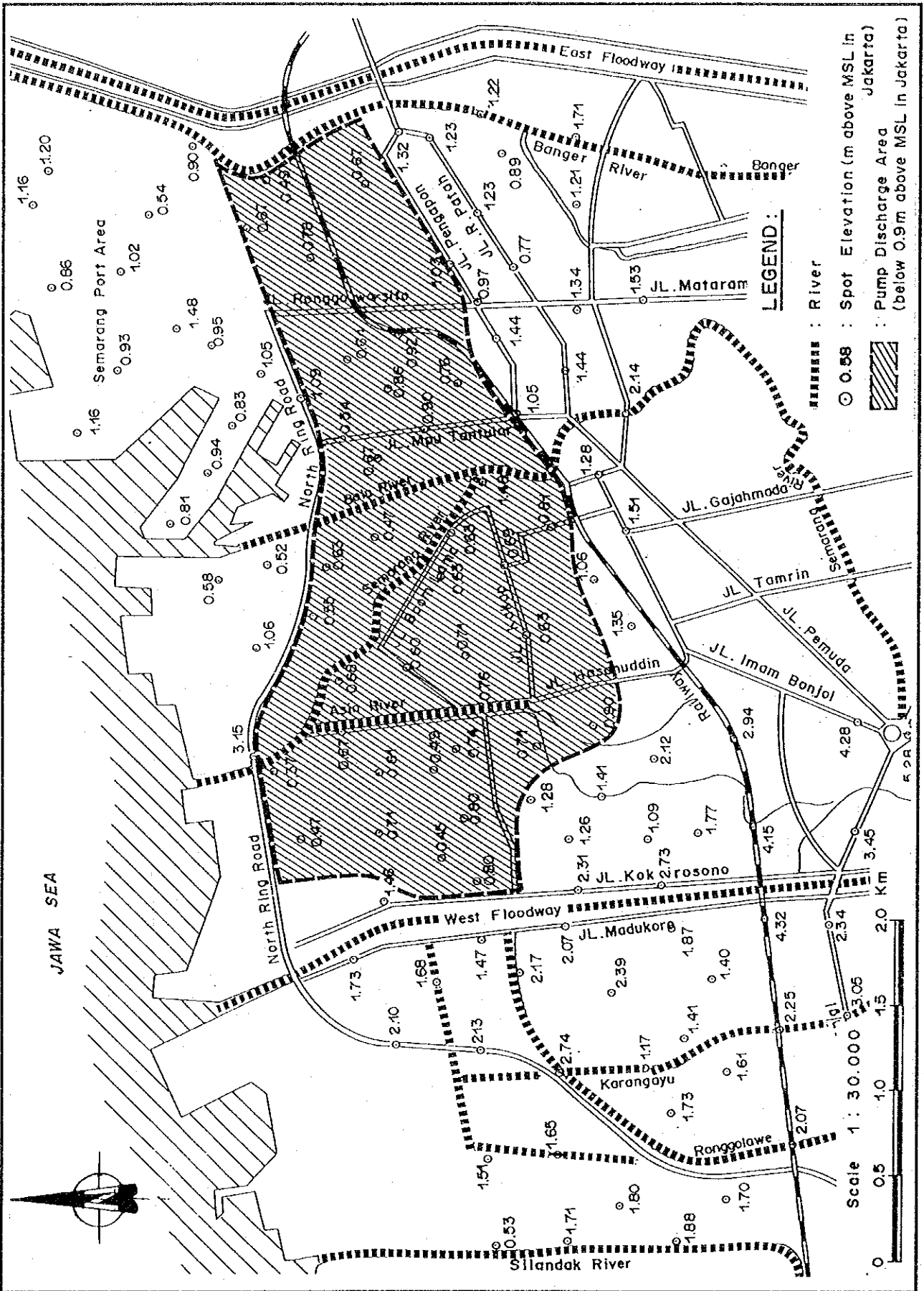
CASE 2 : LONG DURATION TIME (2 hr $< T \leq 12$ hr)



DESIGN RAINFALL FOR PUMP DRAINAGE

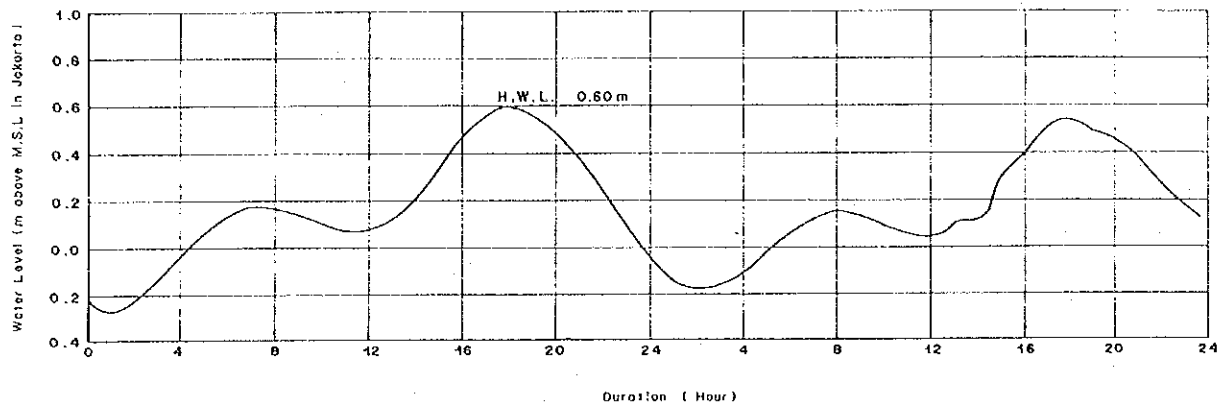


AREAL REDUCTION FACTOR

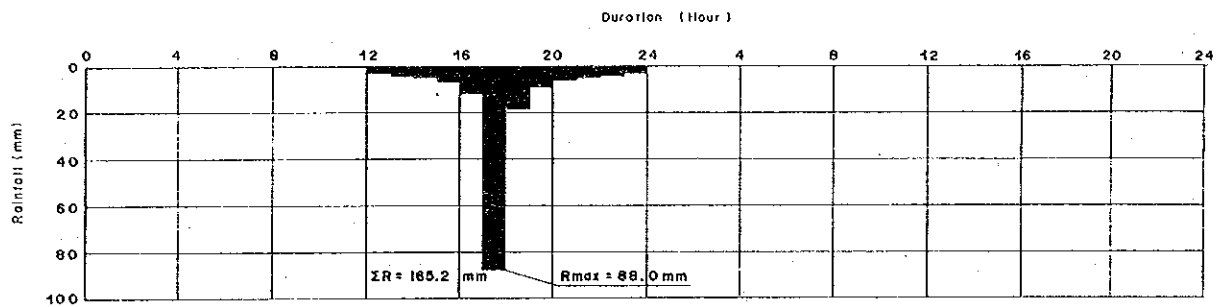


MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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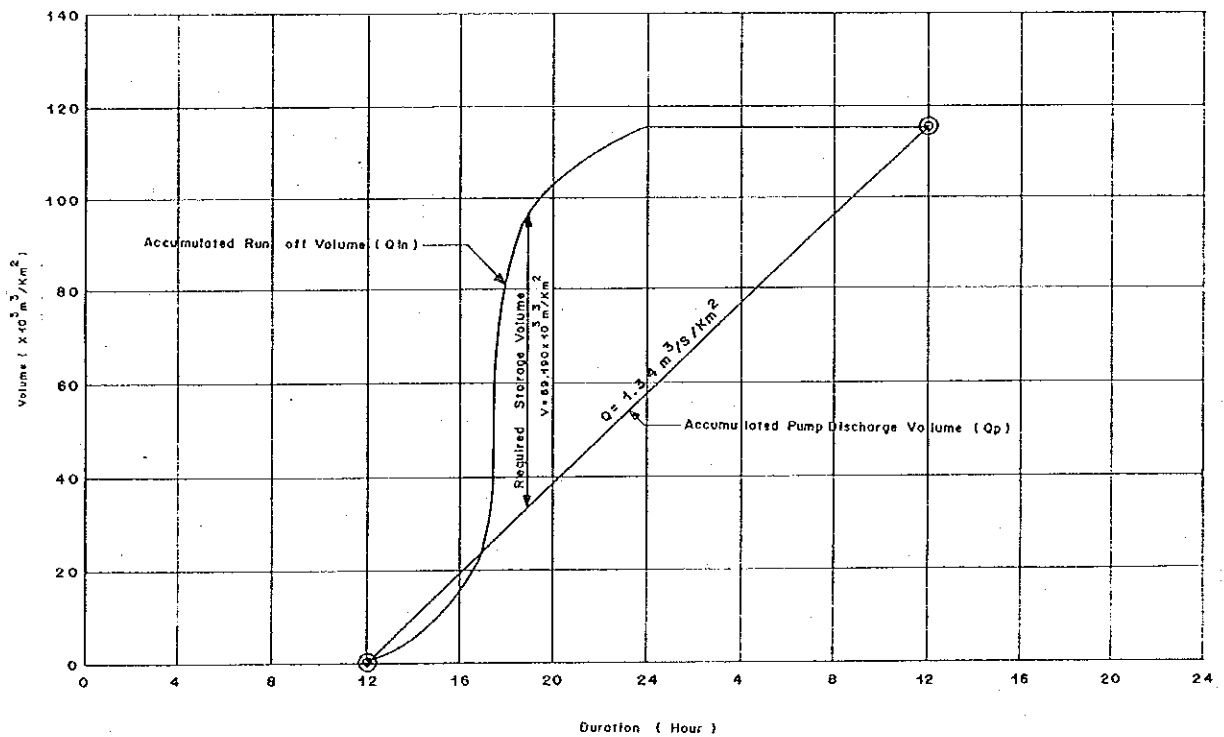
Fig. VI.6.5
 SPOT ELEVATION AND PROPOSED PUMP DRAINAGE AREA



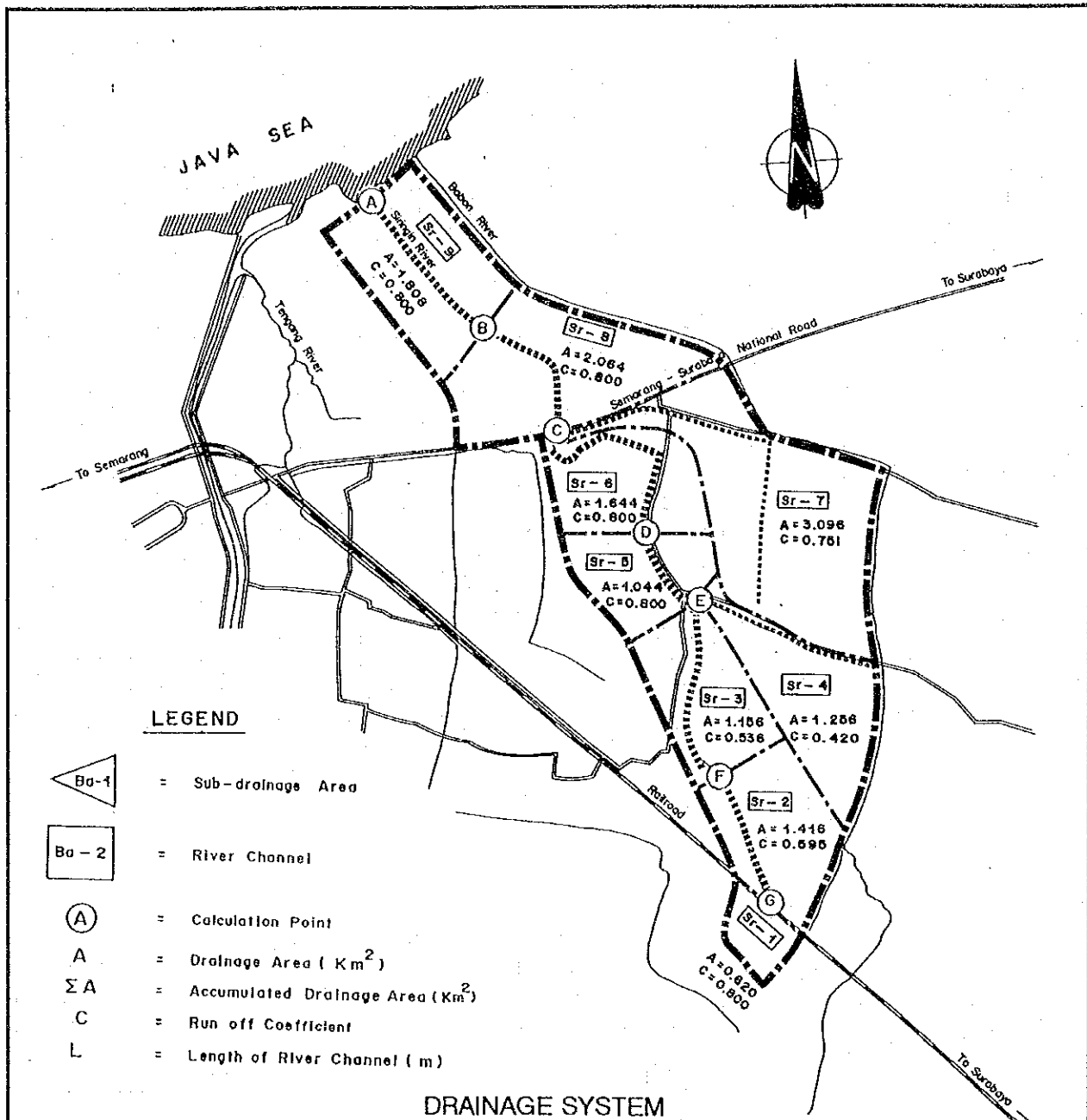
DESIGN TIDAL VARIATION



DESIGN RAINFALL FOR PUMP DRAINAGE



SPECIFIC PUMP CAPACITY AND STORAGE REQUIREMENT

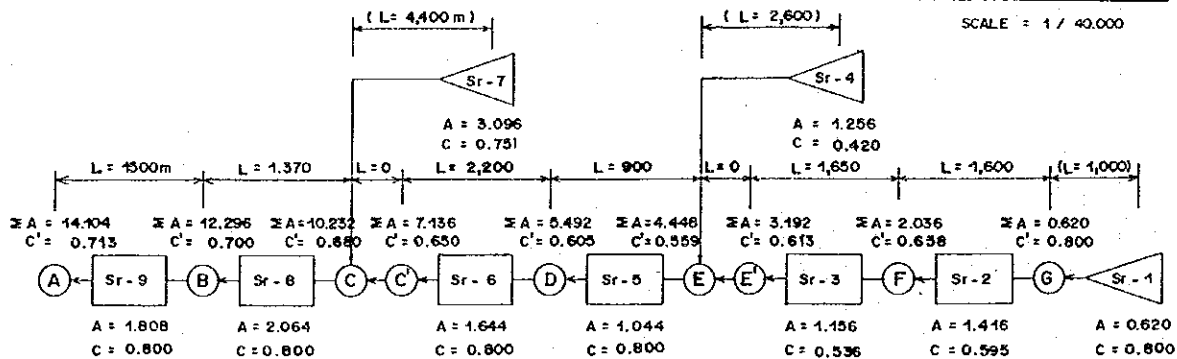


LEGEND

- Ba-1 = Sub-drainage Area
- Ba-2 = River Channel
- A = Calculation Point
- A = Drainage Area (Km²)
- Σ A = Accumulated Drainage Area (Km²)
- C = Run off Coefficient
- L = Length of River Channel (m)

DRAINAGE SYSTEM

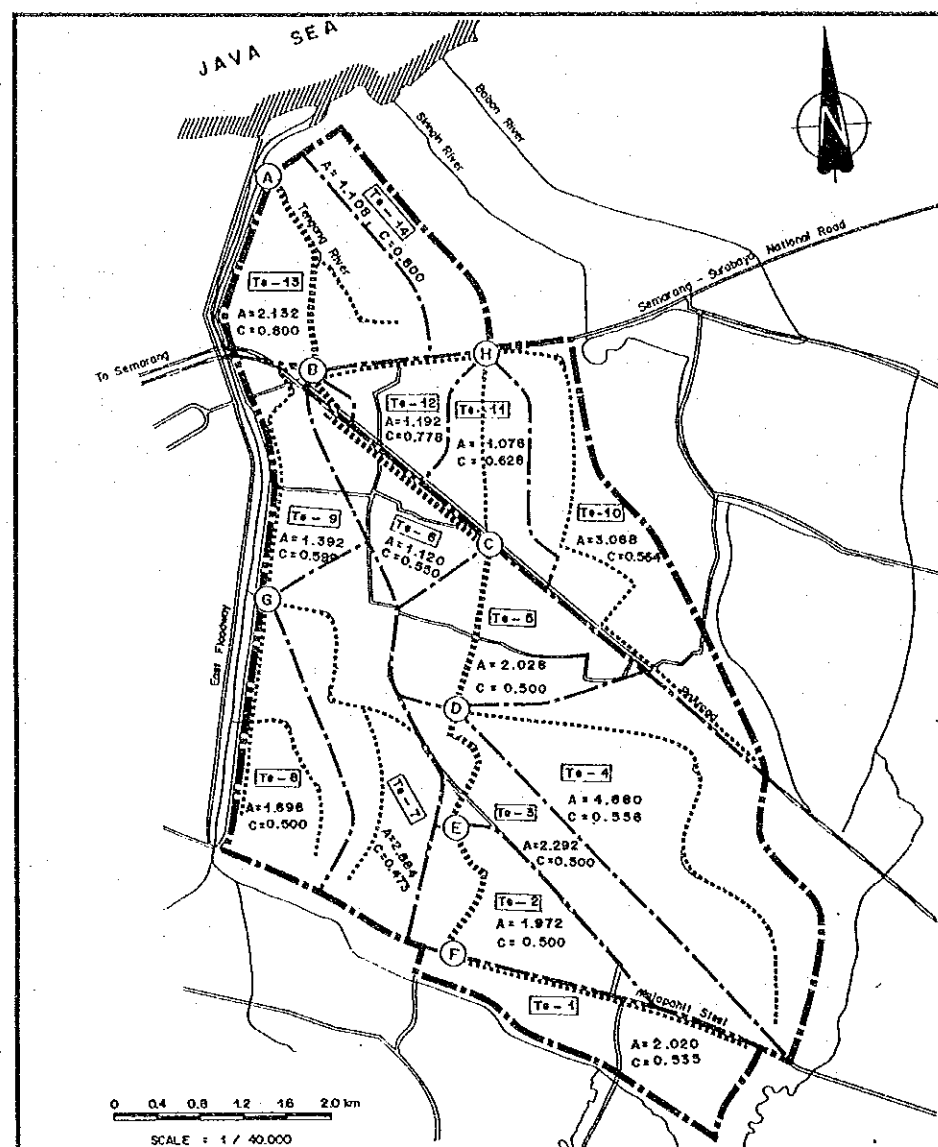
0 0.4 0.8 1.2 1.6 2.0 km
SCALE = 1 / 40,000



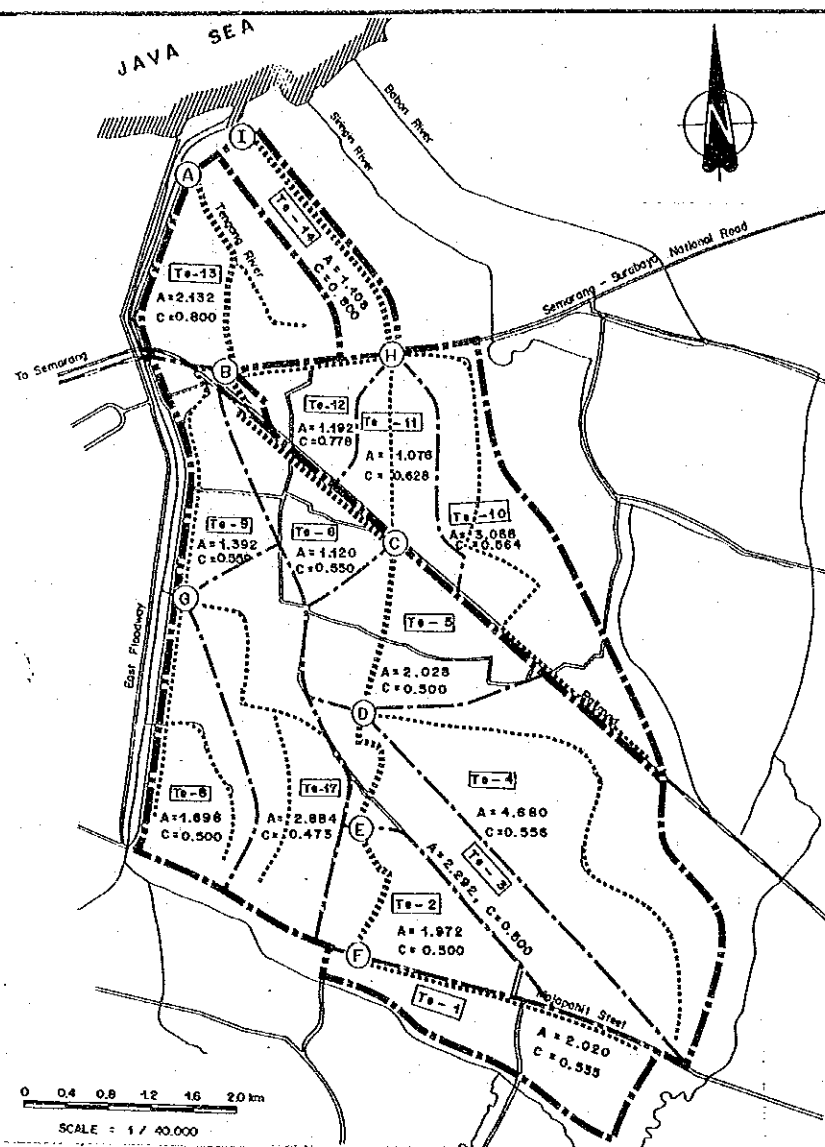
RUN - OFF MODEL

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND
FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND
URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

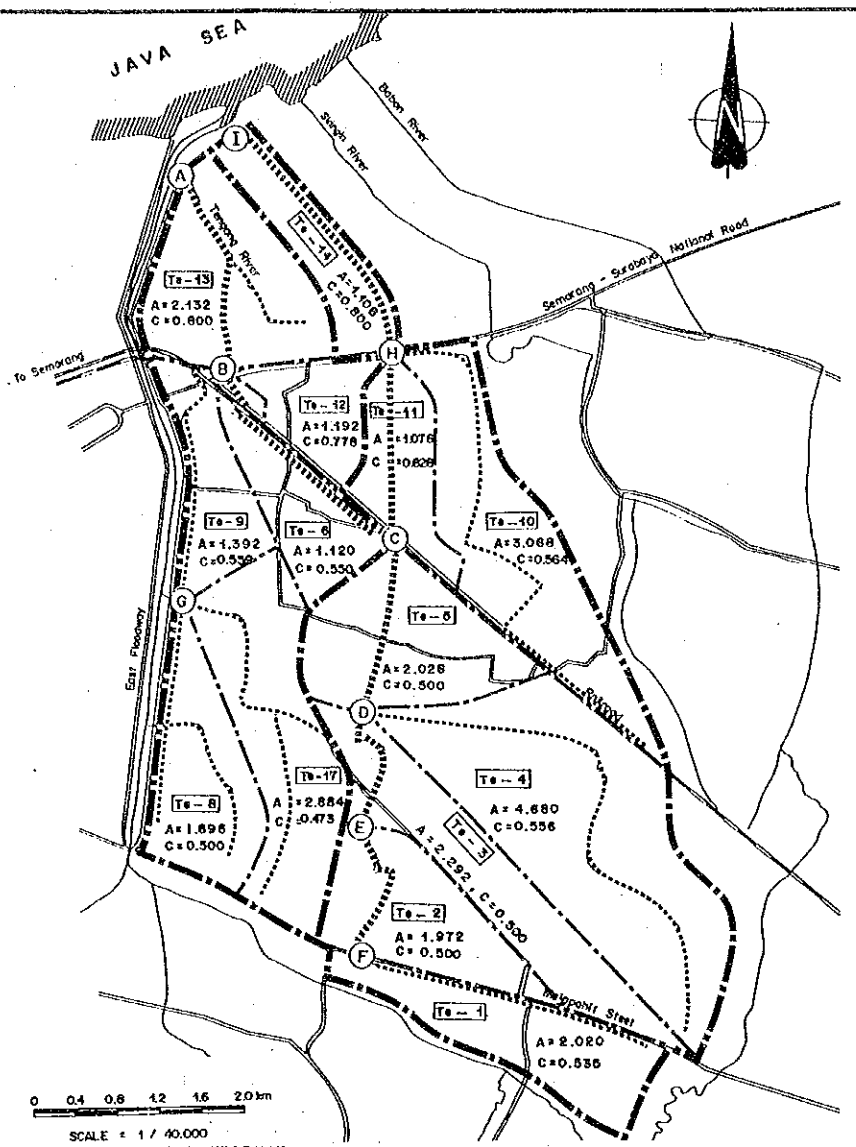
Fig. VI.6.7(1/7)
PROPOSED DRAINAGE SYSTEM AND RUN-OFF
MODEL (SIRINGIN RIVER)



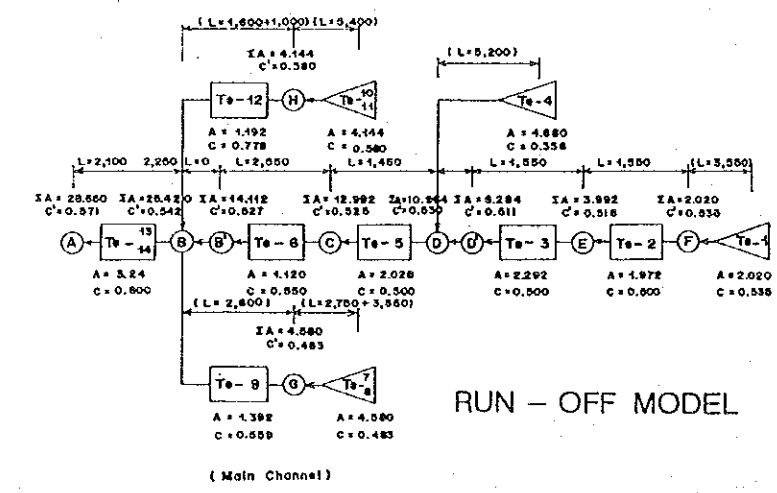
DRAINAGE SYSTEM



DRAINAGE SYSTEM

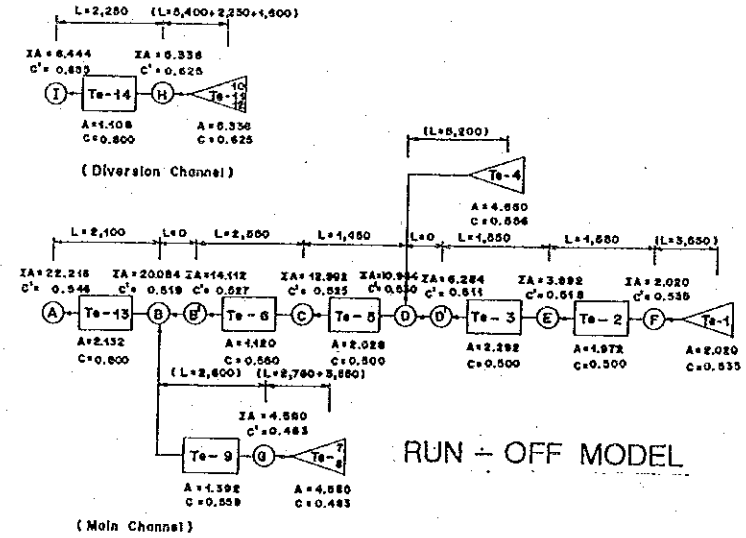


DRAINAGE SYSTEM



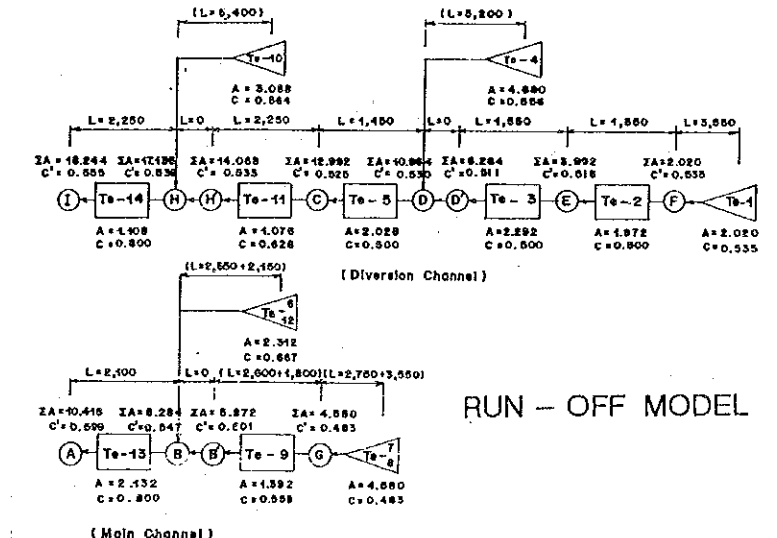
RUN - OFF MODEL

ALTERNATIVE I - A



RUN - OFF MODEL

ALTERNATIVE I - B



RUN - OFF MODEL

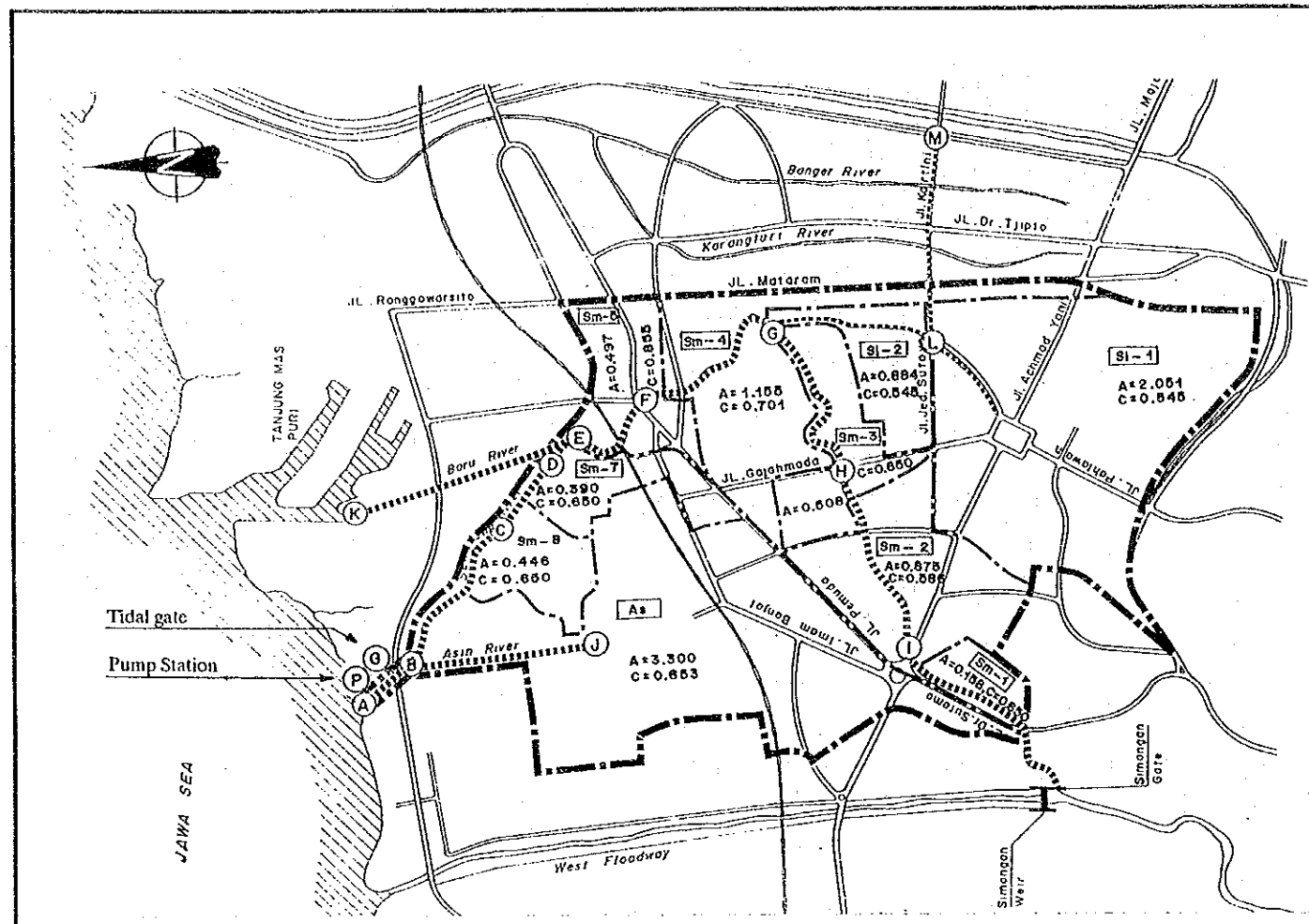
ALTERNATIVE I - C

- LEGEND**
- Ba-1 = Sub-drainage Area
 - Ba-2 = River Channel
 - (A) = Calculation Point
 - A = Drainage Area (Km²)

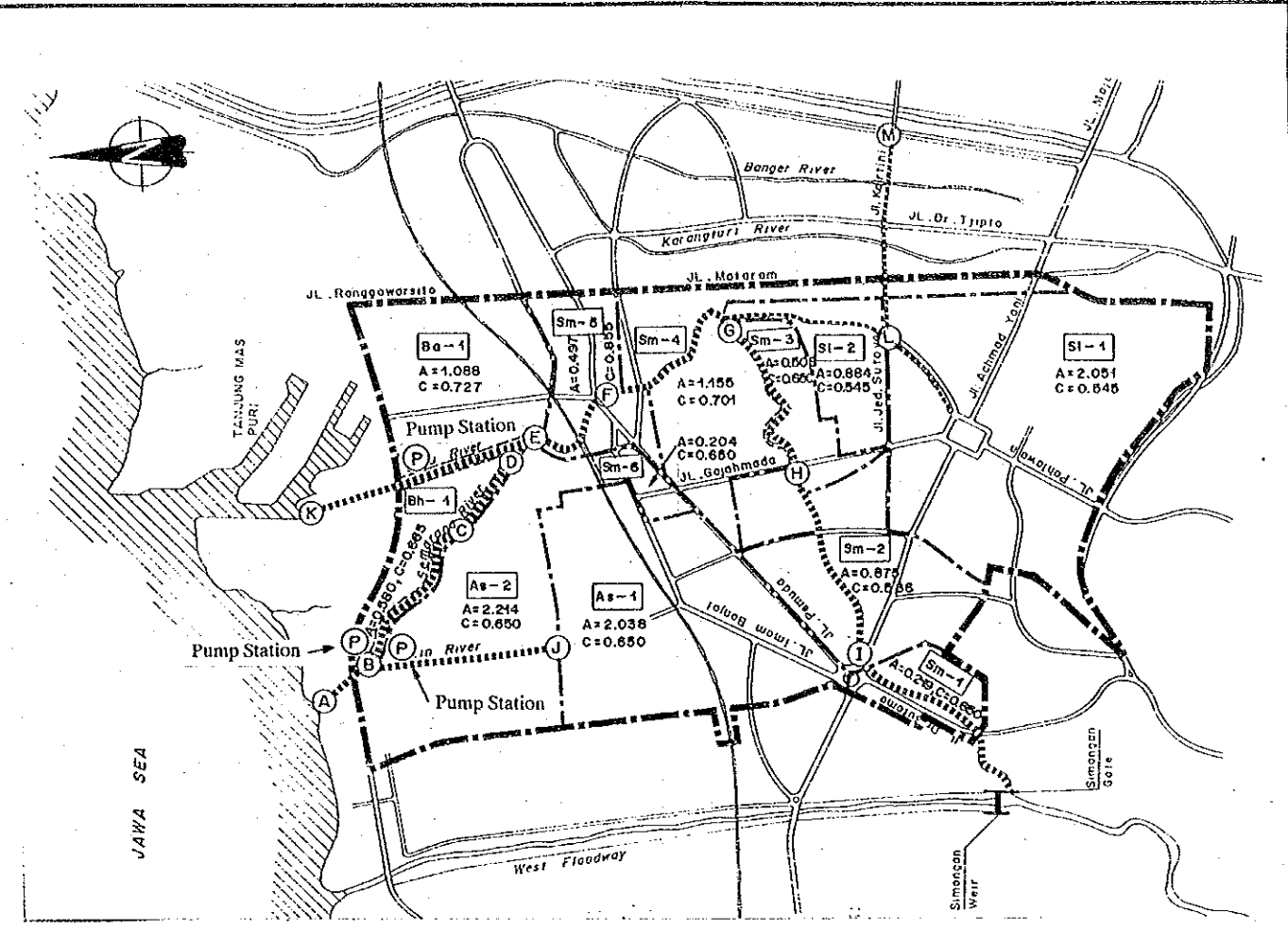
- ΣA = Accumulated Drainage Area (Km²)
- L = Length of River Channel (m)
- C = Run off Coefficient

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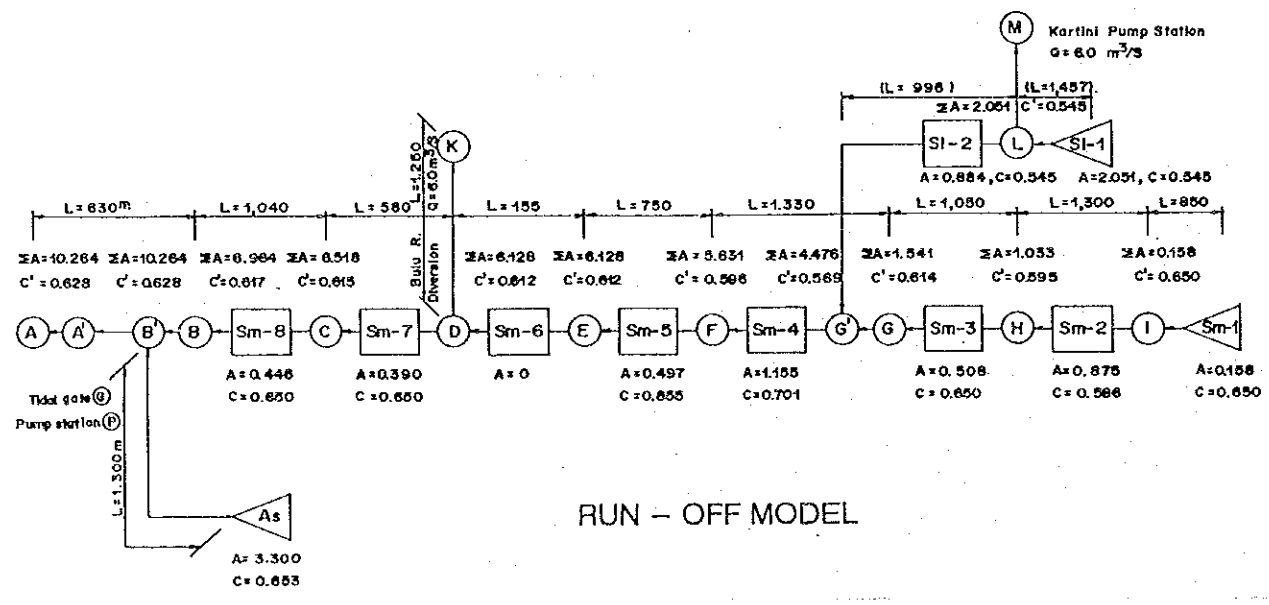
Fig. VI.6.7 (2/7)
ALTERNATIVES OF DRAINAGE SYSTEM
AND RUN-OFF MODEL (TENGGANG RIVER)



DRAINAGE SYSTEM

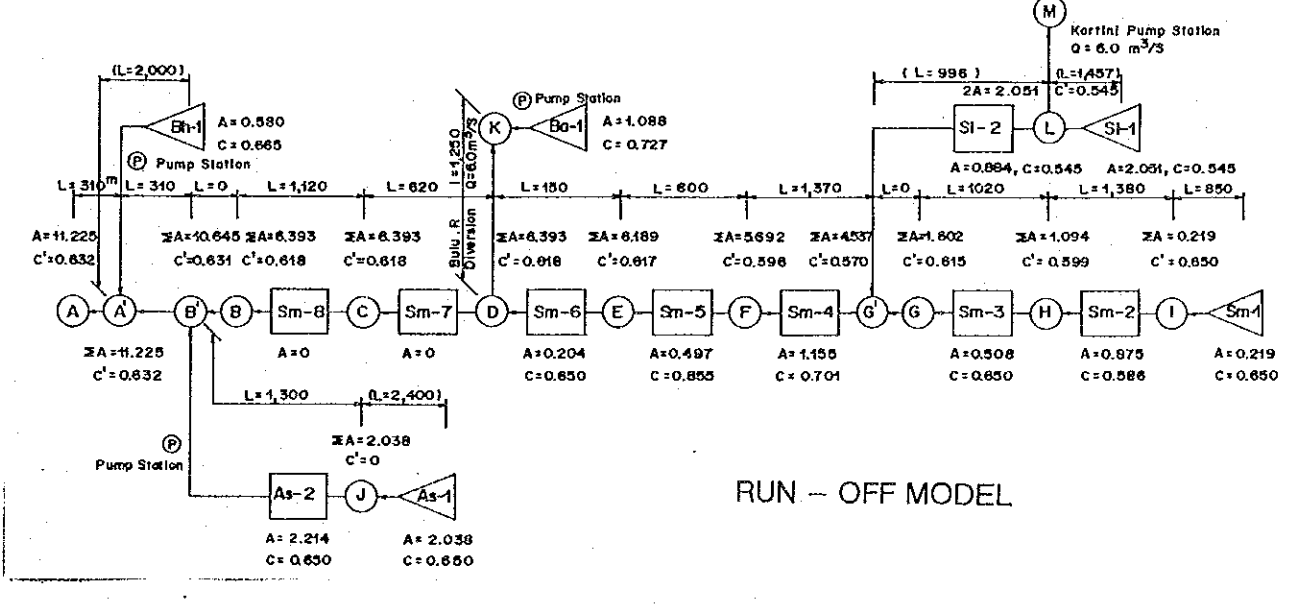


DRAINAGE SYSTEM



RUN - OFF MODEL

ALTERNATIVE 2 - A



RUN - OFF MODEL

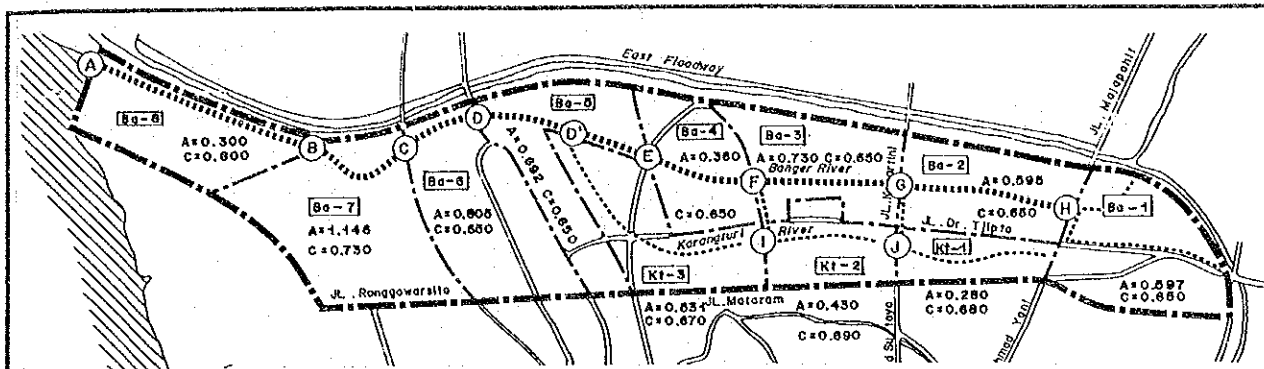
ALTERNATIVE 2 - B

- LEGEND**
- Ba-1 = Sub-drainage Area
 - A = Calculation Point
 - Ba-2 = River Channel
 - A = Drainage Area (Km²)

- ΣA = Accumulated Drainage Area (Km²)
- L = Length of River Channel (m)
- C = Run off Coefficient

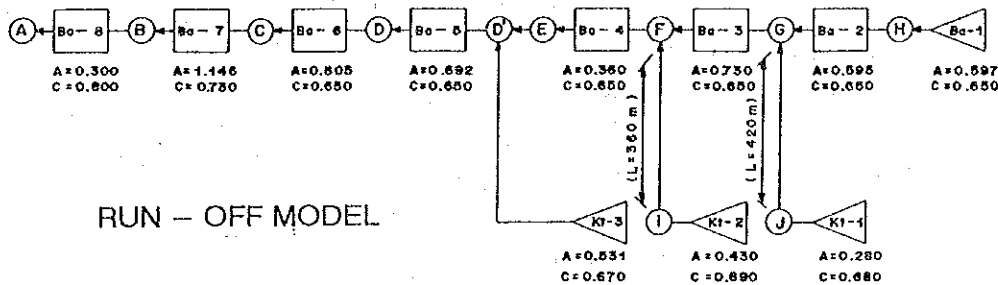
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Fig. VI.6.7(3/7)
ALTERNATIVES OF DRAINAGE SYSTEM
AND RUN-OFF MODEL (SEMARANG RIVER)



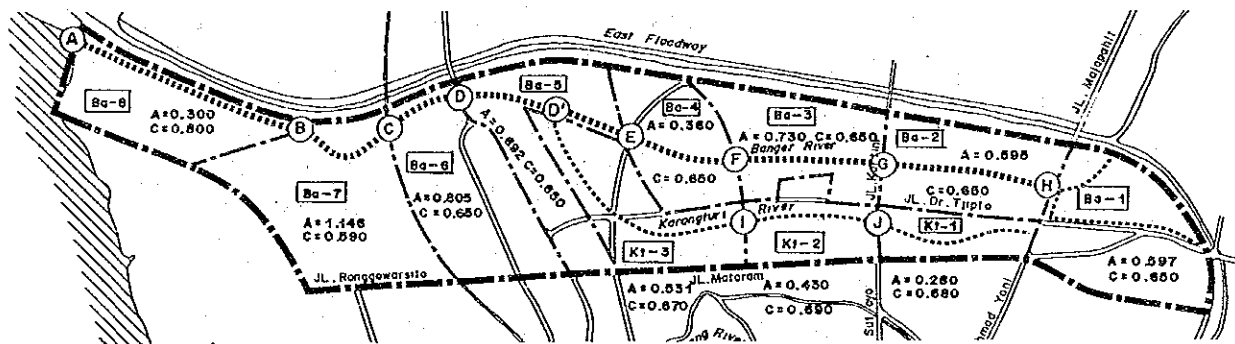
DRAINAGE SYSTEM

L = 1,400 m	L = 690	L = 560	L = 830	L = 420	L = 550	L = 1,150	L = 1,080 (L = 1,400)
IA = 6.466 Km C' = 0.677	IA = 6.166 C' = 0.674	IA = 5.020 C' = 0.657	IA = 4.210 C' = 0.659	IA = 3.523 C' = 0.660	IA = 2.992 C' = 0.659	IA = 2.632 C' = 0.660	IA = 1.472 C' = 0.656



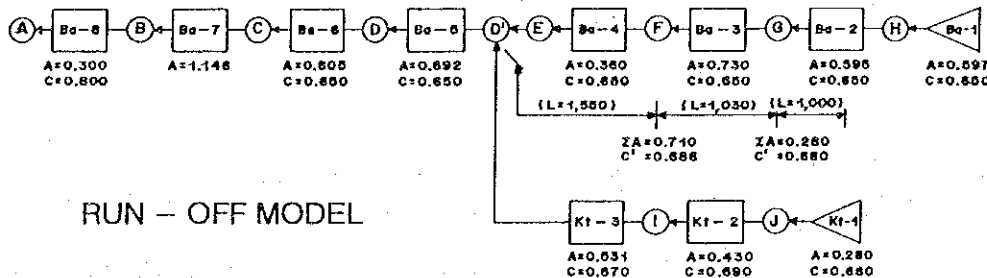
RUN - OFF MODEL

ALTERNATIVE 3 - A



DRAINAGE SYSTEM

L = 1,400 m	L = 690	L = 560	L = 830	L = 420	L = 550	L = 1,150	L = 1,080 (L = 1,400)
IA = 6.466	IA = 6.166	IA = 5.020 C' = 0.657	IA = 4.210 C' = 0.659	IA = 3.523 C' = 0.660	IA = 2.282 C' = 0.660	IA = 1.922 C' = 0.660	IA = 0.597 C' = 0.650

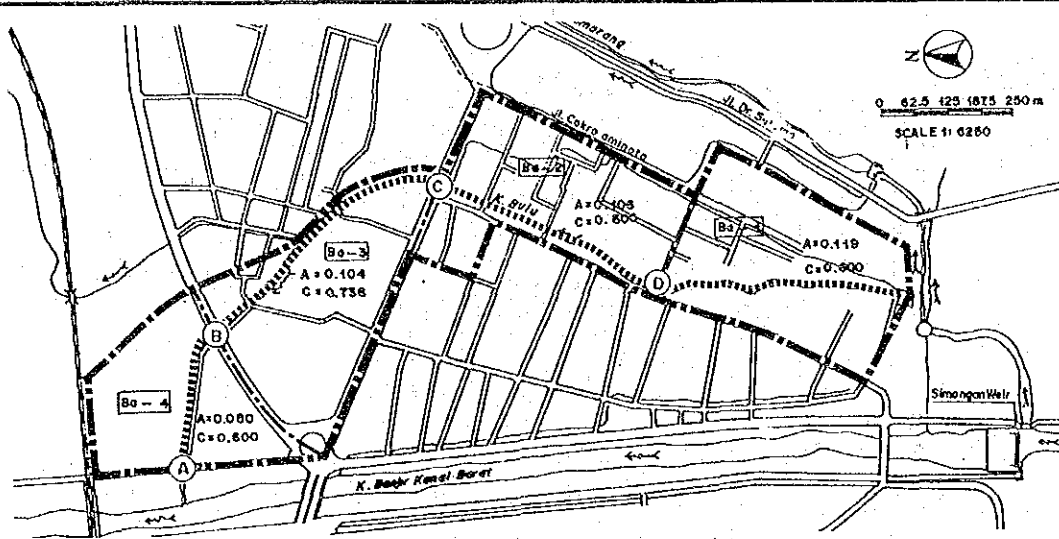


RUN - OFF MODEL

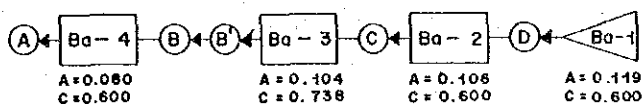
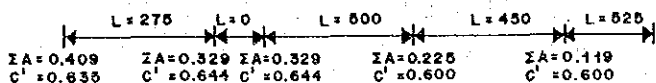
ALTERNATIVE 3 - B

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Fig. VI.6.7 (4/7)
ALTERNATIVES OF DRAINAGE SYSTEM
AND RUN-OFF MODEL (BANGER RIVER)

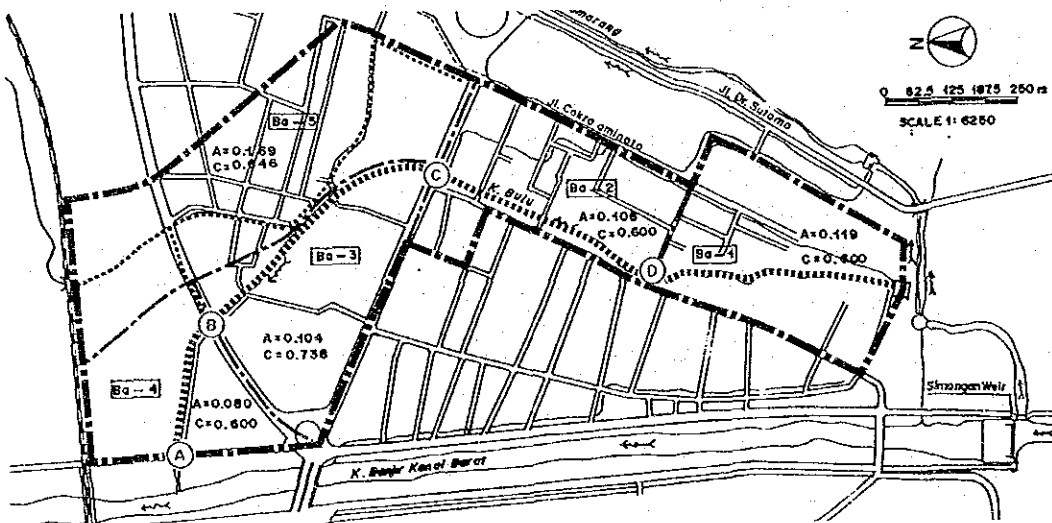


DRAINAGE SYSTEM

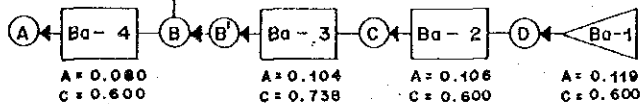
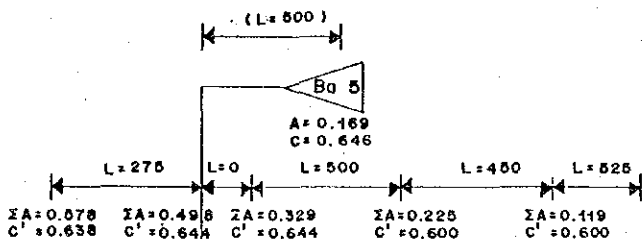


ALTERNATIVE 4 - A

RUN - OFF MODEL



DRAINAGE SYSTEM

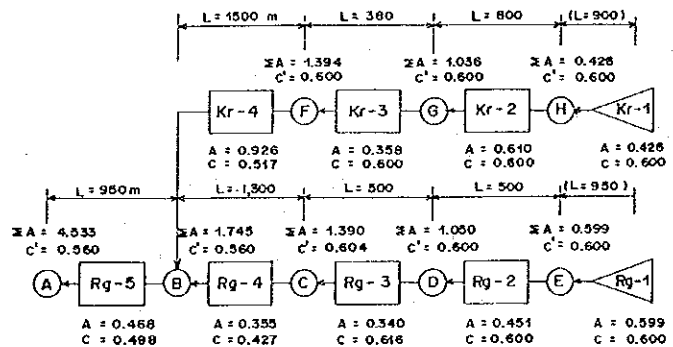
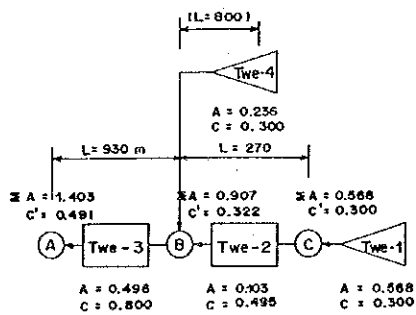
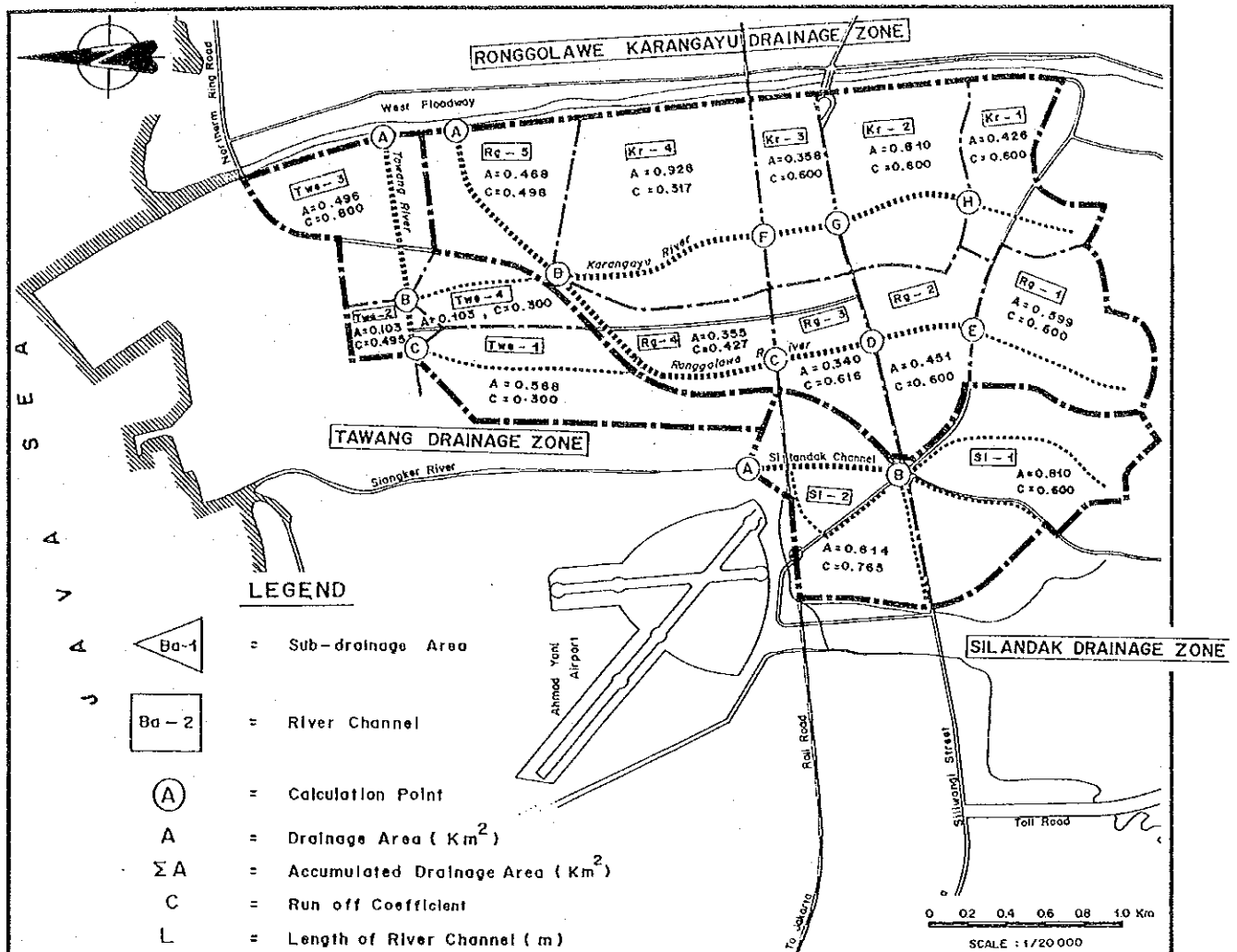


ALTERNATIVE 4 - B

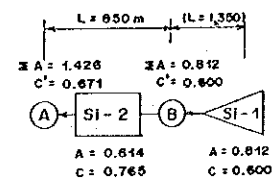
RUN - OFF MODEL

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Fig. VI.6.7(5/7)
ALTERNATIVES OF DRAINAGE SYSTEM
AND RUN-OFF MODEL (BULU RIVER)



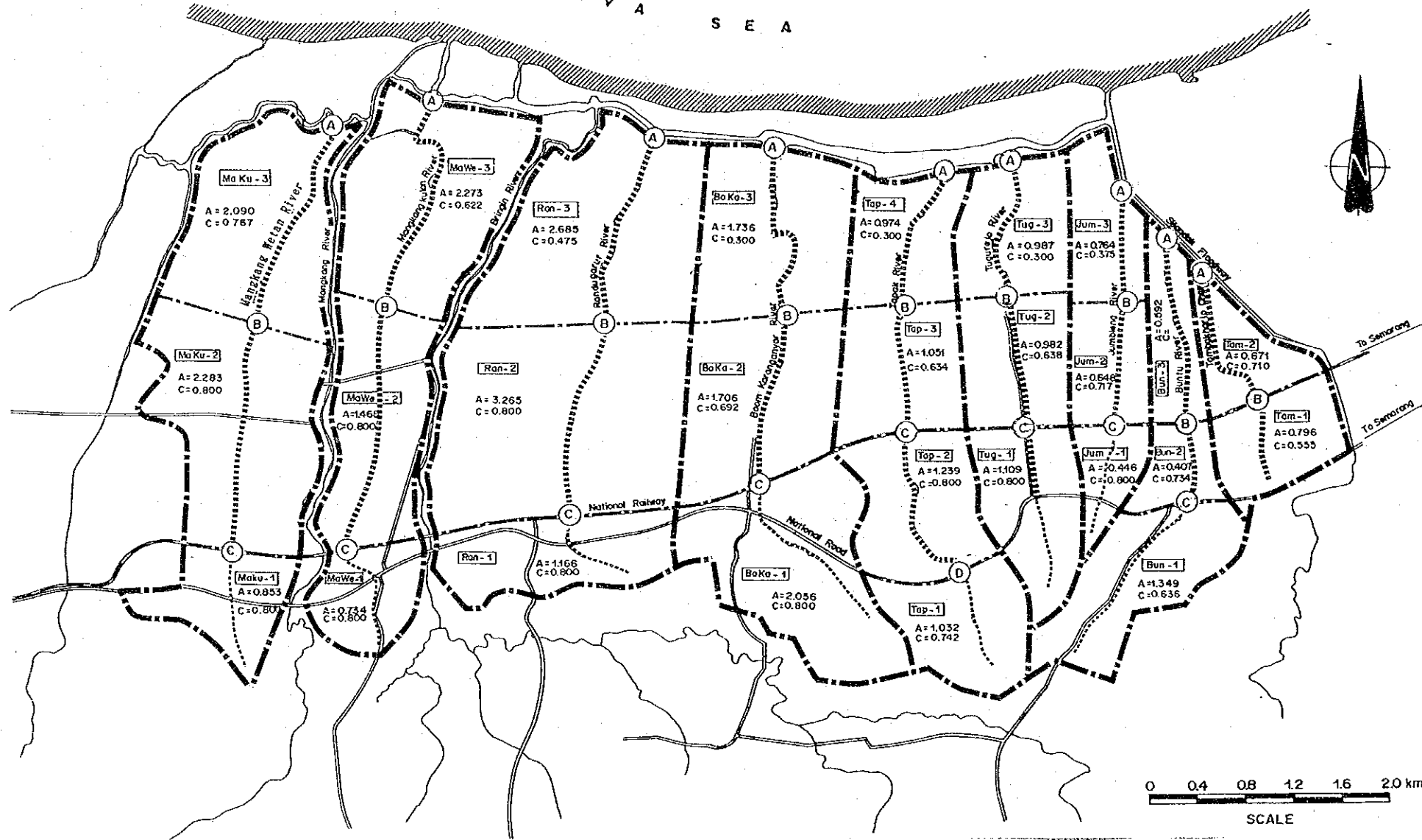
RUN - OFF MODEL



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URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
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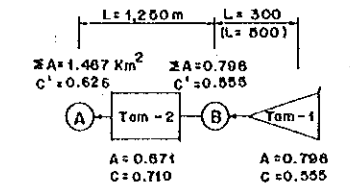
Fig. VI.6.7(6/7)
PROPOSED DRAINAGE SYSTEM AND
RUN-OFF MODEL (WESTERN SEMARANG AREA)

J A V A S E A

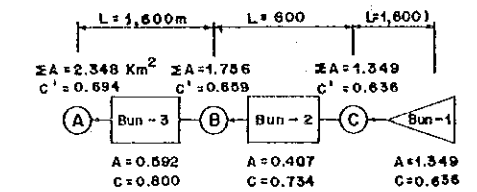


DRAINAGE SYSTEM

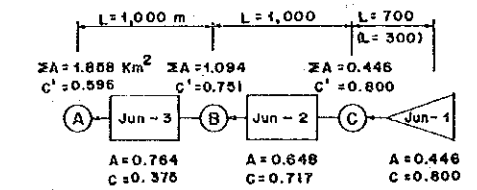
TAMBAKHARJO DRAINAGE SYSTEM



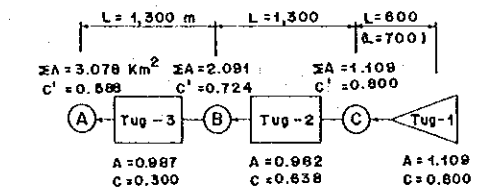
BUNTU DRAINAGE SYSTEM



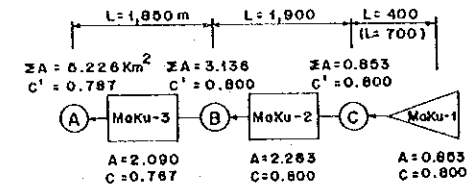
JUMBLENG DRAINAGE SYSTEM



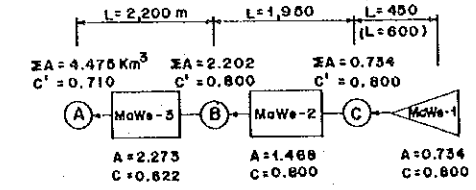
TUGUREJO DRAINAGE SYSTEM



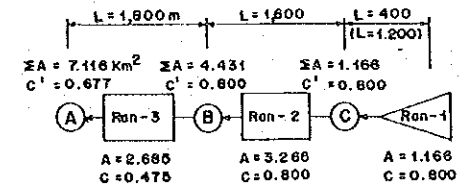
MANGKANG KULON DRAINAGE SYSTEM



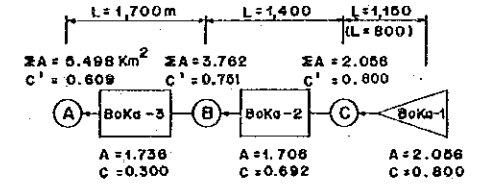
MANGKANG WETAN DRAINAGE SYSTEM



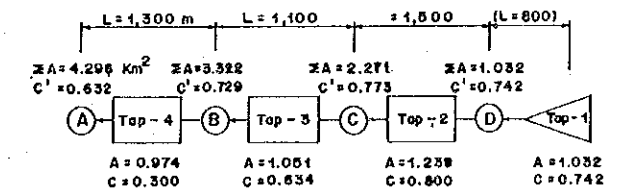
RANDUGARUT DRAINAGE SYSTEM



BOOMKARANGANYAR DRAINAGE SYSTEM



TAPAK DRAINAGE SYSTEM



LEGEND

- = Sub-drainage Area
- = Calculation Point
- = River Channel
- ΣA = Accumulated Drainage Area (Km²)
- L = Length of River Channel (m)
- A = Drainage Area (Km²)
- C = Run off Coefficient

RUN - OFF MODEL

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Fig. VI.6.7 (7/7)
PROPOSED DRAINAGE SYSTEM AND RUN-OFF MODEL (KEC. TUGU AREA)