

The proposed site has favourable conditions for pump drainage, construction and maintenance.

2.4.3 Khal Improvement and Drainage Pipe

(1) Proposed Drainage Networks

Considering the existing drainage system, the topographic conditions, and future land use, the networks of the trunk drainage lines are proposed as illustrated in Fig. N.15.

(2) Design Discharge

- Division of sub-drainage area

Based on the proposed drainage lines, future land use and existing topographic condition, sub-drainage areas of D Zone, H-I and H-II areas are divided into 16, 15 and 9 blocks, respectively, as shown in Fig. N.15.

- Runoff coefficient of sub-drainage area

Runoff coefficient of sub-drainage areas are estimated as shown in Table N.10 and Fig. N.15, based on the proposed standard runoff coefficient and the future land use map.

- Design discharge

The design discharges with a 5-year frequency of short duration rainfall were calculated for each stretch of the proposed khals by the Rational Formula. The calculation results are shown in Fig. N.16 and N.17.

Table N.10 Area and Runoff Coefficient of Sub-Drainage Area

D Zone			H-I Area			H-II Area		
Area No.	A (km ²)	C	Area No.	A (km ²)	C	Area No.	A (km ²)	C
D.1	0.30	0.523	H.1.	0.67	0.508	H.15	0.21	0.300
D.2	0.72	0.500	H.2	0.35	0.515	H.16	0.27	0.455
D.3	0.39	0.515	H.3	0.46	0.515	H.17	0.74	0.460
D.4	0.34	0.410	H.4	0.27	0.525	H.18	0.28	0.300
D.5	0.36	0.350	H.5	0.74	0.320	H.19	0.23	0.360
D.6	0.60	0.313	H.6	0.37	0.470	H.20	0.66	0.330
D.7.	0.50	0.515	H.7	0.83	0.505	H.21	0.33	0.440
D.8	0.30	0.515	H.8	0.34	0.500	H.22	0.41	0.390
D.9	0.50	0.523	H.9	0.64	0.490	H.23	0.25	0.410
D.10	0.16	0.508	H.10	0.89	0.508			
D.11	0.78	0.515	H.11	0.91	0.515			
D.12	0.45	0.343	H.12	0.53	0.500			
D.13	0.67	0.518	H.13	0.52	0.515			
D.14	0.29	0.440	H.14	0.67	0.408			
D.15	0.30	0.214	Others	1.21	0.473			
Others	0.79	0.246						
Total	7.46	0.432	Total	9.40	0.480	Total	3.38	0.390

(3) Proposed Khal Improvement and Drainage Pipe

Based on the design discharge, existing topographic conditions and future land use, the longitudinal and cross sections of the proposed Khal Improvements and the drainage pipes were estimated by the Manning's Formula. In the course of the hydraulic calculations, it is assumed that the proposed khals and the drainage pipes are under the free-flow conditions respectively.

- D Zone

The existing khals are widened or dredged in 14 stretches to drain a total catchment area of 6.67 km². The total improvement length reaches 11.65 km. An additional line of trunk drainage pipe with a diameter of 2.2 m and a length of 1.45 km is to be constructed to drain the Rajabagh area of 0.5 km². The proposed cross sections of the khal improvements and drainage pipe are illustrated in Fig. N.16.

- H-I Area

The existing khals are to be improved in 13 stretches to drain a total catchment area of 8.19 km². The total improvement length reaches 12.60 km. An additional line of trunk drainage pipe with a diameter of 2.8 m and a length of 0.8 km is to be installed to drain the Mirupur area of 0.64 km². The proposed cross sections of the khal improvements and drainage pipe are illustrated in Fig. N.17.

- H-II Area

This area has been fully urbanized and the trunk drainage pipes has constructed along the Dhaka-Aricha Rd. Their capacities, however, are not enough for the design discharge. So, the additional trunk drainage pipe consisted of the box culvert ranging from 3.0x3.0 m to 3.6x3.6 m and the pipes ranging from 1.6 to 3.0 m in dia. are proposed to drain a total catchment area of 3.38 km². The total length is 7.7 km on the 9 routes. The proposed cross sections of the khals and drainage pipes are illustrated in Fig. N.16.

The locations of the proposed facilities in D and H zones are illustrated in Fig. N.18 and Fig. N.19, respectively. The proposed facilities are summarized in Table N.11 to N.16.

Table N.11 Proposed

Zone	Design Flood Level (m G.T.S.)	Crown Level (m G.T.S.)	Free Board (m)	Length (m)	Remarks
D	6.60	7.60	1.00	5,000	
H	7.30	8.30	1.00	3,000	H-I area

Table N.12 Proposed Flood Gate

Zone	Gate No.	Width (m)	Height (m)	Unit	Remarks
D	G-1	6.00	6.00	1	Khilgaon P.S.
	G-2	6.00	6.00	1	
H	G-1	6.00	6.00	1	Kallyanpur P.S.
	G-2	2.00	2.00	1	
	G-3	2.00	2.00	1	

Table N.13 Proposed Pump Station

Zone	Name	Proposed Capacity (m ³ /sec)	Remarks
D	Khilgaon	8.5	
H	Kallyanpur P.S	10.7	H-I Area

Table N. 14 Proposed Regulating Pond

Zone	Name	Proposed Area (km ²)	Proposed Effective Storage Capacity (m ³)	Remarks
D	Khilgaon	0.75	975,000	
H	Kallyanpur	1.15	1,263,000	H-I Area

Table N.15 Proposed Khal Improvement

Zone (Area)	Khal No.	Longitudinal Section			Cross Section		
		No	Length (m)	Type	Min. Required Size (m)		
					Bottom Width	Top Width	Height
D	DK-1	1	600	Trapezoidal	2.0	7.0	2.5
	DK-2	1	750	do	3.5	10.5	3.5
		2	1,050	do	1.5	8.5	3.5
		3	600	do	2.5	7.5	2.5
	DK-3	1	800	do	1.5	6.5	2.5
	DK-4	1	950	do	2.0	7.0	2.5
	DK-5	1	1,050	Rectangular	5.5	5.5	4.5
		2	1,000	do	5.5	5.5	4.5
		3	1,150	do	3.5	3.5	3.0
		4	650	do	4.5	4.5	3.5
		5	350	do	3.5	3.5	3.0
	DK-6	1	1,000	do	4.0	4.0	3.5
		2	400	do	4.0	4.0	3.5
	Sub-Total			11,650	-	-	-
	H (H-I)	HK-1	1	600	Rectangular	7.0	7.0
2			600	do	5.5	5.5	4.5
3			600	do	5.0	5.0	4.5
4			1,400	do	3.5	3.5	3.5
5			1,600	do	4.0	4.0	3.5
6			1,200	do	3.5	3.5	3.0
7			700	do	3.5	3.5	3.0
8			600	do	3.5	3.5	3.0
HK-2		1	1,150	Trapezoidal	4.5	13.5	4.5
		2	1,450	do	4.0	11.0	3.5
		3	1,000	do	2.5	9.5	3.5
HK-3		1	600	do	1.5	8.5	3.5
HK-4		1	900	Rectangular	3.5	3.5	3.5
Sub-Total			12,600	-	-	-	
Total			24,250				

Table N.16 Proposed Drainage Pipe

Zone (Area)	Route No.	Route Length (m)	Cross Section	
			Type	Size
D	D-1	1,450	Pipe	∅2,200
	Sub-Total	1,450	-	-
H	D-10	800	Pipe	∅2,800
(H-I)	Sub-Total	800	-	-
H	D-1	1,250	Box Culvert	3,600 x 3,600
(H-II)	D-2	500	do	3,000 x 3,000
	D-3	600	Pipe	∅2,300
	D-4	850	do	∅1,600
	D-5	1,400	do	∅2,100
	D-6	1,100	do	∅2,400
	D-7	500	do	∅2,100
	D-8	1,100	do	∅3,000
	D-9	400	do	∅1,800
	Total	9,950	-	-

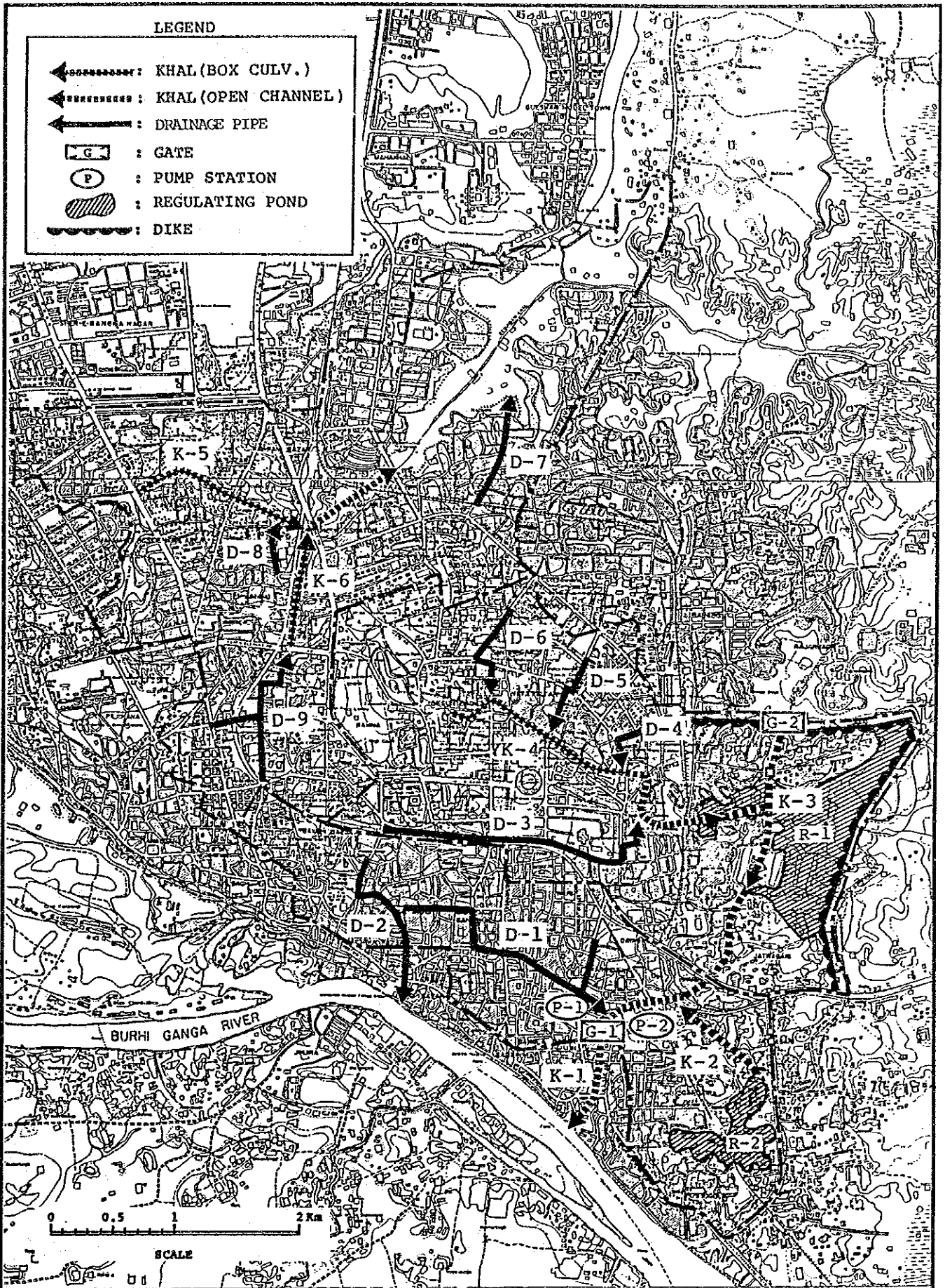
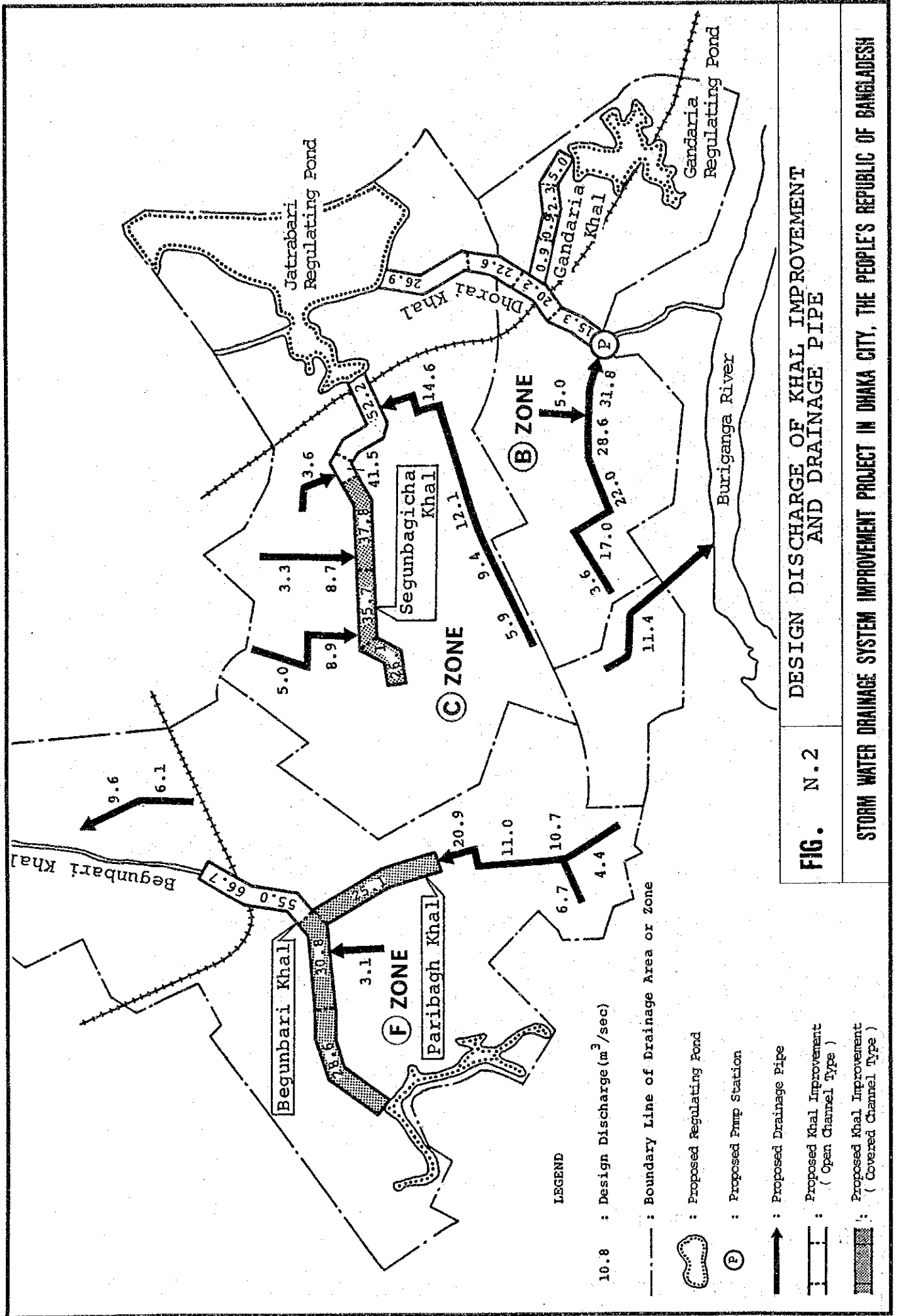


FIG. N.1

**PROPOSED FLOOD PROTECTION AND DRAINAGE SYSTEM
(COVERED CHANNEL TYPE)**

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



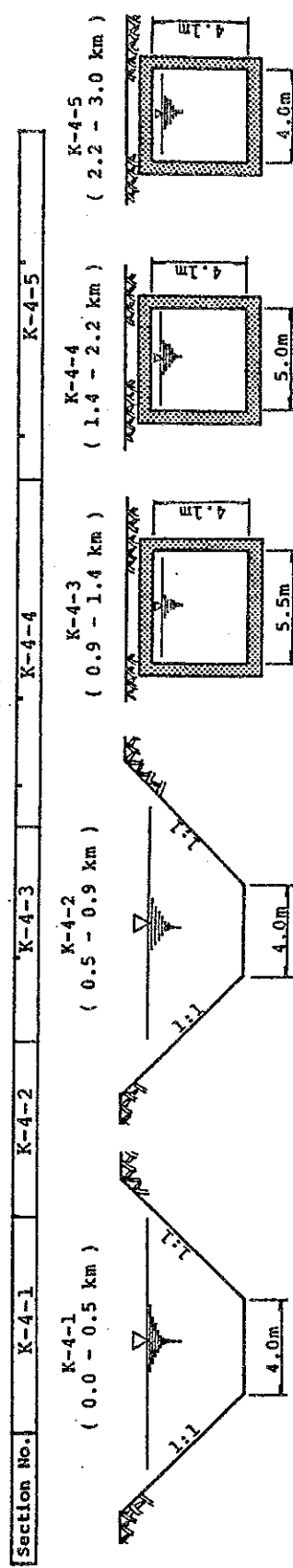
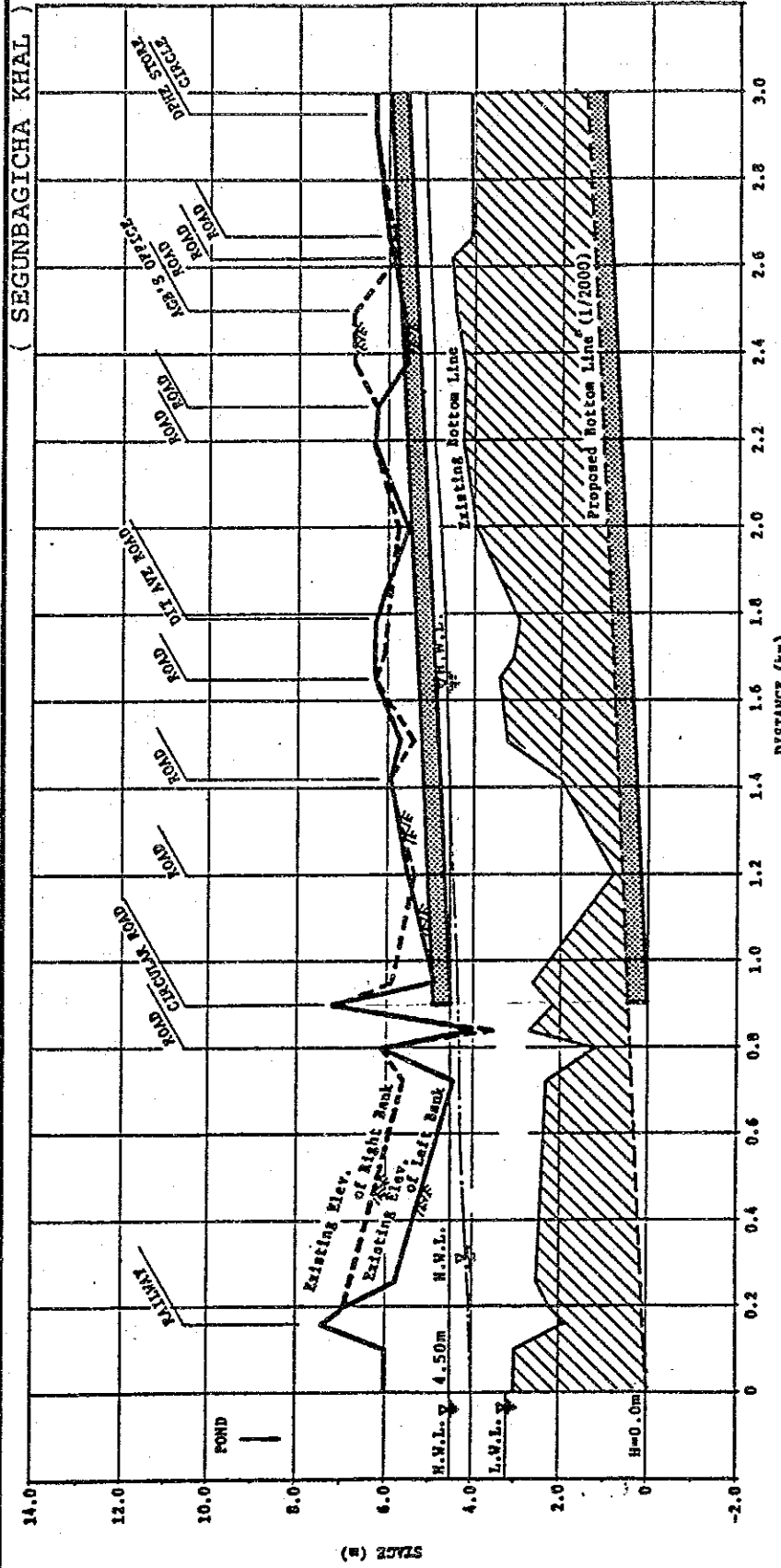


FIG. N.3 PROPOSED LONGITUDINAL AND CROSS SECTIONS OF SEGUNBAGICHA KHAL (COVERED CHANNEL TYPE)

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

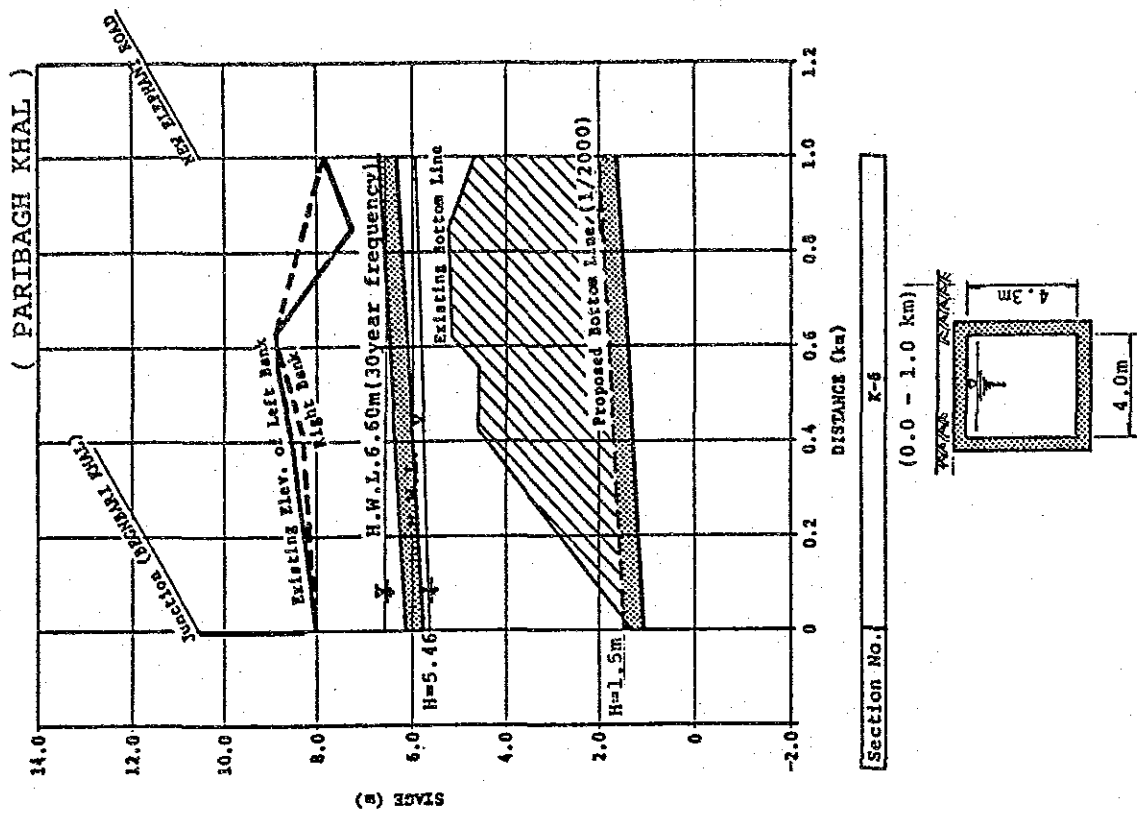


FIG. N.4 PROPOSED LONGITUDINAL AND CROSS SECTIONS OF PARIBAGH KHALS (COVERED CHANNEL TYPE)

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLES REPUBLIC OF BANGLADESH

(BEGUNBARI KHAL)

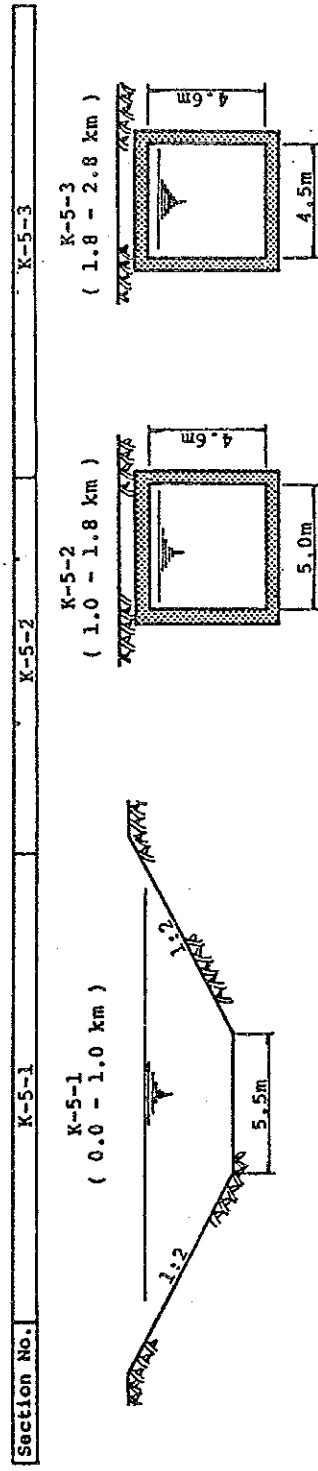
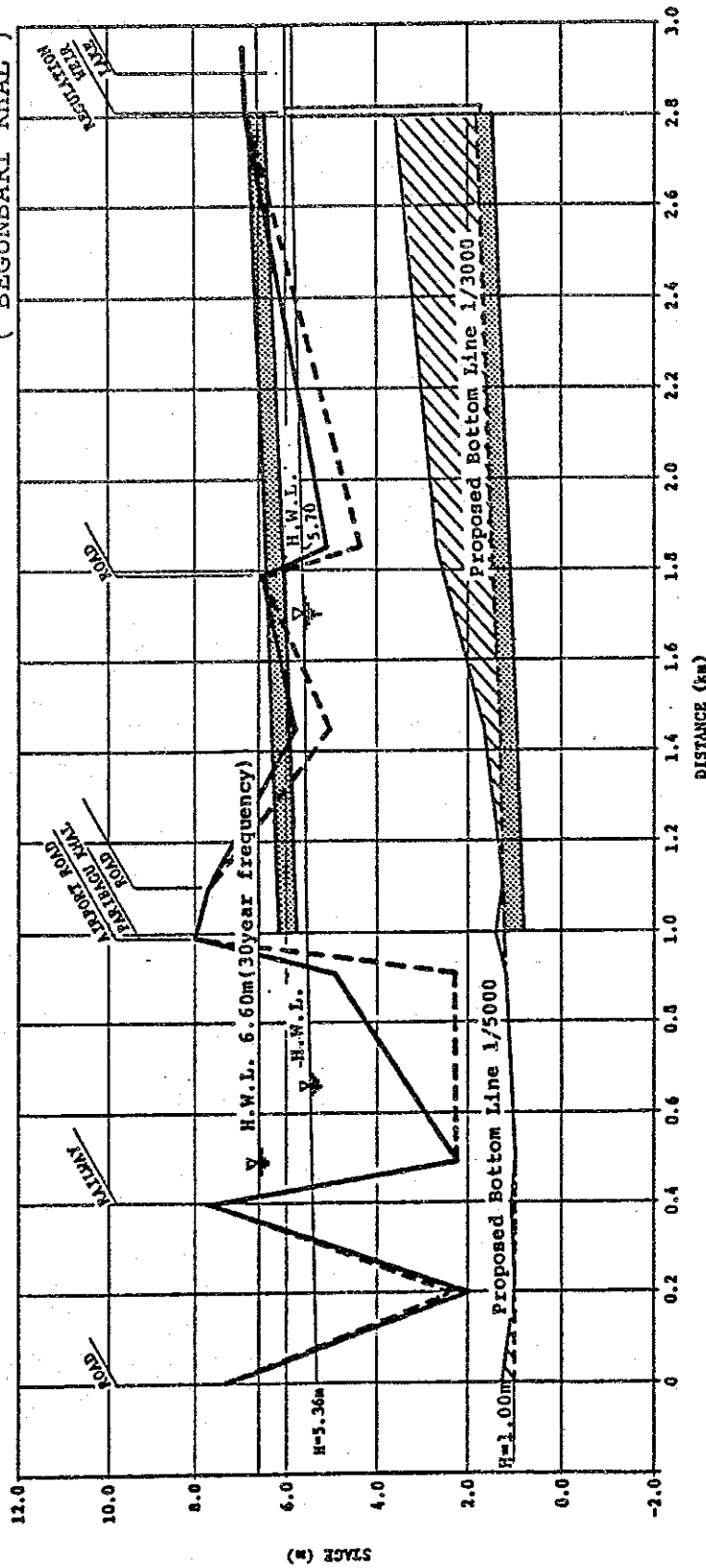


FIG. N.5 PROPOSED LONGITUDINAL AND CROSS SECTIONS OF BEGUNBARI KHAL (COVERED CHANNEL TYPE)

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

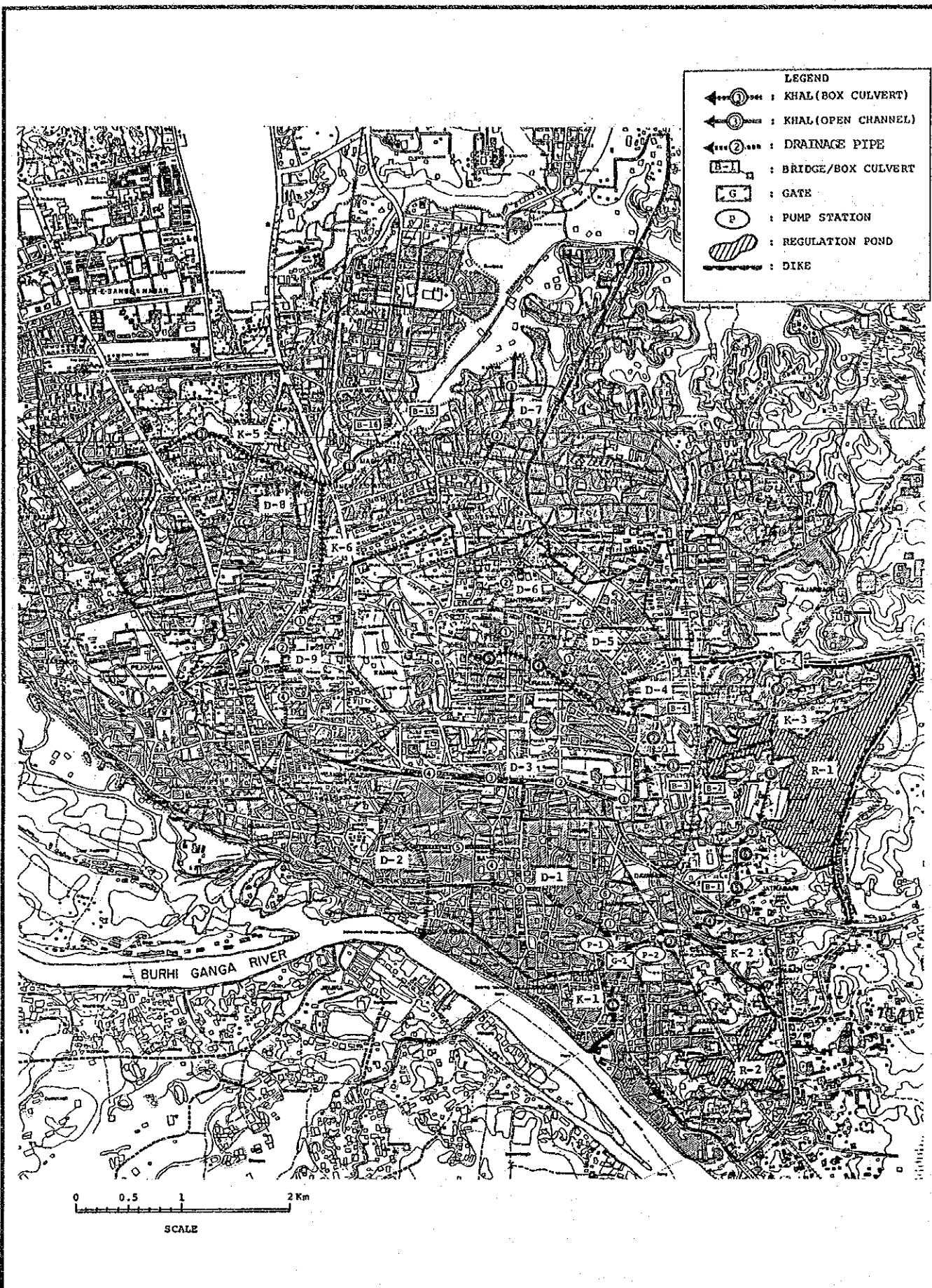
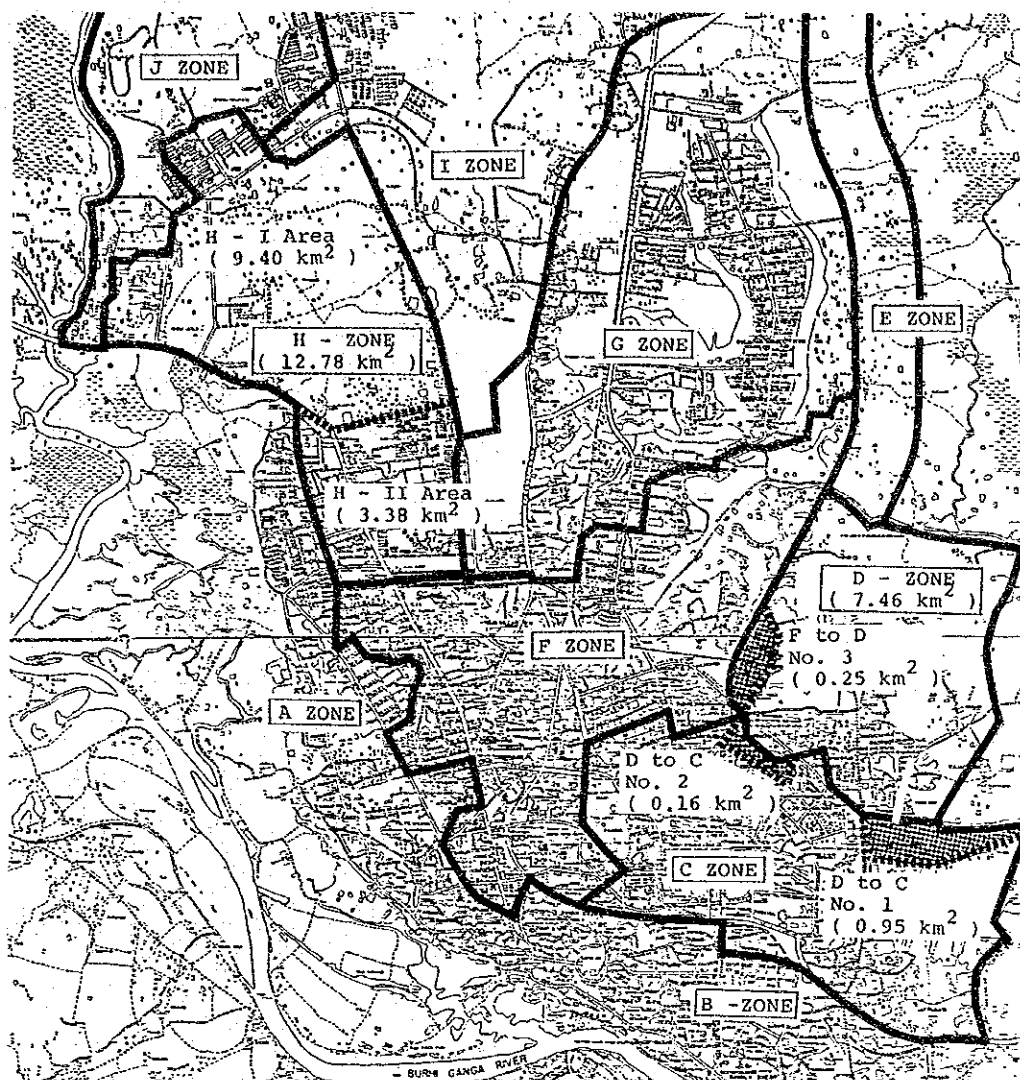


FIG. N.6 PROPOSED FLOOD PROTECTION AND DRAINAGE FACILITIES
(COVERED CHANNEL TYPE)

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



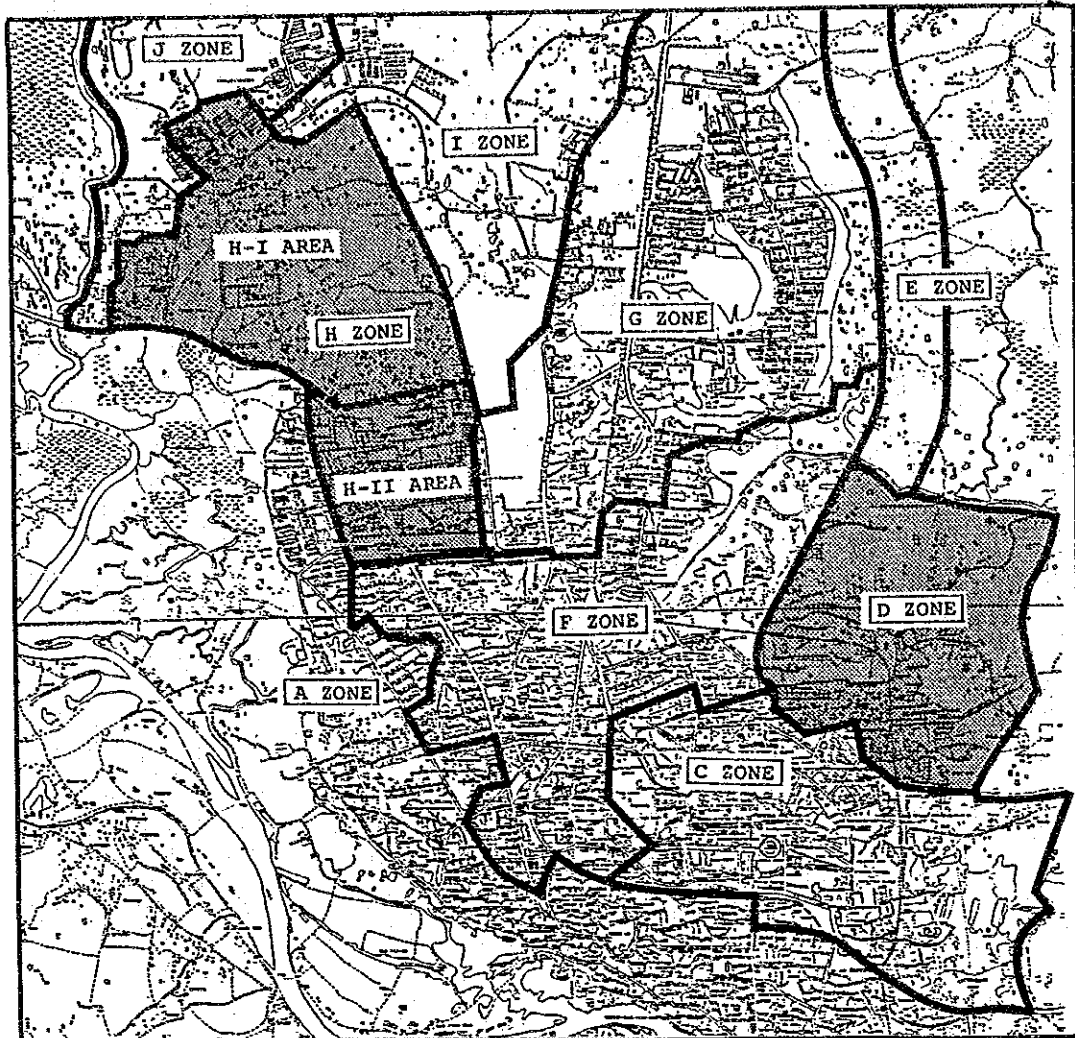
AREA OF DRAINAGE DONE Unit : km²

DRAINAGE ZONE	ORISINAL	REVISED
A : BURIGANGA RIVER ZONE	12.85	15.23
B : DHOLAI KHAL ZONE	7.76	6.68
C : SEGUNBAGICHA KHAL ZONE	9.04	10.92
D : BASHABO ZONE	8.32	7.46
E : NORTH-EAST EDGE ZONE	13.93	13.93
F : BEGUNBARI KHAL ZONE	16.02	13.70
G : GULSHAN-BANANI ZONE	17.64	17.64
H : KALLYANPUR ZONE	12.78	12.78
I : NORTH ZONE	31.42	31.42
J : TURAG RIVER BANK ZONE	7.69	7.69
TOTAL AREA	137.45	137.45

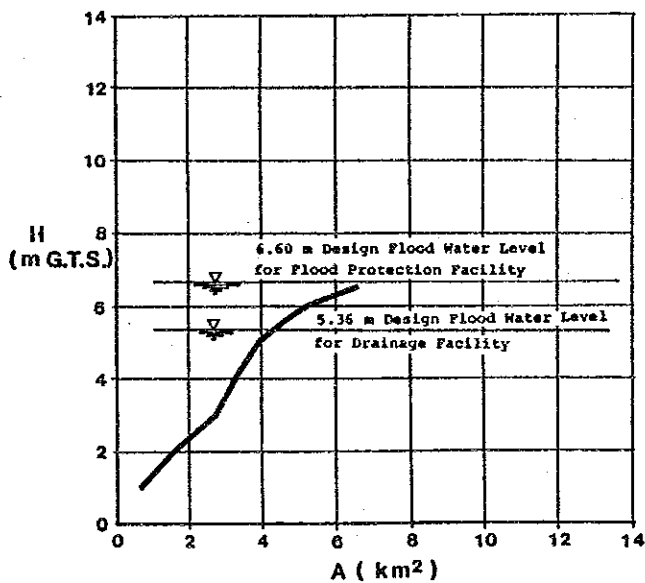
FIG. N.7

REVISION OF DRAINAGE ZONE BOUNDARY

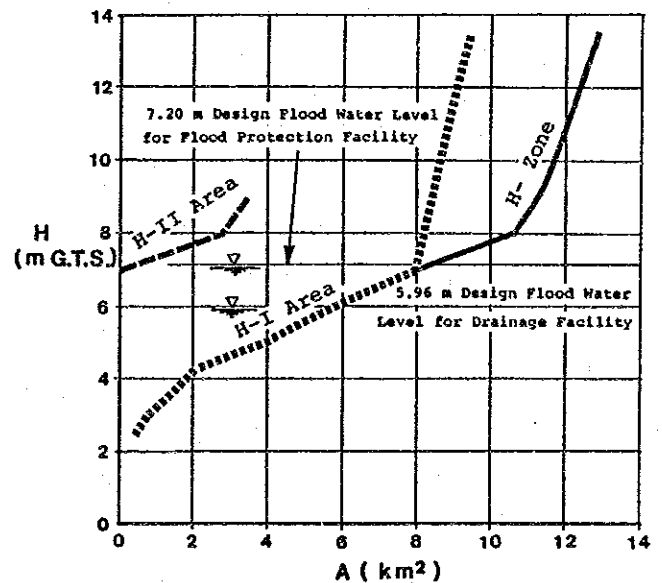
STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



Plan



D Zone

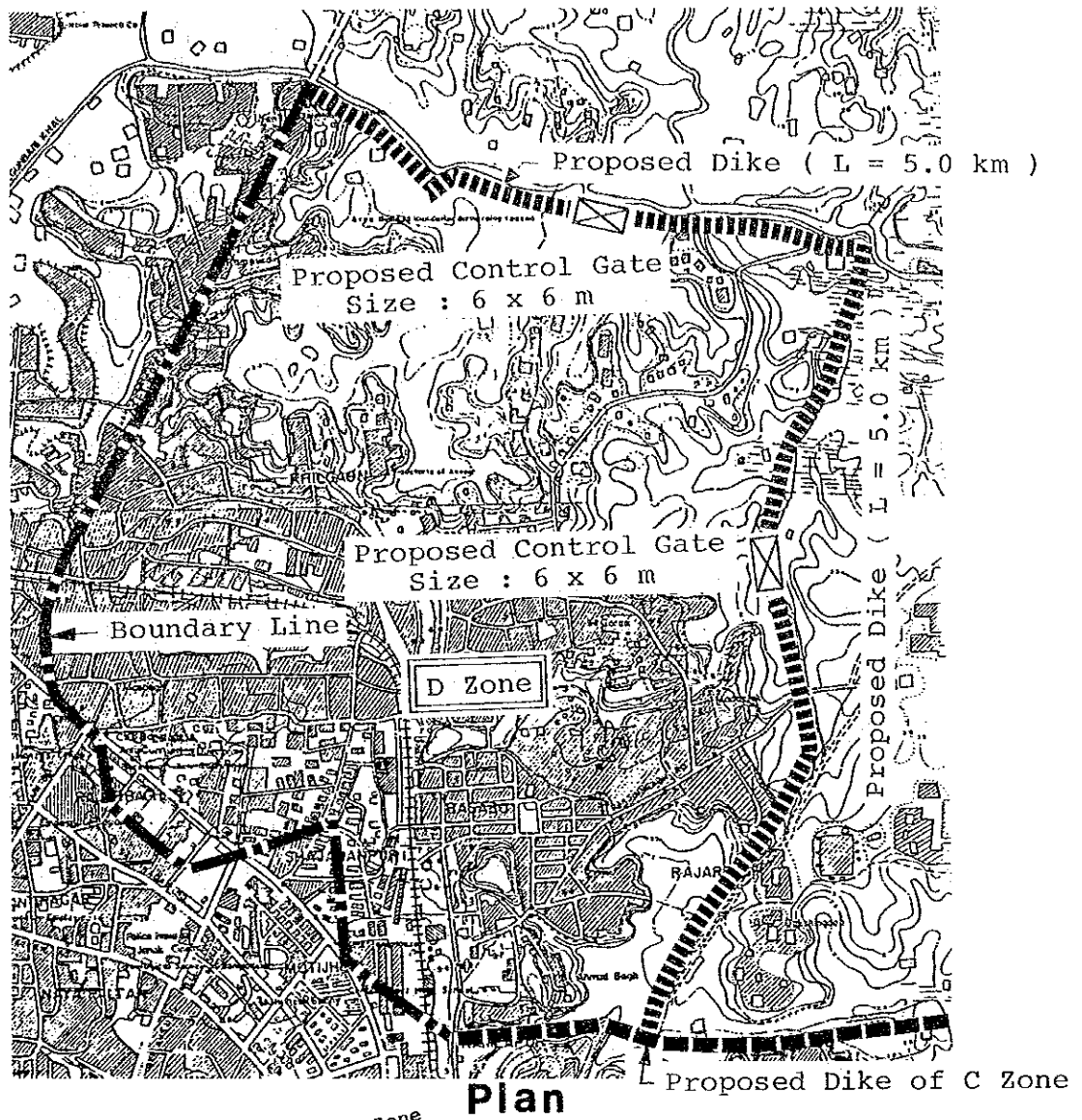


H Zone

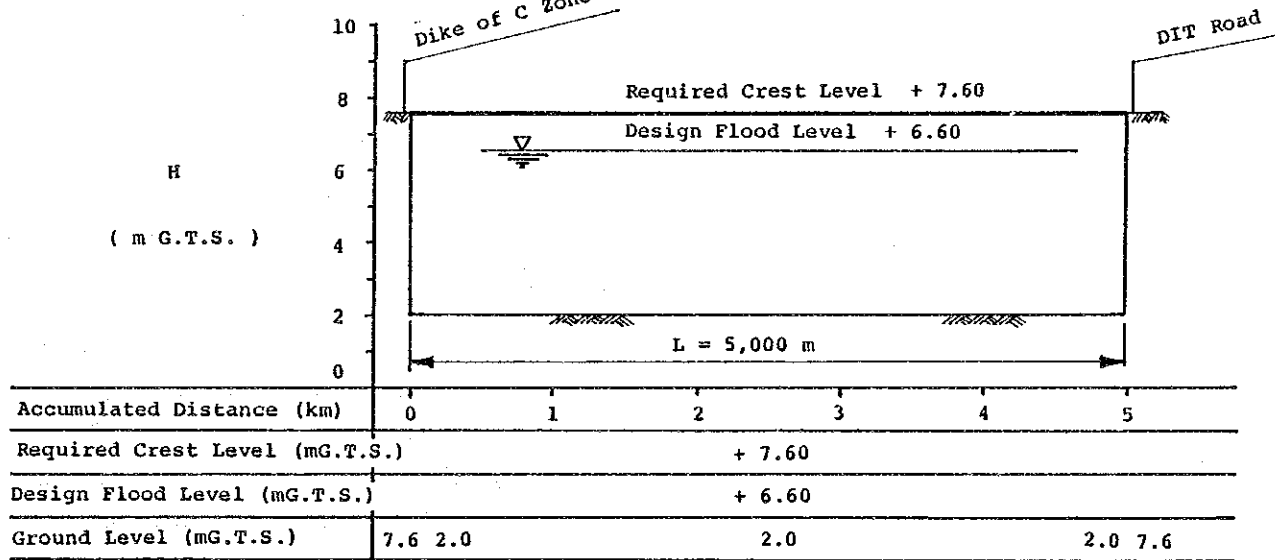
FIG. N.8

GROUND ELEVATION AND AREA CURVES

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



Plan

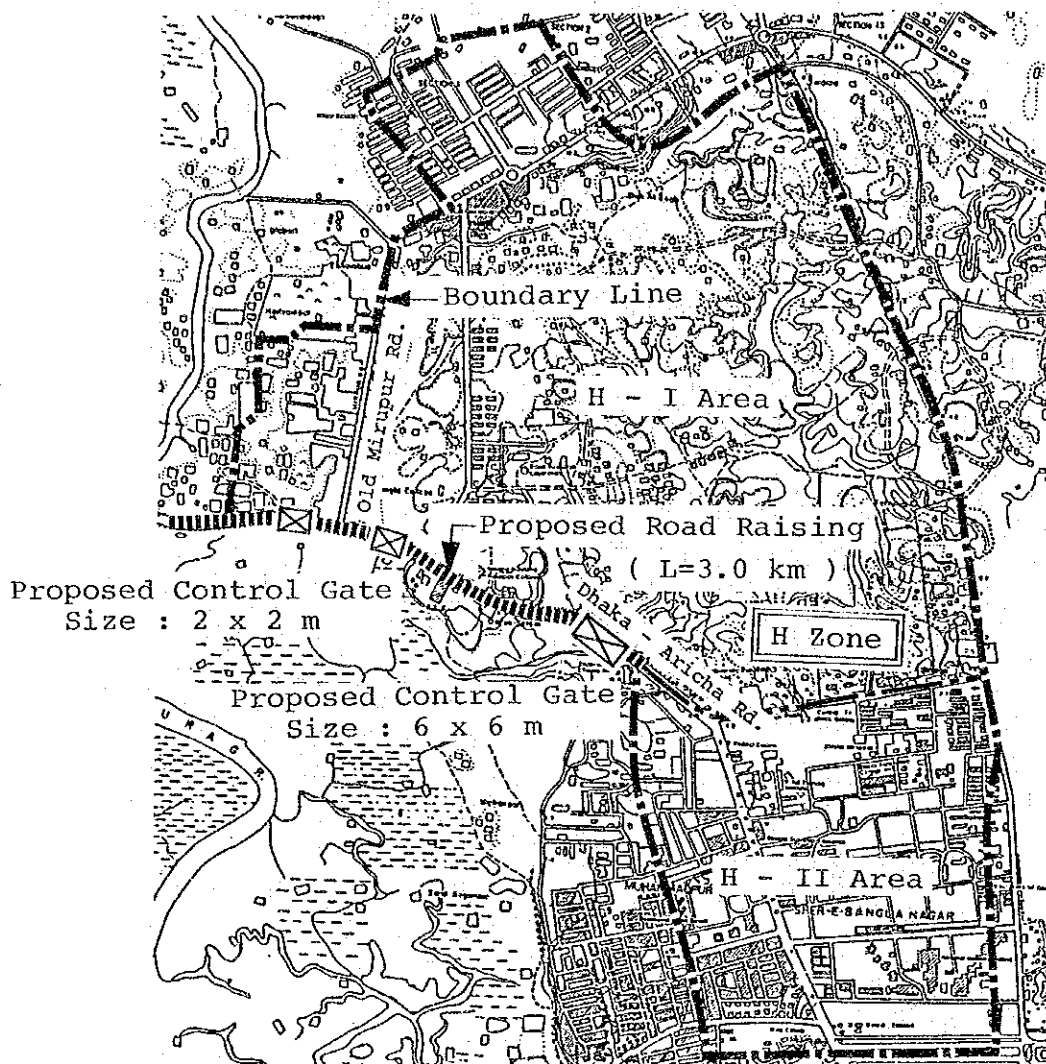


Profile

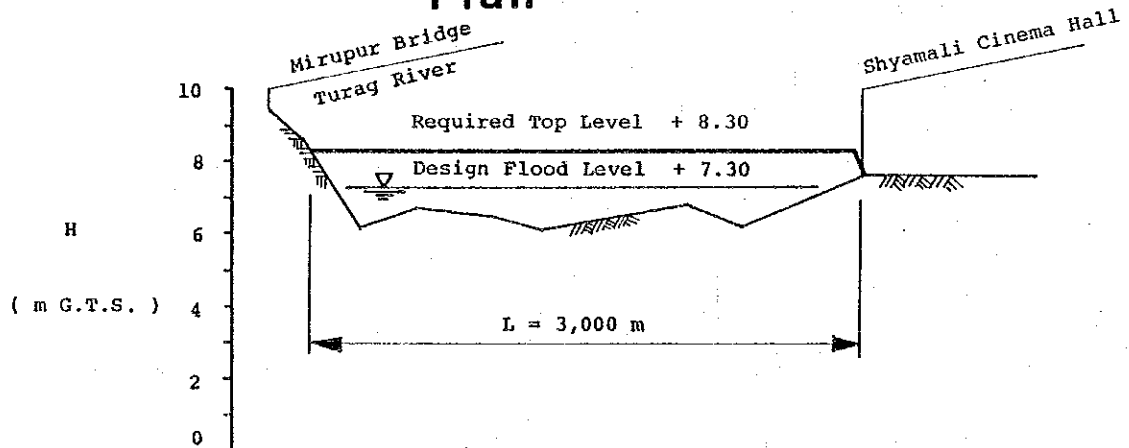
FIG. N.9

PROPOSED DIKE ALIGNMENT OF D ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



Plan



Accumulated Distance (km)	0	1	2	3	4
Required Crest Level (mG.T.S.)	+ 8.30				
Design Flood Level (mG.T.S.)	+ 7.30				
Ground Level (mG.T.S.)	8.6	6.2	6.7	6.2	6.8 6.2 7.6

Profile

FIG. N.10 PROPOSED DIKE ALIGNMENT OF H ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

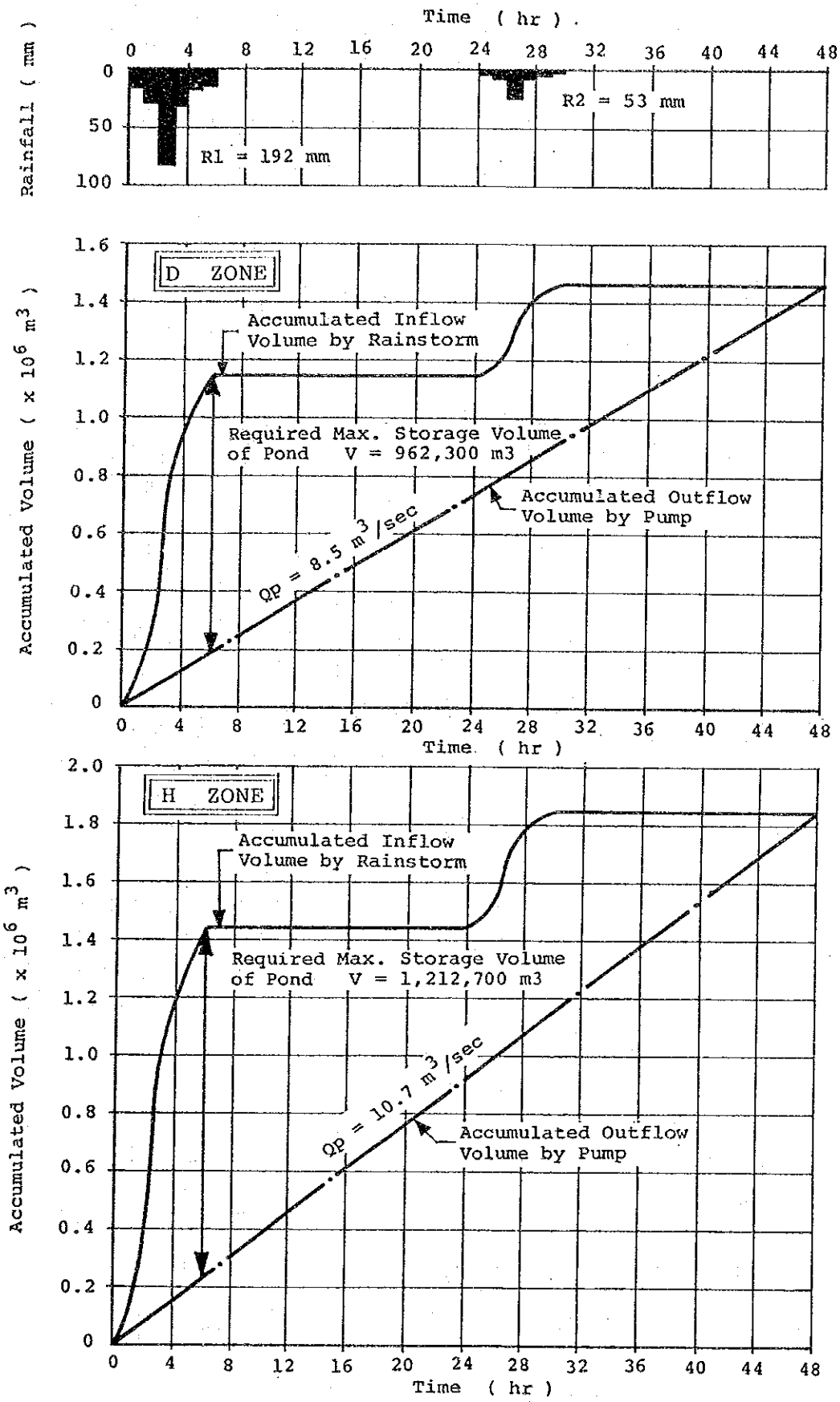
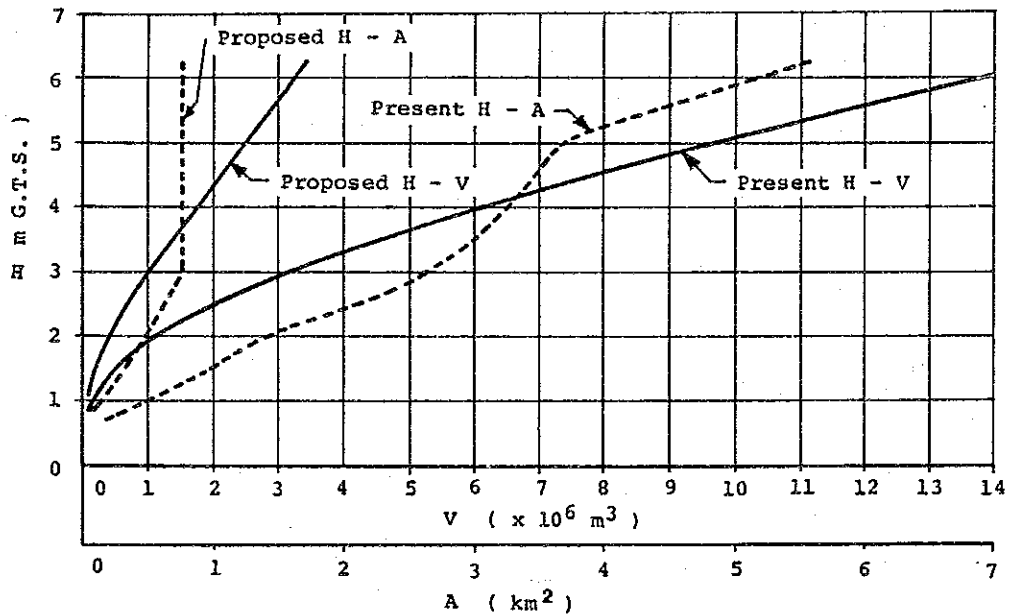
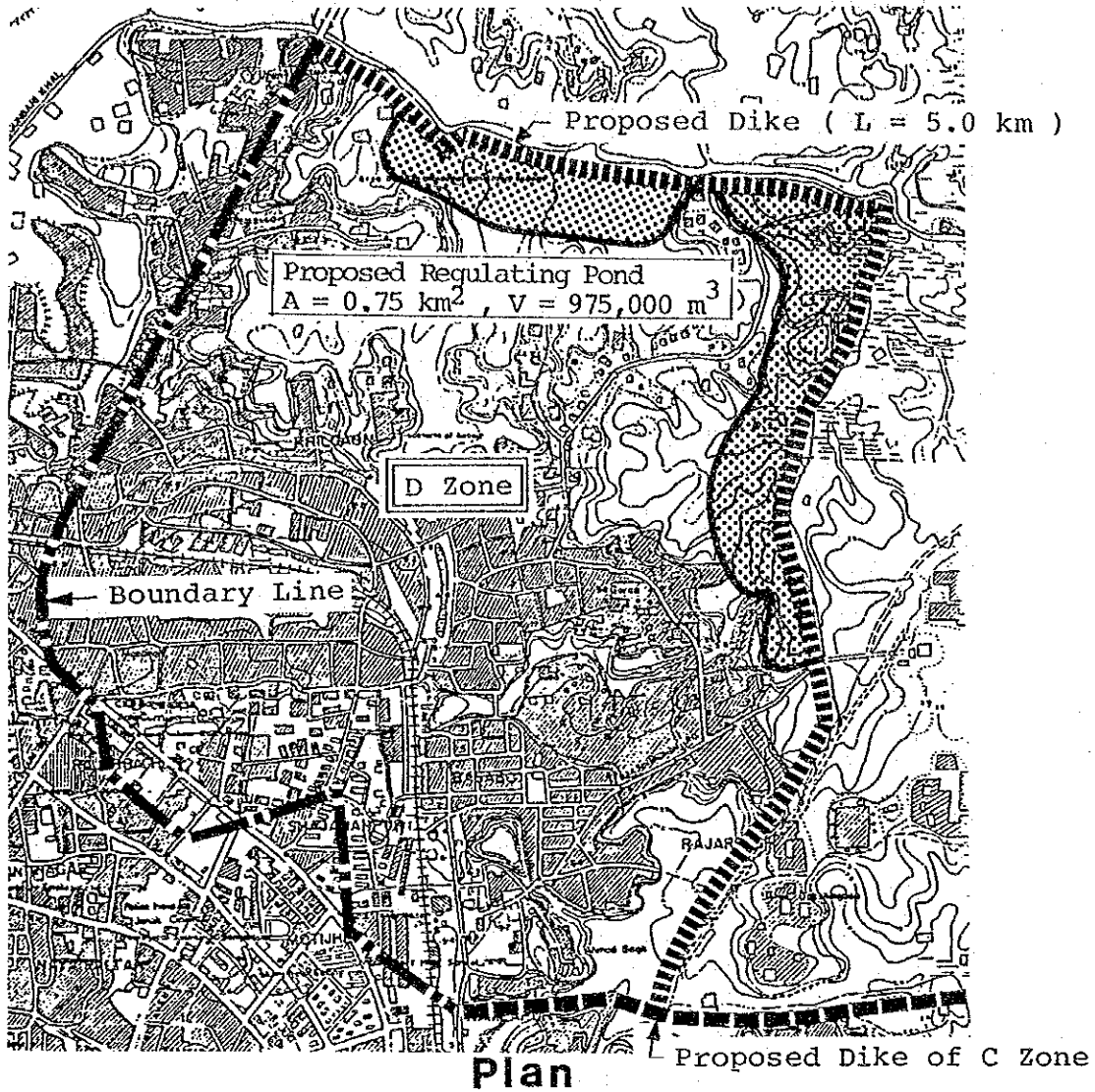


FIG. N.11 MASS CURVES FOR PUMP DRAINAGE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

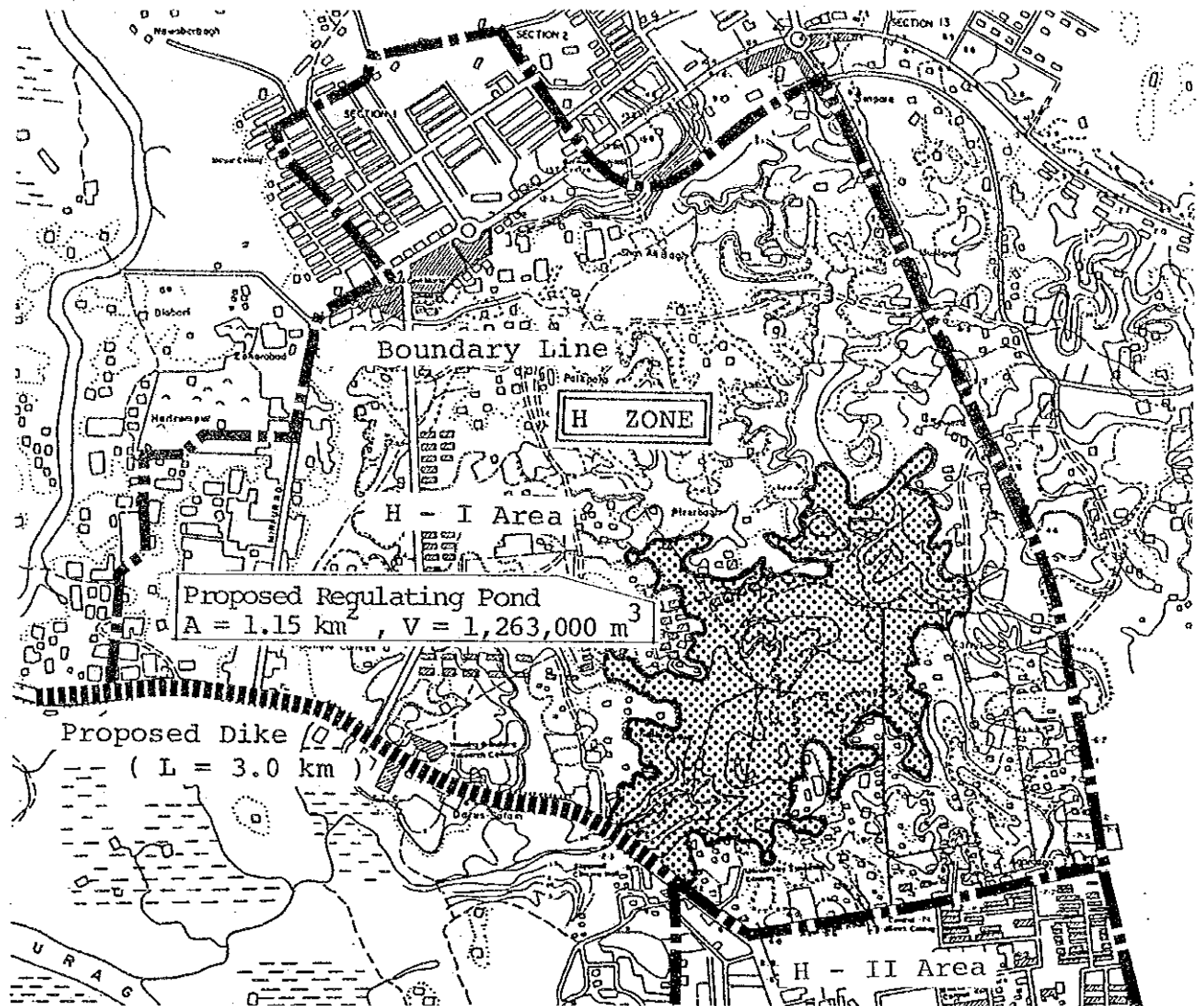


H - A & H - V Curve

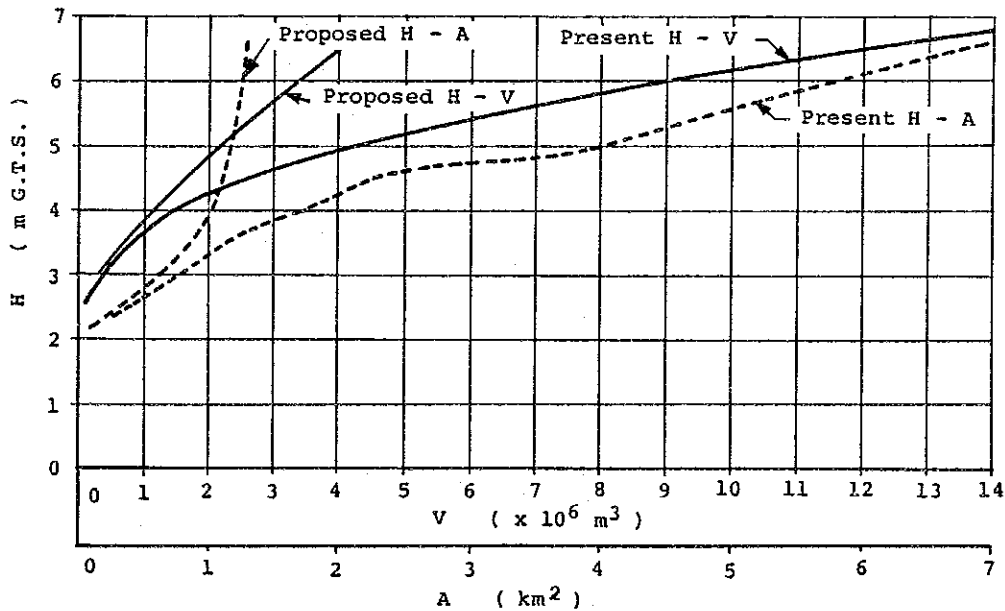
FIG. N.12

PROPOSED REGULATING POND OF D ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



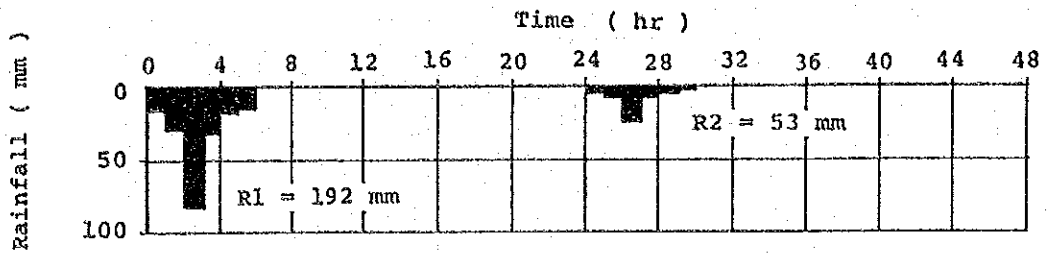
Plan



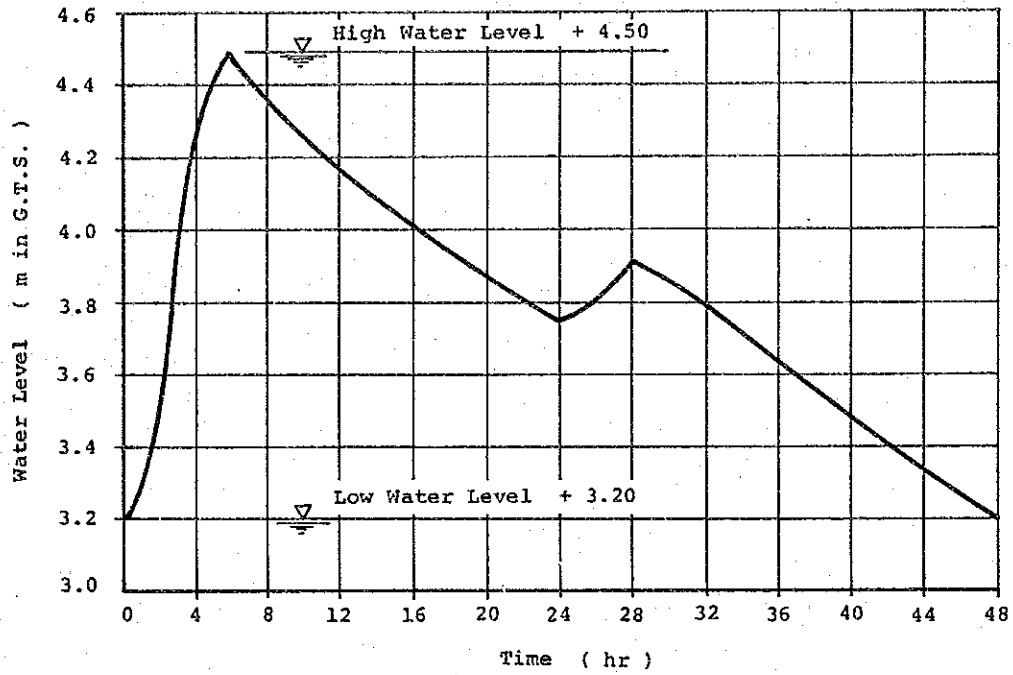
H-A & H-V Curve

FIG. N.13 PROPOSED REGULATING POND OF H ZONE

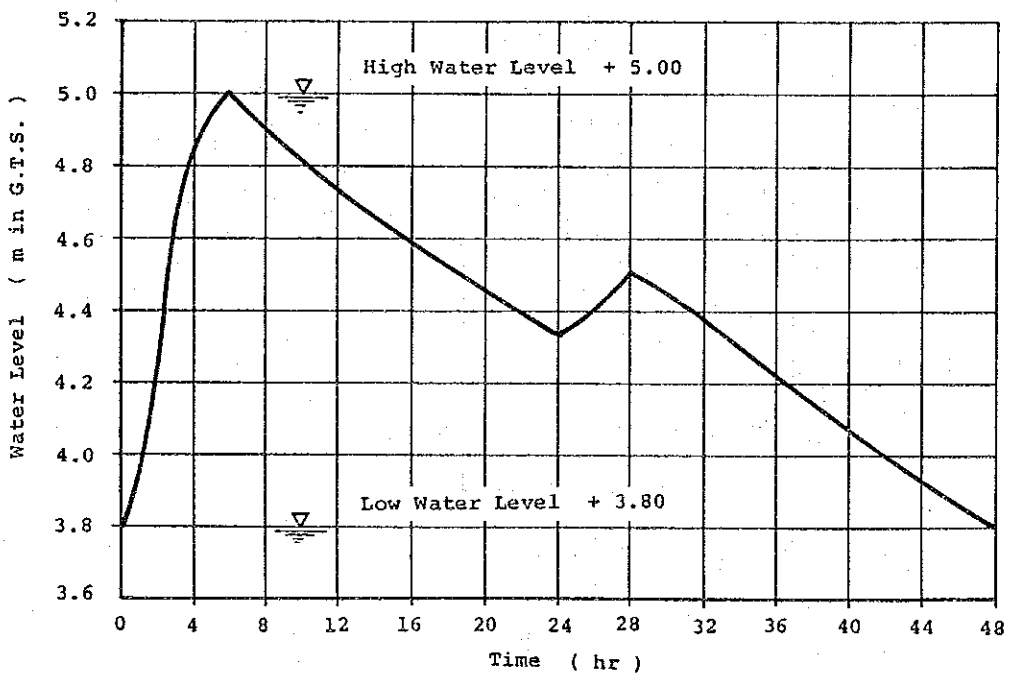
STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH



Design Rainfall



(D ZONE) Khilgaon Regulating Pond

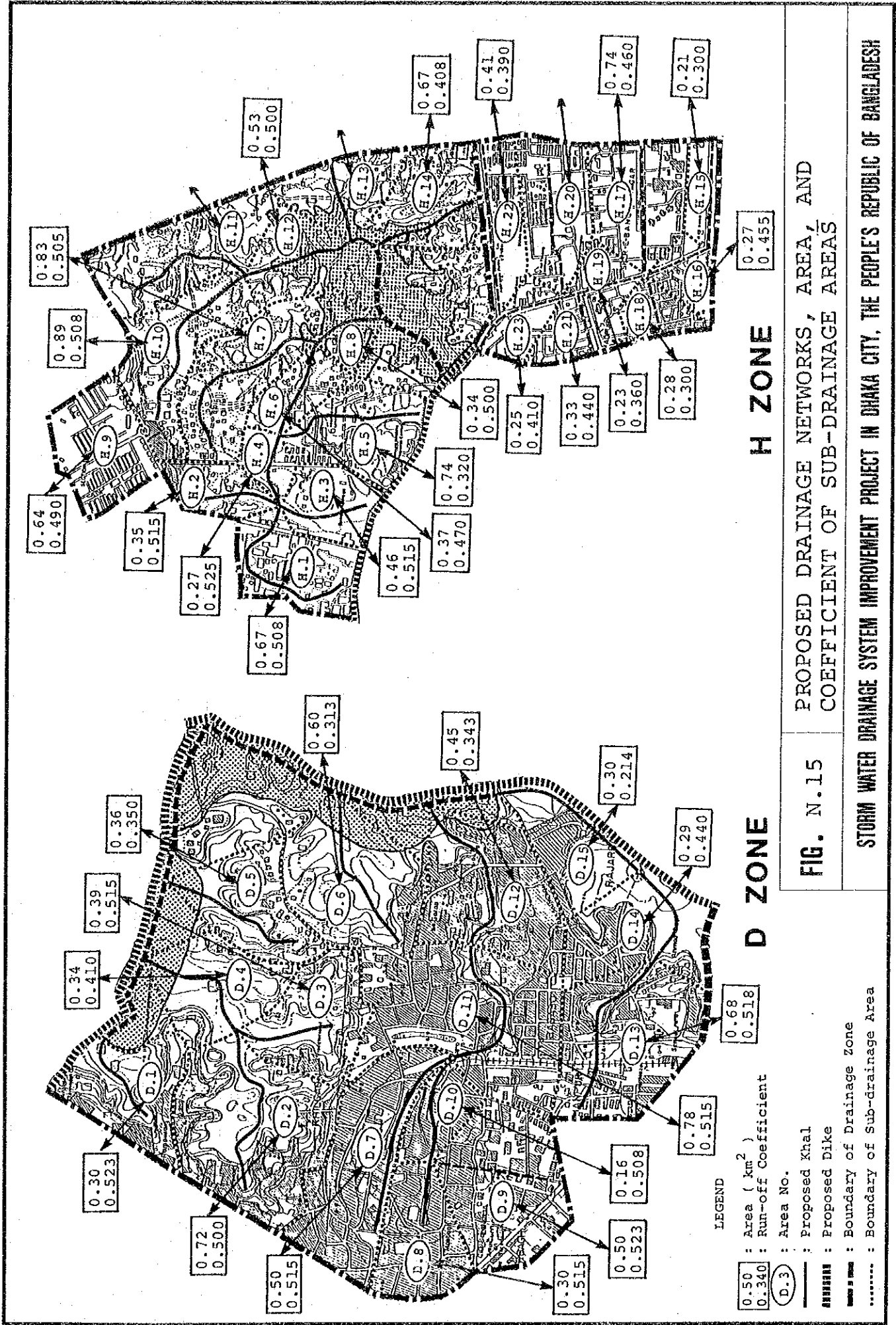


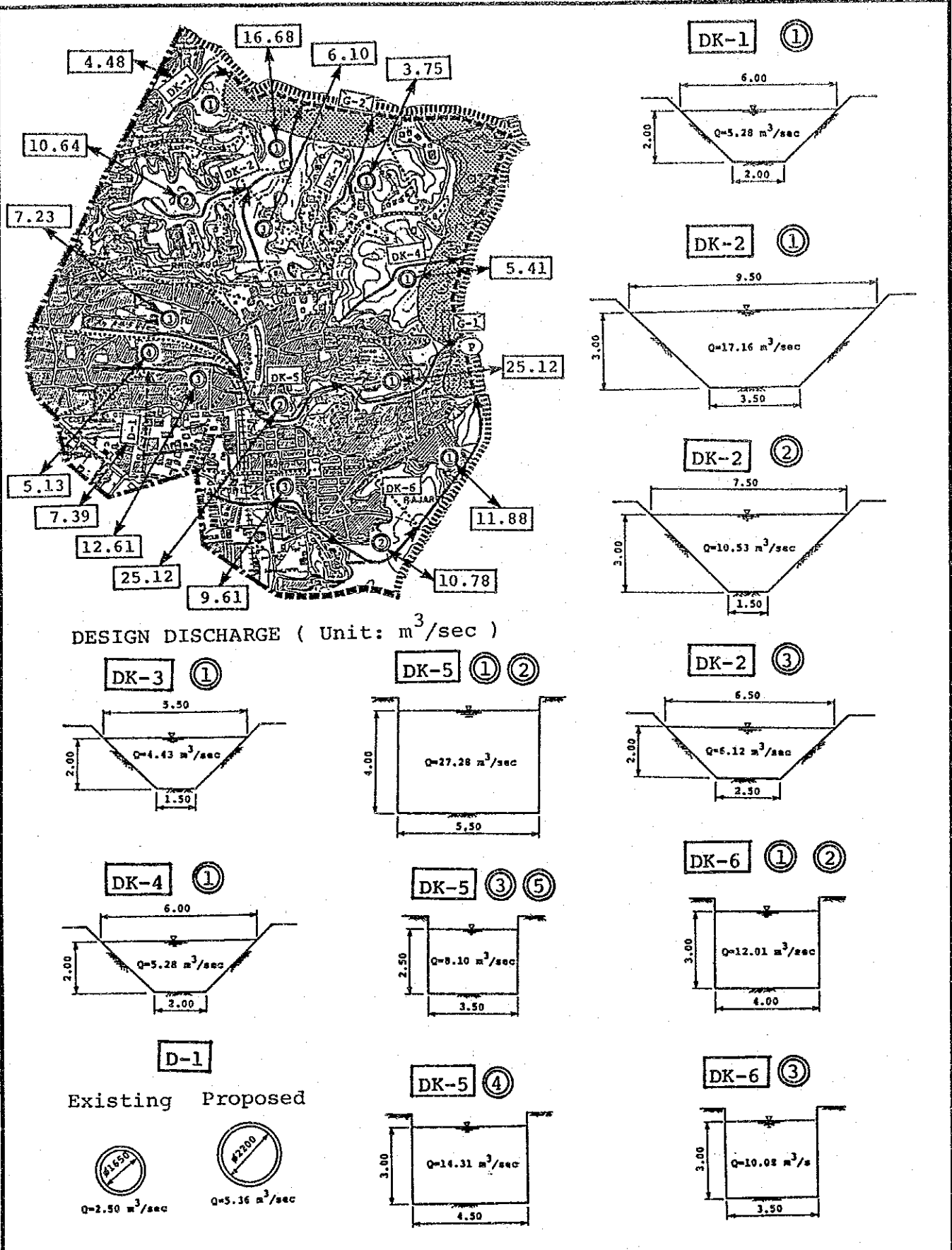
(H - I AREA) Kallyanpur Regulating Pond

FIG. N.14

VARIATION OF WATER LEVELS OF PROPOSED REGULATING POND UNDER DESIGN RAINSTORM

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH





PROPOSED CROSS SECTION OF KHAL IMPROVEMENT AND DRAINAGE PIPE

FIG. N.16 DESIGN DISCHARGES AND PROPOSED CROSS SECTIONS OF KHAL AND PIPE IN D ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

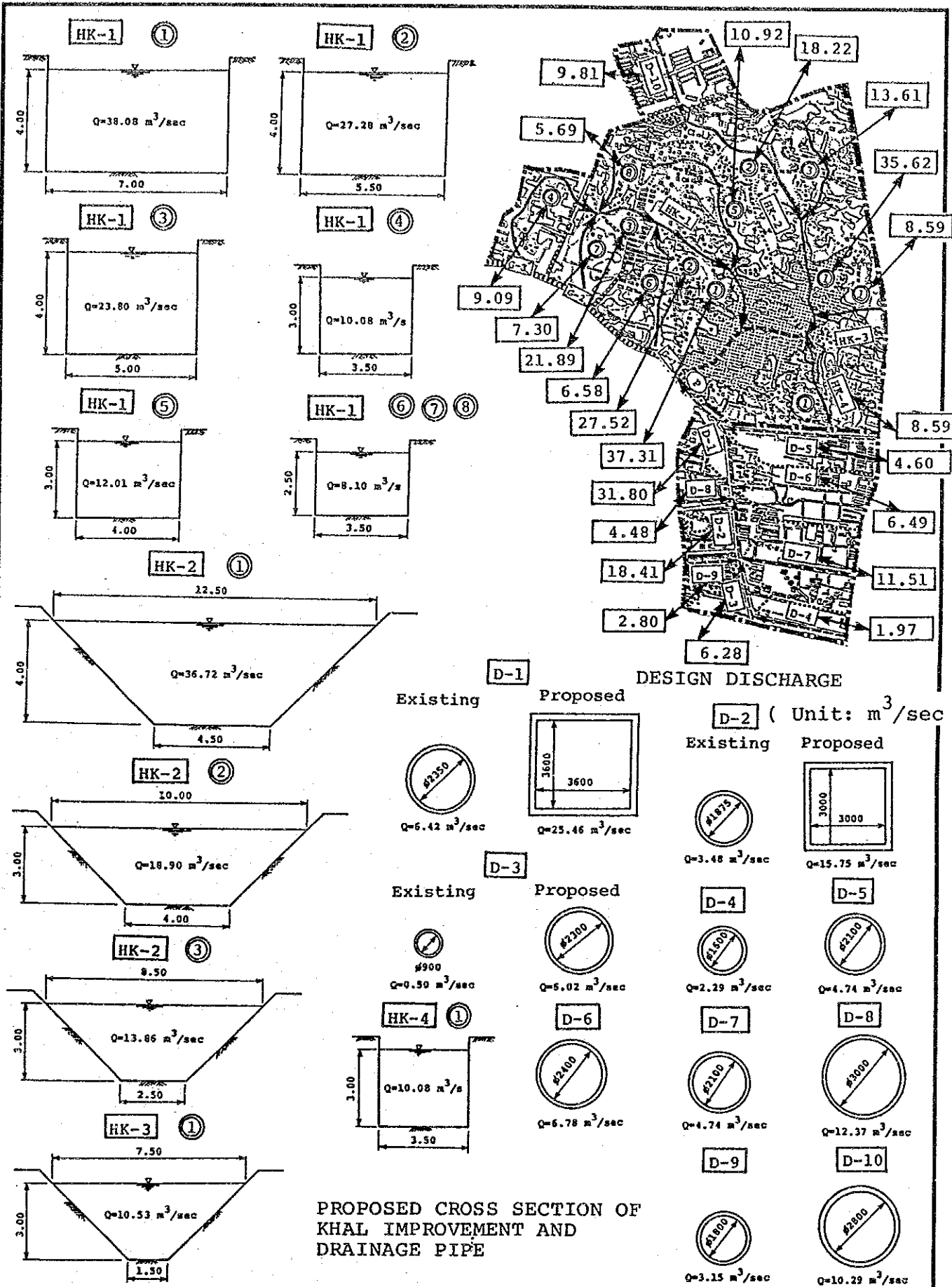


FIG. N.17 DESIGN DISCHARGES AND PROPOSED CROSS SECTIONS OF KHAL AND PIPE IN H ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

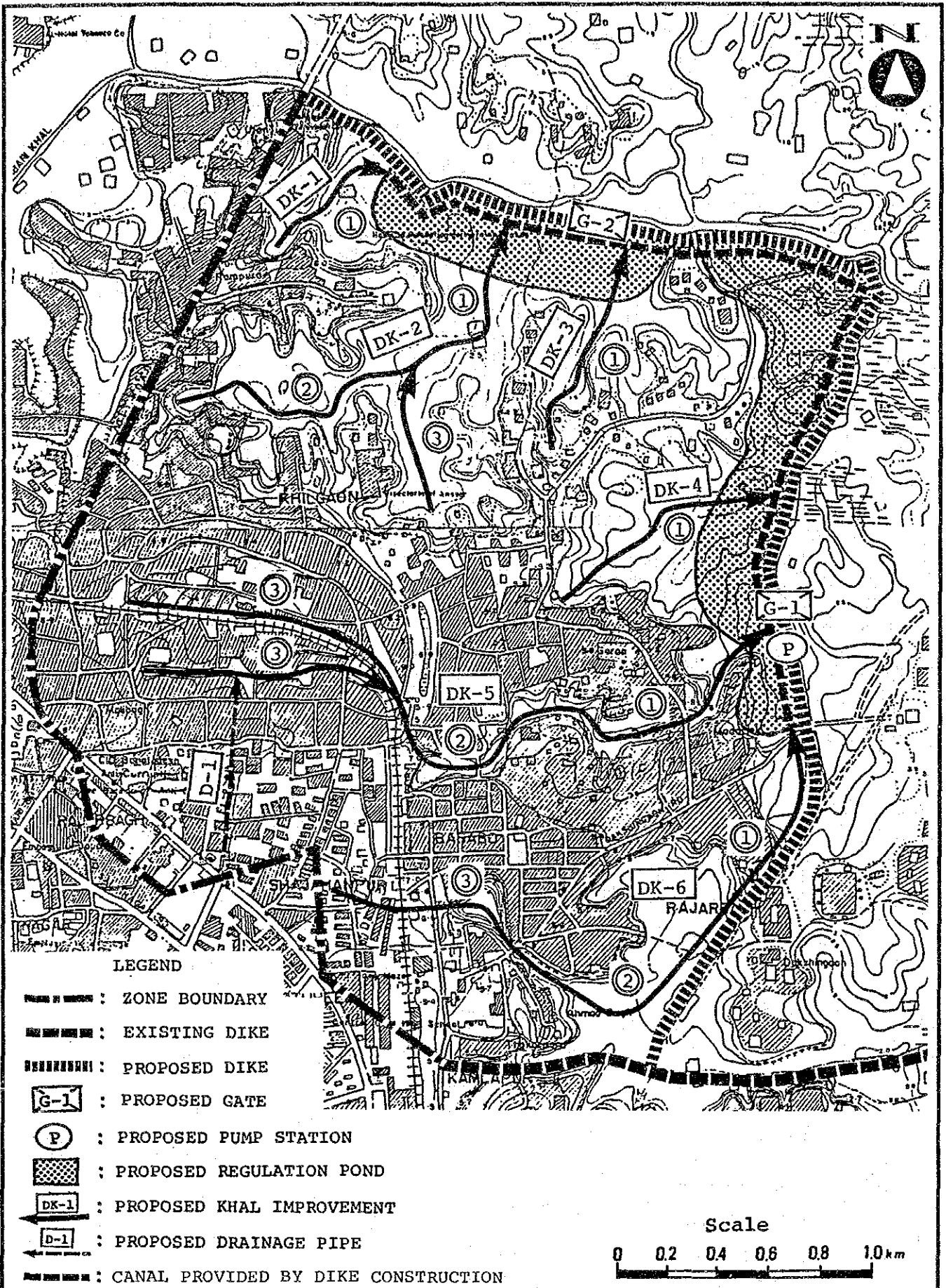


FIG. N.18

LOCATION OF PROPOSED FLOOD PROTECTION AND DRAINAGE FACILITIES IN D ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

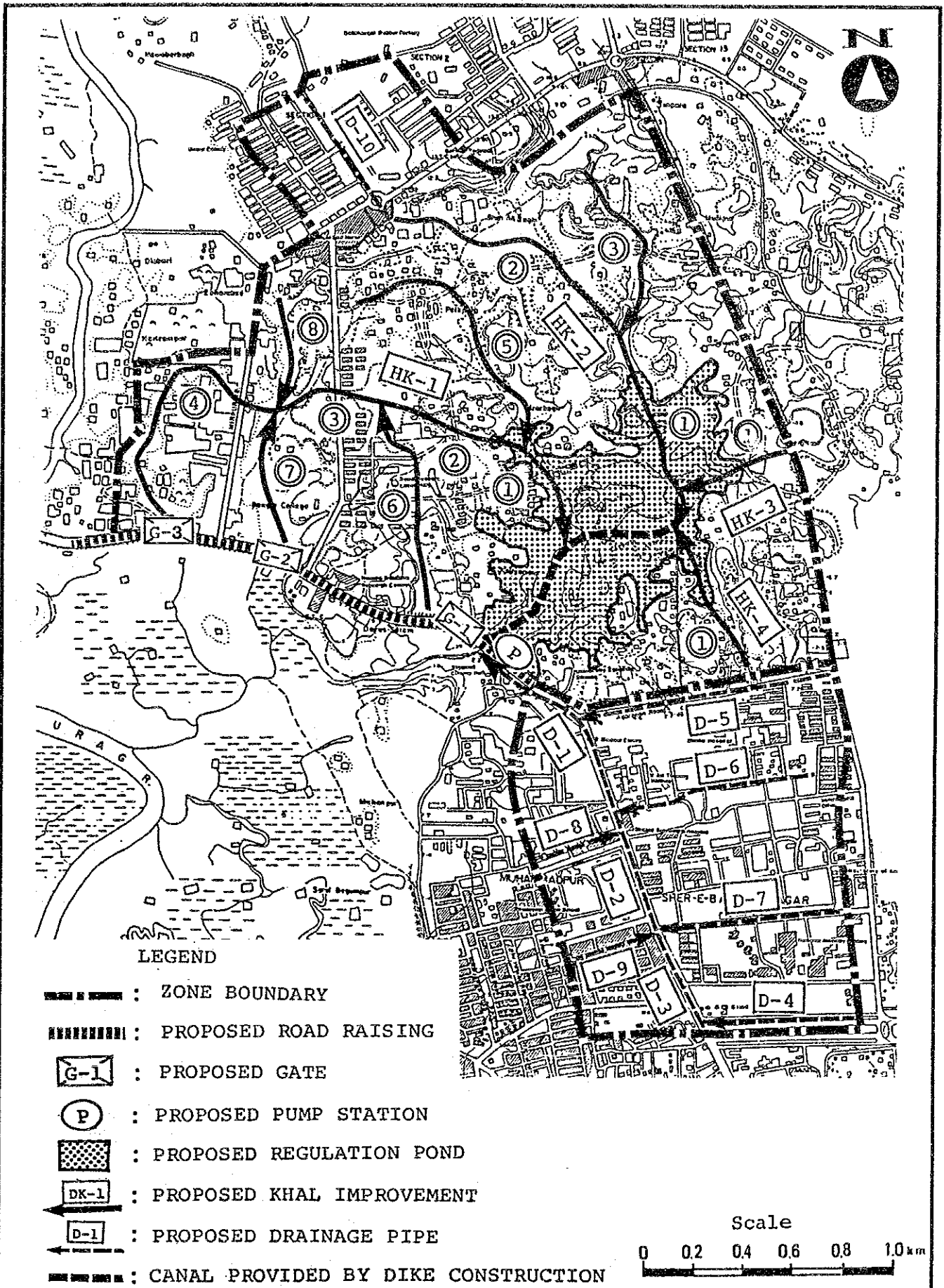


FIG. N.19

LOCATION OF PROPOSED FLOOD PROTECTION AND DRAINAGE FACILITIES IN H ZONE

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

SUPPORTING REPORT O'
TOPOGRAPHIC SURVEY

SUPPORTING REPORT 0' TOPOGRAPHIC SURVEY

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1.3 Spot Height Survey	0'-3
1.4 Topographic Survey	0'-4
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Table 0'.1(6) Description and Heights of Bench Marks	0'-11
Table 0'.1(7) Description and Heights of Bench Marks	0'-12

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SUPPORTING REPORT O'
TOPOGRAPHIC SURVEY

1. Introduction

The topographic survey for the study on the storm water drainage system improvement project in Dhaka City was implemented by the Survey Corporation, Dhaka, related to the Development Design Consultant Limited, New Eskaton Road, Dhaka, contracted with the Japan International Cooperation Agency (JICA), under the supervision of a JICA survey expert.

The project area is in Dhaka city and the contents of the topographic survey are as follows:

- 1) Main levelling survey for water-gauging station
- 2) Longitudinal and cross section survey for drainage
- 3) Spot levelling survey for inundation area
- 4) Topographic survey
- 5) Correction of existing map

The entire survey area is shown in Fig. O'.1.

Existing bench mark in Dhaka City was established during the Pakistan period. The datum for levelling, known as the Great Trigonometrical Survey, GTS datum, is based on Mean Sea Level (M.S.L.) which was determined from the long period tidal records obtained from the nine tidal observatories selected along the coast of the Indo-Pakistan Sub-Continent (1958 to 1909 A.D.).

Throughout Pakistan, there are permanent bench marks (GTS) that were established by the survey of Pakistan.

Nowadays, only one bench mark remains in Dhaka city; it is located near Ramna Park and was established in 1909 along the branch line levelling route of Akhaura to Dacca and Pachuria. This levelling route was surveyed from 1912 to 1913 as the branch line of the route of the Howrah to Ramganj route that was surveyed from 1882 to 83, 1894 to 95, and 1899 to 1902.

There is another datum called the Public Works Department, or PWD datum, which is widely used for hydrographic survey.

The PWD datum is tied to the GTS datum by the following relationship:

$$\text{PWD} = \text{GTS} + 0.4599 \text{ in meter}$$

In this survey, the GTS bench mark (Ramna Park) was used as the datum point.

1.1 Main Levelling Survey for the Water-gauging Station

The main levelling survey was carried out to check the existing water-gauging level and to set up new bench marks for successive survey works.

The main levelling route and the location of new bench marks are shown on Fig. 0'.2. The total length of the levelling route is about 70km, and the allowance of double-running observation is:

$$+ 10\text{mm} \sqrt{S}$$

(in which, S is the length of levelling route in kilometre)

There are four existing water-gauging stations with PWD bench marks in this study area. They are at Mill Barrack, Mirpur, Tongi, and Demra.

In this survey, the "zero" gauge values of water-gauge staff were checked based on the GTS datum to analyze the existing hydrographic data. The results were as follows:

Result of water-gage check

Station name	B.M. values	Staff gauge "0"
Mill Barrack	6.315 m	- 0.497 m
Mirpur	9.934	- 0.418
Tongi	6.674	- 0.338
Demra	6.121	- 0.453

The new bench marks for successive marks were marked and painted on the structures such as bridges, bases of electric poles, gates and traffic islands at road intersections.

Descriptions of the new bench marks are as follows:

1.2 Longitudinal and Cross Section Survey for Drainage

Longitudinal and cross section survey of the main drainage in the study was carried out to a certain width.

Levelling for this survey started from the neighbouring new bench mark and the allowance of closure, or double-running, is $20\text{mm} \sqrt{S}$ (in which S denotes distance in kilometer of route).

The location of the survey is shown in Fig. O'.3. The total length of the channels is about 60km.

There are 197 cross sections. The profile survey of the main manhole route in the inundation area is shown in Fig. P.4.

The drawings were produced on scales of 1/100, 1/500 and 1/800.

1.3 Spot Height Survey

A spot height survey was carried out to investigate the area of habitual inundation (a top priority area for this study) and the contour line was revised.

Spot height survey area is about 30km^2 and is shown in Fig. O'.3.

Allowable discrepancy in double running or closure is $40\text{mm} \sqrt{S}$.

1.4 Topographic Survey

The topographic survey was carried out by means of plane table on a scale of 1/1,000 for the sites of the planned major drainage facilities, such as pump stations, gates and culverts, etc., as shown on Fig. 0'.4.

There are a total of 24 facility sites and the area is 216,000m².

1.5 Correction of Existing Map

The following topographic maps were available for this work:

- 1) City guide maps of 1/20,000 and 1/10,000 covering the southern part of the Study Area and the entire Study Area respectively (no contour line compiled in 1979).
- 2) Topographic maps covering the entire Study Area having the scale of 1/7,920 (contour-line interval: 1 foot, aerophoto taken in 1952, compiled in 1965-1968).

(1) Correction of Entire Study Area Map

The map of the entire Study Area was produced on a scale of 1/30,000. This map was mainly compiled from city guide maps and was corrected by field investigation results.

However, there are many unreasonable planimetric features on this map referring to the actual field, and because the original guide map was compiled from several old maps it was impossible to correct the entire area.

(2) Correction of Contour Lines in the Inundation Area

Contour lines in the top priority area of this study were corrected by referring to the spot height levelling results and the existing map having a scale of 1/7,920. Reference was also made to the drawing map of the "Master Plan and Feasibility Report for Storm Drainage and Flood Control" (DPHE-1968). This correction was produced on the scale of 1/10,000 and the planimetric feature was compiled from Dhaka city guide maps corrected by field investigation with 0.5m contour intervals.

Table O'.1(1) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L (GTS)
	Line A	Meter
A1	On the pukka base of light post at Shahbag near P.G. Hospital.	9,451
A2	On the traffic island at Katabon near Mosque.	9,288
A3	On the traffic island at New Elephant Road.	8,307
A4	On the traffic island at Science Laboratory.	8,645
A5	On the base of P.P. near the west corner of Dhanmondi Playing Field, Road No. 9.	8,490
A6	On the base of P.P. near the New Model High School Boys and Girls, Road No. 11 (South side).	7,365
A7	On the traffic island near the Manik Miya Avenue.	8,303
A8	On the light post of traffic island at Ashad Gate.	8,531
A9	On the gate of the State Guest House near the Residential College, Sher-e-Banglanagar.	8,305
A10	On the light post of Dr. Nurul Islams Talukdar's Dispensary at College Gate near the hemorrhoid clinic.	7,469
A11	On the gate S/E side 23/4 No. Gate at Khil-Jee Road, Dhaka-7.	6,743
A12	On the base of P.P. S/E corner of Shamoli Cinema Hall.	6,866
A13	On the light post of culvert, Mirpur Gabtoli Road, S/E of Shamoli.	7,384
A14	On the base of light post in front of the Star Steel Works, at Darus Salam, Mirpur Road.	7,535
A15	On the base of light post near the Technical College (gate side).	7,071
A16	On the base of light post in front of water tank at Mirpur Road near P.W.D. Office.	7,608
A17	On the base of light post near the P.W.D Vibagiya Procosholi Doptor at Mirpur Road.	7,633

Table 0'.1(2) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L (GTS)
	Line A	Meter
A18	On the base of tower post Mirpur Sec. 1 No. (Tropic Mur) near the Mirpur Upa-Shohar Government Primary School.	11,702
A19	On the gate of Bangladesh Institute of Bank Management near the U.C.P. Technical School, Mirpur-2.	13,441
A20	On the gate of Metropolitan Police Office near the National Bangladesh High School at Mirpur-2.	11,731
A21	On the base of tower post in front of Sultan Decorator's Shop, Mirpur-10.	8,591
A22	On the base of light post near the Inter-trade Distribution at Mirpur Road-10.	8,338
A23	On the gate of Hormon Prathomick Biddaloy (S.O.S. Jubo Poly School) near the old BRTC bus DEPO., Mirpur-13.	6,724
A24	On the S/W side, Mirpur-14 No. Police Fari at Mirpur.	6,816
A25	On the top of culvert pillar, oposite side of Manik Hotel at Mirpur Road-14.	6,282
A26	On the light post of shop No. 50 at Cant's Supermarket at Kachuket.	7,104
A27	On the light post of M.P. Check Post Building at kaf-rulcantt.	8,211
A28	On the signboard of Shadhid Mynul Road near President Jiya's House.	-
A29	On the plinth level at the S/E corner of Sahid Sattar Market.	-
A30	On the base of transformer post near the signboard, Cantonment-Sadar-Administrative Branch on Cantonment Road.	-
A31	On the top of signboard of Staff Quarter's Shahid Basar Road near the cantonment trapic Mur.	-

Table O'.1(3) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L (GTS)
	Line B	Meter
B1	Bottom of P.P. NO. 523014 south side of New Airport Road near the Banani Railway Station.	7,069
B2	Bottom of P.P. NO. 523028 east side of B.R.T.C. bus terminal and Railway Gate of Sawra Bazar.	7,335
B3	On the mile post (Dhaka 14 K.M.) on highway.	6,773
B4	Bottom of P.P. No. 523055 oposite of Uttra Bank Zoyar Shara Branch, east side of B.R.T.C. bus stand.	7,013
B5	On the parapet wall S/W corner of Khagrapara or Kawrapara Bridge.	6,929
B6	On the plinth of check post of Zia International Airport.	7,260
B7	Bottom of P.P. in front of Jasimuddin Avenue side of Tongi Road, Uttra Model Town.	7,232
WAPDA BM	Established west side of Tongi bridge near the river bank.	6,674
	Line C	
C1	Bottom of P.P. in front of 27 Zohura Market between Star Agency and Sowdagar Agency west side of Mymensingh Road, Bangla Motor.	8,992
C2	On the foot path S/E corner of Metropolitan Police box side of New Airport Road Firmgate.	9,405
C3	On the gate of Secretariat.	-
C4	On the plinth of Local Objection P.D.B. Center, west side of New Airport Road.	8,629
C5	Bottom of 11 K.V. transmission line opposite to Shahin College gate (P.P. NO. : 445183.).	8,504
C6	On the plinth of Metropolitan Box near the rail crossing of Mohakhali Railgate.	7,728
C7	Bottom of the P.P. NO. : 485028 near the rail crossing of the cantonment gate.	8,047

Table O'.1(4) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L. (GTS)
	Line C	Meter
C8	Bottom of the P.P. No : 484044 N/E corner of Poni Photographers, Banani (New Airport Road)	7,302
G.T.S BM	Near the railway culvert, north side of Banani Rail Station.	-
C9	On the plinth of cantonment canon No-3 west side of New Airport Road, north side of Railway Crossing, Banani.	8,412
	Line D	
D1	On the traffic island of trifurcated road at Kakrail near Kakrail Mosque.	7,567
D2	On the traffic island of trifurcated road at Kakrail near Rajmoni Cinama Hall.	6,945
D3	On the traffic island at Santinagar trifurcated Road.	6,801
D4	On the traffic island at Malibag trifurcated Road.	7,307
D5	On the traffic island at Mouchak trifurcated Road.	7,158
D6	On the traffic island at Chowdhary para trifurcated Road,	6,966
D7	On the traffic island at east Hazipara near Wills Garments Ltd.	6,574
D8	On the ground level S/W corner of Agrani Bank at Rampura T.V. Branch.	7,001
D9	On the plinth of P.P. No. 614/009 near Rampura Bridge.	8,574
D10	On the plinth N/E corner of S.N. Traders at Badda.	6,447
D11	On the N/W corner of a culvert north side of Merul Bazar.	6,415
D12	On the plinth of gate S/E corner of Badda Baitul Aman Zame Moszid.	7,033
D13	On the ground level S/E corner of Tania Flower and Rice Mill, 92/1, North Badda.	6,797

Table O'.1(5) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L. (GTS)
	Line D	Meter
D14	On the Railing N/W corner of bridge at north Badda.	8,003
D15	On the plinth S/W corner of Prince Steel Agency at Baridhara.	7,162
D16	Bottom of P.P. No. 609/190 at Baridhara.	6,571
D17	Bottom of P.P. No. 609/211 at Kalachanpur.	6,385
D18	On the culvert S/W corner beside the foot path of Kalachanpur Lake.	7,492
D19	On the road demarcation post at Gulshan Road No. 71..	7,596
D20	On the S/W corner of island Gulshan-2.	7,430
D21	On the S/W corner of culvert at Kamal Ataturk Road.	6,998
D22	Bottom of P.P. No. 483/006 at Banani Road No. 27.	7,436
D23	On the S/W corner of culvert at Banani Road No. 27.	7,002
	Line E	
E1	On the plinth of the telephone box at Sutrapur trifurcate Road.	6,905
E2	On the plinth of middle west corner of private house No-95, Hrishikesh Das Road.	6,861
E3	On the plinth S/W corner of Dhaka Steel House at Narinda-Dolaikhal trifurcate Road.	6,656
E4	On the ground level south west corner of Goalbhat Mosque.	6,210
E5	On the traffic island at trifurcate road of English Road.	7,617
E6	On the traffic island at north-south Road trifurcated.	7,005
E7	On the traffic island at Bongsal trifurcated Road.	7,055
E8	On the traffic island of Hazi Osman Goni Road.	6,959

Table O'.1(6) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L. (GTS)
	Line E	Meter
E9	On the Gulistan traffic island, Kaptan Bazar.	7,883
E10	On the Fulbaria traffic island.	8,454
E11	On the G.P.O. traffic island.	7,431
E12	On the traffic island at Press Club trifurcated road.	7,691
	Line F	
F1	On the plinth of traffic island at Tikatoli More.	7,817
F2	On the plinth of Studio Viena at 75 Shamebag.	6,650
F3	On the plinth of Sayadabad railway crossing Guard Room it is on the west side of railway line and north side of Chittagong Road.	7,797
F4	On the plinth of the S/W corner of Sayadabad Bridge.	9,609
F5	On the plinth of the N/E corner of Uttra Bank at Jattrabari.	6,682
F6	On the plinth of the south west corner of north Jattrabari culvert, culvert No : 14-1/3.	6,974
F7	On the gate of Shukur Bhuia at Kajla.	5,878
F8	On the bottom of boundary wall of Rupsha Re-rolling Mill's and Industries Ltd. on Chittagong Road Kajla.	5,696
F9	On the plinth of the S/E corner of Matuail Bridge, Bridge No : 41-1/4.	9,229
F10	On the plinth of the S/W corner of Matuail Bridge near Matuail Community Center, Bridge No : 131-2/4.	7,647
F11	On the plinth of the S/W corner of Konapara Mosque near Matuail Islamia Maddrasa.	5,680
F12	On the plinth of Konapara Bridge at N/W corner, Bridge No : 52-1/5.	8,434
F13	On the parapet wall of the S/E corner of Konapara Bridge in front of Sufia Rolling Steel Mills Ltd, Bridge No : 15-2/5.	7,196

Table O'.1(7) Description and Heights of Bench Marks

BM Name	Description of Bench Marks	Height above M.S.L. (GTS)
	Line F	Meter
F14	On the plinth of the S/E corner of Konapara Bridge, Bridge No : 45-3/5.	8,054
F15	On the plinth of the S/W corner of Dilla Bridge, Bridge No : 15-1/6.	6,742
F16	On the plinth of the S/W corner of Dilla Culvert near Marm Industrial Chemicals Ltd.	5,358
F17	On the plinth of the gate near the Banani Jute Mills Staff Quarter, south side of Emra Road.	6,456
F18	On the island of Demra trifurcate road.	7,509
F19	On the pucca Drain S/E corner of Latif Baowani Jute Mills Ltd.	5,255
F20	On the Safety Tank N/E corner of Latif Baowani Jute Mills Ltd, near the east side of the river.	6,107
F21	On the 1st step of the Moklatur Rahman Shop near Baowani High School.	5,719
WAPDA BM.	North side of Demra Bazar.	6,121
FB	On the gate of Bangladesh Homopathic College Hospital, 46/2 Twenbe Circular Road.	7,852
FC	Bottom of the transformer in front of Art Press Ltd, 16 No. Air Street Wari Road.	7,427
	Line G	
G1	On the plinth of petrol pump station opposite the Beauty Cinema Hall at Gabtoli bus stand.	6,908
WAPDA BM	Under the Mirpur Bridge at Gabtoli.	9,934

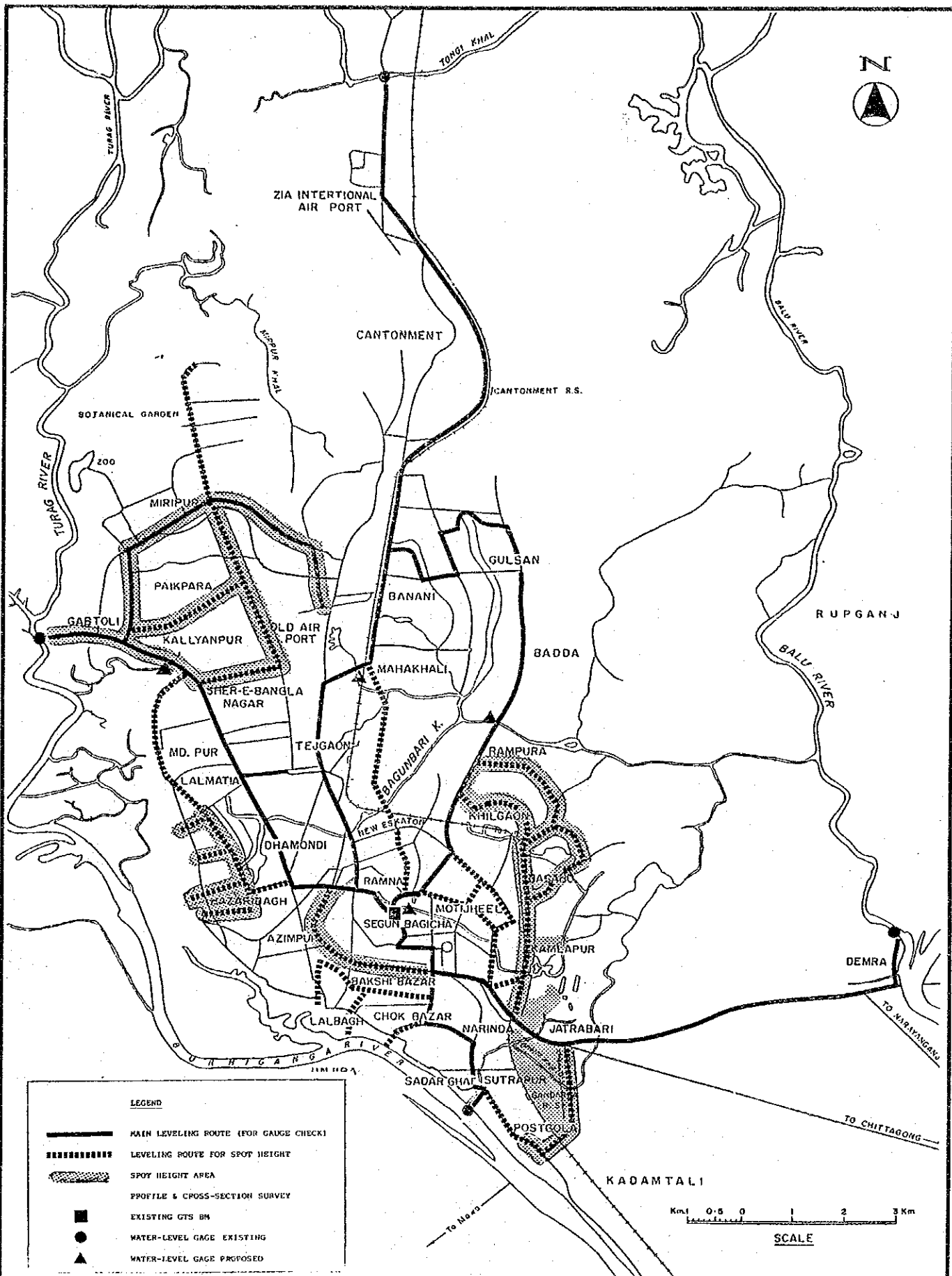


FIG. 0'.1

SURVEY AREA

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

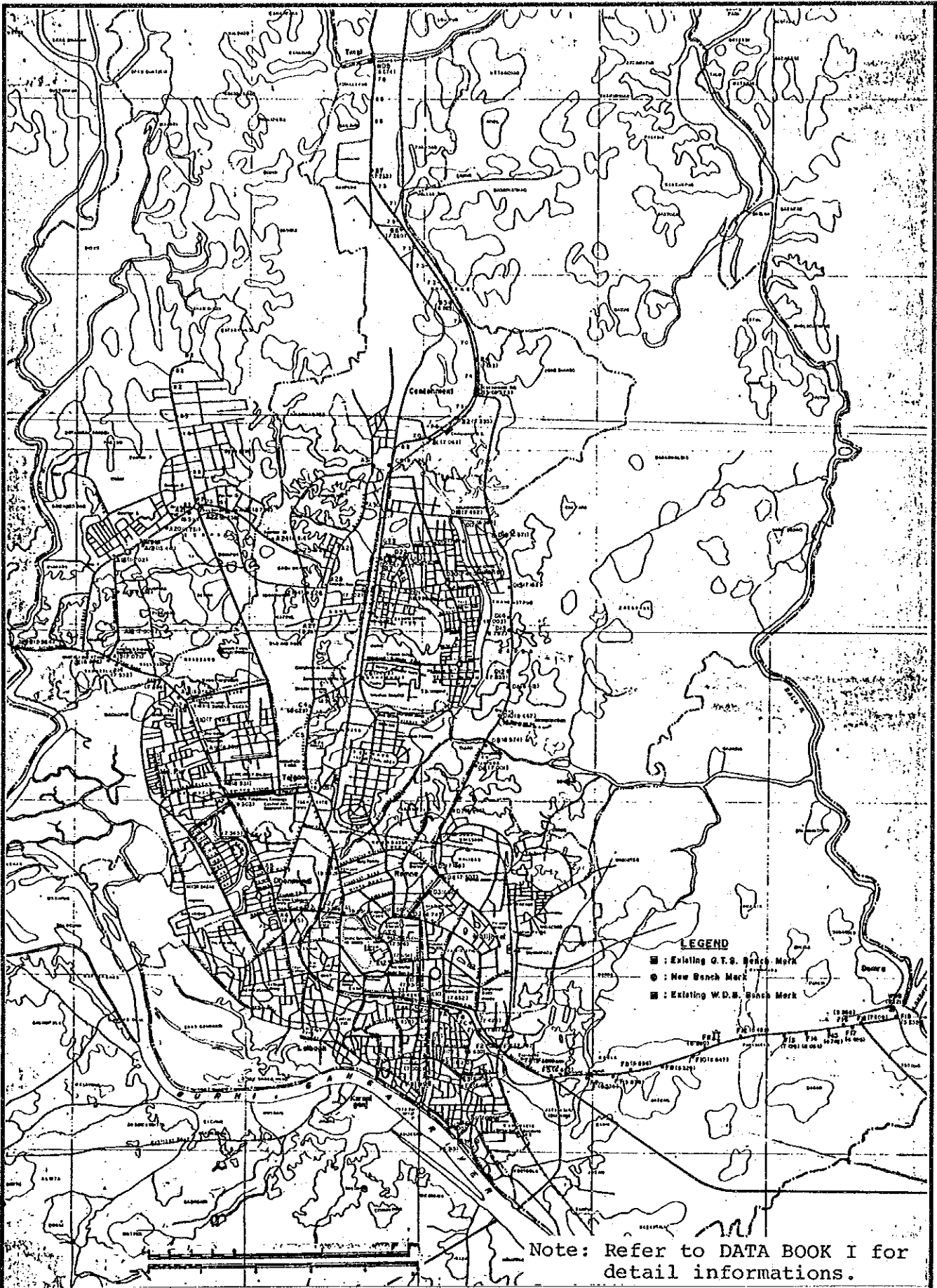


FIG. O'.2

LOCATION OF NEW BENCH MARKS

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

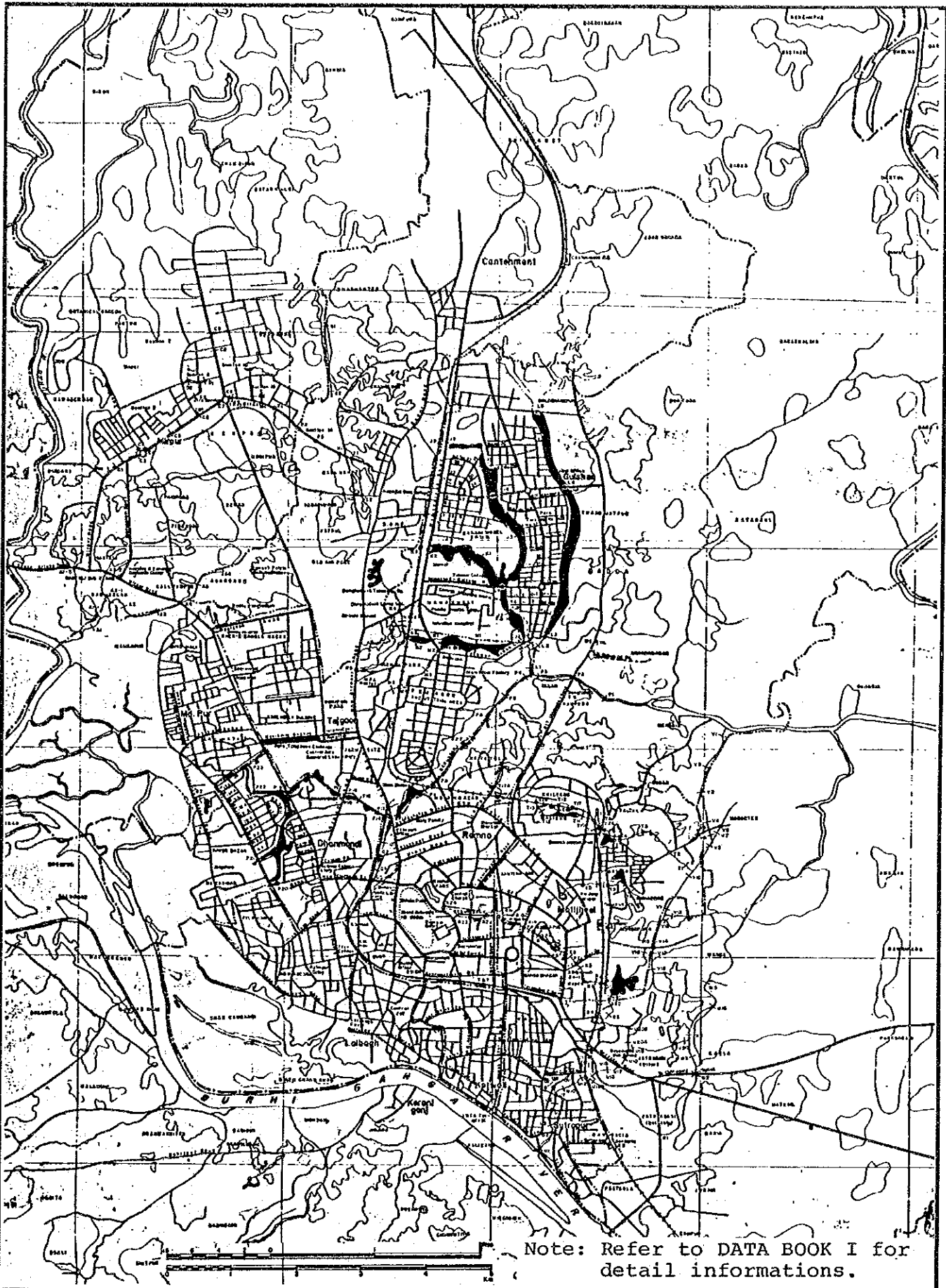


FIG. 0' .3

LOCATION OF LONGITUDINAL AND CROSS SECTION SURVEY

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

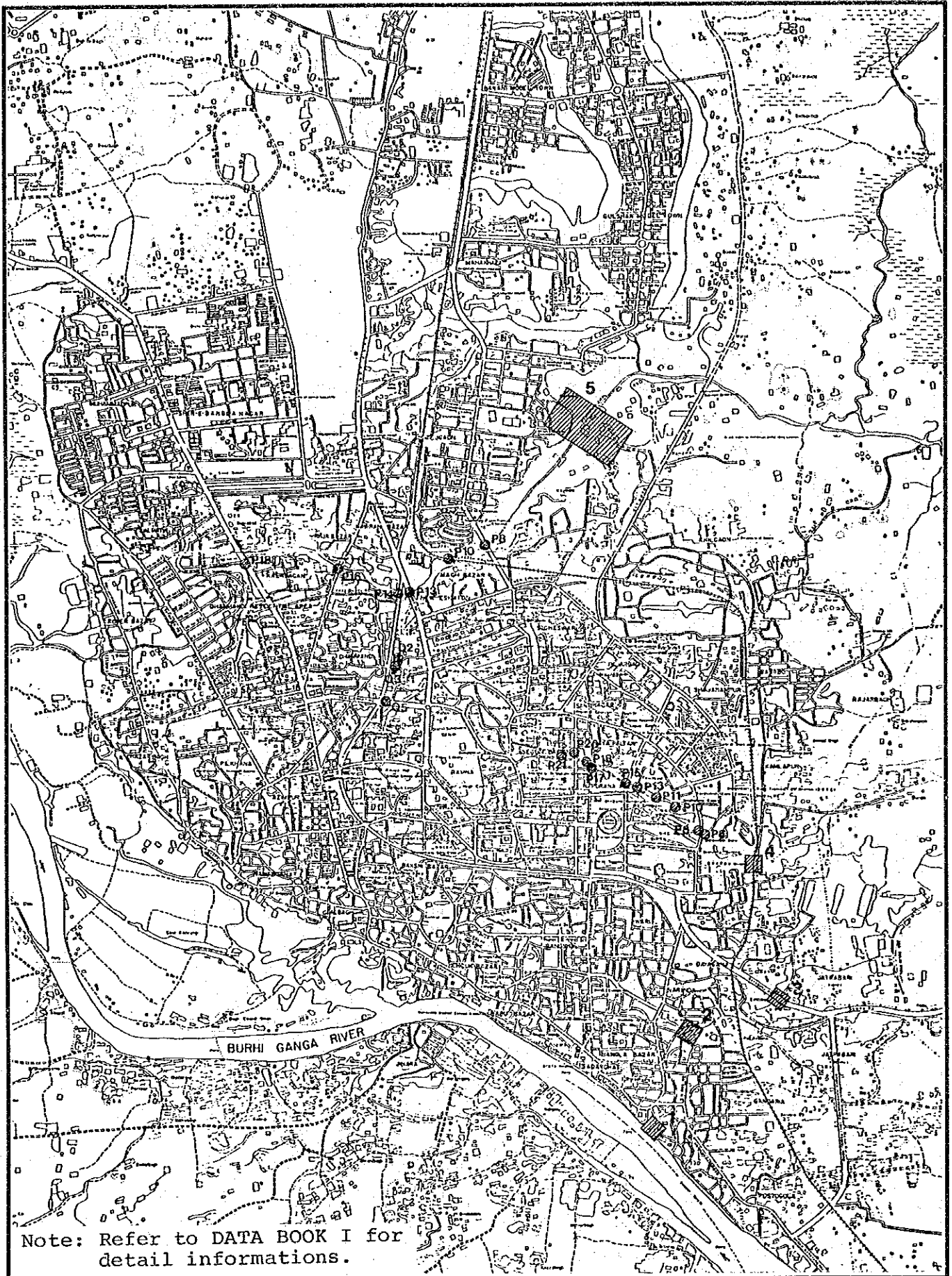


FIG. O' .4

LOCATION OF TOPOGRAPHIC SURVEY

STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY, THE PEOPLE'S REPUBLIC OF BANGLADESH

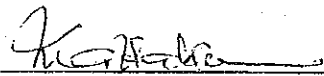
SUPPORTING REPORT P.

SCOPE OF WORK

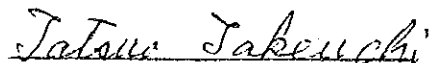
SCOPE OF WORK
FOR
STUDY ON STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT
IN
DHAKA CITY

AGREED UPON BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE GOVERNMENT OF BANGLADESH

BANGLADESH, JUNE 5, 1986


5.6.86

Mr. M.A. Hakim
Joint Secretary
Local Government Division,
Ministry of Local Government,
Rural Development and Cooperatives
Government of Bangladesh



Mr. TAKEUCHI Tatsuo
Leader of
Preliminary Survey Team,
Japan International
Cooperation Agency

I. INTRODUCTION

In response to the request of the Government of the People's Republic of Bangladesh (hereinafter refer to as " the Government of Bangladesh ") the Government of Japan decided to conduct the Study on Storm Water Drainage System Improvement Project in Dhaka City (hereinafter referred to as " the Study "), in accordance with the relevant laws and legislations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as " JICA "), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government of Bangladesh.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are

1. to prepare a phased program on the storm water drainage system improvement project in Dhaka city and to identify the top priority area.
2. to conduct a feasibility study on the storm water drainage system improvement Project in the aforementioned top priority area (the Project area).

III. STUDY AREA

1. The Study area for the phased program shall cover the existing developed area of Dhaka city.
It is approximately 260 Km² and is shown in the Attached map.
2. The Project area for the feasibility study will be selected from the result of the phased program study.

IV. OUTLINE OF THE STUDY

In order to achieve the objectives mentioned above, the Study shall cover the following items:

1. Data collection and analysis

- (1) land use, topographical map
- (2) drainage or related facilities
- (3) city development plan, road-traffic system
- (4) population
- (5) meteorology and hydrology
- (6) soil and geological condition
- (7) past storm damages
- (8) previous studies concerned
- (9) administration and socio-economic condition
- (10) others

2. Survey on past storm damages

3. Review of previous studies concerned

4. Preparation of a phased program on storm water drainage system improvement project in the Study area

5. Identification of the top priority project area

6. Ground survey

- (1) longitudinal and sectional survey for drainage channels and rivers
- (2) topographic survey for proposed major facilities

7. Study on basic plan for storm water drainage in the top priority area identified

8. Preliminary design of main facilities

9. Preliminary design of other related facilities

10. Construction programme

11. Operation and maintenance programme

JJ. 12. Project cost estimation

13. Benefit estimation

14. Financial evaluation

15. Socio-economic impact

16. Project justification

V. SCHEDULE OF THE STUDY

The Study will be performed in accordance with the tentative study schedule drawn in the appendix.

VI. REPORTS

JICA will prepare and submit the following reports in English to the Government of Bangladesh.

1. Inception Report;

Twenty (20) copies at the commencement of the field survey in Bangladesh

2. Progress Report ;

Twenty (20) copies within five (5) months after commencement of the Study.

3. Interim Report;

Twenty (20) copies within eight (8) months after commencement of the Study.

4. Draft Final Report;

Twenty (20) copies within eleven (11) months after commencement of the Report.

The Government of Bangladesh will provide JICA with its comments within two (2) months after its reception of the Draft Final Report.

5. Final Report;

Fifty (50) copies each within two (2) months after JICA's reception of the said comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF BANGLADESH

1. To facilitate smooth conduct of the Study, the Government of Bangladesh shall take necessary measures:

- (1) to secure the safety of the Japanese Study Team for the Study (hereinafter referred to as " the Team ").
- (2) to permit the members of the Team to enter, leave and stay in Bangladesh for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees.
- (3) to exempt the members of the Team from taxes, duties and other charges on equipment, machinery and other materials brought into Bangladesh for the conduct of the Study.
- (4) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the member of the Team for their services in connection with the implementation of the Study.
- (5) to provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Bangladesh from Japan in connection with the implementation of the Study.
- (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study.
- (7) to secure permission for the Team to take all data and documents (including photographs and maps) related to the Study out of Bangladesh to Japan.
- (8) to provide medical services as needed. Its expenses will be chargeable on members of the Team.

2. The Government of Bangladesh shall bear claims, if any arises against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.
3. The Department of Public Health Engineering (hereinafter referred to as " DPHE ") shall act as counterpart agency to the Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.
4. DPHE shall, at its own expense, provide the Team with the following, in cooperation with other relevant organizations concerned, if necessary:
 - (1) available data and information related to the Study
 - (2) counterpart personnel and support staff necessary for the Study
 - (3) suitable office space
 - (4) credentials or identification cards.
 - (5) One (1) four-wheeled drive vehicle, drivers and fuel
 - (6) longitudinal and cross-sectional survey for drainage channels and rivers
 - (7) topographic survey for proposed main facilities

J.J.

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VIII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1. to dispatch, at its own expense, the Team to Bangladesh.
2. to perform technology transfer to the Bangladesh counterpart personnel in the course of the Study.

IX. CONSULTATION

JJ.
JCA
JICA and Ministry of Local Government, Rural Development & Co-operatives (Local Government Division) will consult each other in respect of any matter that may arise from or in connection with the study.

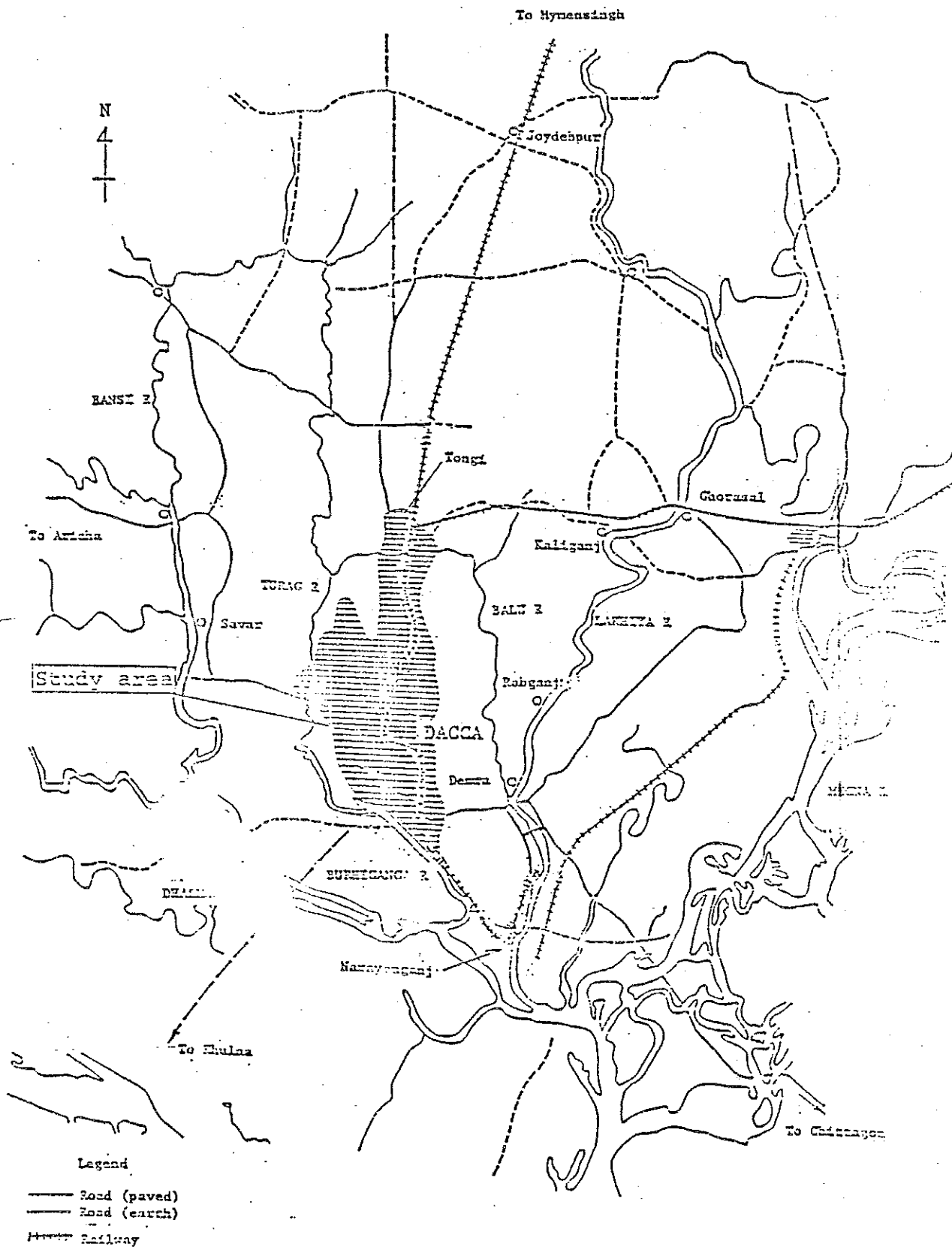
APPENDIX

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TENTATIVE SCHEDULE

ITEM	MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	F/R
STUDY IN BANGLADESH																	
STUDY IN JAPAN																	
REPORT																	

(REMARKS) IC/R : Inception Report P/R : Progress Report
 IT/R : Interim Report DF/R : Draft Final Report
 © : Comment F/R : Final Report



T.J.
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MINUTES OF MEETING
ON
THE STUDY ON STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT
IN
DHAKA CITY , THE PEOPLE'S REPUBLIC OF BANGLADESH

June 5 , 1986
Dhaka, BANGLADESH


Mr. M.A. HARIM 5.6.86

Joint Secretary,
Local Government Division,
Ministry of Local Government,
Rural Development and Cooperatives
Government of Bangladesh


Mr. TAKEUCHI Tatsuo

Leader of the Japanese
Preliminary Survey Team
Japan International
Cooperation Agency

A preliminary survey team (the Team) of Japan International Cooperation Agency (JICA), visited the Bangladesh from June 1 to June 6, 1986 to discuss the Scope of work for the study on storm water drainage system improvement project in Dhaka city (the Study).

The Team carried out field surveys of the study area and held series of discussions with officials of the Local Government Division, Ministry of Local Government, Rural Development & Cooperatives (MLGRDC) and the agencies concerned.

A final meeting was held on June 5, 1986 at the Conference room of MLGRDC, Dhaka. Mr. M.A. Hakis, Joint Secretary, Local Govt. Division presided over the meeting on behalf of the Local Govt., Rural Development & Cooperatives Ministry. A list of those who attend the meeting is shown in the attached sheet. The draft scope of work proposed by the Team was discussed in details and agreed between the Team and MLGRDC with minor modifications, which are as follows :-

1) In the introduction the Chairman proposed to put the word 'and Bangladesh' in the last line of the introductory para of the draft scope of work. The Japanese Team clarified that under the laws and regulations of Japan Govt. it was decided to undertake the study. It will not effective for implementation of the project as such. The point was discussed with ERD, who in turn confirmed the matter.

2) In para 6(2) it was clarified that no areal survey is required.

3) In section VII(I), the ^{meaning is} 'as is normally provided for any citizen of this country'.

4) In section VII para 4(3) it is clarified that equipments and office space will be provided by DPE as follows:

- i) Office accommodation,
- ii) Office furniture,
- iii) Telephone,
- iv) One Vehicle
- v) Fuel & maintenance of vehicles with Driver,
- vi) Electricity,
- vii) Electric Typewriter,
- viii) Photo copier
- ix) Amenia printing arrangement,
- x) Other sundries.

The meeting ended with a vote of thanks from the chair.

ATTENDANTS LIST

- JJ.
CA
1. Mr. Takuchi, Tatsuo, Team Leader
 2. Mr. Seiji Masato Member
 3. Mr. Nakagawa Kazuo Member
 4. Mr. Iwata Katsuo Embassy of Japan
 5. Mr. Egawa Keiichi JICA-Bangladesh Office, Dhaka.
 6. Mr. M.A. Karim, Supdt. Engineer, DPHE, Dhaka.
 7. Mr. S.A. Rob, Deputy Secretary, Local Govt. Division
 8. Mr. Abdur Rahim Bhuiyan, Deputy Chief, Local Govt. Division.

MINUTES OF MEETING
ON THE STUDY ON STORM WATER DRAINAGE SYSTEM
IMPROVEMENT PROJECT IN DHAKA CITY.

An Advisory Committee team (the team) of Japan International Cooperation Agency (JICA), visited Bangladesh from Jan 25 to Jan 30, 1987 to discuss the progress of the Study on Storm Water Drainage System Improvement Project in Dhaka City (the Study).

The team held series of discussions with Japanese Study Team, officials of the Local Government Division, Ministry of Local Government, Rural Development & Co-operatives (MLGRDC) and other Agencies concerned.

A final meeting was held on Jan 27, 1987 at DPHE. The undertakings of both sides on Scope of Work regarding the Study was discussed and confirmed between the Team and DPHE which are as attached herewith.

28 January, 1987.

M.H. Khan
Chief Engineer
Department of Public Health
Engineering.

T. TAKEUCHI
Chairman of Advisory
Committee of the Study
JICA.

Ministry of Local Government,
Rural Development and Cooperatives.

ATTACHMENT

1. Counter part personnel and vehicle necessary for the Study team are temporarily supported by the Japanese side. However, in view of technical transfer and smooth implementation of the Study, DPHE provides one vehicle from the end of Jan, 1987 and also DPHE engineers join the Study on part time basis.
2. In view of technical importance among the survey items, it was decided that topographic, longitudinal and cross sectional survey for drainage channels and rivers are undertaken by Japanese side.
3. It was requested that an immediate action is to be taken for custom clearance of equipments which were already sent from Japan to Bangladesh.
4. Provision of aerial map with the Study Team is essential and urgently required for securing the implementation schedule of the Study.
5. From the reason of urgent necessity of the realization of the Project, the Study report would be completed as early as possible even though the commencement of the Study was delayed than expected.

JICA