

JICA - Ho Chi Minh City Urban Drainage & Sewerage Project

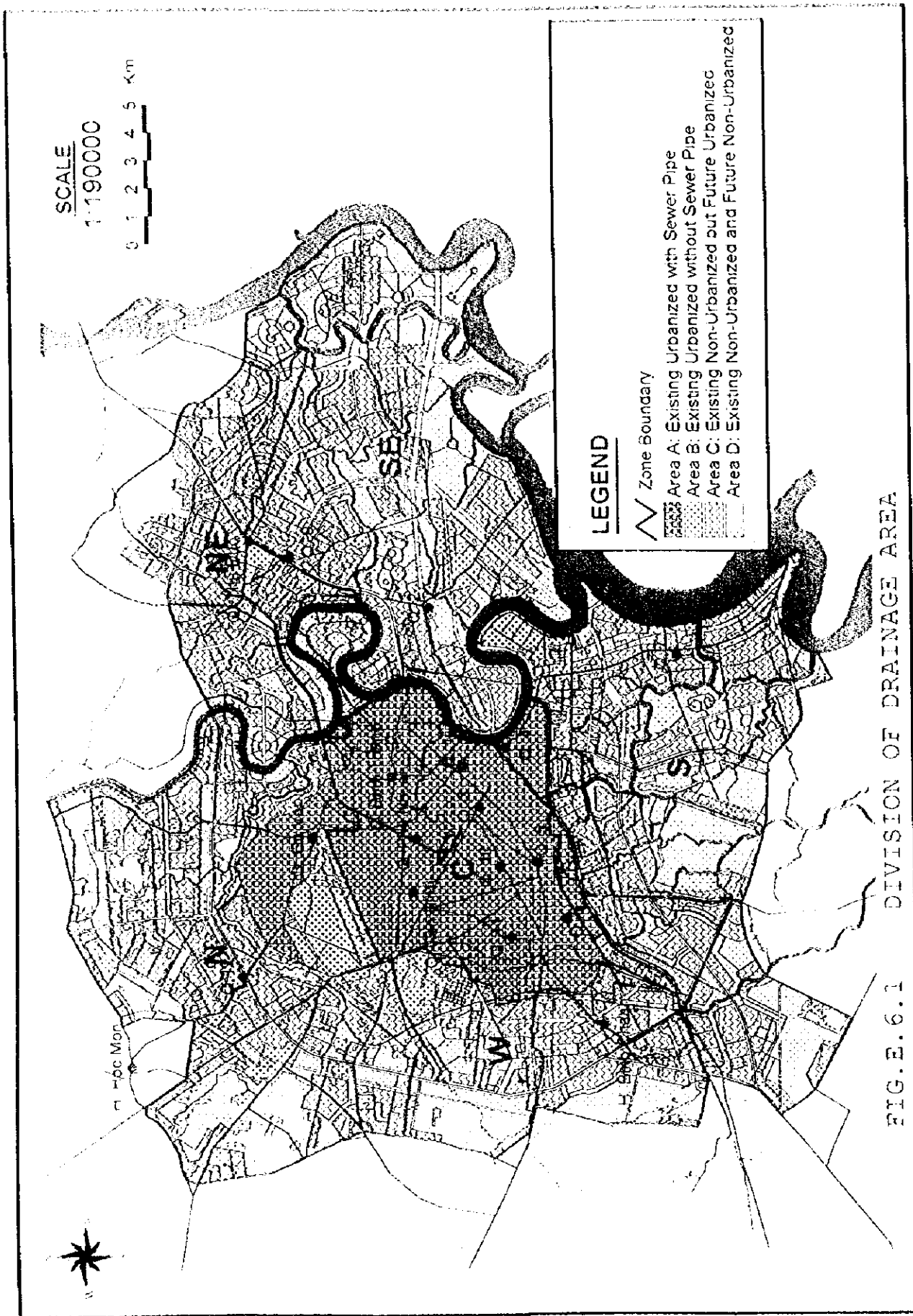
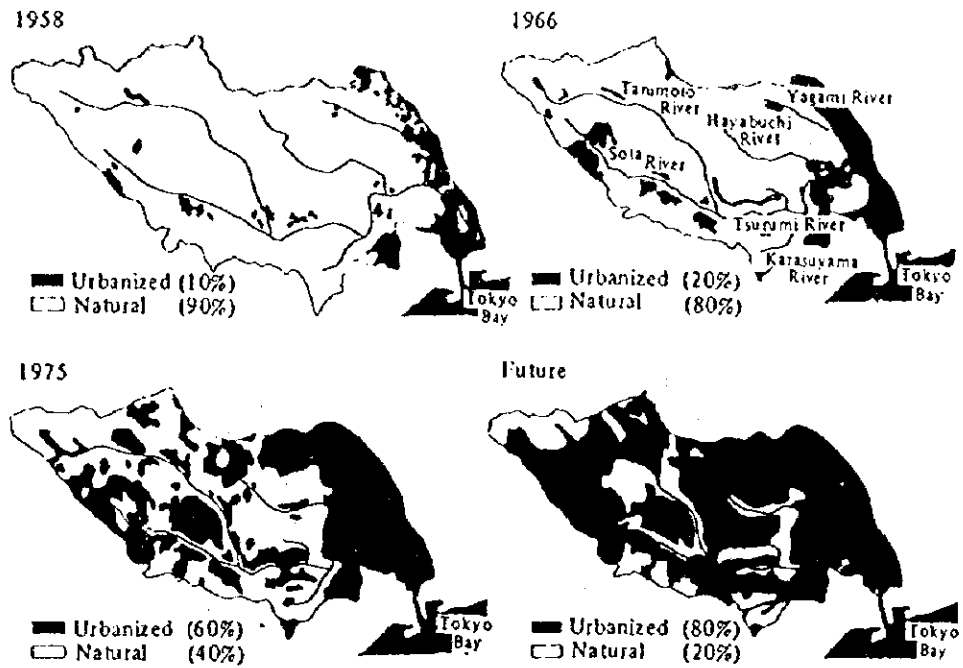
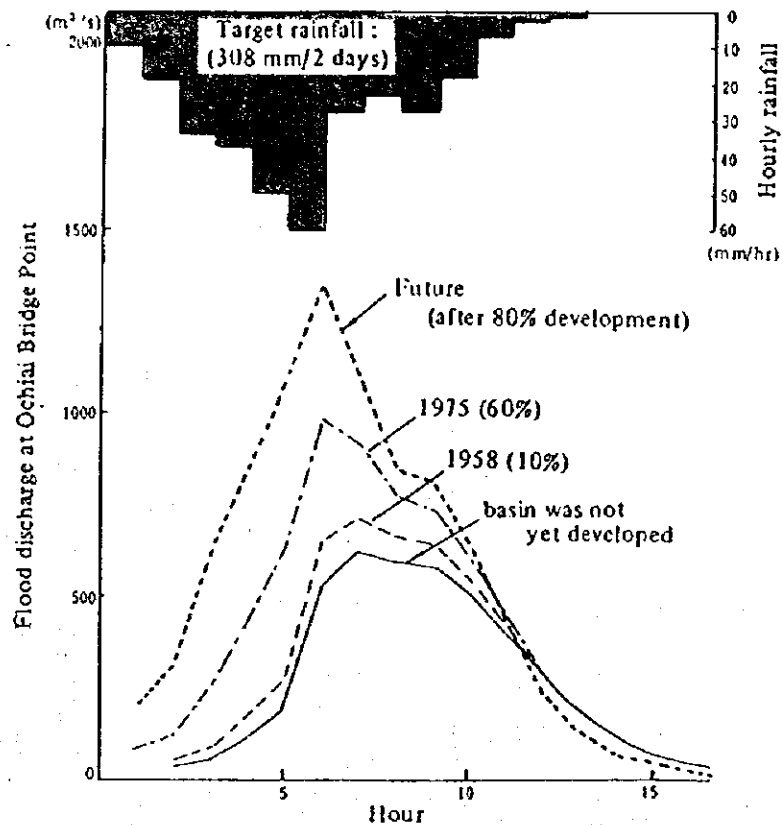


FIG.E.6.1 DIVISION OF DRAINAGE AREA



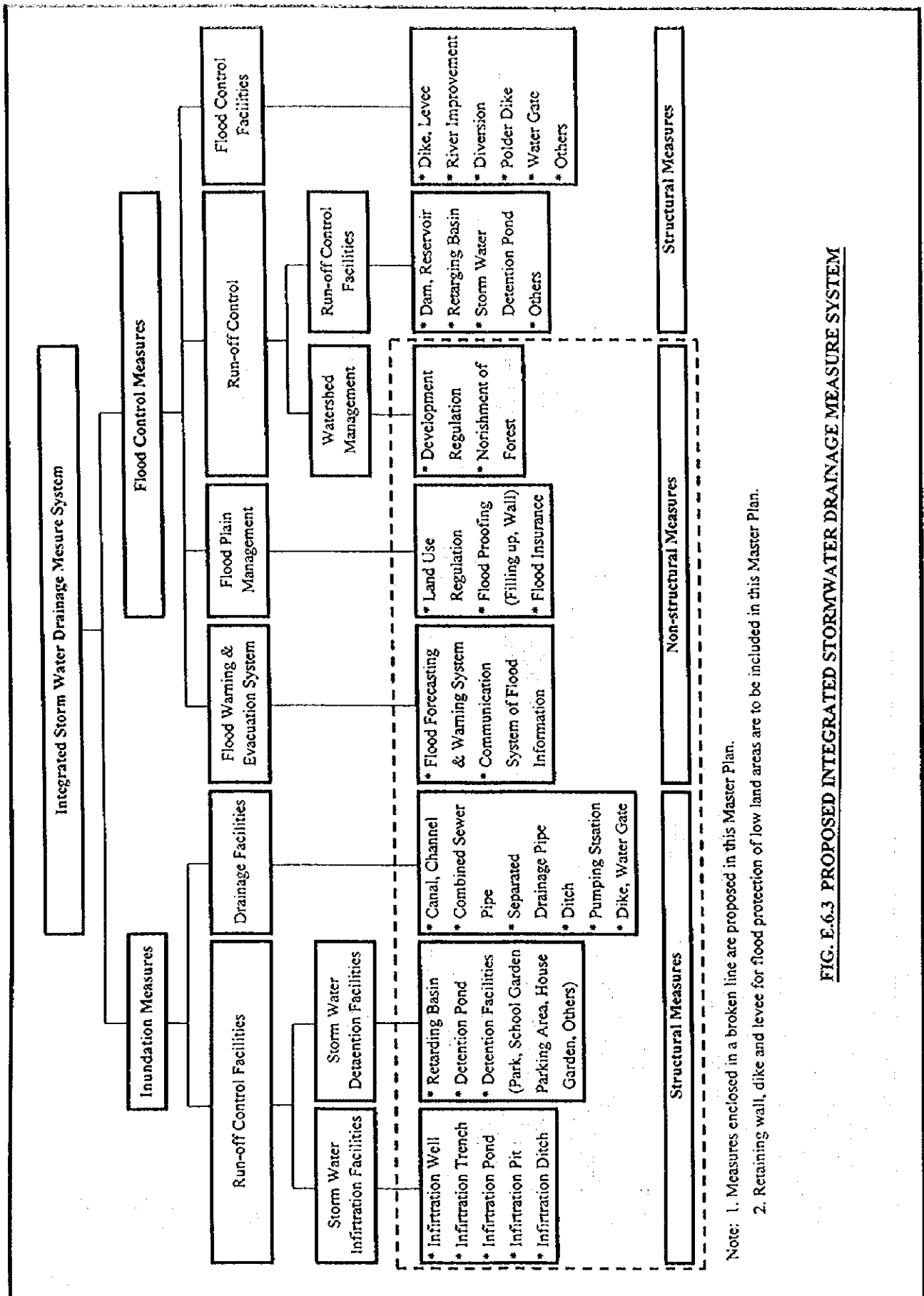
(CHANGE OF LAND USE)



(INCREASE OF FLOOD DISCHARGE)

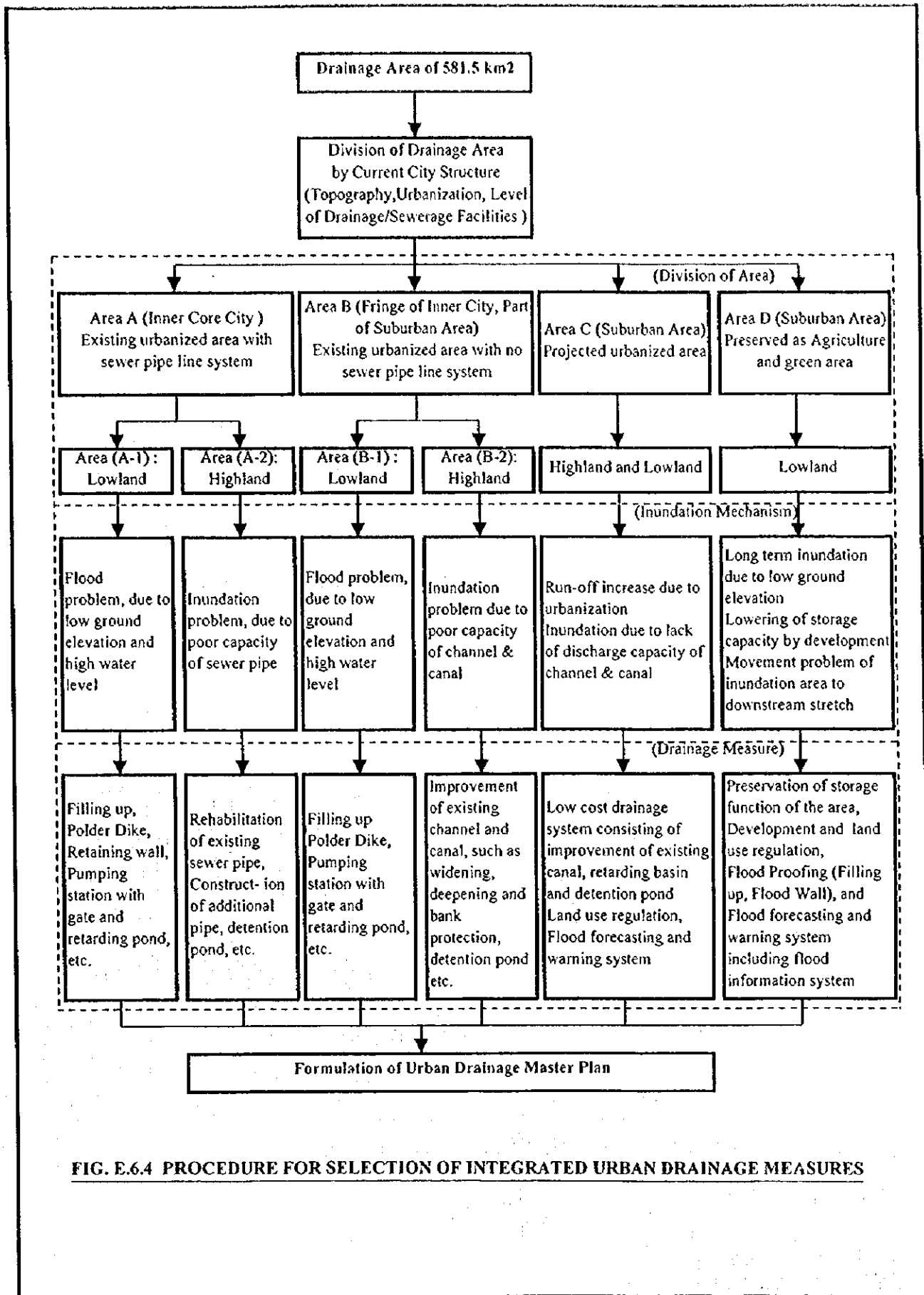
This is a typical sample for increasing of flood discharge due to urbanization in Tsurumi River basin in Tokyo, Japan.

FIG. E.6.2 INCREASE OF FLOOD DISCHARGE DUE TO URBANIZATION



Note: 1. Measures enclosed in a broken line are proposed in this Master Plan.  
 2. Retaining wall, dike and levee for flood protection of low land areas are to be included in this Master Plan.

FIG. E.6.3 PROPOSED INTEGRATED STORMWATER DRAINAGE MEASURE SYSTEM



**FIG. E.6.4 PROCEDURE FOR SELECTION OF INTEGRATED URBAN DRAINAGE MEASURES**

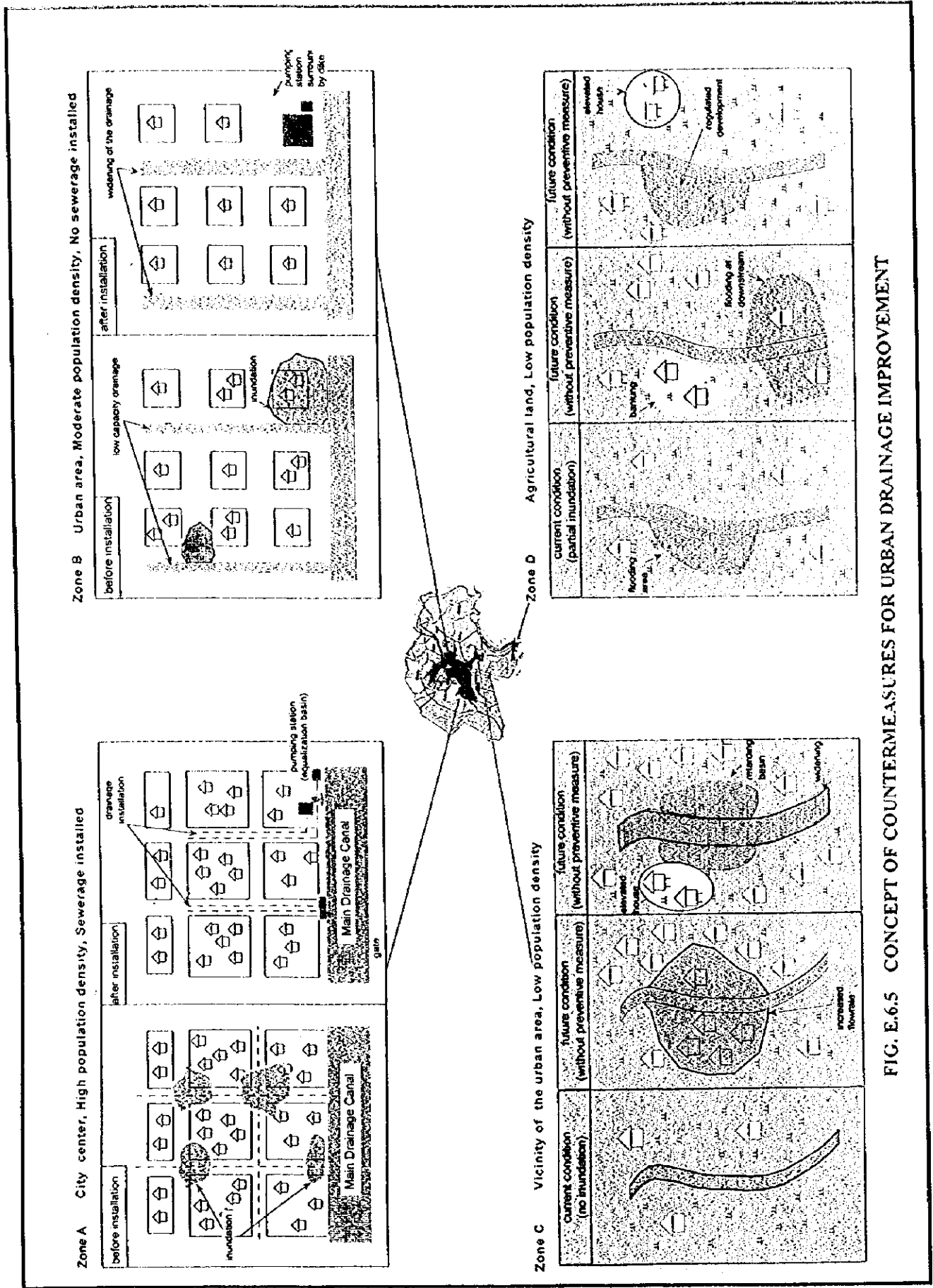
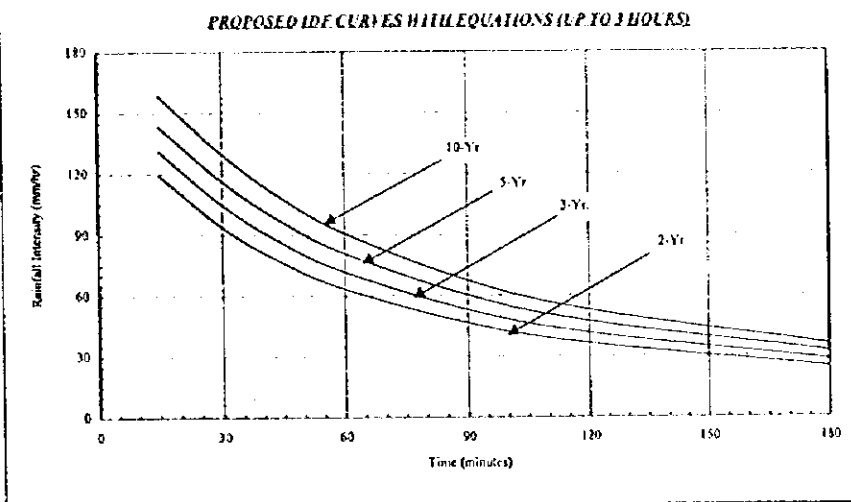


FIG. E.6.5 CONCEPT OF COUNTERMEASURES FOR URBAN DRAINAGE IMPROVEMENT



**Proposed Equations of IDF Curves**

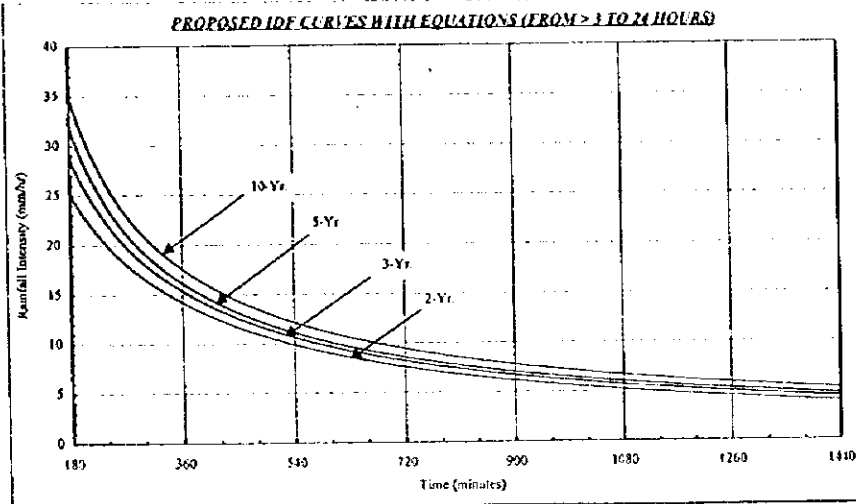
Kimijima Type:  $i = \frac{b}{t^n + a}$

$i$  = Rainfall Intensity, mm/hr  
 $t$  = Duration, minutes

Return Period (Years)	Parameter		
	b	n	a
1	3,055	1.04	24
1.5	10,633	1.15	74
2	13,567	1.18	89
3	17,439	1.20	107
5	22,294	1.22	128
10	29,125	1.25	154
20	36,410	1.27	179
25	38,836	1.28	186
30	40,861	1.28	192
50	46,733	1.29	209
70	50,683	1.30	220
100	54,976	1.31	231

Data : 1952 - 1997

**PROPOSED IDF CURVES WITH EQUATIONS (UP TO 3 HOURS)**



**Proposed Equations of IDF Curves**

Kimijima Type:  $i = \frac{b}{t^n + a}$

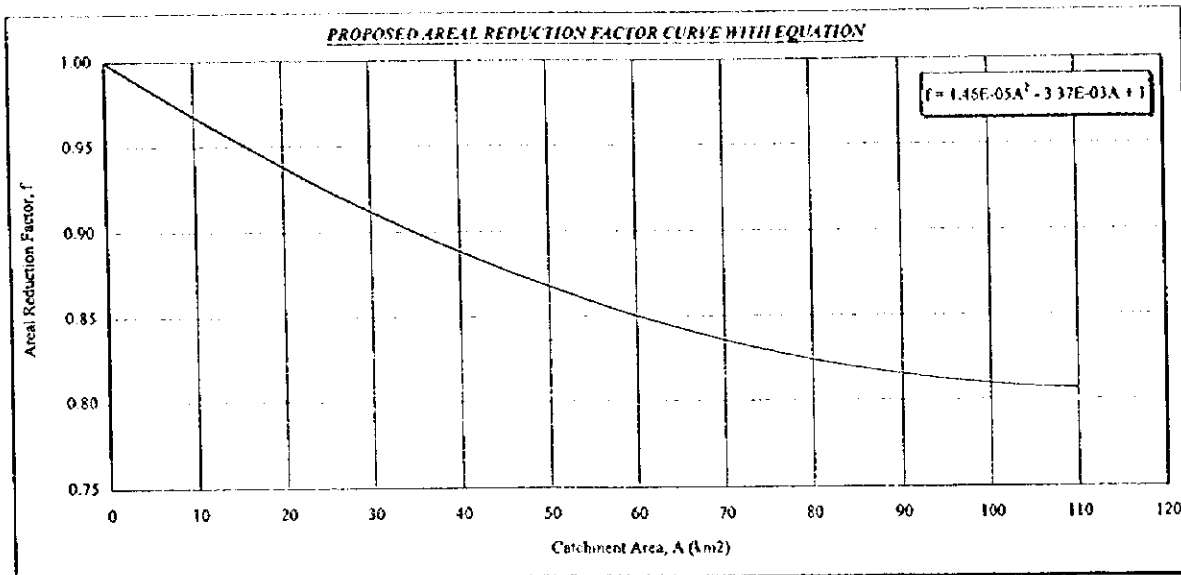
$i$  = Rainfall Intensity, mm/hr  
 $t$  = Duration, minutes

Return Period (Years)	Parameter		
	b	n	a
1	515,409	1.68	35,181
1.5	7,372	1.05	94
2	5,858	1.00	53
3	3,269	0.91	1
5	2,024	0.84	-15
10	1,669	0.80	-16
20	1,229	0.75	-17
25	1,305	0.75	-17
30	1,073	0.72	-17
50	886	0.69	-17
70	872	0.68	-16
100	875	0.68	-16

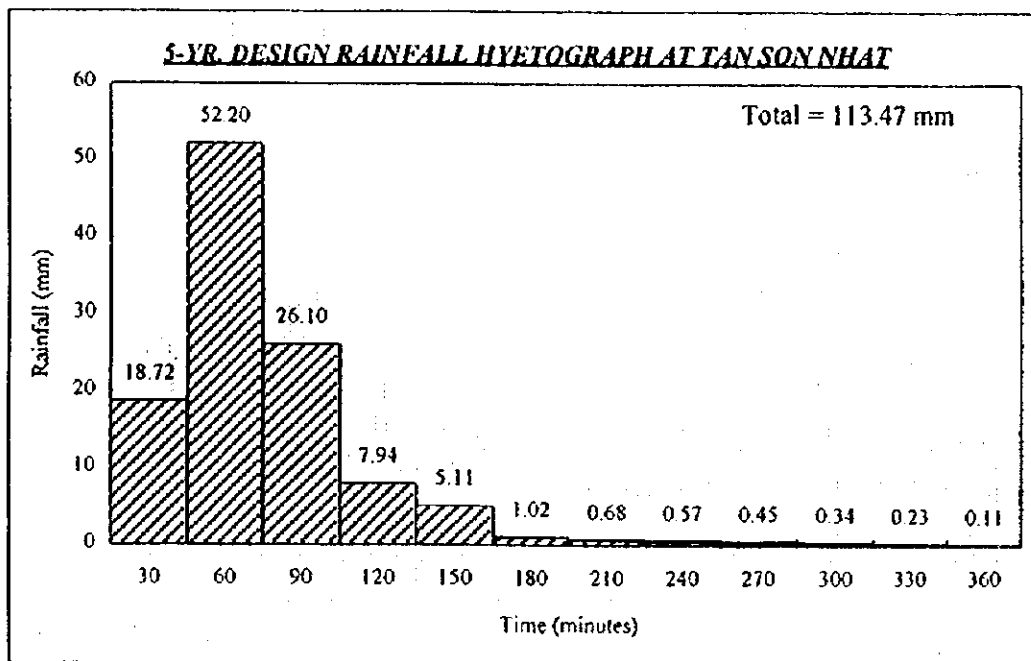
Data : 1952 - 1997

**PROPOSED IDF CURVES WITH EQUATIONS (FROM MORE THAN 3 TO 24 HOURS)**

**FIG. E.6.6 PROPOSED RAINFALL INTENSITY - DURATION CURVES AT TAN SON NHAT STATION**

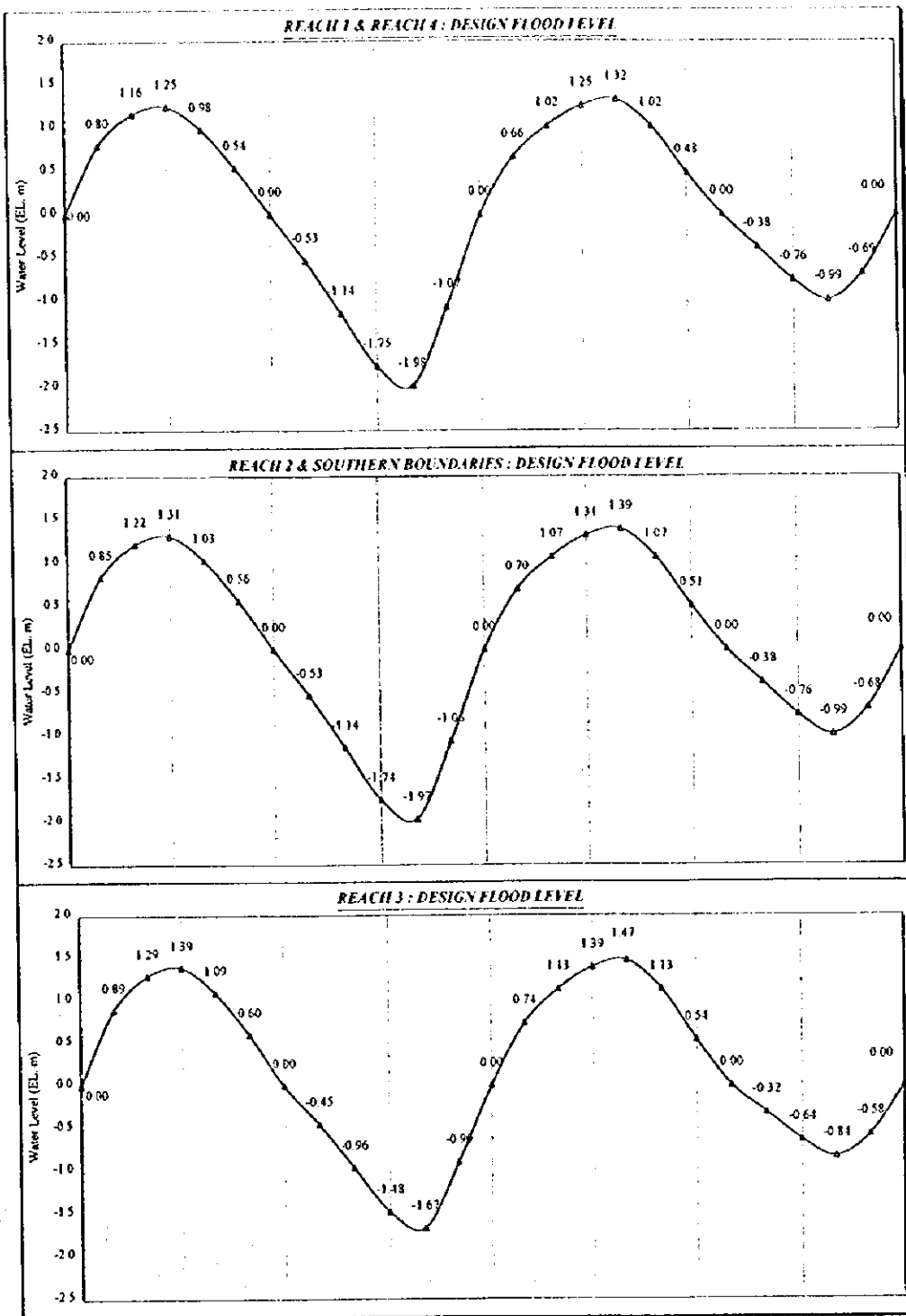


**FIG. E.6.7 PROPOSED AREA REDUCTION FACTOR CURVE WITH EQUATION**



**FIG. E.6.8 PROPOSED DESIGN RAINFALL HYETOGRAPH**

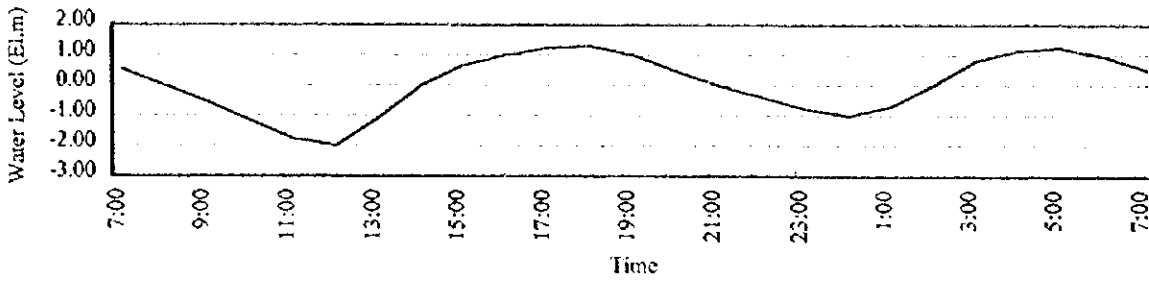




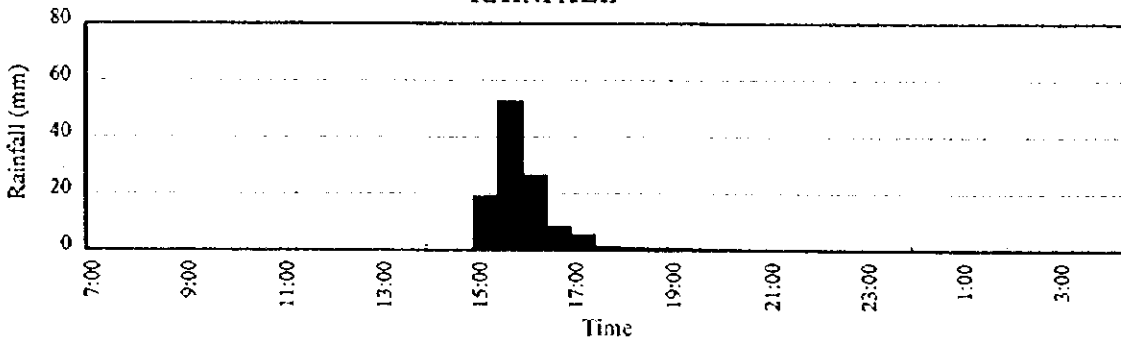
- Reach 1: From confluence point of Rach Ba Hong with Song Saigon to confluence point of Kinh Te with Song Saigon (33.97 km)
- Reach 2: From confluence point of Kinh Te with Song Saigon to confluence point of Song Meong Chuoi with Song Nha Be (27.83 km)
- Reach 3: From confluence point of Song Saigon with Song Nha Be to (northern) confluence point of Song Tac with Song Dong Nai (26.33 km)
- Reach 4: From confluence point of Kinh Te with Song Saigon to confluence point of Rach Ba Goc with Song Ben Luc (15.60 km)
- Southern Boundaries: The southern boundaries of Rach Can Giuoc, Rach Ba Lao etc. flowing towards the south.

**FIG. E.6.9 DESIGN 24-HOUR WATER LEVEL PROFILE BY REACH**

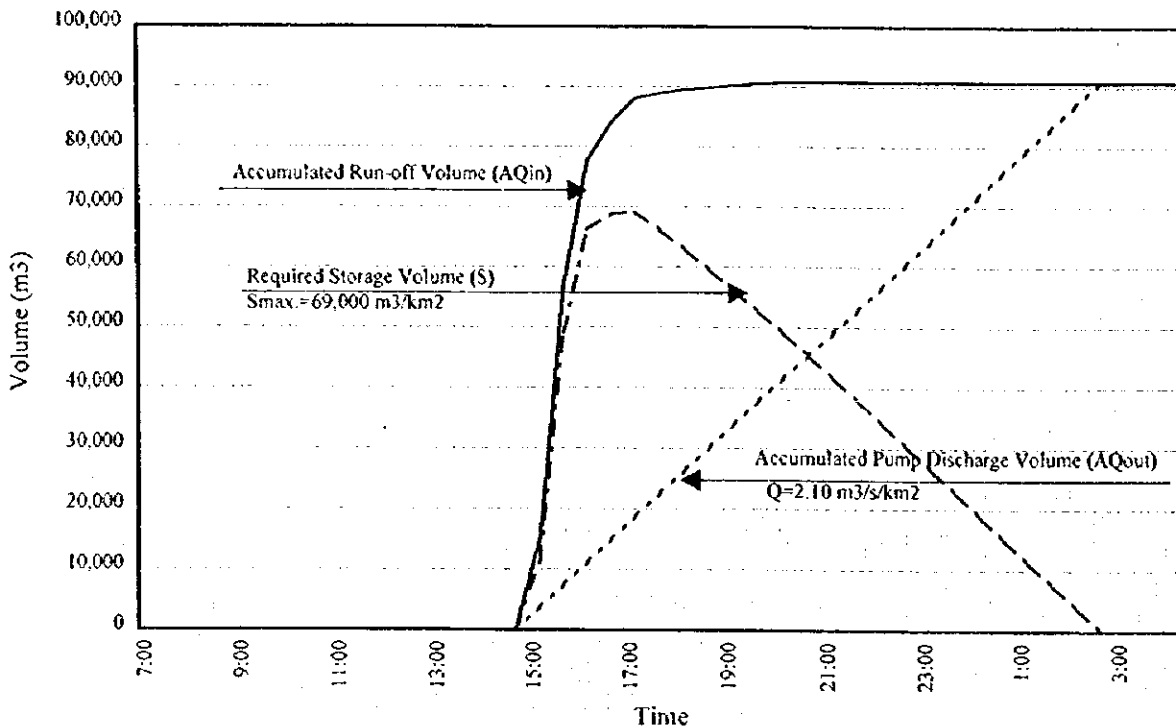
**Water Level of Sai Gon River at Phu An (m above MSI.)**



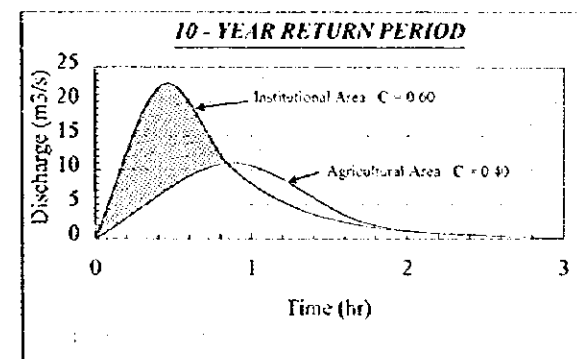
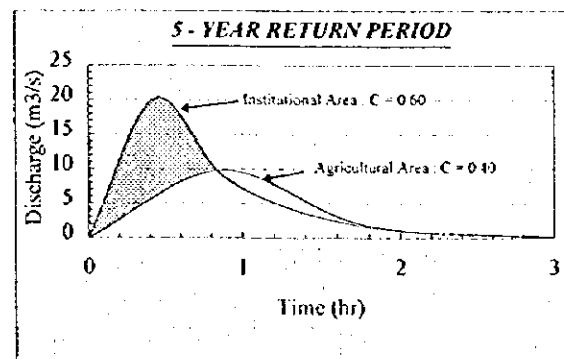
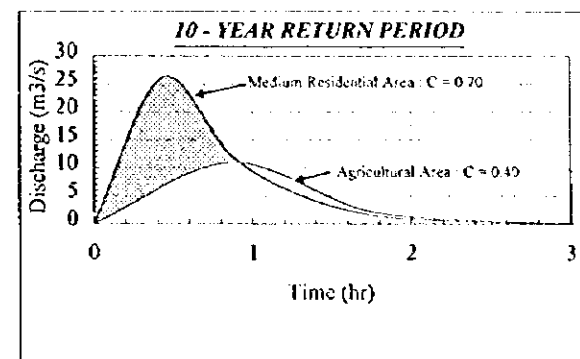
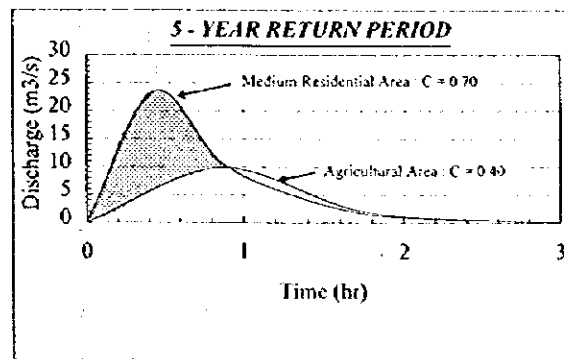
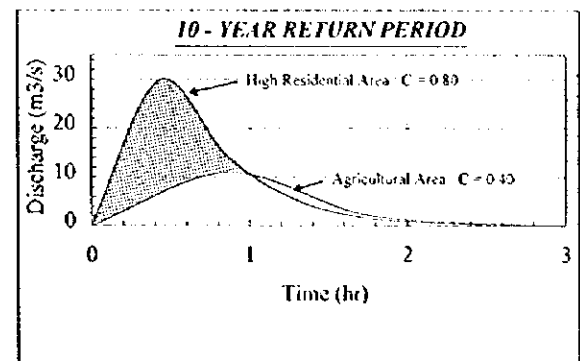
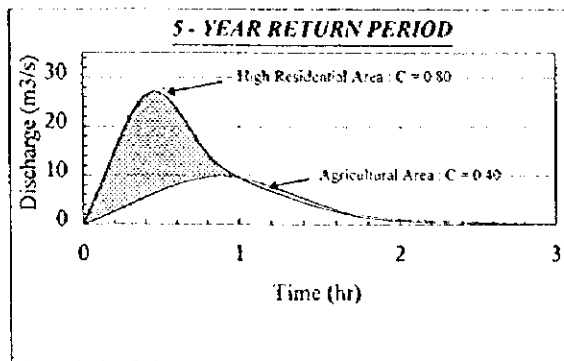
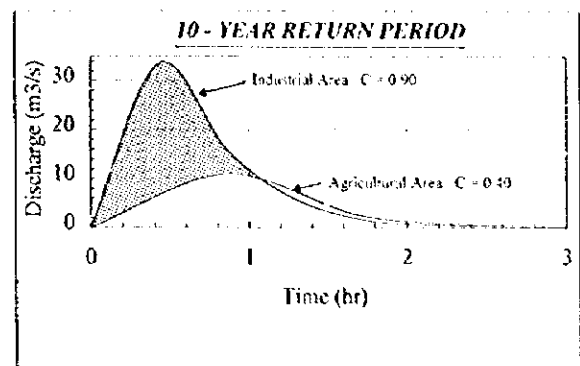
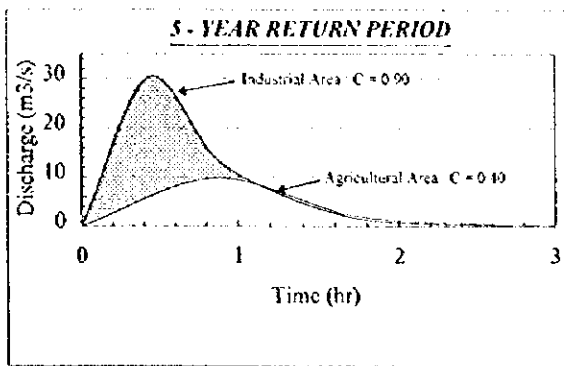
**RAINFALL**



**SPECIFIC PUMP CAPACITY AND STORAGE REQUIREMENT**



**FIG. E.6.10 RELATION BETWEEN REQUIRED SPECIFIC PUMP CAPACITY AND STORAGE REQUIREMENT OF RETARDING POND**



For non-urbanized area (C = 0.40) : Time of concentration =  $10 + 1.25 * 1000(0.5*60) = 51.67$  minutes.  
 For urbanized area (C = 0.60, 0.70, 0.80, 0.90) : Time of concentration =  $5 + 1.25 * 1000(1.0*60) = 25.83$  minutes.

Required specific storage volume (m3/km2) due to urbanization

FIG. E.6.11 EFFECT OF URBANIZATION ON RUNOFF HYDROGRAPHS (A = 1.0 km<sup>2</sup>)

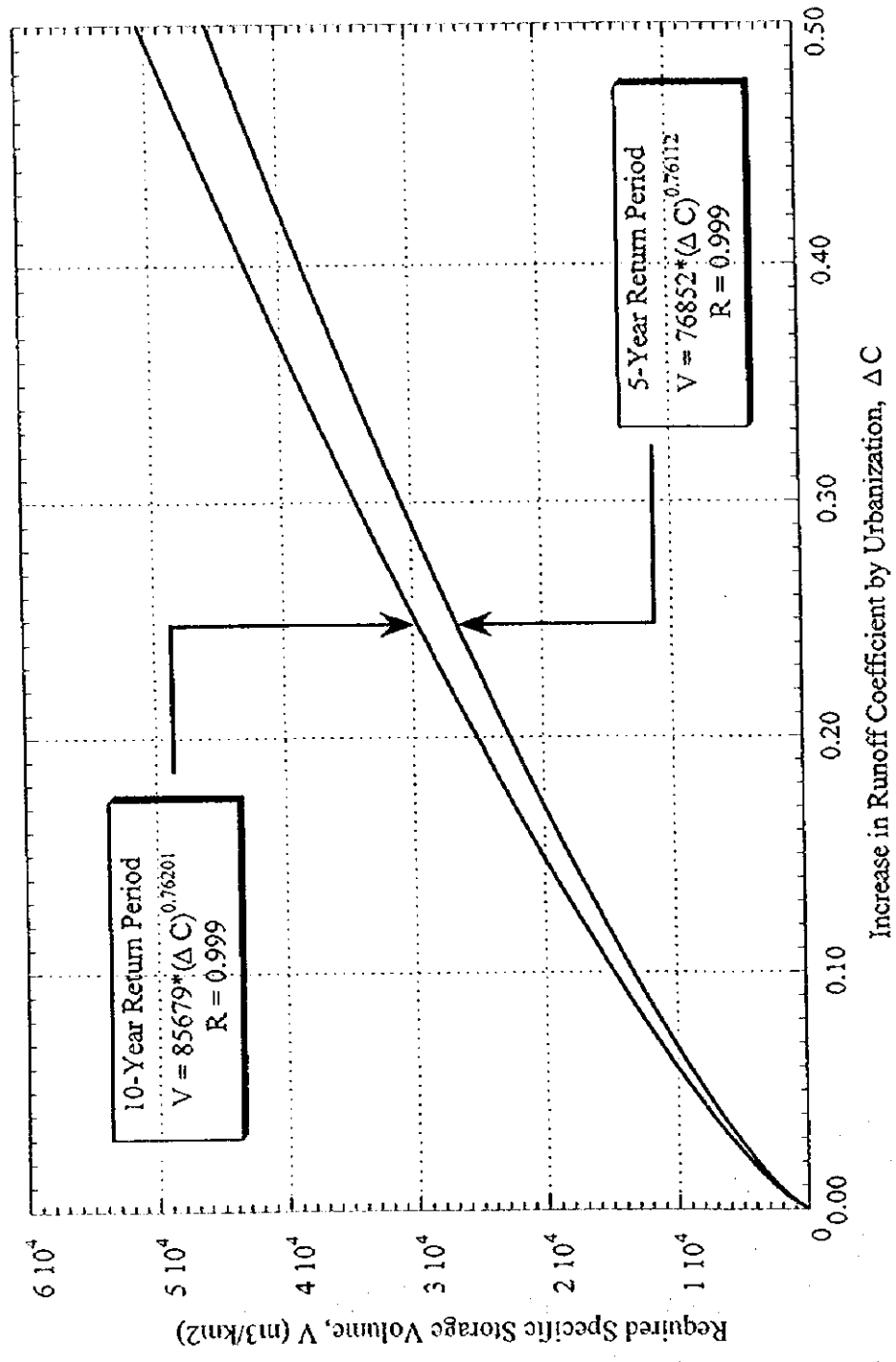
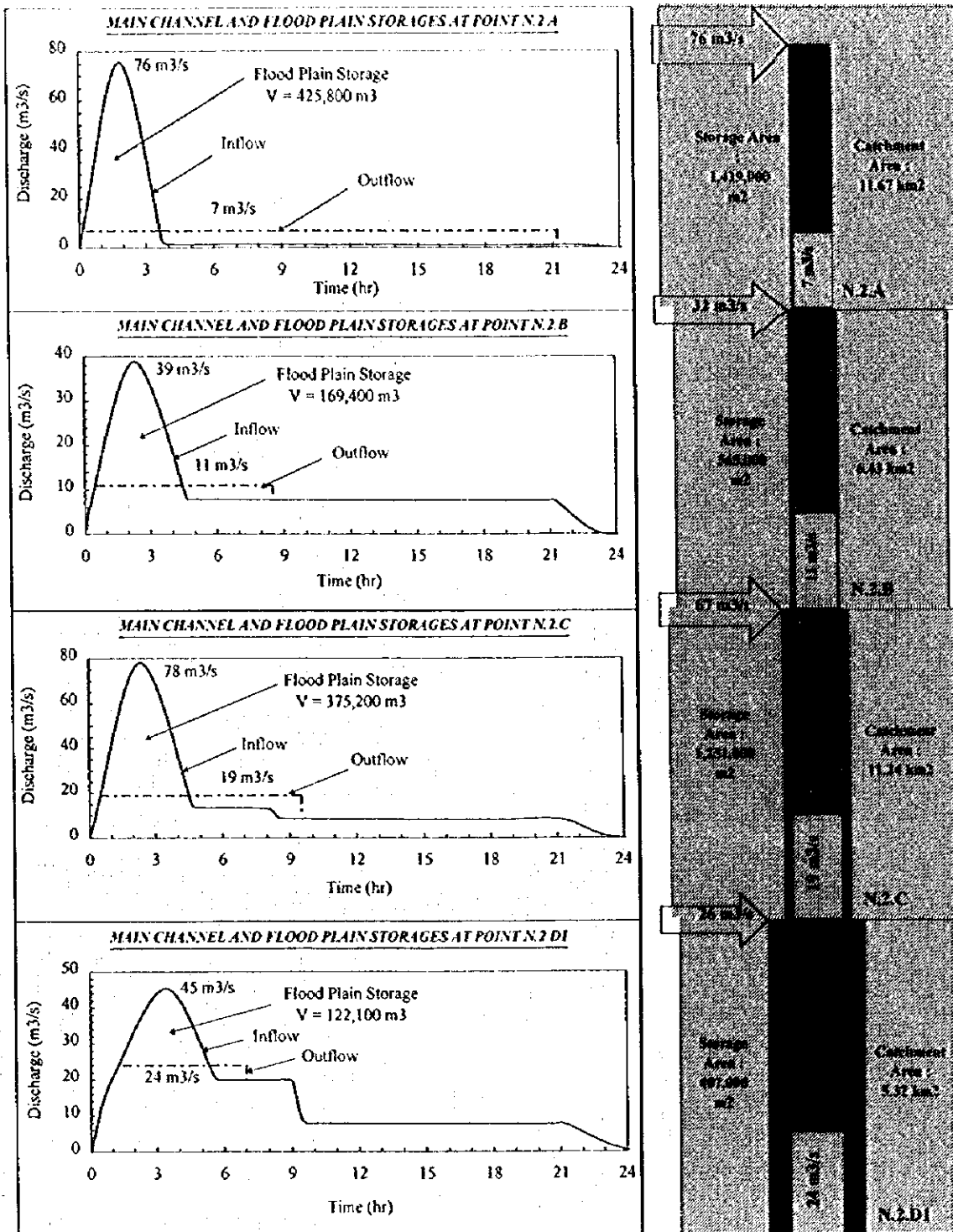
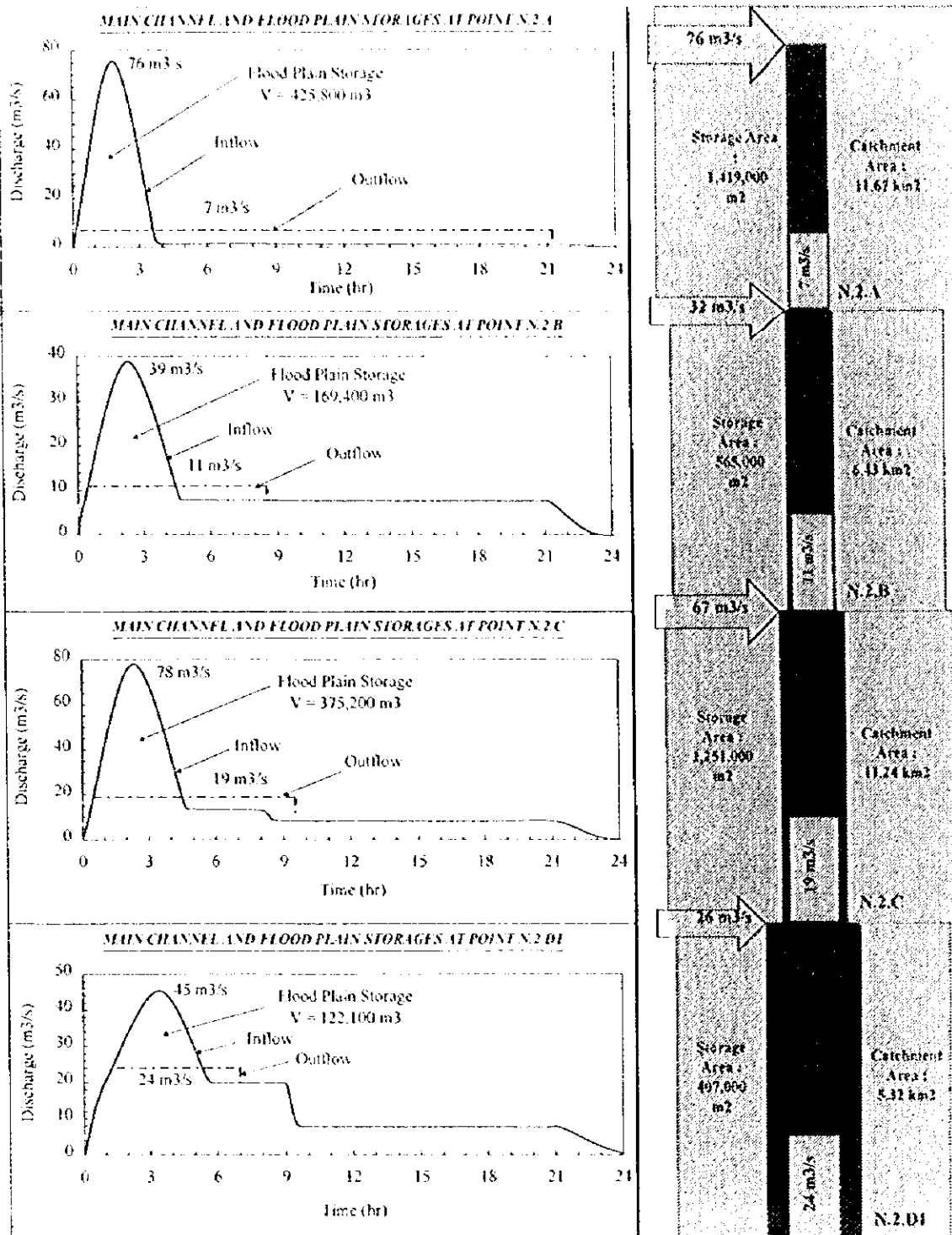


FIG. E.6.12 REQUIRED SPECIFIC STORAGE VOLUME DUE TO INCREASE IN RUN-OFF COEFFICIENT BY URBANIZATION



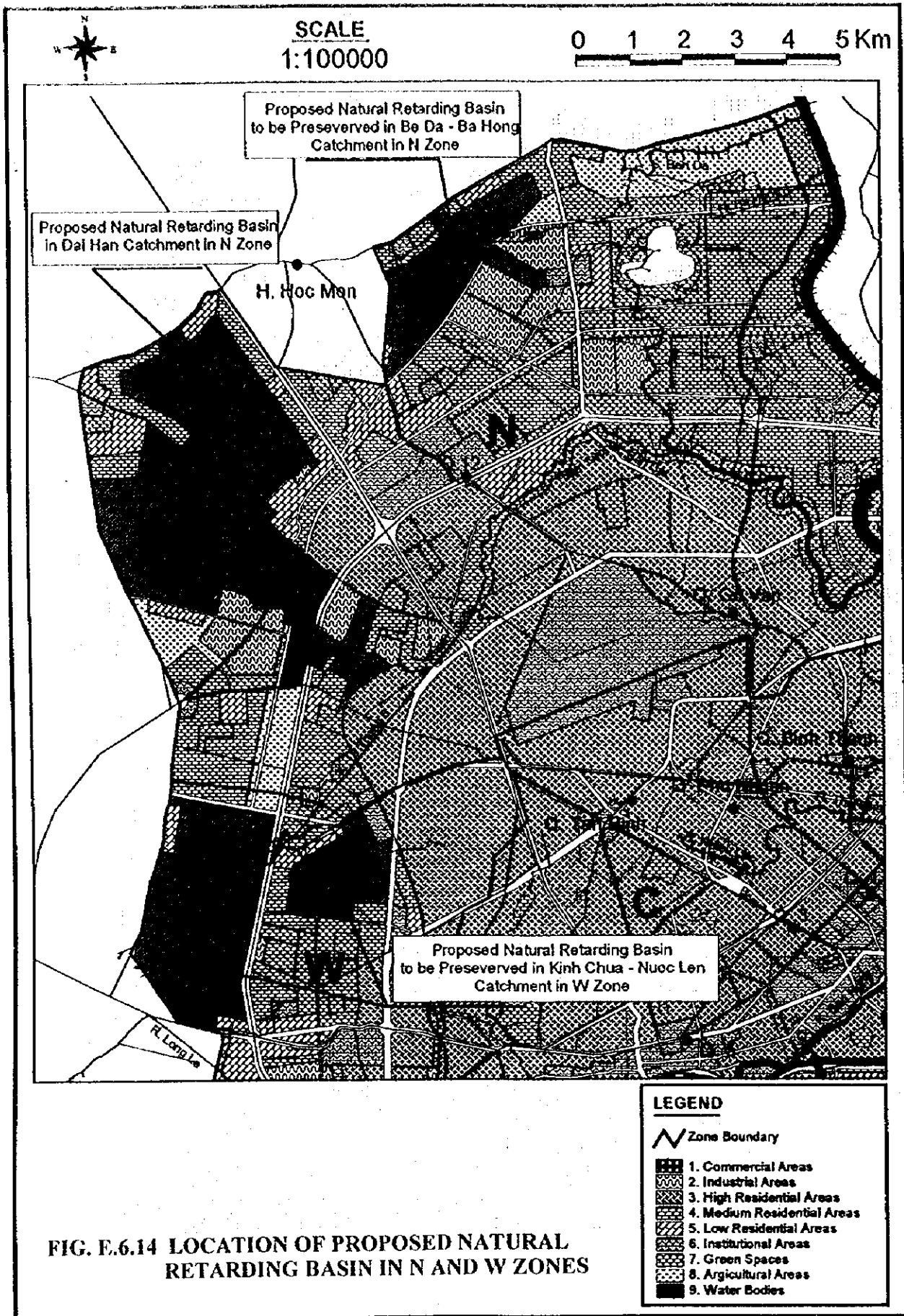
Note : Flood plain storage areas have been estimated based on a 30 cm inundation depth

FIG. E.6.13 FLOOD PLAIN STORAGES ALONG RACH DAIHAN (5-Year R.P.)



Note : Flood plain storage areas have been estimated based on a 30 cm inundation depth

FIG. E.6.13 FLOOD PLAIN STORAGES ALONG RACH DAHIAN (5-Year R.P.)



**FIG. E.6.14 LOCATION OF PROPOSED NATURAL RETARDING BASIN IN N AND W ZONES**

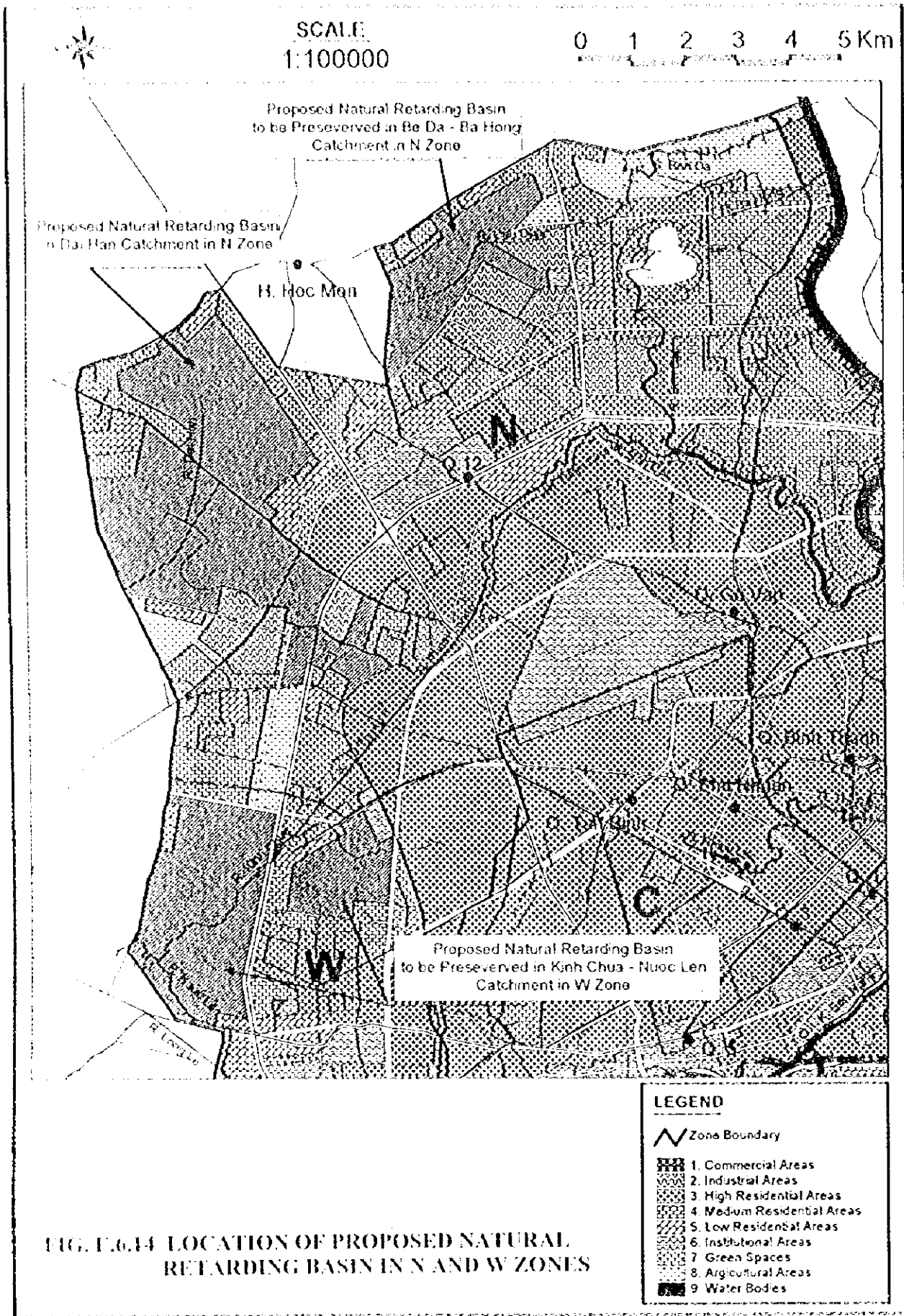


FIG. T.6.14 LOCATION OF PROPOSED NATURAL RETARDING BASIN IN N AND W ZONES



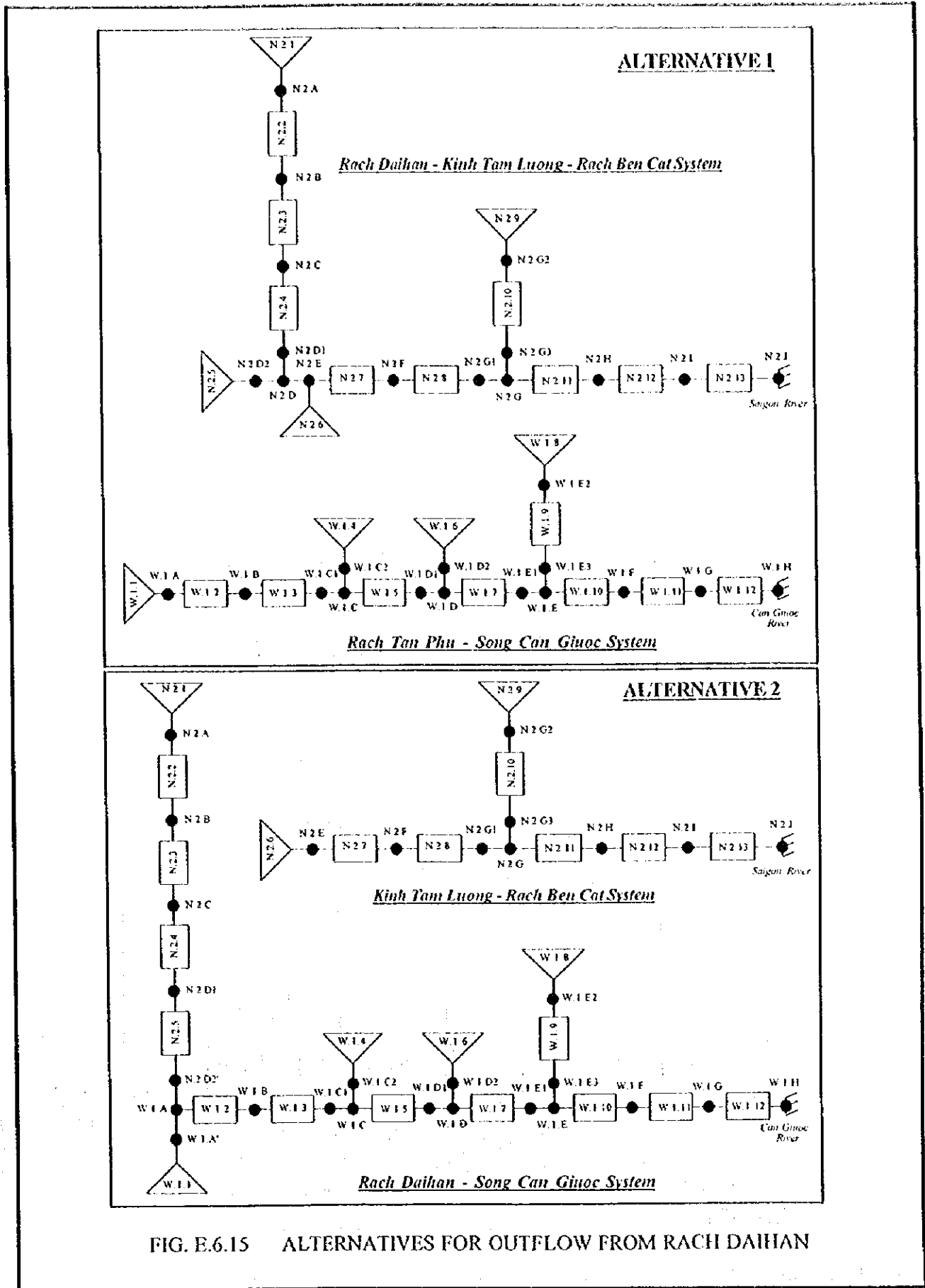
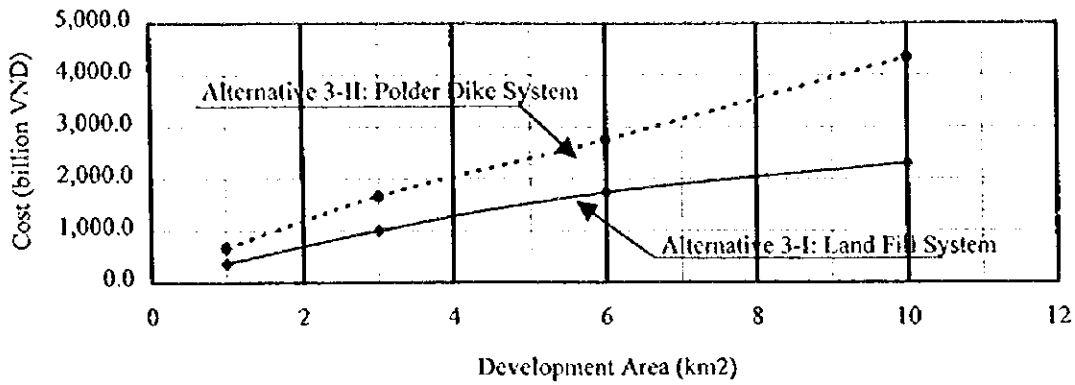
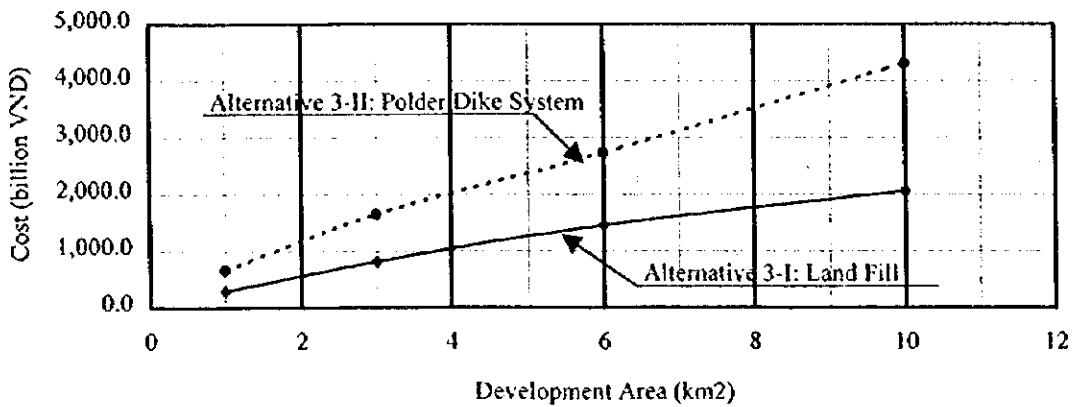


FIG. E.6.15 ALTERNATIVES FOR OUTFLOW FROM RACH DAIHAN

(EXISTING GROUND ELEVATION: GL.0.6 m above MSL)



(EXISTING GROUND ELEVATION: GL.0.9 m above MSL)



(EXISTING GROUND ELEVATION: GL.1.2 m above MSL)

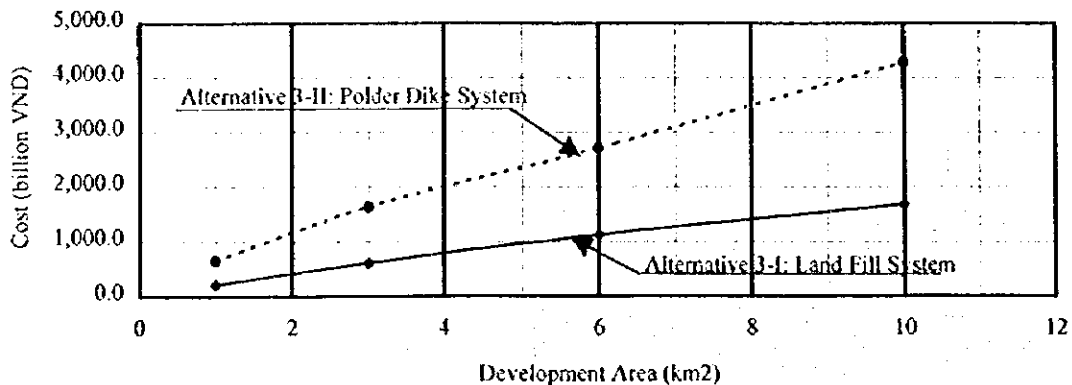


FIG. E.6.16 COST COMPARISON OF ALTERNATIVES 3-I AND 3-II

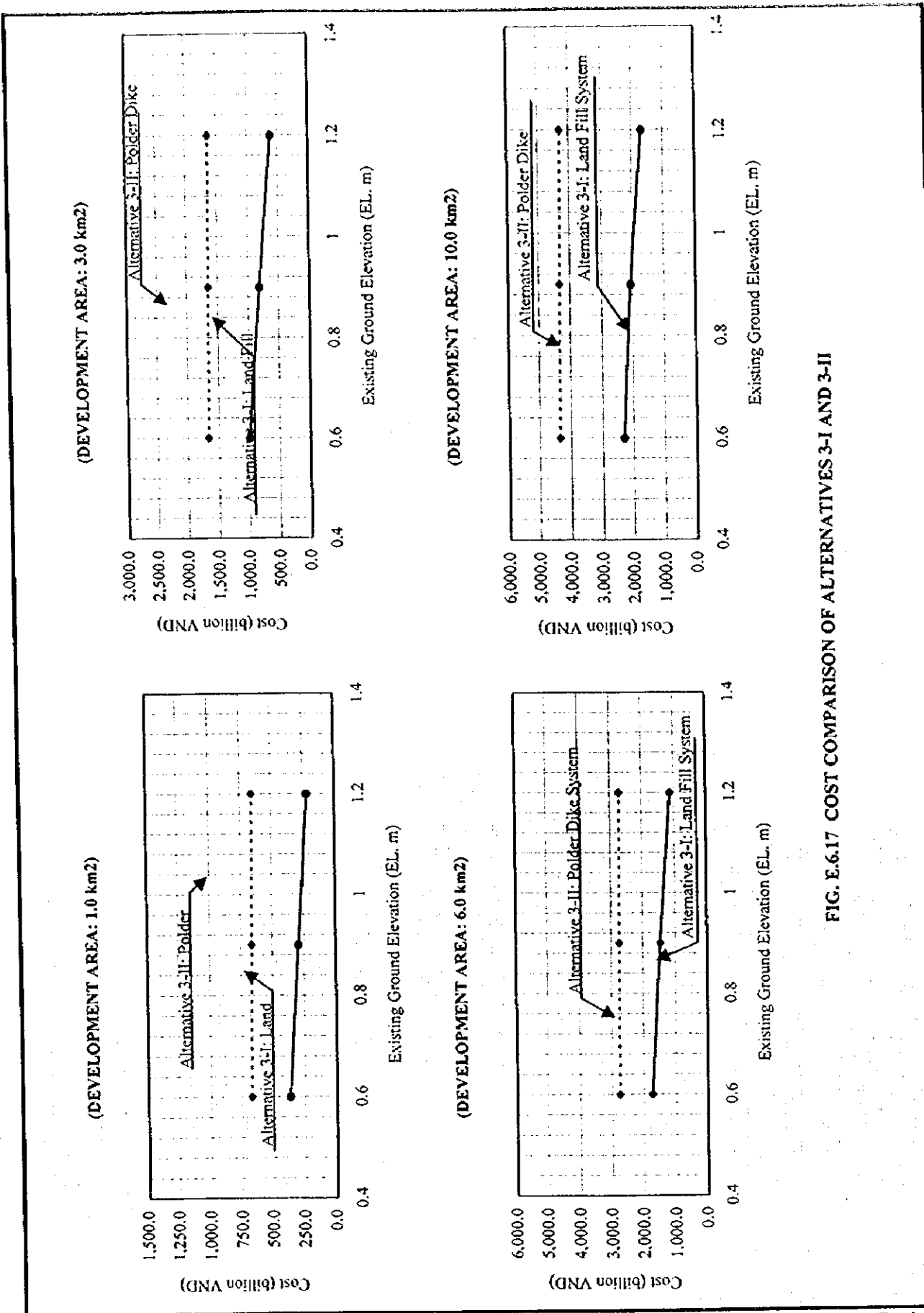
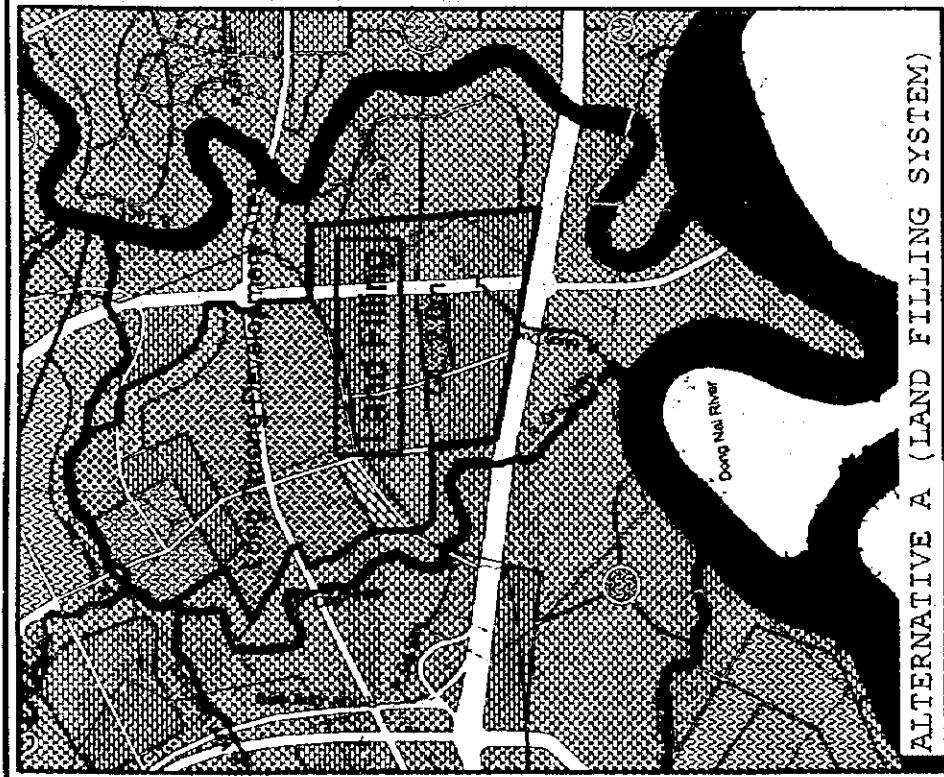
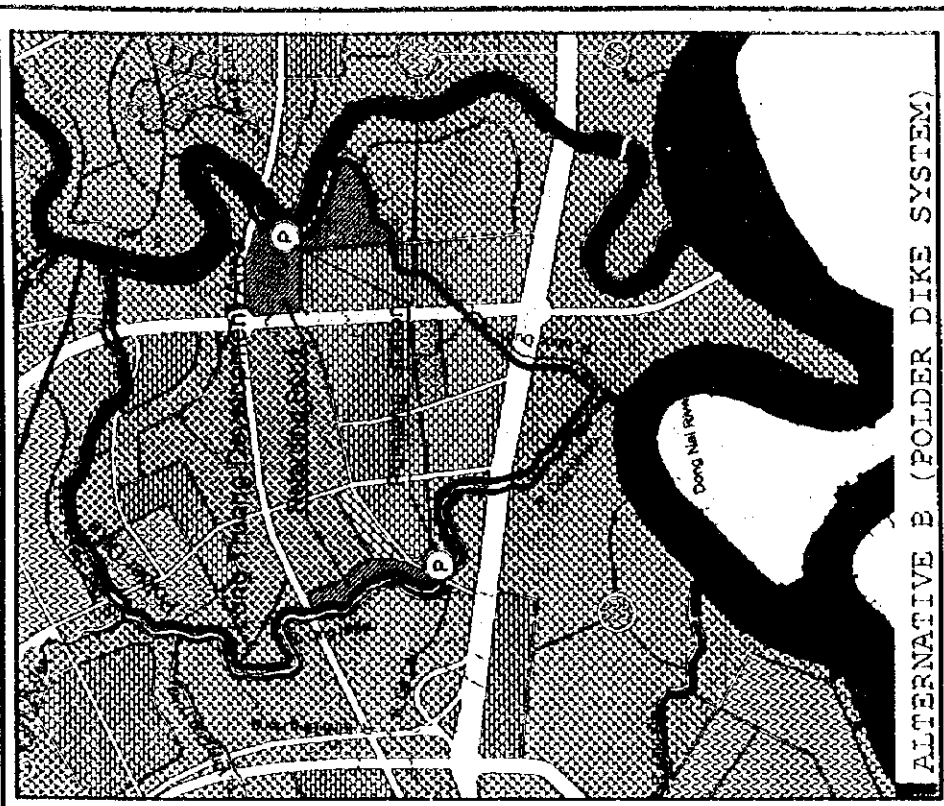


FIG. E.6.17 COST COMPARISON OF ALTERNATIVES 3-I AND 3-II



ALTERNATIVE A (LAND FILLING SYSTEM)



ALTERNATIVE B (POLDER DIKE SYSTEM)

SCALE  
1:70000



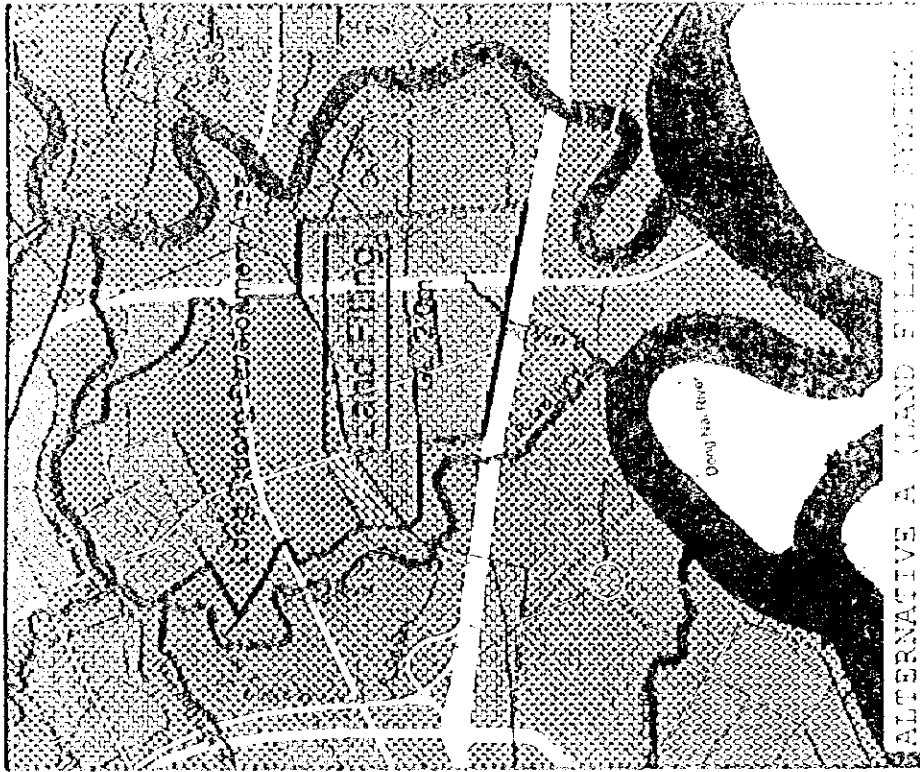
COST COMPARISON OF DRAINAGE SYSTEM ALTERNATIVES OF SE-ZONE

Item	Case A (Urban Drainage) Cost (Billion VND)	Case B (Polder Discharge) Cost (Billion VND)
1. Land Development		
Subtotal	1,294.57	417.96
2. Construction of Polder Dike		
Subtotal		112.83
3. Construction of Pumping Station		
Subtotal		1,720.99
4. Construction of Retarding Pond		
Subtotal		9.35
5. Civil Cost of Pumping Station and Retarding Pond		
Subtotal		1,682.73
6. Total Cost	1,294.57	3,923.77

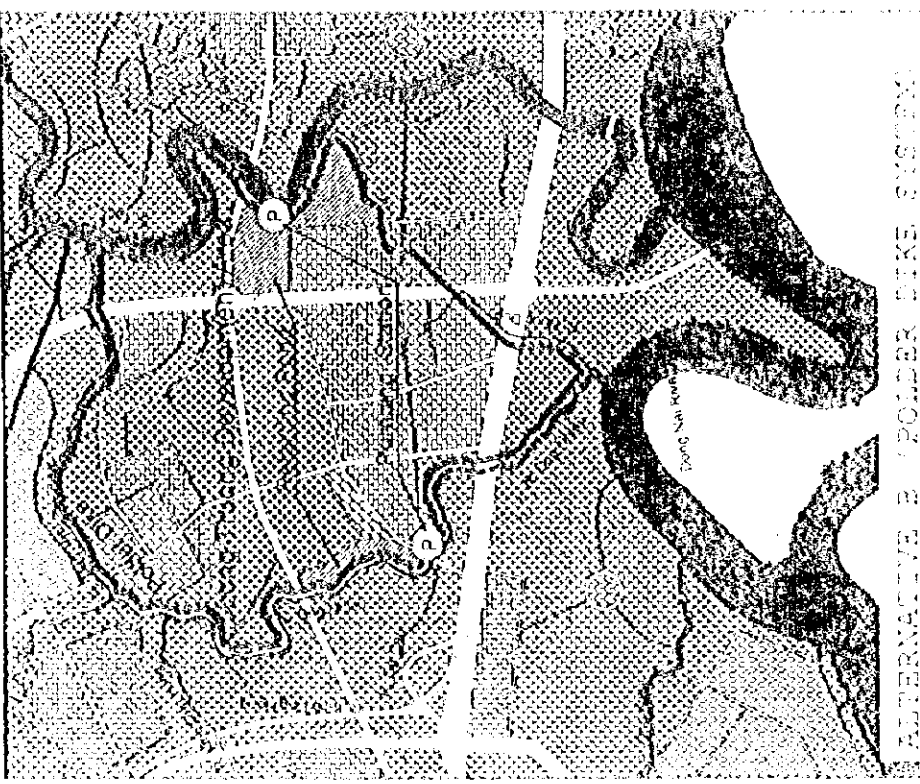
LEGEND

- Zone Boundary
- 1. Commercial Areas
- 2. Industrial Areas
- 3. High Residential Areas
- 4. Medium Residential Areas
- 5. Low Residential Areas
- 6. Institutional Areas
- 7. Green Spaces
- 8. Agricultural Areas
- 9. Water Bodies

FIG. E.6.18 ALTERNATIVES OF URBAN DRAINAGE IN LONG TRUONG DEVELOPMENT AREA



ALTERNATIVE A (FLOOD FILLING SYSTEM)



ALTERNATIVE B (POLDER DIKE SYSTEM)



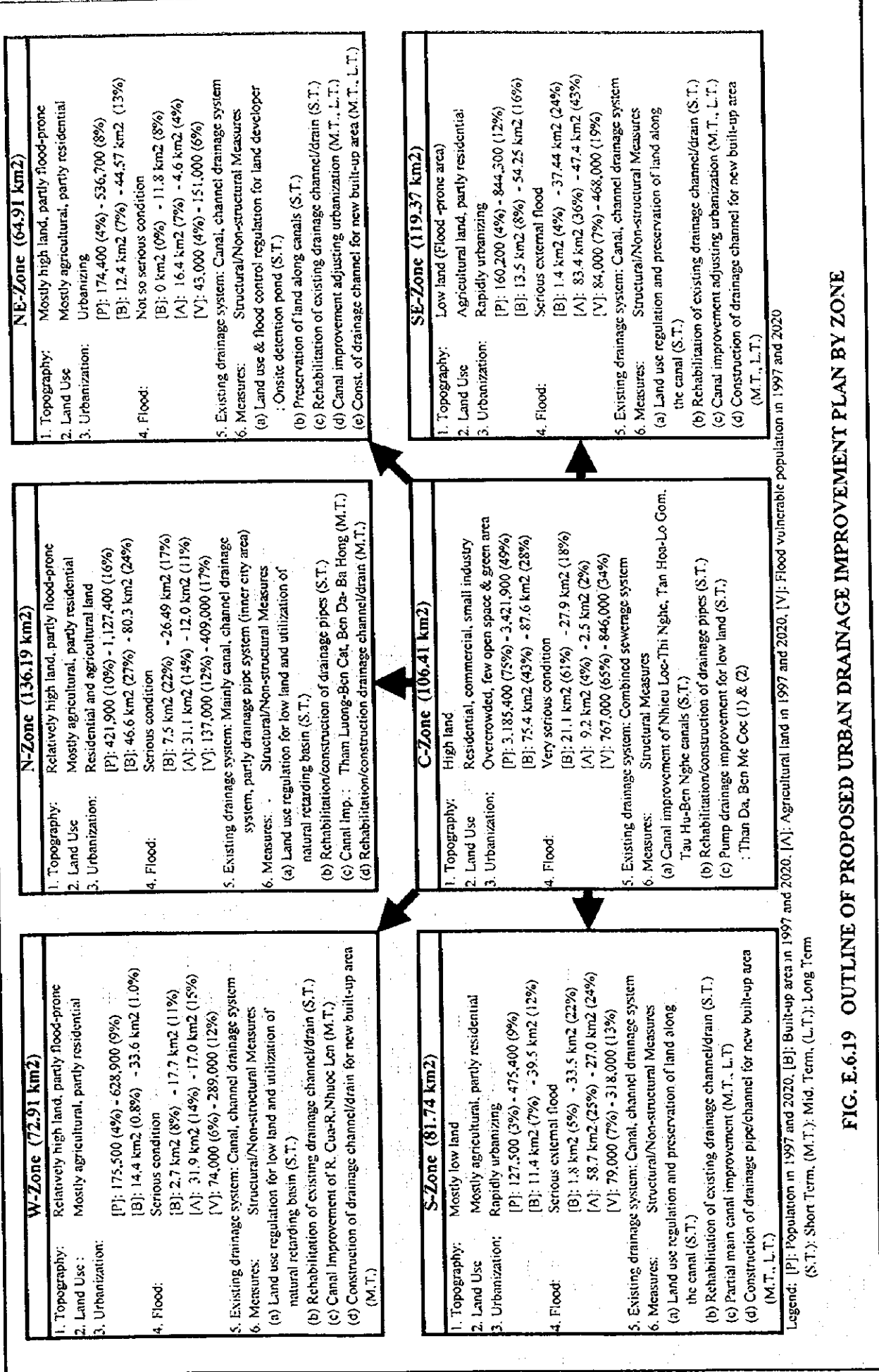
SCALE  
1:70000

LEGEND

1	Urban Residential Areas	4	Medium Residential Areas
2	High Residential Areas	5	Low Residential Areas
3	Medium Residential Areas	6	Industrial Areas
4	Medium Residential Areas	7	Green Spaces
5	Low Residential Areas	8	Agriculture Areas
6	Industrial Areas	9	Water Bodies
7	Green Spaces		
8	Agriculture Areas		
9	Water Bodies		



FIG. E.6.18 ALTERNATIVES OF URBAN DRAINAGE IN LONG TRUONG DEVELOPMENT AREA



**W-Zone (72.91 km<sup>2</sup>)**  
 1. Topography: Relatively high land, partly flood-prone  
 2. Land Use: Mostly agricultural, partly residential  
 3. Urbanization: [P]: 175,500 (4%) - 628,900 (9%)  
 [B]: 14.4 km<sup>2</sup> (0.8%) - 33.6 km<sup>2</sup> (1.0%)  
 [V]: 74,000 (6%) - 289,000 (12%)  
 4. Flood: Serious condition  
 [B]: 2.7 km<sup>2</sup> (8%) - 17.7 km<sup>2</sup> (11%)  
 [A]: 31.9 km<sup>2</sup> (14%) - 17.0 km<sup>2</sup> (15%)  
 5. Existing drainage system: Canal, channel drainage system  
 6. Measures: Structural/Non-structural Measures  
 (a) Land use regulation for low land and utilization of natural retarding basin (S.T.)  
 (b) Rehabilitation of existing drainage channel/drain (S.T.)  
 (c) Canal Improvement of R. Cua-R, Nhuoc Len (M.T.)  
 (d) Construction of drainage channel/drain for new built-up area (M.T.)

**N-Zone (136.19 km<sup>2</sup>)**  
 1. Topography: Relatively high land, partly flood-prone  
 2. Land Use: Mostly agricultural, partly residential  
 3. Urbanization: [P]: 421,900 (10%) - 1,127,400 (16%)  
 [B]: 46.6 km<sup>2</sup> (2.7%) - 80.3 km<sup>2</sup> (2.4%)  
 4. Flood: Serious condition  
 [B]: 7.5 km<sup>2</sup> (2.2%) - 26.49 km<sup>2</sup> (1.7%)  
 [A]: 31.1 km<sup>2</sup> (1.4%) - 12.0 km<sup>2</sup> (1.1%)  
 [V]: 137,000 (12%) - 409,000 (17%)  
 5. Existing drainage system: Mainly canal, channel drainage system, partly drainage pipe system (inner city area)  
 6. Measures: Structural/Non-structural Measures  
 (a) Land use regulation for low land and utilization of natural retarding basin (S.T.)  
 (b) Rehabilitation/construction of drainage pipes (S.T.)  
 (c) Canal Imp.: Tham Luong-Ben Cat, Ben Da-Ba Hong (M.T.)  
 (d) Rehabilitation/construction drainage channel/drain (M.T.)

**NE-Zone (64.91 km<sup>2</sup>)**  
 1. Topography: Mostly high land, partly flood-prone  
 2. Land Use: Mostly agricultural, partly residential  
 3. Urbanization: [P]: 174,400 (4%) - 536,700 (8%)  
 [B]: 12.4 km<sup>2</sup> (7%) - 44.57 km<sup>2</sup> (13%)  
 4. Flood: Not so serious condition  
 [B]: 0 km<sup>2</sup> (0%) - 11.8 km<sup>2</sup> (8%)  
 [A]: 16.4 km<sup>2</sup> (7%) - 4.6 km<sup>2</sup> (4%)  
 [V]: 43,000 (4%) - 151,000 (6%)  
 5. Existing drainage system: Canal, channel drainage system  
 6. Measures: Structural/Non-structural Measures  
 (a) Land use & flood control regulation for land developer  
 : Onsite detention pond (S.T.)  
 (b) Preservation of land along canals (S.T.)  
 (c) Rehabilitation of existing drainage channel/drain (S.T.)  
 (d) Canal improvement adjusting urbanization (M.T., L.T.)  
 (e) Const. of drainage channel for new built-up area (M.T., L.T.)

**S-Zone (81.74 km<sup>2</sup>)**  
 1. Topography: Mostly low land  
 2. Land Use: Mostly agricultural, partly residential  
 3. Urbanization: [P]: 127,500 (3%) - 475,400 (9%)  
 [B]: 11.4 km<sup>2</sup> (7%) - 39.5 km<sup>2</sup> (12%)  
 4. Flood: Serious external flood  
 [B]: 1.8 km<sup>2</sup> (5%) - 33.5 km<sup>2</sup> (22%)  
 [A]: 58.7 km<sup>2</sup> (25%) - 27.0 km<sup>2</sup> (24%)  
 [V]: 79,000 (7%) - 318,000 (13%)  
 5. Existing drainage system: Canal, channel drainage system  
 6. Measures: Structural/Non-structural Measures  
 (a) Land use regulation and preservation of land along the canal (S.T.)  
 (b) Rehabilitation of existing drainage channel/drain (S.T.)  
 (c) Partial main canal improvement (M.T., L.T.)  
 (d) Construction of drainage pipe/channel for new built-up area (M.T., L.T.)

**C-Zone (106.41 km<sup>2</sup>)**  
 1. Topography: High land  
 2. Land Use: Residential, commercial, small industry  
 3. Urbanization: [P]: 3,185,400 (75%) - 3,421,900 (49%)  
 [B]: 75.4 km<sup>2</sup> (43%) - 87.6 km<sup>2</sup> (28%)  
 4. Flood: Very serious condition  
 [B]: 2.1 km<sup>2</sup> (61%) - 27.9 km<sup>2</sup> (18%)  
 [A]: 9.2 km<sup>2</sup> (4%) - 2.5 km<sup>2</sup> (2%)  
 [V]: 767,000 (65%) - 846,000 (34%)  
 5. Existing drainage system: Combined sewerage system  
 6. Measures: Structural Measures  
 (a) Canal improvement of Nhieu Loc-Thi Nghe, Tan Hoa-Lo Gom, Tau Hu-Ben Nghe canals (S.T.)  
 (b) Rehabilitation/construction of drainage pipes (S.T.)  
 (c) Pump drainage improvement for low land (S.T.)  
 : Than Da, Ben Me Coc (1) & (2)

**SE-Zone (119.37 km<sup>2</sup>)**  
 1. Topography: Low land (Flood-prone area)  
 2. Land Use: Agricultural land, partly residential  
 3. Urbanization: [P]: 160,200 (4%) - 844,300 (12%)  
 [B]: 13.5 km<sup>2</sup> (8%) - 54.25 km<sup>2</sup> (16%)  
 4. Flood: Serious external flood  
 [B]: 1.4 km<sup>2</sup> (4%) - 37.44 km<sup>2</sup> (24%)  
 [A]: 83.4 km<sup>2</sup> (36%) - 47.4 km<sup>2</sup> (43%)  
 [V]: 84,000 (7%) - 468,000 (19%)  
 5. Existing drainage system: Canal, channel drainage system  
 6. Measures: Structural/Non-structural Measures  
 (a) Land use regulation and preservation of land along the canal (S.T.)  
 (b) Rehabilitation of existing drainage channel/drain (S.T.)  
 (c) Canal improvement adjusting urbanization (M.T., L.T.)  
 (d) Construction of drainage channel for new built-up area (M.T., L.T.)

Legend: [P]: Population in 1997 and 2020. [B]: Built-up area in 1997 and 2020. [A]: Agricultural land in 1997 and 2020. [V]: Flood vulnerable population in 1997 and 2020 (S.T.): Short Term, (M.T.): Mid Term, (L.T.): Long Term

**FIG. E.6.19 OUTLINE OF PROPOSED URBAN DRAINAGE IMPROVEMENT PLAN BY ZONE**

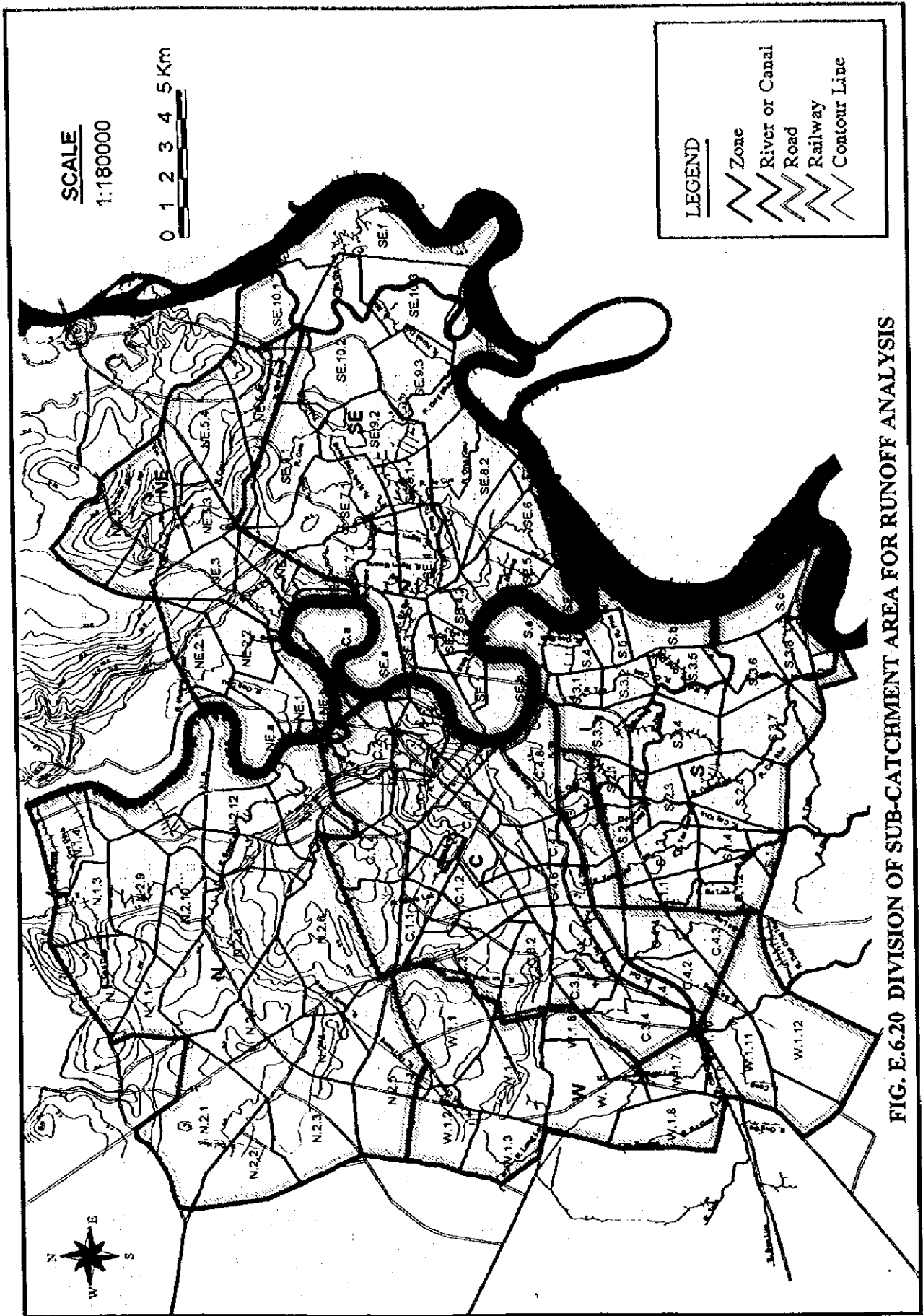


FIG. E.6.20 DIVISION OF SUB-CATCHMENT AREA FOR RUNOFF ANALYSIS

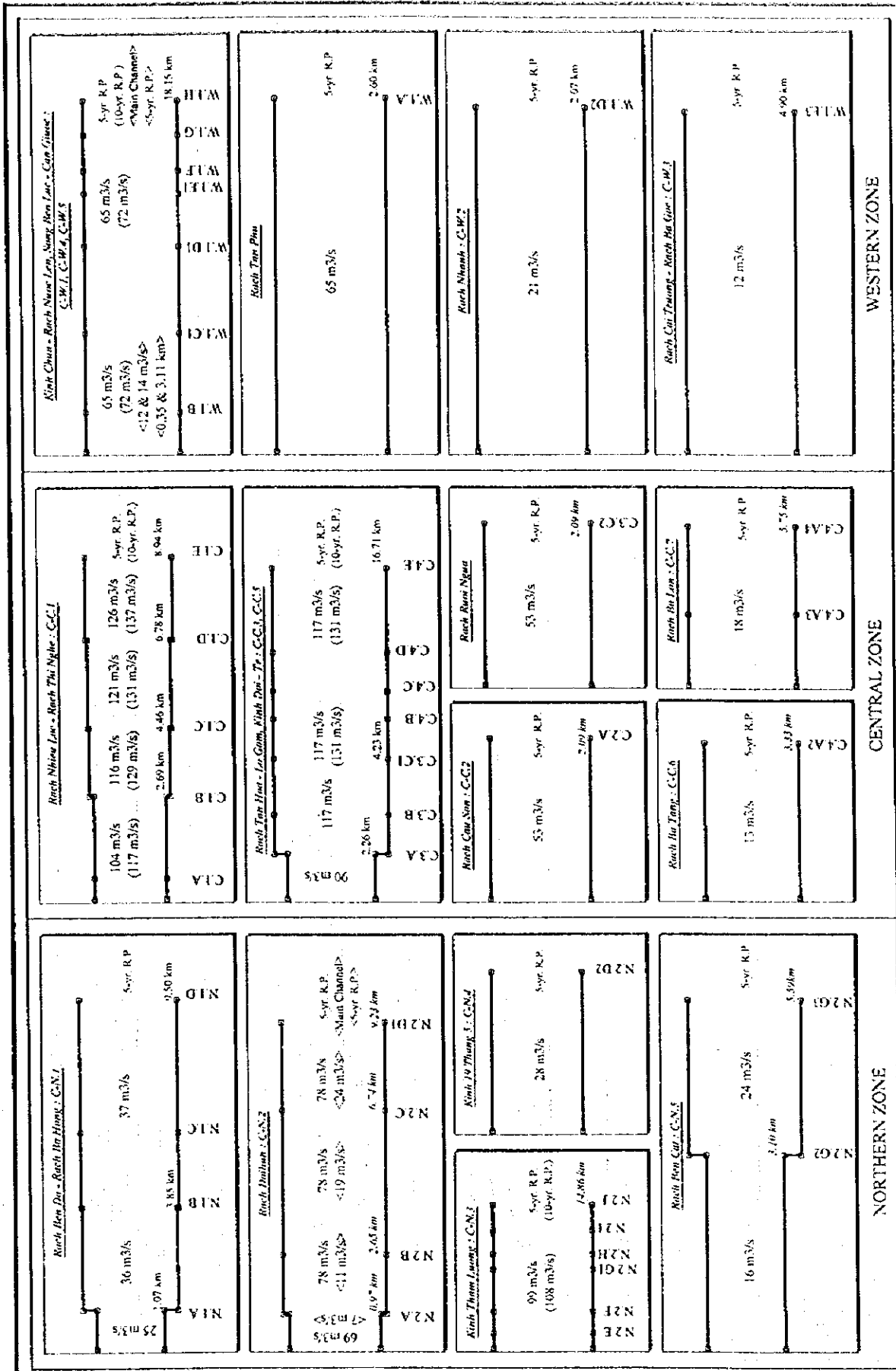


FIG. E.6.2(1/3) DESIGN DISCHARGE DISTRIBUTIONS OF THE CANALS



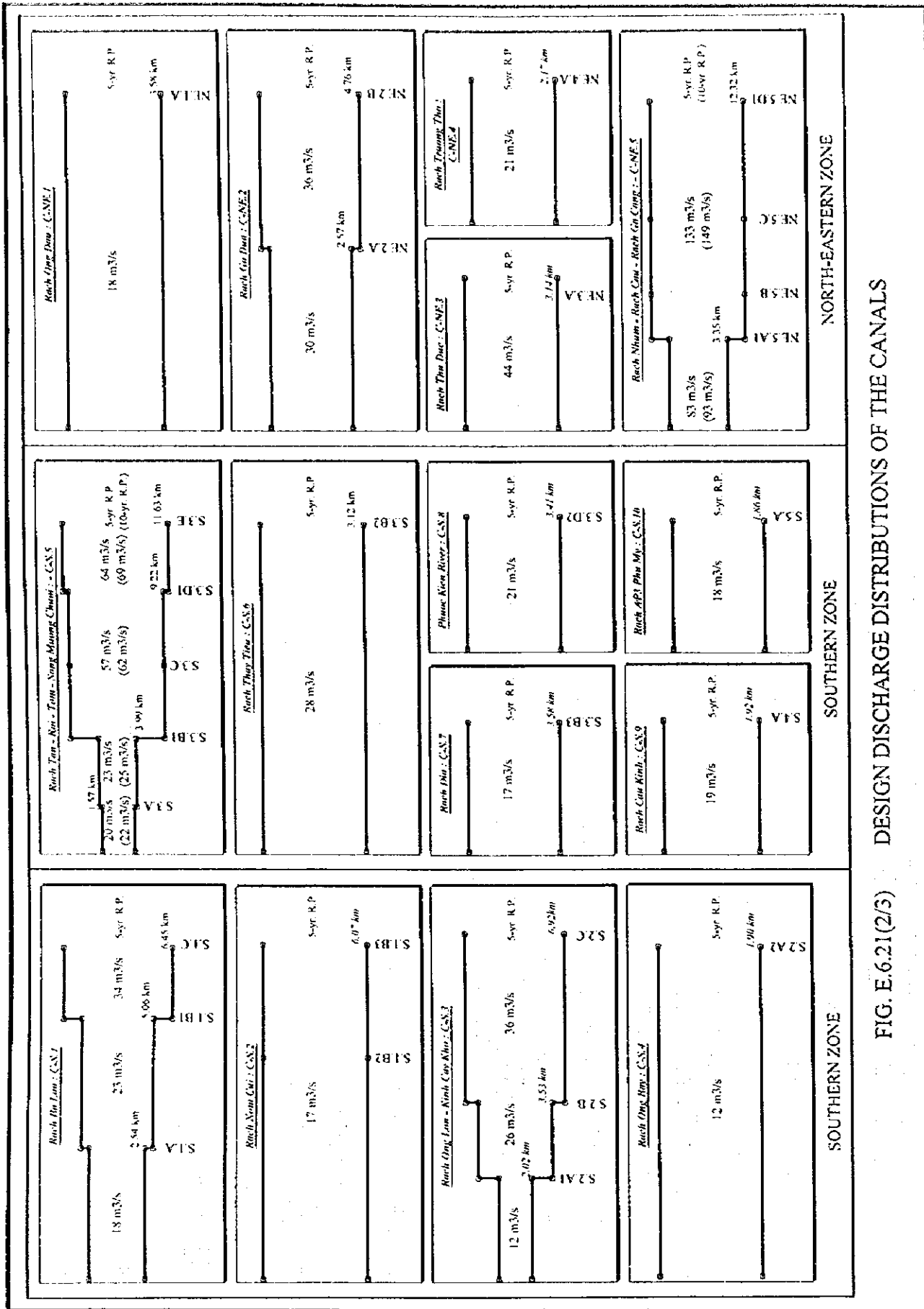


FIG. E.6.21(2/3) DESIGN DISCHARGE DISTRIBUTIONS OF THE CANALS

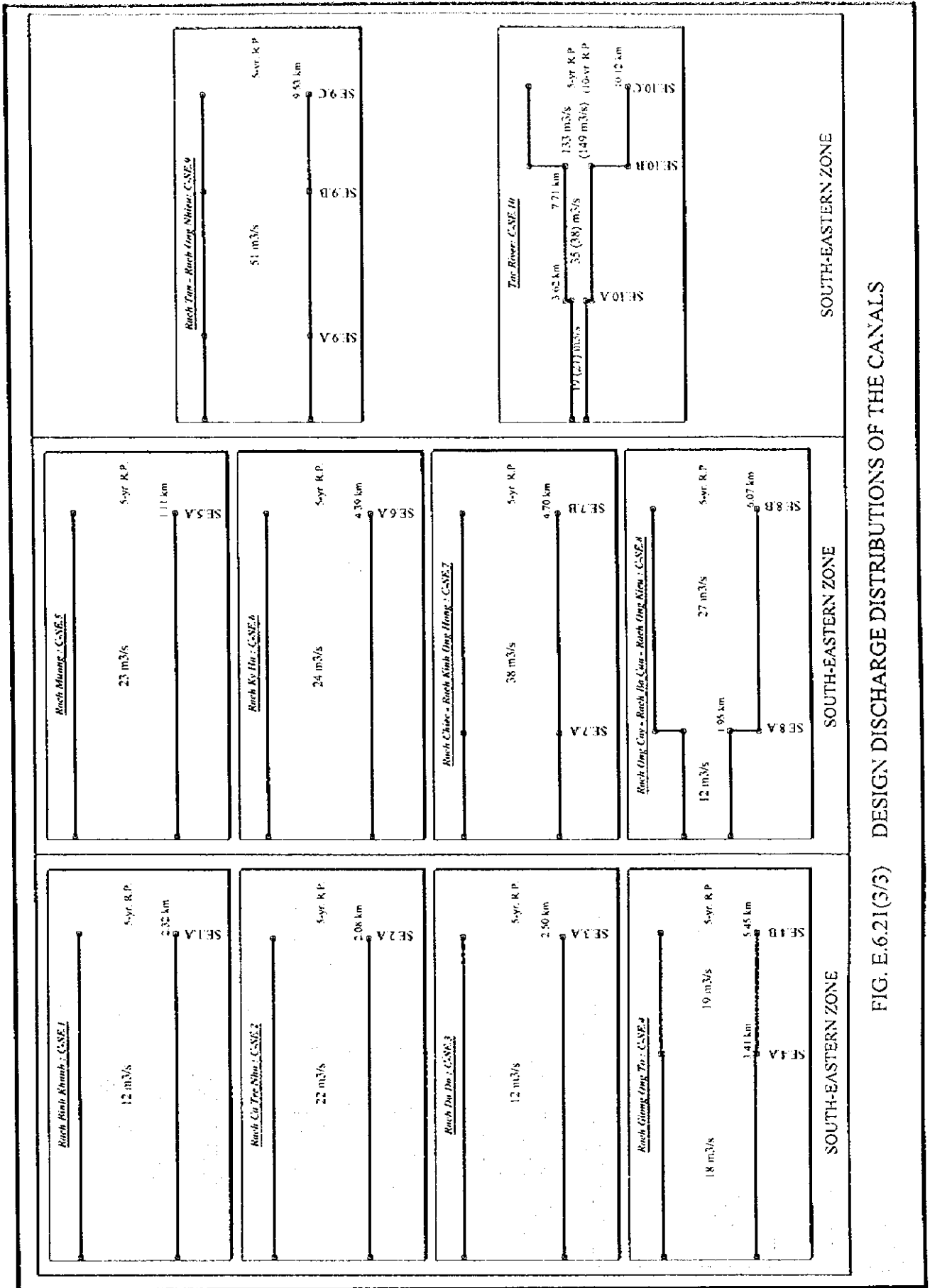
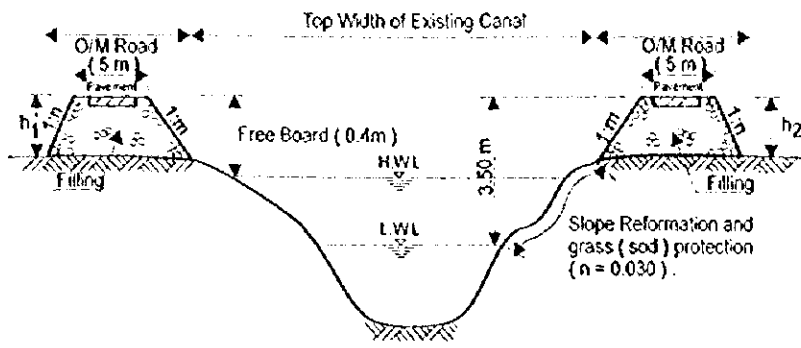
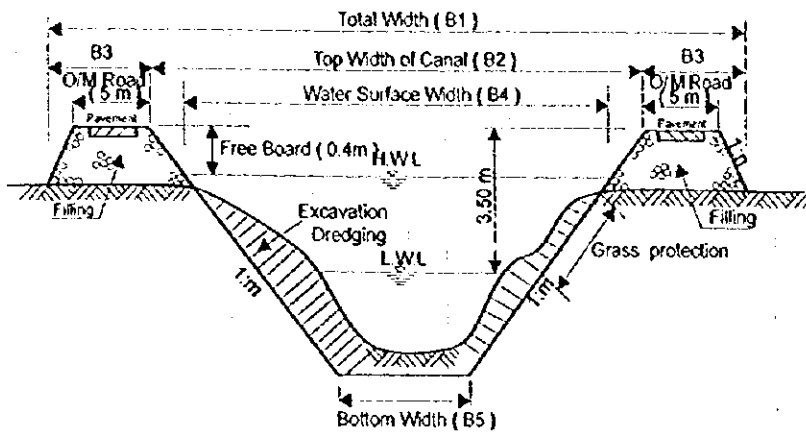


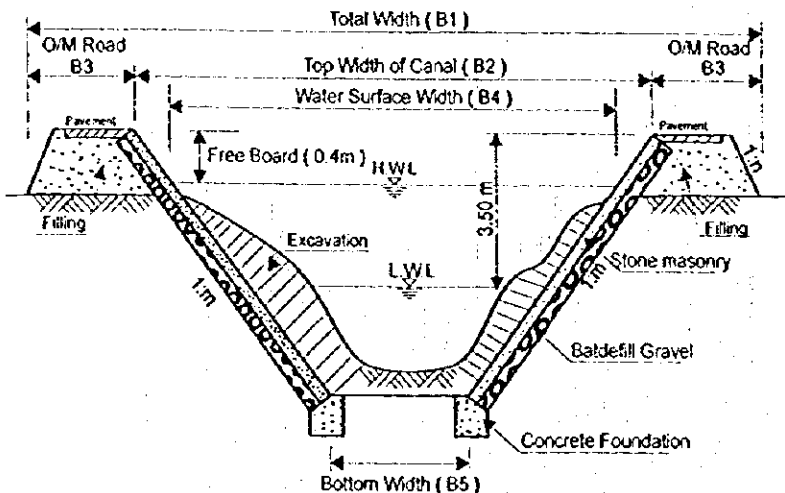
FIG. E.6.21(3/3) DESIGN DISCHARGE DISTRIBUTIONS OF THE CANALS



**Type - A**

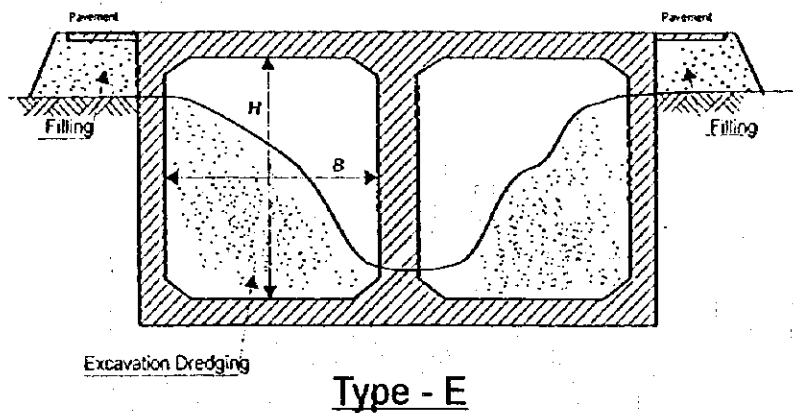
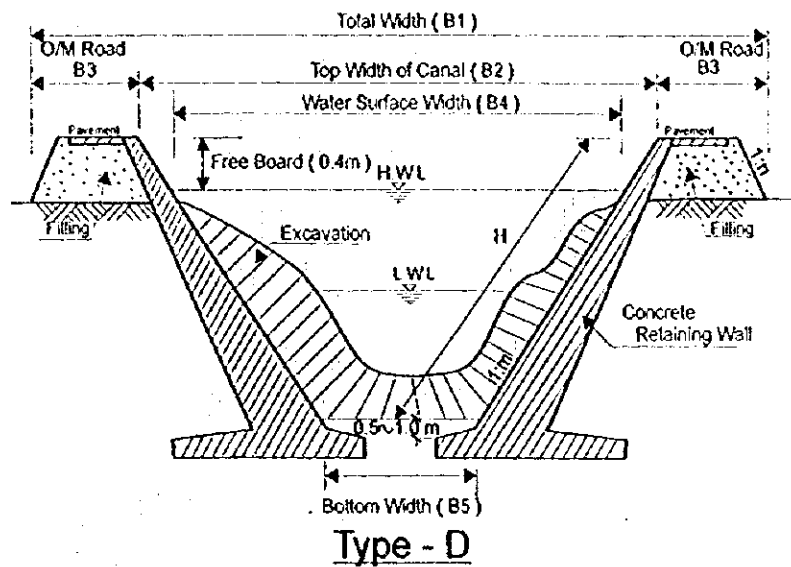


**Type - B**

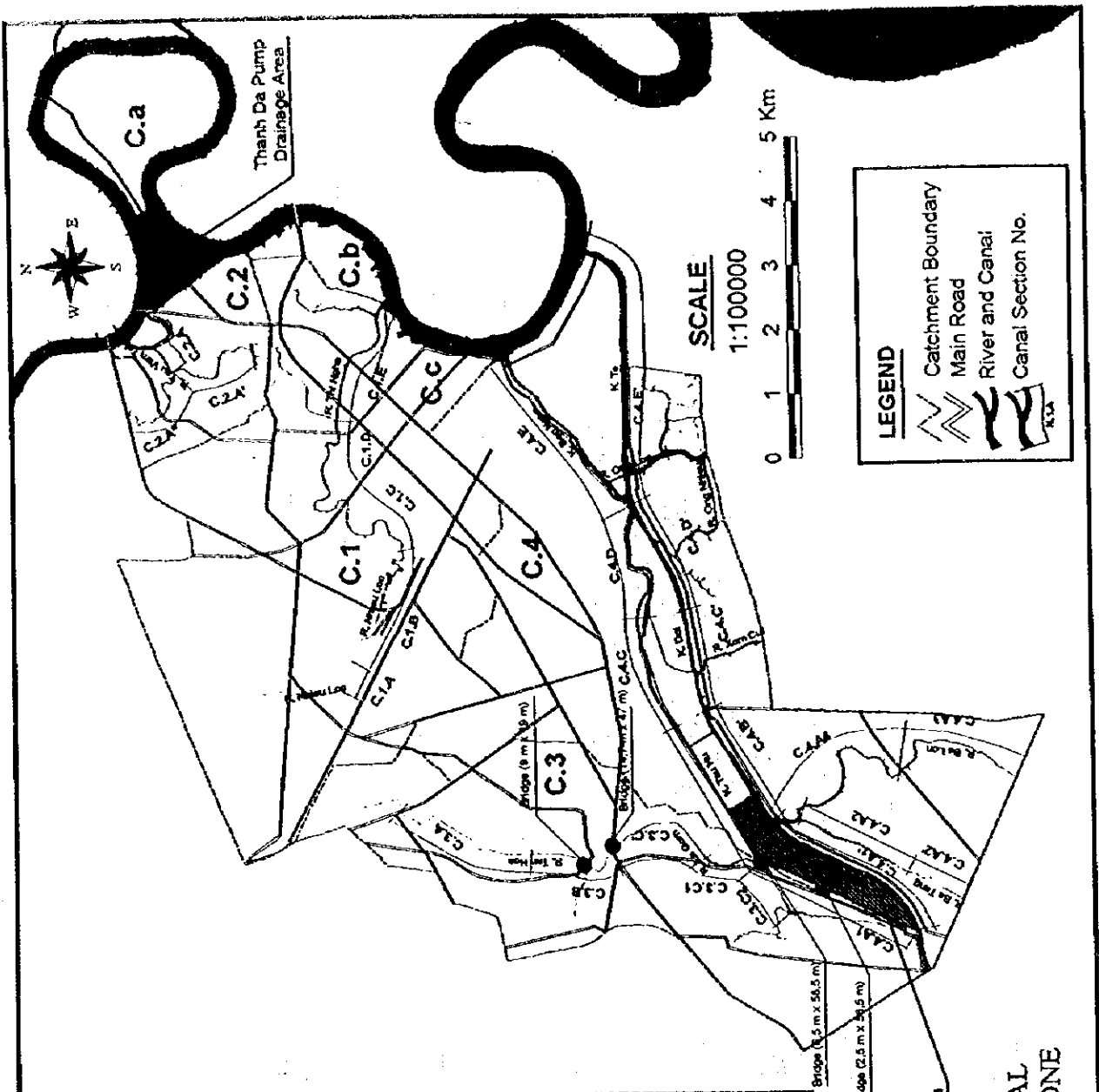


**Type - C**

**FIG. E.6.22 (1/2) TYPICAL CROSS SECTION OF PROPOSED CANAL IMPROVEMENT**



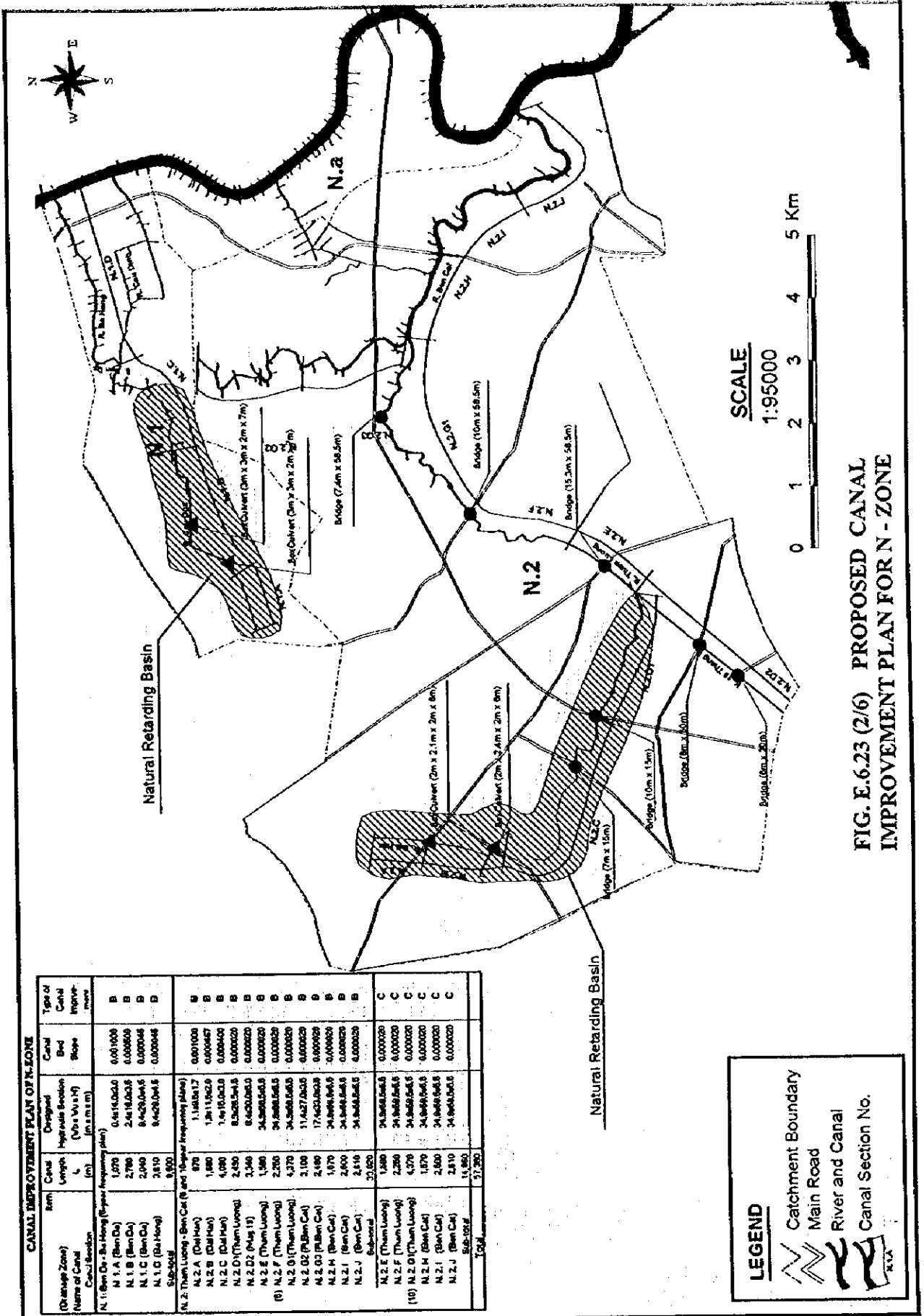
**FIG. E.6.22 (2/2) TYPICAL CROSS SECTION OF PROPOSED CANAL IMPROVEMENT**



Canal Section No.	Canal Name	Canal Length (m)	Designed Hydraulic Section (No. x V <sub>0</sub> x H)	Canal Slope	Type of Canal
<b>C.1: Minh Loc - Thi Nghan (10-year frequency plan)</b>					
C.1.A	9,362.4, 0x4.5	0.000400	C		
C.1.B	22,324.0, 0x5.5	0.000050	C		
C.1.C (10-Year)	24,342.0, 0x5.5	0.000050	C		
C.1.D	25,349.0, 0x5.5	0.000050	C		
C.1.E	26,344.0, 0x5.5	0.000050	C		
Subtotal	8,930				
<b>C.2: Cau Soc - Tay Yot (2-year frequency plan)</b>					
C.2.A (10-Year)	500, 16,830.0, 0x4.0	0.000050	C		
C.2.A' (Cau Soc)	1,500, 6,320.0, 0x3.5	0.000050	C		
C.2.A''	1,500, 5,317.0, 0x3.5	0.000050	C		
Subtotal	3,500				
<b>C.3: Tay Hoa - Lo Gom (5-year frequency plan)</b>					
C.3.A (Tay Hoa)	2,260, 12,817.5, 0x3.5	0.000400	D		
C.3.B (Tay Hoa)	1,970, 14,519.0, 0x4.0	0.000400	D		
C.3.C (Lo Gom)	1,840, 26,239.0, 0x5.0	0.000050	C		
C.3.C1 (Lo Gom)	1,000, 35,817.0, 0x5.5	0.000050	C		
C.3.C2	1,500, 24,836.0, 0x4.0	0.000020	C		
Subtotal	8,570				
<b>C.4: Tay Ho - Ben Nghia, Doi - To (10-year plan except Doi - Tang &amp; Ba Lon)</b>					
C.4.A (Ba Tang)	1,330, 16,452.0, 0x3.5	0.000020	D		
C.4.A2 (Ba Tang)	2,000, Existing Section	0.000020	A		
Subtotal	3,330				
<b>(5) C.4.A3 (Ba Lon)</b>					
C.4.A3	2,560, 12,428.0, 0x3.5	0.000020	D		
C.4.A4 (Ba Lon)	3,180, Existing Section	0.000020	A		
Subtotal	5,740				
<b>C.4.A1 (Tay Ho)</b>					
C.4.A1	2,460, 22,058.0, 0x3.7	0.000011	C		
C.4.B (Tay Ho)	2,190, 22,056.0, 0x3.7	0.000011	C		
C.4.C (Tay Ho)	2,190, 21,050.4, 0x4.5	0.000011	C		
C.4.D (Tay Ho)	1,960, 21,050.4, 0x4.5	0.000011	C		
C.4.E (Ben Nghia)	3,170, 26,055.4, 0x4.5	0.000011	C		
Subtotal	12,150				
<b>(10) C.4.A1' (Doi)</b>					
C.4.A1'	3,470, Existing Section	0.000011	A		
C.4.B' (Doi)	2,020, Existing Section	0.000011	A		
C.4.C' (Doi)	1,400, Existing Section	0.000011	A		
C.4.D' (Doi)	1,970, Existing Section	0.000011	A		
C.4.E' (Ta)	4,250, Existing Section	0.000011	A		
Subtotal	13,110				
Subtotal	54,330				
Total	23,330				

Ben Me Coc (1), (2)  
Pump Drainage Area

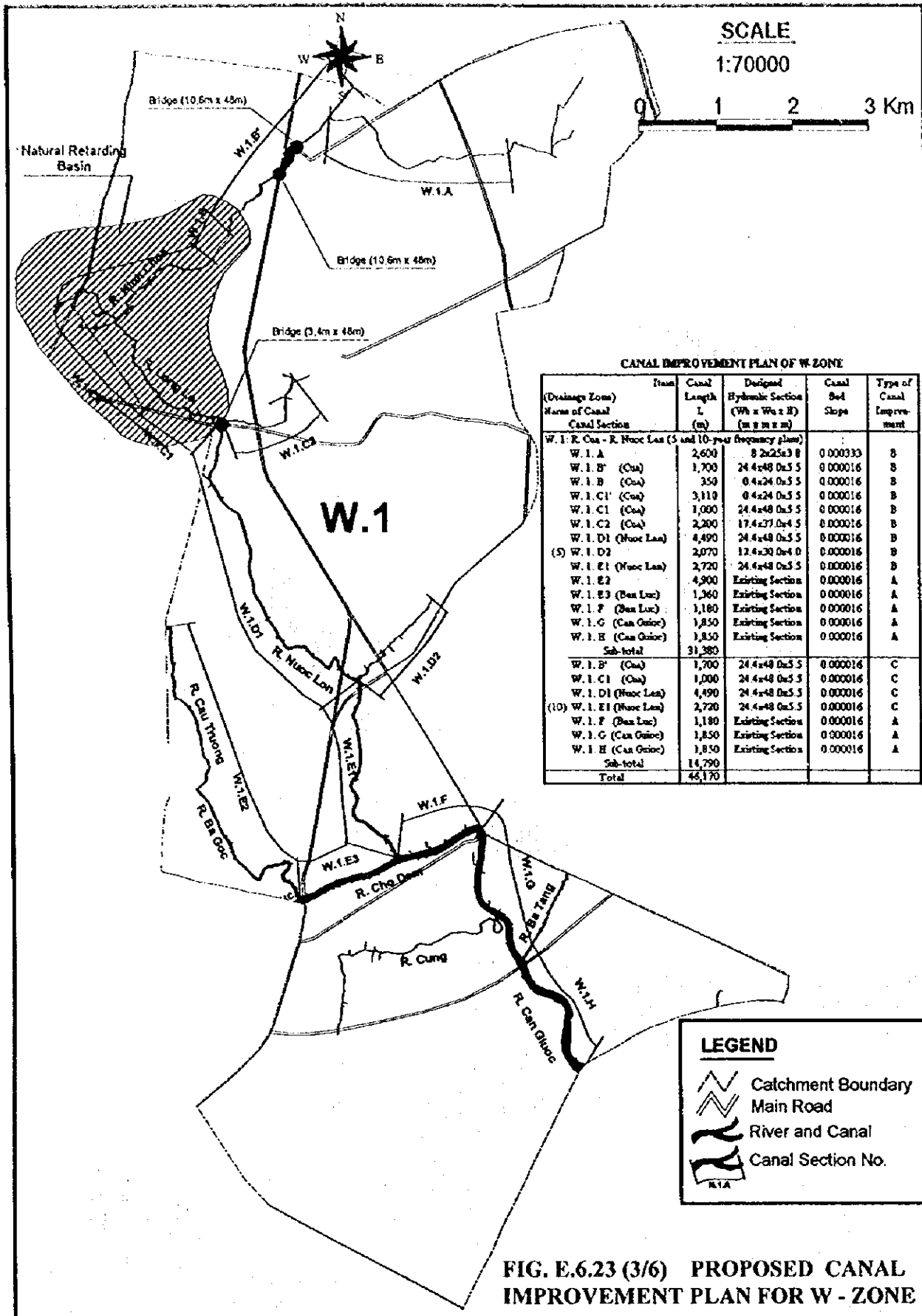
FIG.E.6.23.(1/6) PROPOSED CANAL IMPROVEMENT PLAN FOR C - ZONE



**CANAL IMPROVEMENT PLAN OF N-ZONE**

(Canal Zone) Name of Canal Canal Section	Canal Length (m)	Designed Hydraulic Section (No. VxH) (m x m)	Canal Bed Slope	Type of Canal Improvement
N.1 (Ben Do - Ben Hong (Ben Hong frequency plan))				
N.1.A (Ben Da)	1,070	0.41x0.60x0.0	0.001000	B
N.1.B (Ben Ca)	2,780	2.41x0.50x0.5	0.000500	B
N.1.C (Ben Ca)	2,040	0.4x0.50x0.45	0.000048	B
N.1.D (Ben Hong)	3,810	0.4x0.50x0.45	0.000048	D
N.1.E (Ben Hong)	3,930			
N.2 (Thum Luong - Ben Cat (B and B-super frequency plan))				
N.2.A (Dai Huu)	870	1.140x0.17	0.001000	B
N.2.B (Dai Huu)	1,880	1.261x0.225	0.000467	B
N.2.C (Dai Huu)	4,090	1.41x0.20x0.5	0.000400	B
N.2.D (Thum Luong)	2,450	0.526x0.5x0.5	0.000020	B
N.2.E (Thum Luong)	3,540	0.4x0.50x0.5	0.000020	B
N.2.F (Thum Luong)	1,980	0.4x0.50x0.5	0.000020	B
N.2.G (Thum Luong)	2,265	0.4x0.50x0.5	0.000020	B
N.2.H (Thum Luong)	4,370	0.4x0.50x0.5	0.000020	B
N.2.I (Ben Cat)	3,100	11.4x27.0x0.5	0.000020	B
N.2.J (Ben Cat)	2,480	17.4x25.0x0.5	0.000020	B
N.2.K (Ben Cat)	1,670	0.4x0.50x0.5	0.000020	B
N.2.L (Ben Cat)	2,400	0.4x0.50x0.5	0.000020	B
N.2.M (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.N (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.O (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.P (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.Q (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.R (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.S (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.T (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.U (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.V (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.W (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.X (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.Y (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.Z (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.01 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.02 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.03 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.04 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.05 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.06 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.07 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.08 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.09 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.10 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.11 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.12 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.13 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.14 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.15 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.16 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.17 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.18 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.19 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.20 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.21 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.22 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.23 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.24 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.25 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.26 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.27 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.28 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.29 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.30 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.31 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.32 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.33 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.34 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.35 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.36 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.37 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.38 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.39 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.40 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.41 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.42 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.43 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.44 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.45 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.46 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.47 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.48 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.49 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.50 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.51 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.52 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.53 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.54 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.55 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.56 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.57 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.58 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.59 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.60 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.61 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.62 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.63 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.64 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.65 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.66 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.67 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.68 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.69 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.70 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.71 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.72 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.73 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.74 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.75 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.76 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.77 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.78 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.79 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.80 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.81 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.82 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.83 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.84 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.85 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.86 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.87 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.88 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.89 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.90 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.91 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.92 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.93 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.94 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.95 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.96 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.97 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.98 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.99 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B
N.2.100 (Ben Cat)	2,410	0.4x0.50x0.5	0.000020	B

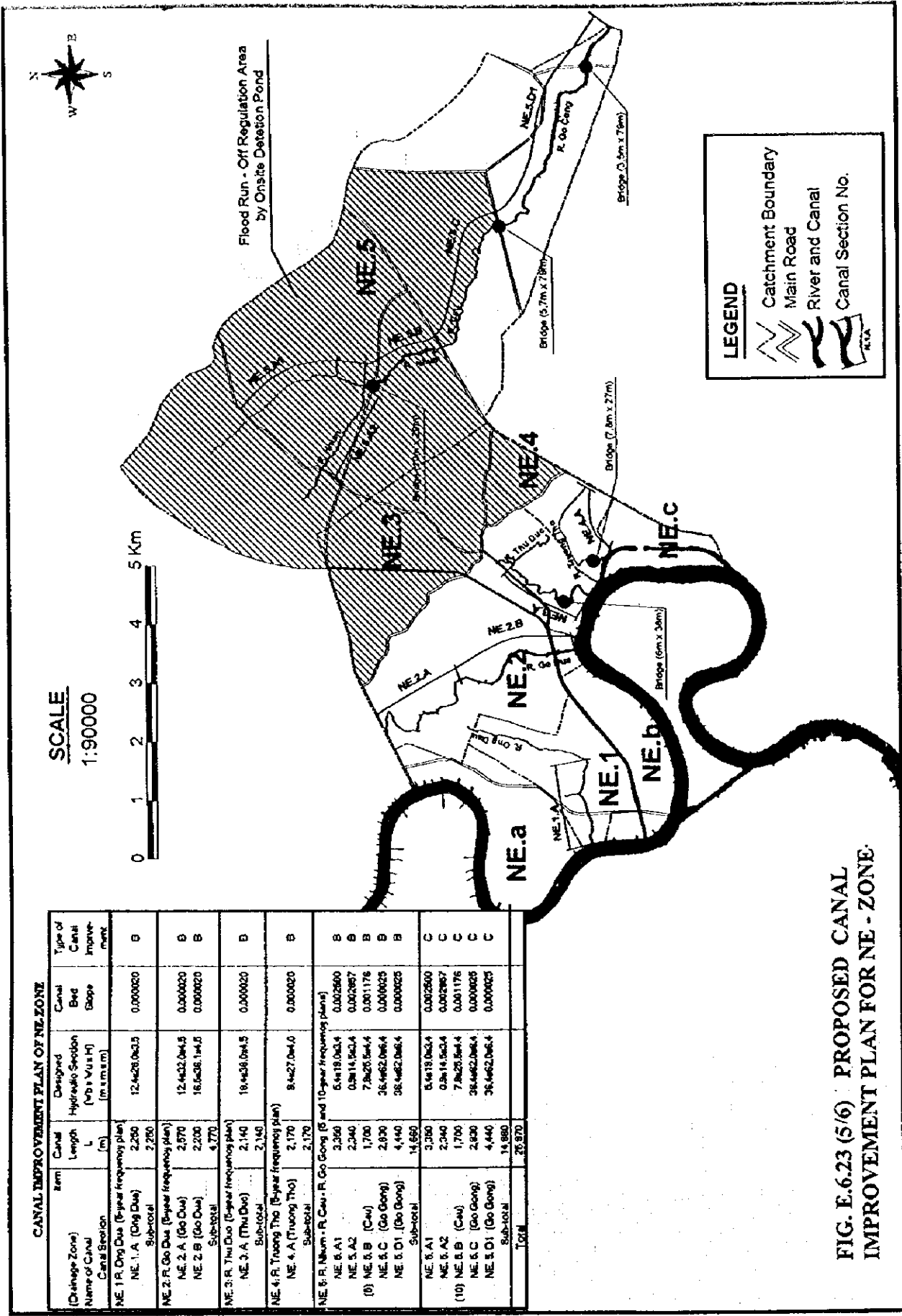
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**FIG. E.6.23 (3/6) PROPOSED CANAL IMPROVEMENT PLAN FOR W - ZONE**







SCALE  
1:90000

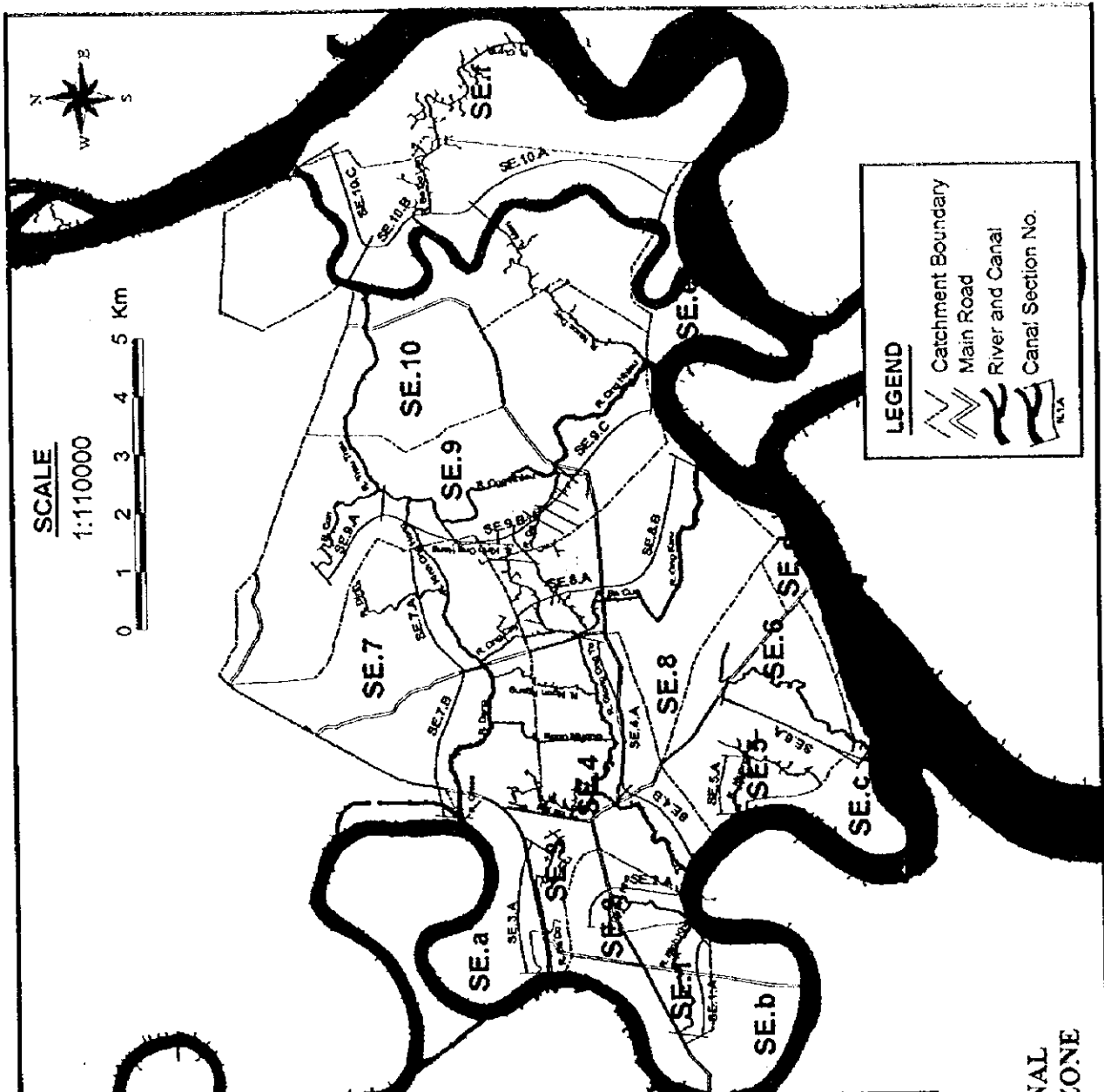


**LEGEND**

- Catchment Boundary
- Main Road
- River and Canal
- Canal Section No.

(Drainage Zone) Name of Canal Canal Section	Canal Length L (m)	Designed Hydraulic Section (m <sup>3</sup> /s vs H) (m.s.m.s.m)	Canal Bed Slope	Type of Canal Improve- ment
NE.1.R. Ong Dau (5-year frequency plan) Sub-total	2,260 2,260	12.4428.043.3	0.000020	B
NE.2.R. Go Dau (5-year frequency plan) NE.2.A (Go Dau) NE.2.B (Go Dau) Sub-total	2,970 2,200 4,770	12.4432.044.5 16.6438.144.0	0.000020 0.000020	B B
NE.3.R. Thu Duc (5-year frequency plan) NE.3.A (Thu Duc) Sub-total	2,140 2,140	18.4438.044.5	0.000020	B
NE.4.R. Truong Tho (5-year frequency plan) NE.4.A (Truong Tho) Sub-total	2,170 2,170	8.4427.044.0	0.000020	B
NE.5.R. Mlum - R. Cau - R. Go Gong (5 and 10-year frequency plans) NE.5.A1 NE.5.A2 (10) NE.5.B (Cau) NE.5.C (Go Gong) NE.5.D1 (Go Gong) Sub-total	3,060 2,340 1,700 2,800 4,140 14,660	6.4418.043.4 0.3414.343.4 7.8425.544.4 36.4462.044.4 38.4462.044.4	0.002640 0.002967 0.001176 0.000025 0.000025	B B B B B
NE.5.A1 NE.5.A2 (10) NE.5.B (Cau) NE.5.C (Go Gong) NE.5.D1 (Go Gong) Sub-total	3,060 2,340 1,700 2,800 4,440 14,860	6.4418.043.4 0.3414.343.4 7.8425.544.4 38.4462.044.4 38.4462.044.4	0.002640 0.002967 0.001176 0.000025 0.000025	C C C C C
<b>TOTAL</b>	<b>40,870</b>			

FIG. E.6.23 (5/6) PROPOSED CANAL IMPROVEMENT PLAN FOR NE - ZONE.



CANAL IMPROVEMENT PLAN OF SE-ZONE

(Divulge Zone) Name of Canal	Canal Length L (m)	Outsized Hydraulic Section ( $V^3 \times W^2 / H^3$ ) (a, b, c, d, e)	Civil Bed Slope	Type of Canal Improvement
SE.1: R. Bnh Khakh (5-year frequency plan)	2,320	Existing Section	0.000050	A
Sub-total	2,320			
SE.2: R. Ca Tra Nho (5-year frequency plan)	2,080	Existing Section	0.000050	A
Sub-total	2,080			
SE.3: R. Da Do (5-year frequency plan)	2,500	Existing Section	0.000050	A
Sub-total	2,500			
SE.4: R. Quang Ong To (5-year frequency plan)	3,410	Existing Section	0.000030	A
SE.4. A (Ghon ong To)	2,050	Existing Section	0.000030	A
SE.4. B (Ghon ong To)	1,360	Existing Section	0.000030	A
Sub-total	3,410			
SE.5: R. Nhung (5-year frequency plan)	1,110	14.4x30.0x0.5	0.000050	B
SE.5. A (Nhung)	1,110			
Sub-total	1,110			
SE.6: R. Ky Ho (5-year frequency plan)	4,390	13.6x30.0x0.7	0.000040	B
SE.6. A (Ky Ho)	4,390			
Sub-total	4,390			
SE.7: R. Nhong Ong Hong - R. Chuiac (5-year frequency plan)	2,500	10.4x30.0x1.5	0.000020	B
SE.7. A (Chuiac)	2,500	Existing Section	0.000020	A
Sub-total	2,500			
SE.8: R. Ong Cay - R. Bn Cao - R. Ong Kiep (5-year frequency plan)	5,700	Existing Section	0.000020	A
SE.8. A (Ong Cay)	1,950	Existing Section	0.000020	A
SE.8. B (Ong Kiep)	4,120	Existing Section	0.000020	A
Sub-total	5,700			
SE.9: R. Tam - R. Ong Mhuo (5-year frequency plan)	2,470	Existing Section	0.000014	A
SE.9. A (Tam)	2,470	Existing Section	0.000014	A
SE.9. B (Ong Mhuo)	4,240	Existing Section	0.000014	A
SE.9. C (Ong Mhuo)	2,830	Existing Section	0.000014	A
Sub-total	9,540			
SE.10: Tue River (10-year frequency plan)	3,620	Existing Section	0.000014	A
SE.10. A (Tue River)	4,080	Existing Section	0.000014	A
SE.10. B (Tue River)	2,410	Existing Section	0.000014	A
SE.10. C (Tue River)	10,110	Existing Section	0.000014	A
Sub-total	10,110			
Total	49,280			

FIG. E.6.23 (6/6) PROPOSED CANAL IMPROVEMENT PLAN FOR SE - ZONE

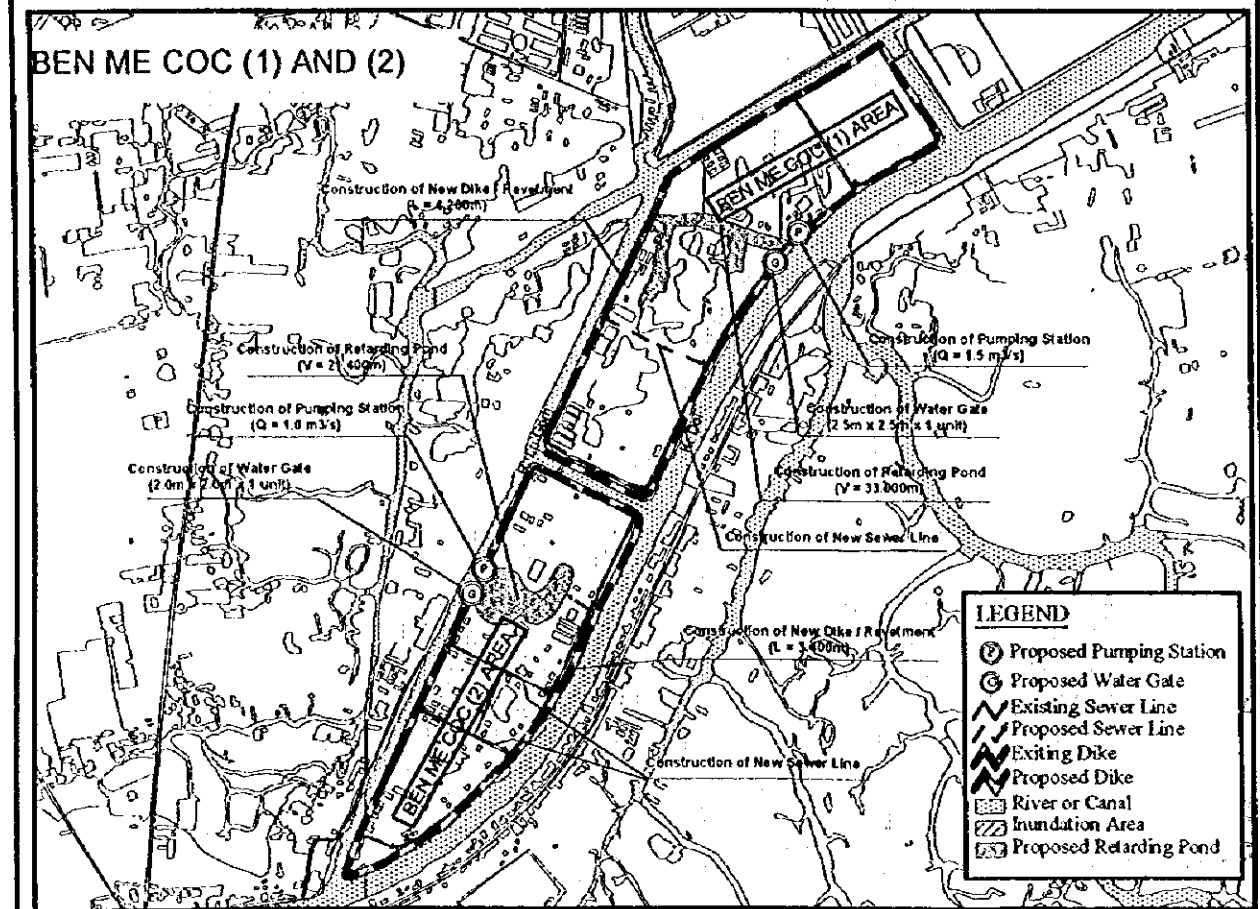
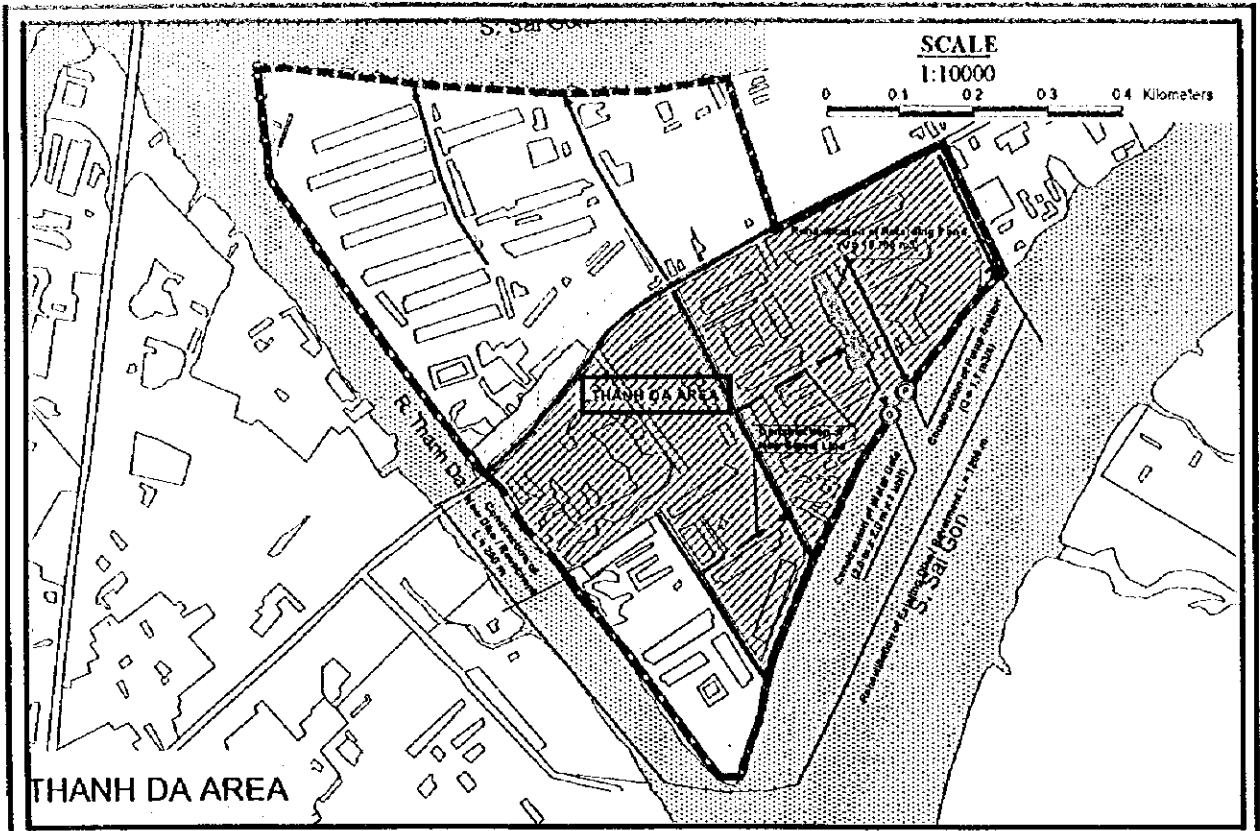


FIG. E.6.24 PROPOSED PUMP DRAINAGE PLAN

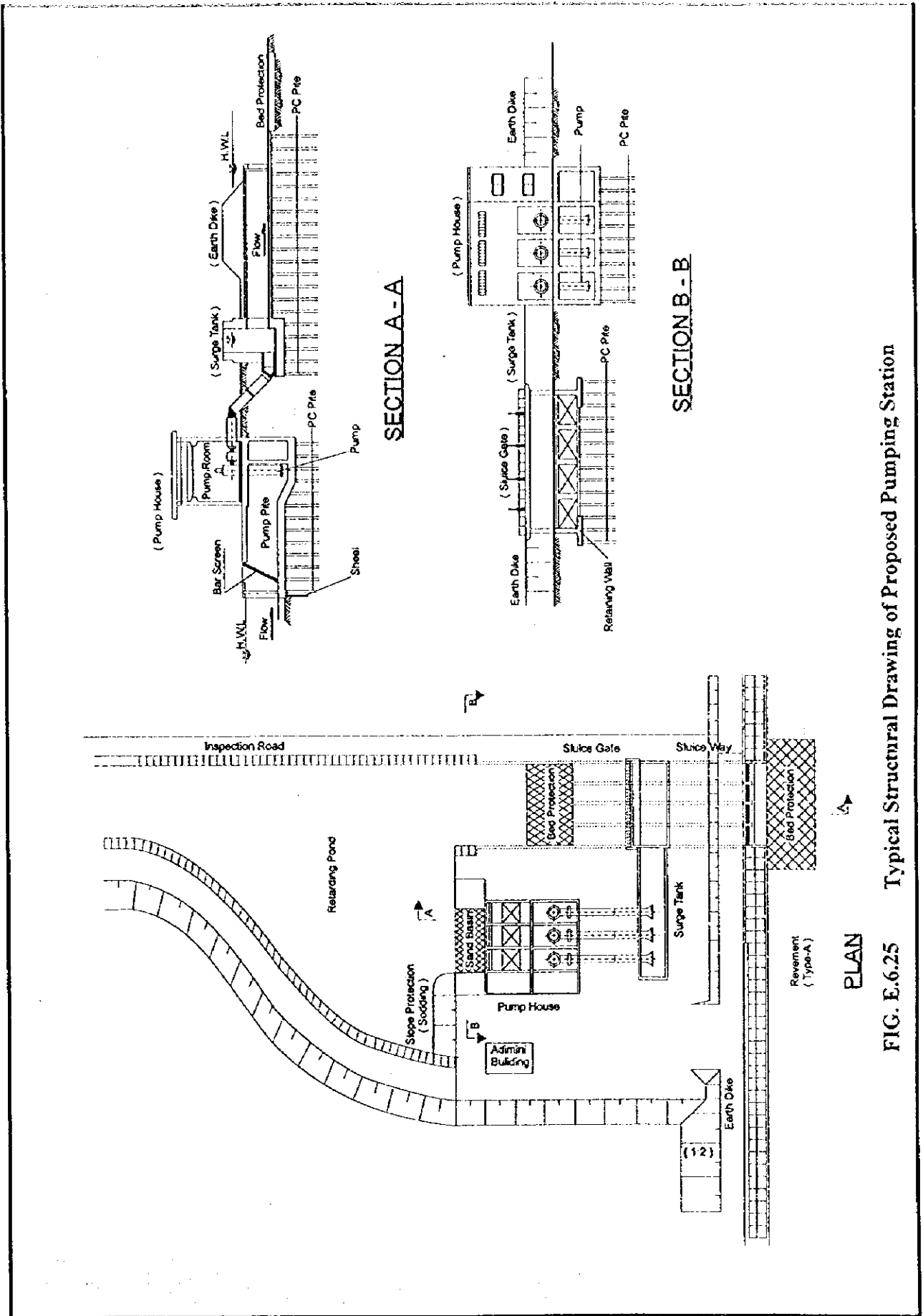


FIG. E.6.25 Typical Structural Drawing of Proposed Pumping Station

PLAN

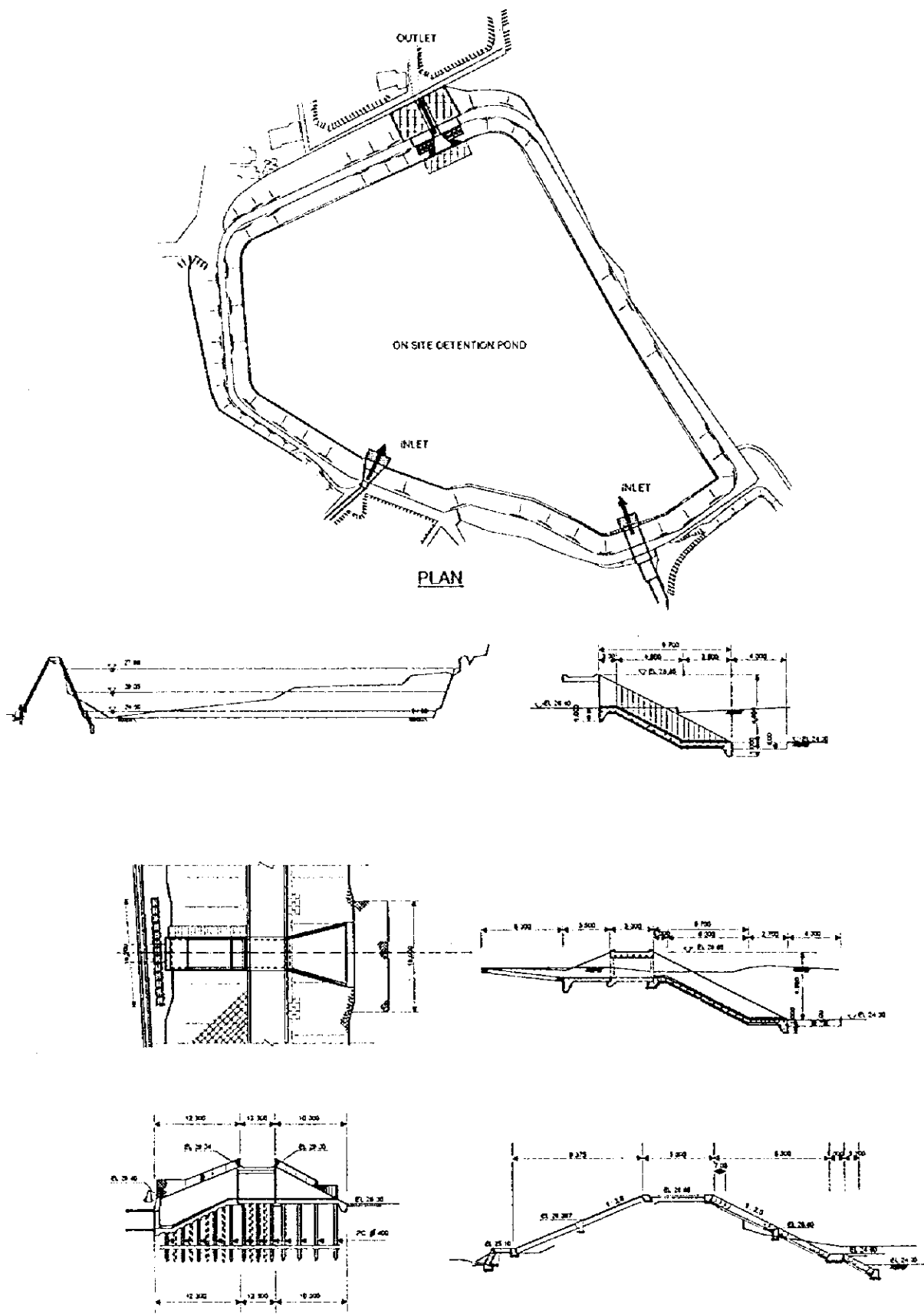
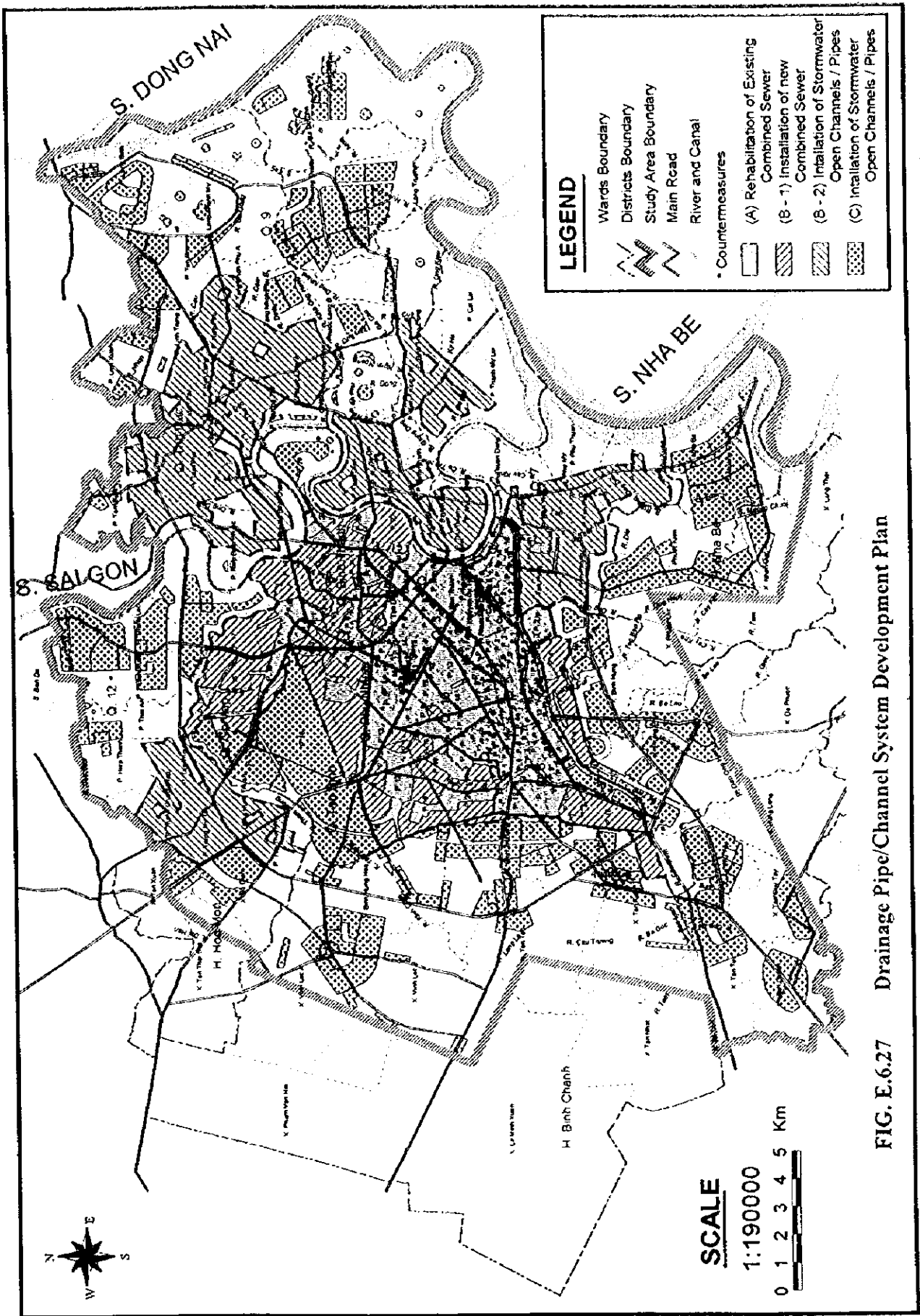


FIG. E.6.26 Typical Structural Drawing of Proposed Onsite Detention Pond



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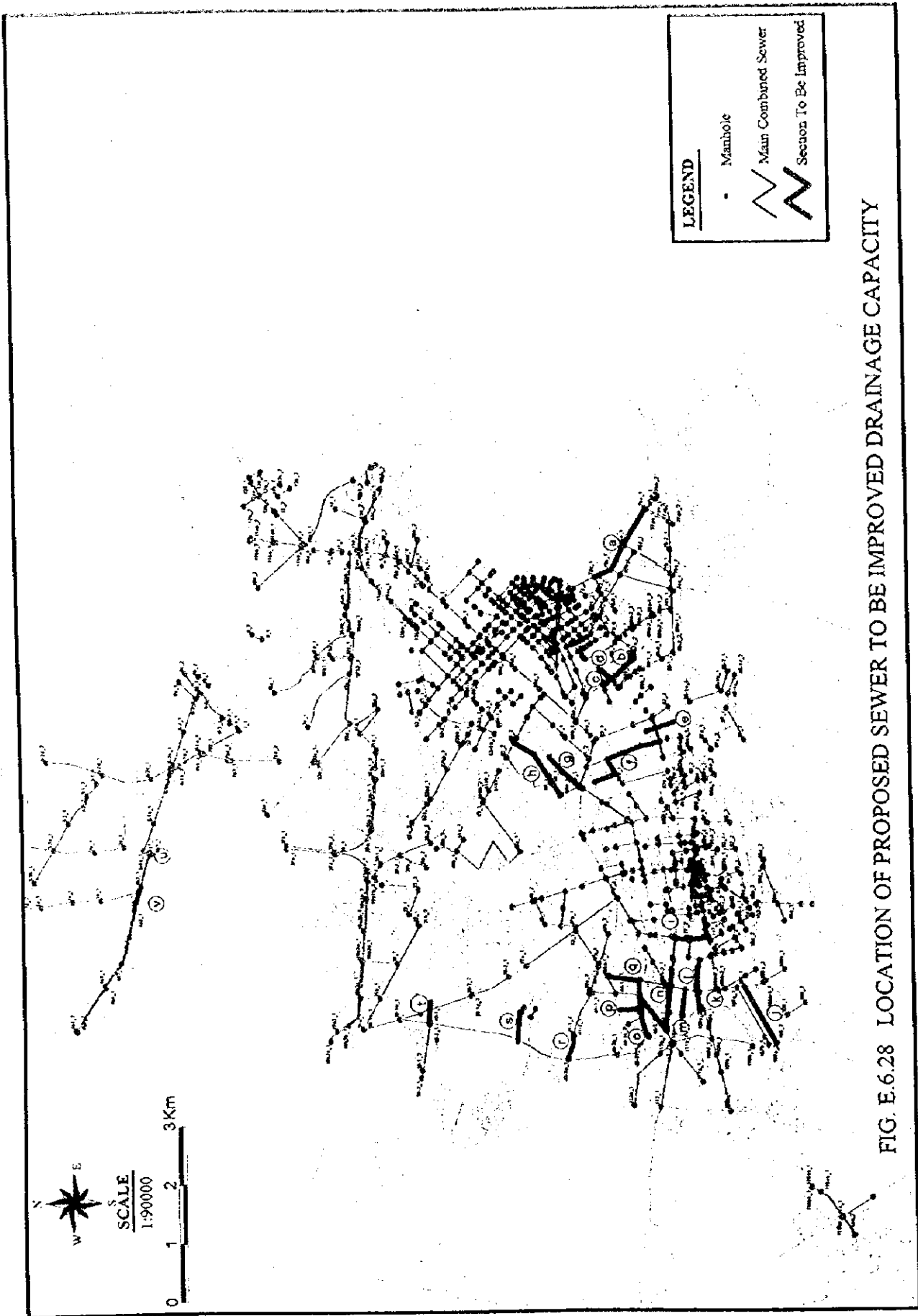


FIG. E.6.28 LOCATION OF PROPOSED SEWER TO BE IMPROVED DRAINAGE CAPACITY

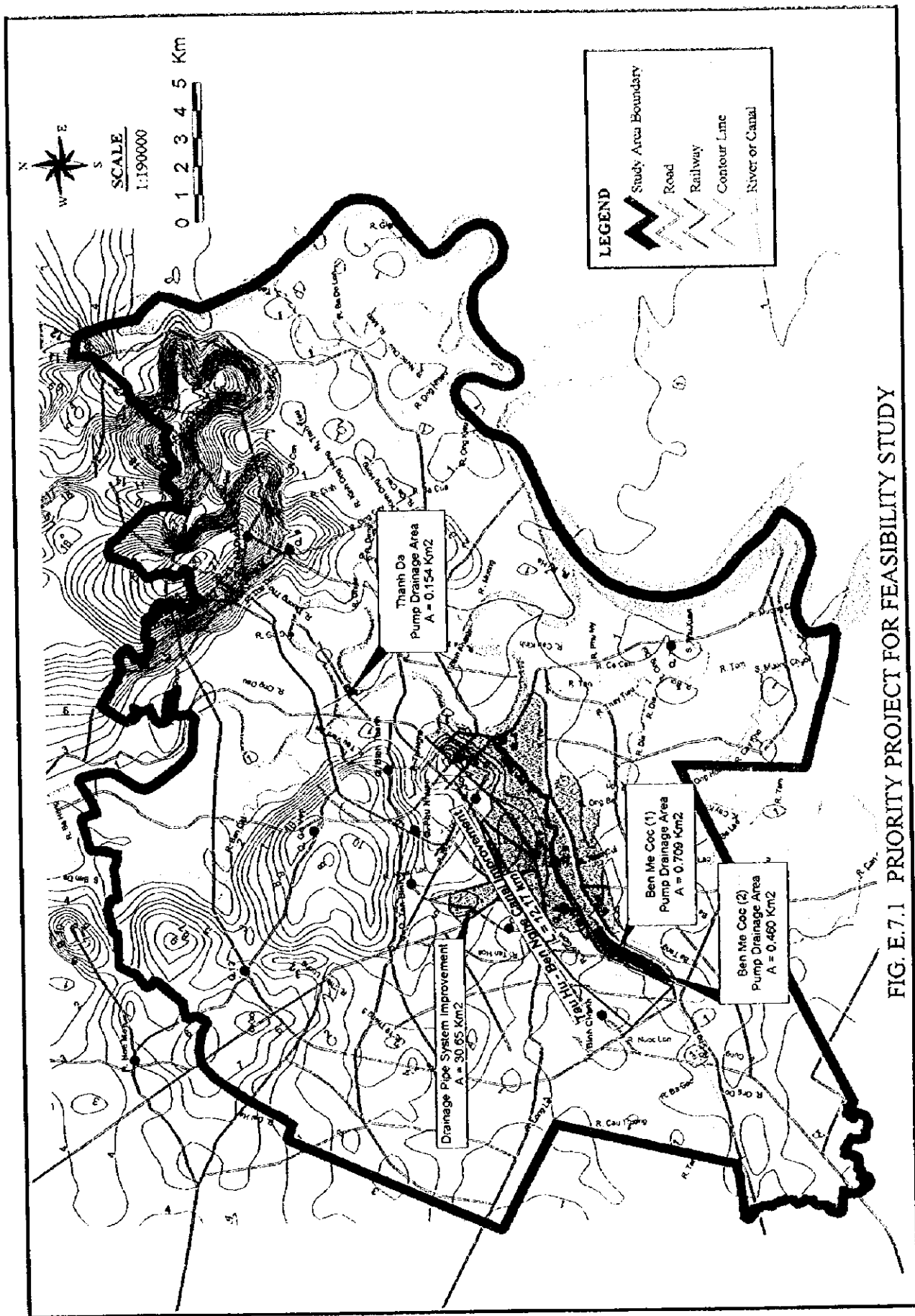
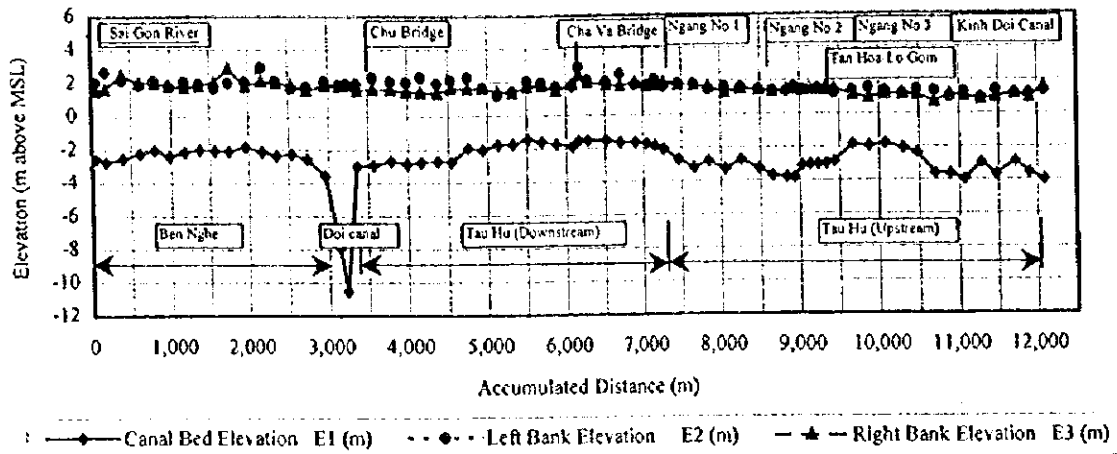


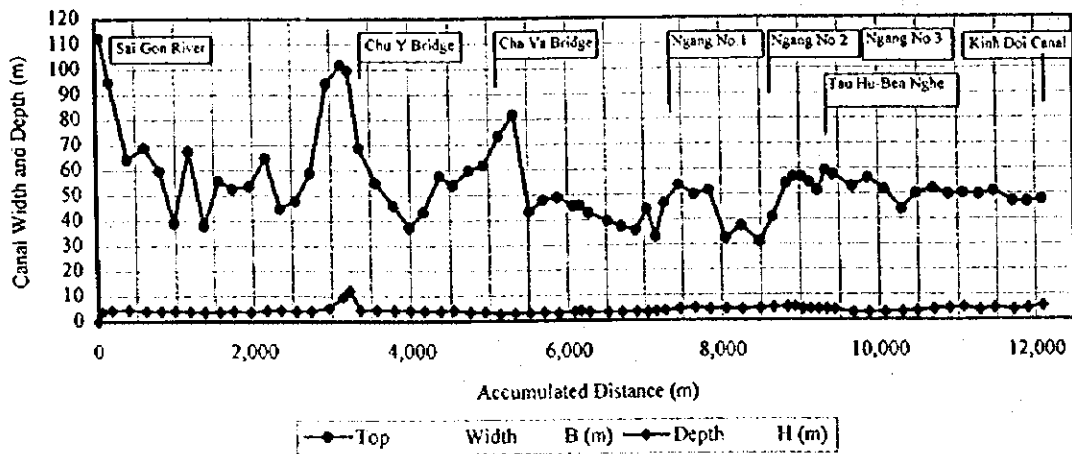
FIG. E.7.1 PRIORITY PROJECT FOR FEASIBILITY STUDY



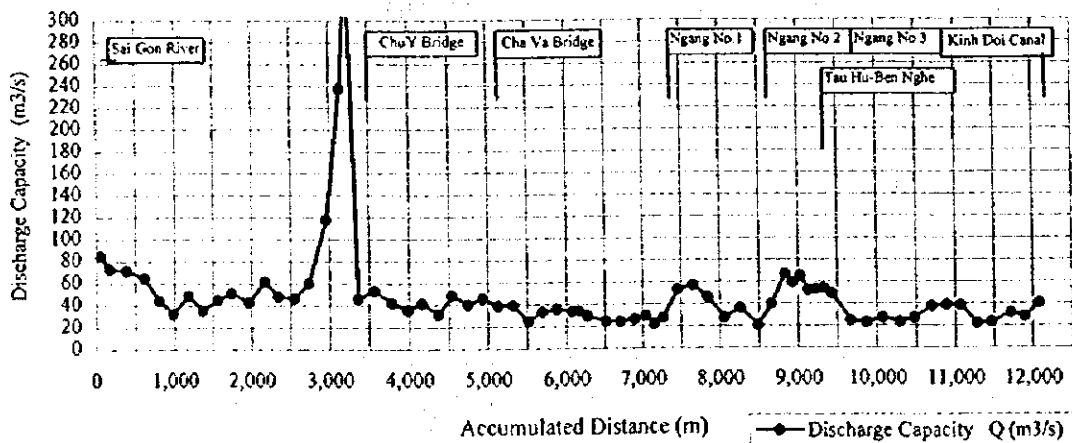
### LONGITUDINAL PROFILE



### CANAL WIDTH AND DEPTH



### DISCHARGE CAPACITY



**FIG. E.8.1 HYDRAULIC CHARACTERISTIC AND DISCHARGE CAPACITY OF EXISTING TAU HU - BEN NGHE CANAL**

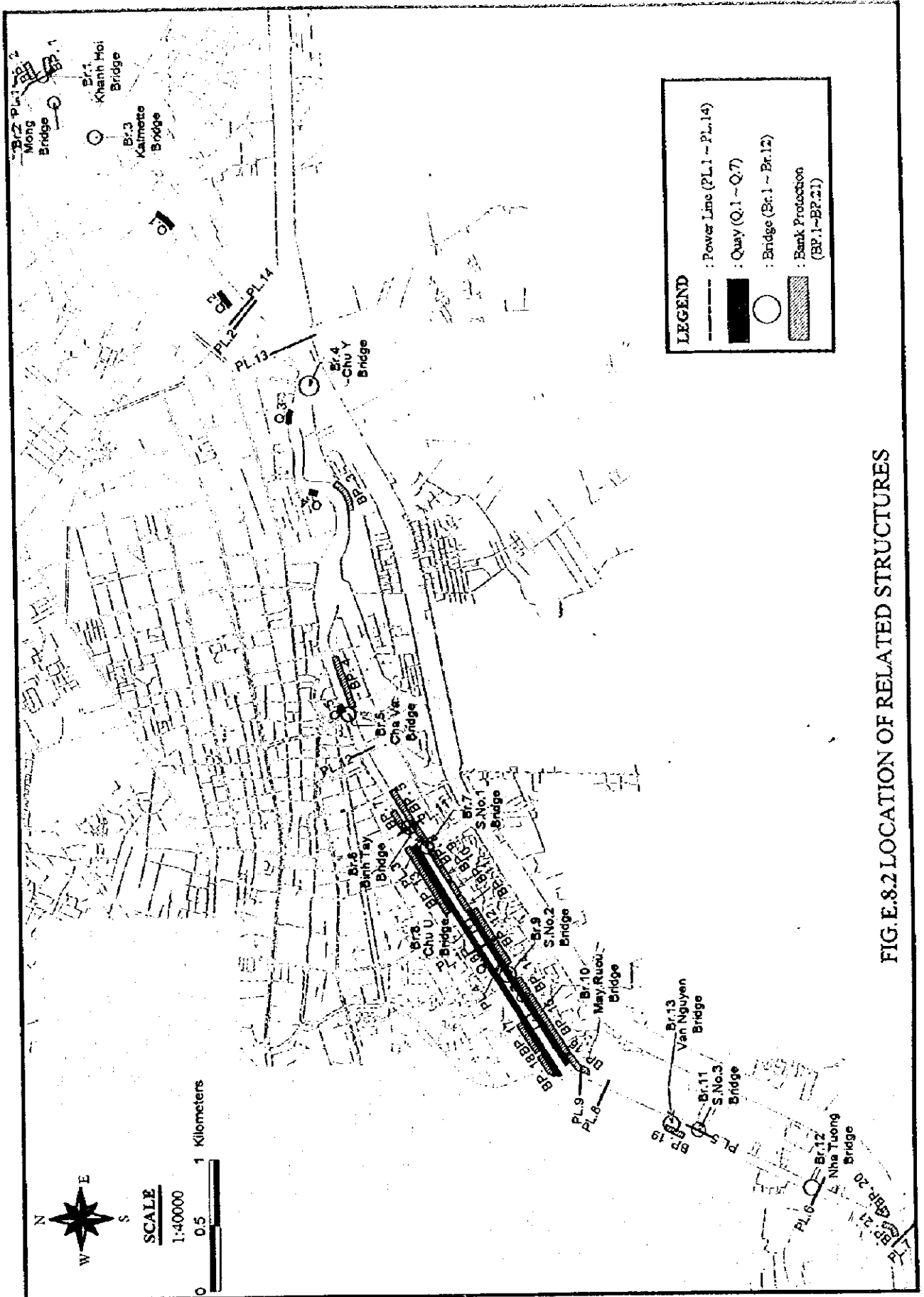
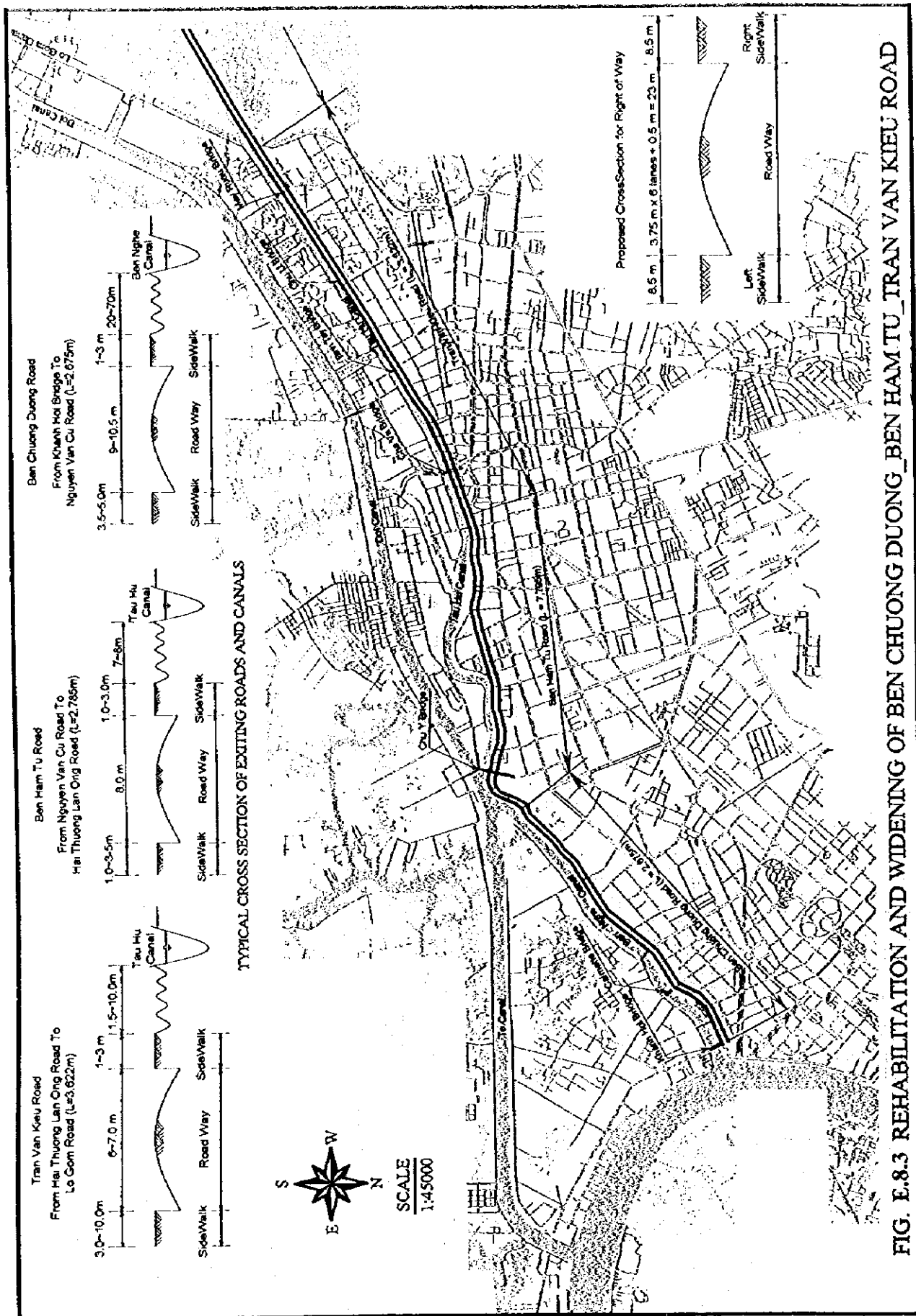
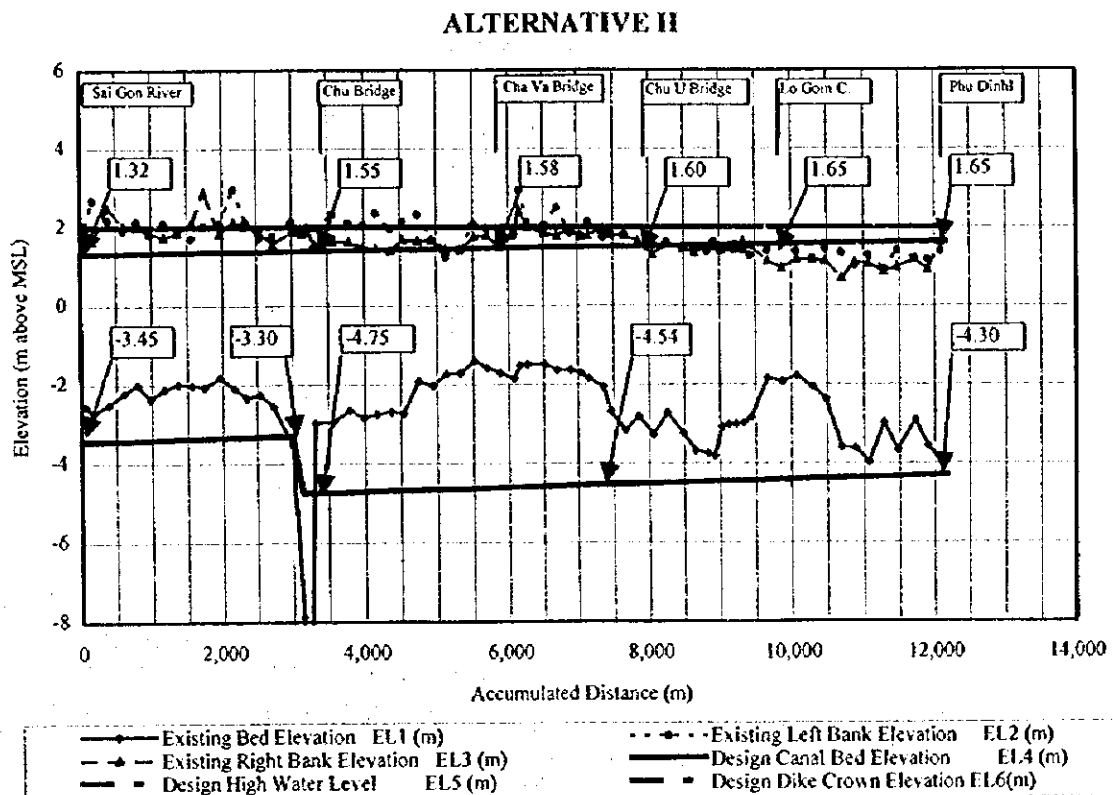
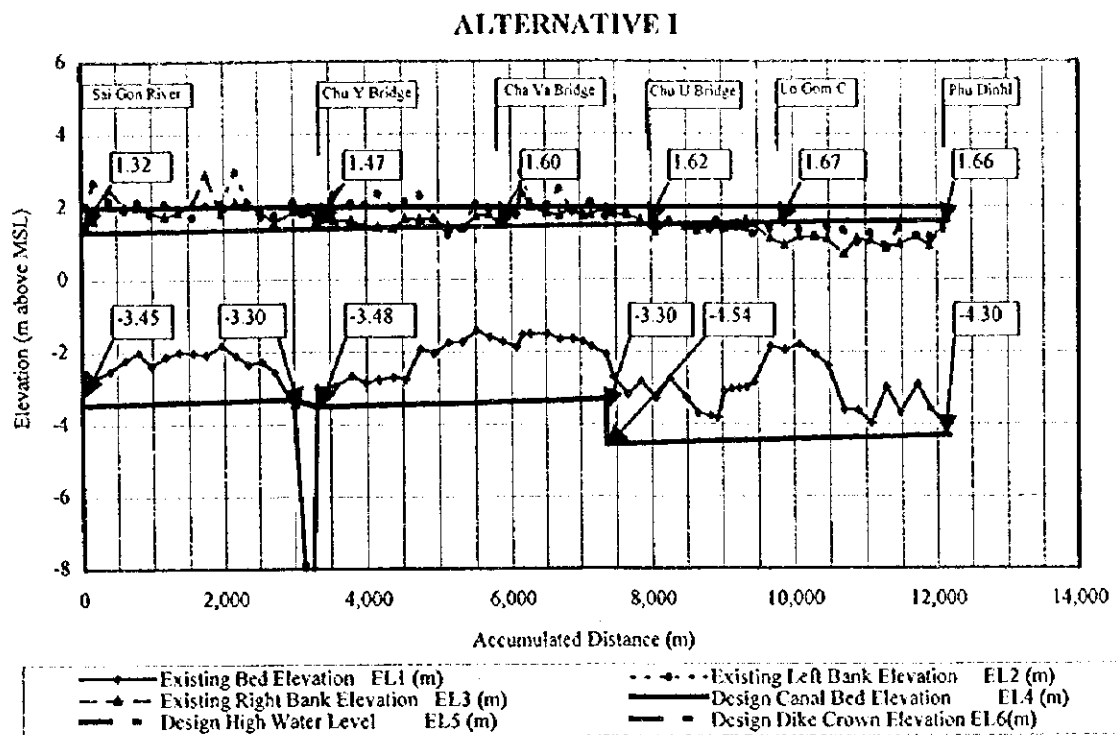


FIG.E.8.2 LOCATION OF RELATED STRUCTURES



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**FIG. E.8.4 LONGITUDINAL PROFILES OF ALTERNATIVE I AND II**

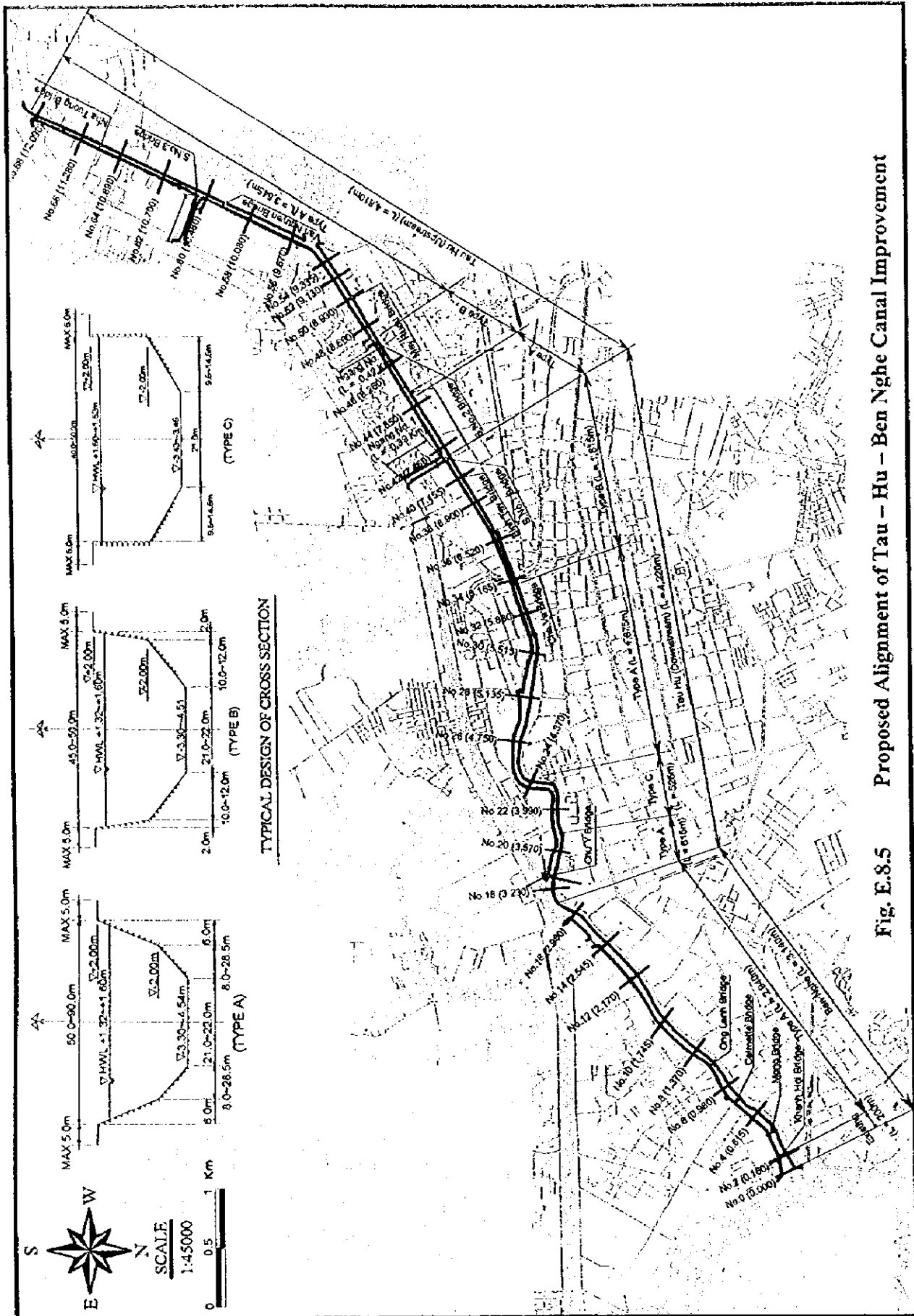


Fig. E.8.5 Proposed Alignment of Tau - Hu - Ben Nghe Canal Improvement

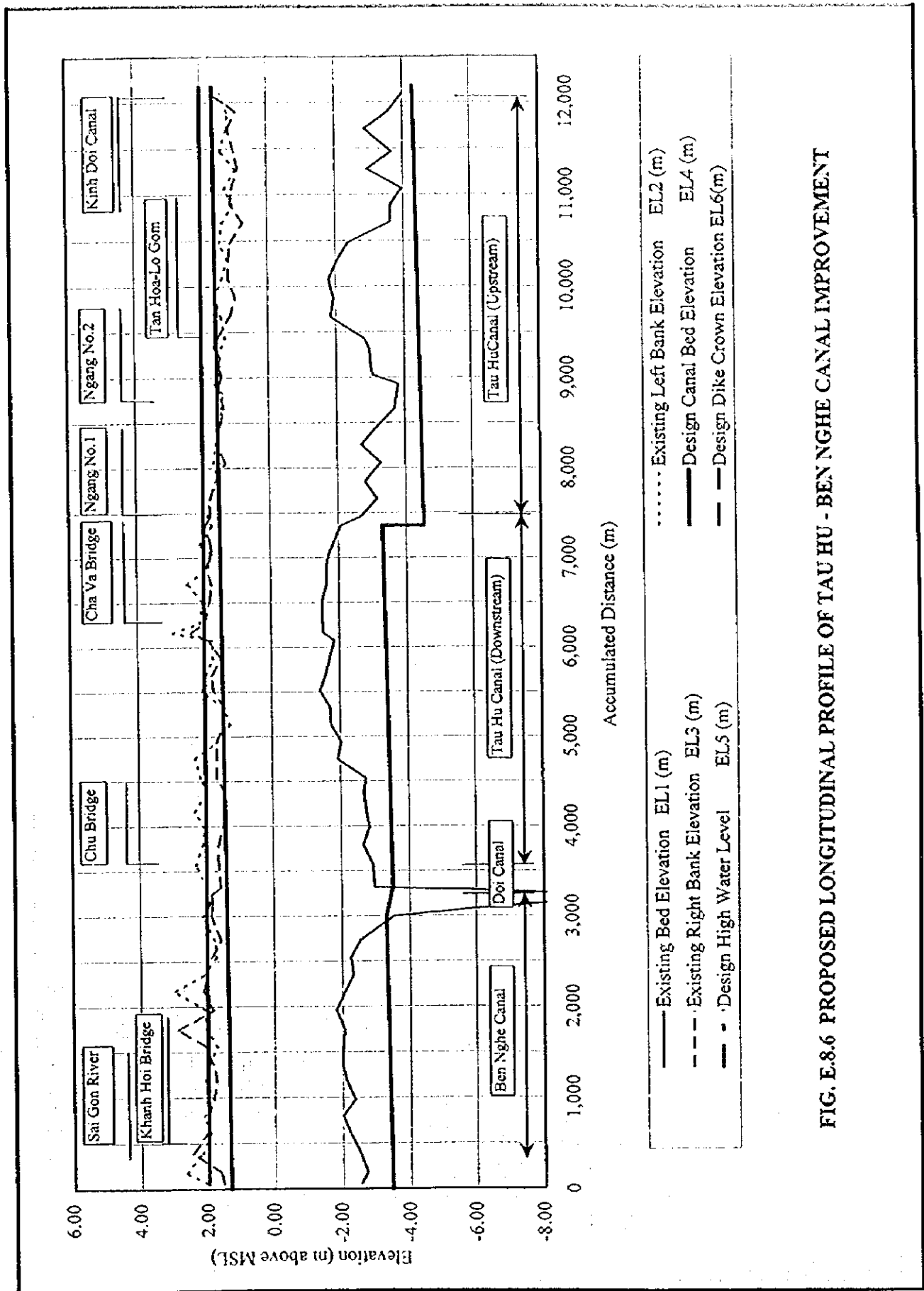


FIG. E.8.6 PROPOSED LONGITUDINAL PROFILE OF TAU HU - BEN NGHE CANAL IMPROVEMENT