DATA BOOK II-3 : Living Environment

(Supporting Report F)

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3.1 Water Quality Sampling Results

Table - 1 : Name of Apparatus/Methods used in field test and laboratory analysis.

Name of the tests	Apparatus/ Methods	Unit
A. Field tests		
1. Temperature	pH meter/Temperature ELE International,	^{0}C
2. Color	DR/2000 Direct reading Spectrophotometer HACH	Pt-Co colour unit.
3. Odour	Human perception	
4. Turbidity	a) DR/2000 Direct spectrophotometer b) Turbidimeter, model 2100A	FTU NTU
5. pH	pH meter/Temperature ELE international,	
6. Electric Conductivity	DR/2000 Conductivity/TDS meter HACH	ums/cm
7. Total dissolved Solids	DR/2000 TDS/conductivity meter HACH	mg/l
B. Laboratory Analysis		
1. Suspended solid	Total suspended malter.*	mg/l
2. Dissolved Oxygen(DO)	Azide Modification Method *	mg/l
3. BOD	Oxygen Demand (Biochemical)*	mg/l
4. COD	Oxygen Demand (Chemical)*	mg/l
5. Organic Nitrogen	Nitrogen (Organic) by Kjeldhl's method*	mg/l
6. Ammonium Nitrogen	Nessbrization Method (Direct) and following distillation)*	mg/l
7. Feacal Coliform	Feacal Coliform Membrane Filter procedure/standard plate count *	No/100ml

* Standard Methods for the examination of water and wastewater.

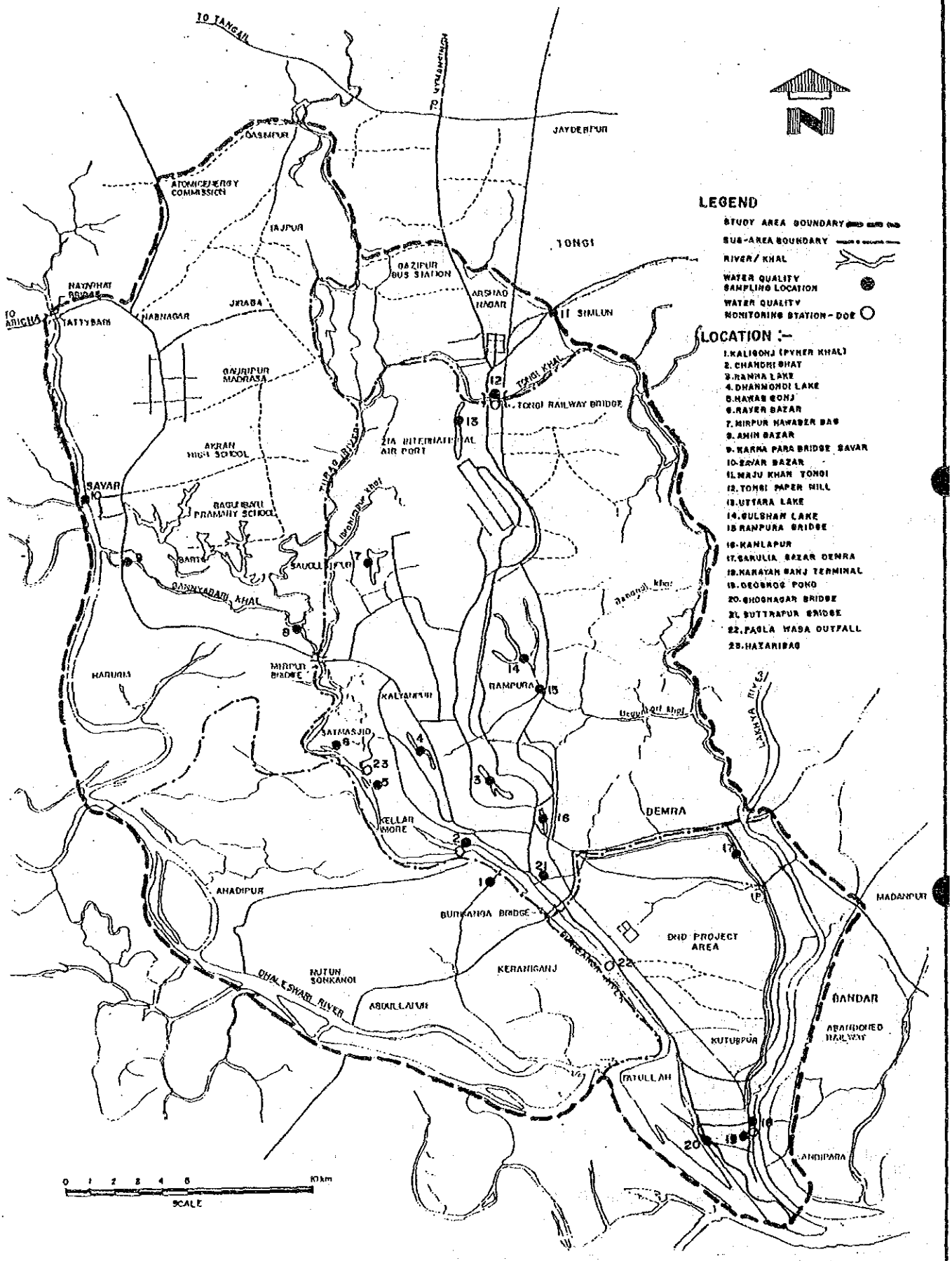

FIG. 7.5 SAMPLING AND MONITORING STATION OF WATER QUALITY

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROLOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

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Table - 2 : Results of on site test of surface water sample collected from different locations.

Sampling Location	Date Time	Temp cels	Color Pt-Co Colour Unit	Odour	Turbi-dity NTU/ FTU	pH	EC ums/cm	TDS mg/l
Pyner Khal Keraniganj	10-2-91 12-52 PM	24.7	77	Bad	17 49	6.92	492	246
Chandni ghat WASA intake	10-2-91 12-12 PM	24.3	65	"	12 34	7.11	431	215
Ramna Lake	26-1-91 1-15 PM	23.0	-	Bad	24 -	6.70	164	84
	10-2-91 10-20 AM	22.0	40	"	24 30	6.82	264	130
Dhanmondi Lake	30-1-91 12-23 AM	23.5	144	Not Bad	12 144	7.35	571	289
	17-2-91 3-04 PM	25.5	180	"	16 43	6,91	632	316
Nawabganj Khal	28-1-91 1-45 PM	22.4	244	Bad	50 96	7.22	812	477
	17-2-91 1-54 PM	24.8	176	"	26 52	7.00	719	358
Rayer Bazar Khal	28-1-91 11-45 AM	22.5	120	Bad	47 70	6.81	1042	642
	17-2-91 2-40 PM	26.0	153	"	40 52	7.22	775	388
Nawaberbag Lake Mirpur	30-1-91 1-13 PM	22.5	26	Not Bad	12 12	7.11	121	61
Amin Bazar Bagun Bari Khal	4-2-91 11-45 AM	22.0	5	Bad	8 10	7.69	368	184
Savar Bank Town	30-1-91 1-01 PM	23.0	67	"	6.5 2.0	7.26	473	237
Savar Bazar Banshi River	4-2-91 12-10 PM	22.1	20	Bad	20 11	7.66	424	213
Majukhan Rly.Bridge	4-2-91 2-05 PM	22.5	126	Bad	40 167	7.56	244	120
Tongi River paper mill	10-2-91 2-20 PM	25.1	63	Bad	12 33	7.04	338	169

Table - 2 (contd.)

Sampling Location	Date Time	Temp cels	Color Pt-Co Colour Unit	Odour	Turbi-dity NTU/ FTU	pH	EC ums/cm	TDS mg/l
Tongi River Bridge	4-2-91 2.30 PM	23.2	56	Not bad	10 42	7.40	290	145
Uttara Lake	4-2-91 3-00 PM	22.0	19	Not Bad	7 19	6.92	159	79
Gulsan Lake	26-1-91 11-45 AM	23.0	-	Bad	77 -	6.96	202	104
	10-2-91 9-30 AM	21.0	73	Bad	68 100	7.00	221	110
Rampura Bridge	26-1-91 12-30 AM	24.1	-	Object-ionable Bad	44 -	6.61	754	404
	10-2-91 10-0 AM	22.5	114	"	15 88	6.99	827	413
Kamalapur Segun Bag-icha Khal	26-1-91 2-15 PM	24.1	-	Object-ionable	100	6.43	708	665
	10-2-91 10-55 AM	22.9	108	Bad "	104 80	6.68	831	415
Sarulia Bazar DND Khal	2-2-91 11-45 AM	23.6	60	Bad	3.5 10	6.37	407	205
	17-2-91 12-05 PM	24.8	26	"	3.1 15	7.20	381	562
Narayanganj Terminal	2-2-91 2-00 PM	24.0	62	Not Bad	25 22	7.36	303	147
Deobhog pond Narayanganj	2-2-91 1-40 PM	23.4	143	Bad	20 16	7.36	911	557
	17-2-91 12-40 PM	26.0	190	"	22 43	7.22	1262	631
Ghognagar Bridge Mushiganj Road	2-2-91 12-20 PM	23.9	49	Not Bad	17 14	7.24	457	228
Sutrapur Bridge,	28-1-91 2-10 PM	25.3	218	Object-ionable	47 70	6.50	1150	846
Dholai Khal	17-291 11-30 AM	25.0	318	Bad	40 114	6.55	1117	562

Table - 2A : Results of on site test of surface water sample collected from different locations (July - August'91)

Sampling Location	Date Time	Temp cels	Color Pt-Co Colour Unit	Odour	Turbi-dity NTU FTU	pH	EC µmho/cm	TDS mg/l
Pyner Khal Keraniganj	03-8-91 12-05 PM	29.0	102	Not Bad	55 17	7.30	124	62.3
Chandni ghat WASA intake	03-8-91 12-30 PM	29.5	81	"	28 23	6.90	140	72.0
Ramna Lake	25-7-91 12-15 PM	33.4	107	Not Bad	40 20	7.10	130.9	65.3
Dhanmondi Lake	28-7-91 1-35 PM	34.1	188	"	39 30	7.50	270	137.5
	11-8-91 11-30 AM	31.5	160	"	22	6.9	260	110.5
Nawabganj Khal	03-8-91 2-00 PM	30.3	74	"	32 30	7.20	130	65.2
Rayer Bazar Khal	28-7-91 1-15 PM	33.3	144	"	<25 26	7.40	540	271.5
	11-8-91 11-0 AM	30.9	150	"	<25 30	7.00	602	290.5
Nawaberbag Lake Mirpur	05-8-91 1-10 PM	33.9	150	"	37 23	7.00	140	72.0
Amin Bazar Bagun Bari Khal	05-8-91 12-30 PM	31.9	101	"	<25 14	6.90	120	60.7
Savar Bank Town	05-8-91 11-30 AM	31.8	151	"	<25 57	6.80	110	58.5
Savar Bazar Banshi River	05-8-91 11-15 AM	31.3	149	"	95 39	7.00	110	55.9
Majukhan Railway Bridge	30-7-91 11-50 PM	31.7	36	"	<25 12	7.10	89	41.3
Tongi River near paper mill	30-7-91 12-37 PM	32.4	111	"	35 41	7.90	107	54.1

Sampling Location	Date Time	Temp cels	Color Pt-Co Colour Unit	Odour	Turbi-dity NTU FTU	pH	EC µmho/cm	TDS mg/l
Uttara Lake	30-7-91 1-00 PM	32.0	57	Not Bad	<25 19	7.00	129	64.6
Gulsan Lake	28-7-91 2-10 PM	34.0	114	"	<25 14	7.60	200	102.9
	11-8-91 12-15 PM	33.5	119	"	<25 29	7.00	129	92.8
Rampura Bridge	25-7-91 12-45 PM	31.8	324	"	27 18	7.60	384	192.0
Kamalapur Segun Bag-icha Khal	25-7-91 11-15 AM	30.9	143	Bad	85 25	6.70	601	299.0
Sarulia Bazar DND Khal	01-8-91 12-25 PM	32.5	59	"	49 14	7.20	230	130.0
Narayanganj Terminal	01-8-91 11-50 AM	33.0	179	Not Bad	39 69	7.00	130	59.4
Deobhog pond Narayanganj	01-8-91 11-25 AM	32.4	103	Bad	<25 39	7.90	640	329.0
Ghognagar Bridge Munshiganj Road	01-8-91 11-00 AM	32.2	139	Not Bad	55 40	6.80	110	55.6
Sutrapur Bridge, Dholai Khal	03-8-91 11-40 AM	27.8	236	Object-ionable	160 94	7.40	727	364.0

Table - 3 : Results of laboratory analysis of Surface water samples collected from different locations.

Sampling Location	S.S mg/l	BOD mg/l	COD mg/l	Or-N. mg/l	NH_4-N mg/l	FC No/100ml	DO mg/l
Pyner Khal Keraniganj	100	198	381.14	1.14	0.5	1.8×10^{6}	0.9
Chandni ghat	69	9.8	63.28	0.68	1.3	1.2×10^{5}	3.6
Ramna Lake	48	10.9	76.9	0.84	1.10	1.3×10^{4}	1.9
	56	3.7	83.16	-	-	1.2×10^{4}	3.2
Dhanmondi Lake	14	4.4	26.5	1.42	15.50	-	7.5
	68	2.9	20.78	1.47	12.50	3.2×10^{5}	9.8
Nawabganj Khal	350	250	796.72	0.90	17.00	3.6×10^{6}	1.4
	310	231.5	799.0	1.14	11.90	-	2.5
Rayer Bazar Khal	225	112	400	1.86	23.50	-	3.35
	175	198.6	420	1.03	8.05	4.4×10^{5}	4.0
Nawaberbag Lake	14	1.85	5.01	0.92	1.80	4.3×10^{2}	6.3
Amin Bazar Begun bari khal	98	2.4	27.71	0.42	0.60	9×10^{3}	8.3
Savar Bank Town on Karnapara Khal	22	2.8	41.57	1.40	0.90	9×10^{2}	7.8
Savar Bazar Bangshi River	132	5.0	31.18	0.37	0.57	5.0×10^{3}	8.0
Majukhan Rail-way bridge	388	3.95	6.93	0.44	0.90	1.3×10^{4}	7.9
Tongi River paper mill	108	0.4	353.40	0.73	1.1	3.2×10^{4}	3.4
Tongi River bridge	61	2.3	76.50	-	-	1.6×10^{5}	5.0
Uttara Lake	228	7.0	69.28	0.45	0.57	4×10^{3}	7.6
Gulshan Lake	91	8.4	70.28	0.40	1.20	4.9×10^{3}	2.1
	118	4.8	76.23	-	-	5.1×10^{3}	3.2

Table - 3 (contd.)

Sampling Location	S.S mg/l	BOD mg/l	COD mg/l	Or-N mg/l	NH_4-N mg/l	FC No/100ml	DO mg/l
Rampura bridge	210	360	1189.4	0.8	21.80	-	0
	230	400	1333.64	-	-	8.4×10^5	0
Kamalapur	1790	292.5	901.92	1.42	23.50	-	0
Segun Baghicha Khal	1560	348	981.46	-	-	8.0×10^5	0
Sarulia Bazar DND Khal	110	62	210	1.75	5.30	-	3.6
	110	75.5	275	-	-	3.2×10^4	3.8
Narayanganj Terminal	12	1.5	6.93	0.31	2.60	4.5×10^3	10.6
Deobhog pond	158	199	578.85	1.74	50.50	1.2×10^4	3.7
Narayanganj	202	290	570.0	1.40	17.00	2×10^5	2.4
Ghognagar bridge, Munshi-ganj Road	62	0.9	6.54	0.62	1.3	5×10^2	10.8
Sutrapur Bridge	298	270	805	1.3	33.50	-	0
Dholai Khal	372	219.9	812.4	1.56	41.00	3.6×10^7	0

Table - 3A: Results of laboratory analysis of surface water samples collected from different locations (July - August 91).

Sampling Location	S.S mg/l	BOD mg/l	COD mg/l	Or-N_2 mg/l	NH_4-N_2 mg/l	FC Nr/100ml	DO mg/l
Pyner Khal Keraniganj	56	2.2	120.0	0.69	0.35	$9.1x10^3$	6.0
Chandni ghat	85	2.5	16.0	0.59	0.60	$1.8x10^4$	5.8
Ramna Lake	15	1.5	46.0	1.04	0.96	$1.0x10^3$	5.3
Dhanmondi Lake	39	2.4	12.0	0.30	0.93	$2.8x10^1$	7.0
	42	1.9	10.0	-	-	$1.0x10^4$	7.2
Nawabganj Khal	94	12.9	104.0	0.36	0.77	$3.0x10^3$	5.6
Rayer Bazar Khal	79	9.8	120.0	0.20	6.55	$5.0x10^1$	0.8
	60	20.0	150.0	-	-	$4.5x10^5$	0.4
Nawaberbag Lake	17	0.4	4.0	0.48	1.05	$1.5x10^2$	5.9
Amin Bazar Begun bari khal	16	1.0	8.0	0.47	1.26	$4.0x10^3$	3.4
Savar Bank Town on Karnapara Khal	48	1.0	24.0	0.37	0.80	$1.8x10^2$	6.2
Savar Bazar Bangshi River	157	3.4	12.0	0.40	0.90	$7.0x10^2$	5.8
Majukhan Rail-way bridge	43	1.1	4.0	0.48	0.39	$3.0x10^2$	5.0
Tongi River paper mill	43	4.6	22.0	1.22	0.39	$2.5x10^4$	6.2
Uttara Lake	17	5.6	11.0	0.75	0.38	$1.0x10^4$	6.8
Gulshan Lake	80	1.9	22.0	0.62	0.53	$5.5x10^1$	8.0
	78	1.2	18.0	-	-	$1.5x10^4$	8.6
Rampura bridge	22	27.0	156.0	1.48	6.30	$1.5x10^4$	7.2
Kamalapur Segun Baghicha Khal	192	32.5	176.0	1.47	16.0	$5.0x10^4$	0.0

Sampling Location	S.S mg/l	BOD mg/l	COD mg/l	Or-N_2 mg/l	NH_4-N_2 mg/l	FC Nr/100ml	DO mg/l
Sarulia Bazar DND Khal	65	24.0	64.0	0.45	0.23	$8.0x10^4$	5.7
Narayanganj Terminal	36	0.4	7.0	0.83	0.20	$2.5x10^3$	5.7
Deobhog pond Narayanganj	49	5.0	98.0	0.76	10.25	$7.0x10^4$	3.5
Ghognagar bridge,Munshi-ganj Road	22	1.0	3.0	0.78	0.25	$3.0x10^2$	3.9
Sutrapur Bridge Dholai Khal	105	25.0	108.0	0.72	17.75	$2.0x10^4$	0.0

Table - 4 : General description of the selected sampling locations

Sl. No.	Location	Name of canal, river, lake	Description of location
1.	Keraniganj	Pyner Khal	Kaliganj bazar 80 ft from the bazar. 15.244 m (50 ft) from the Buriganga river, inside the khal.
2.	Chandni ghat	Buriganga River	WASA water works intake point.
3.	Ramna park Gate No. 1	Ramna Lake	15.244 m (50 ft) from the culvert. 1.829 m (6 ft) from the bank
4.	Dhanmondi Road No. 8	Dhanmondi Lake	Near bridge 24.39 m (80 ft) from the road 0.609 m (2 ft) from the bank
5.	Nawabganj (Old Dhaka)	Nawabganj Khal	Near Tample and Mosque 15.244 m (50 ft) from the house, Behind the embankment Hazaribag. 1.524 m (5 ft) from the bank
6.	Rayer Bazar	Rayer Bazar Khal	Behind the market 91.463 m (300 ft) from the piller 1.524 m (5 ft) from the bank
7.	Mirpur Section - 1	Nawaberbag Lake	27.439 m (90 ft) from the Wall of 200 1.524 m (5 ft) from the bank.
8.	Amin bazar Begumbari ghat	Karnapara Khal	Begum bari gudara ghat 6.097 m (20 ft) from bank inside the khal.
9.	Savar Bank Town	Karnapara Khal	Near bridge, right side towards Savar 60.976 m (200 ft) from the bridge 1.524 m (5 ft) from the bank.
10.	Savar Bazar	Bangshi River	Near the market 27.439 m (90 ft) from the market 1.524 m (5 ft) from the bank.
11.	Majukhan Railway bridge	Hyderabad Khal	Under the railway bridge 15.244 m (50 ft) from the bridge 1.524 m (5 ft) from the bank.

Table -4 (contd.)

Sl. No.	Location	Name of canal, river, lake	Description of location
12.	a) Tongi paper mill	Tongi River	Near Paper Mill. 15.244 m (50 ft) from the drainage of the mill. 1.244 m (5 ft) from the bank.
12.	b) Tongi Rd. bridge	Tongi River	6.00 m (20 ft) from the bridge. 1.52 m (5 ft) from the bank.
13.	Uttara Town	Uttara Lake	7.622 m (25 ft) from the embankment 1.524 m (5 ft) for bank.
14.	Gulshan No.1 Round	Gulshan Lake	Near No. 1 market 4.87 m (16 ft) from the culvert, 0.914 m (3 ft) from the bank.
15.	Rampura Baridge	Begunbari Khal	North of TV station 6.40 m (21 ft) from the bridge, 1.524 m (5 ft) from the bank.
16.	Kamalapur	Segunbagicha Khal	Kamlapur Road behind Senakalyan 9.146 m (30 ft) from the Road 1.524 m (5 ft) from the bank.
17.	Sarulia Bazar	DND Khal	6.097 m (20 ft) from the bridge 1.524 m (5 ft) from the bank.
18.	Narayanganj Terminal	Sitalakhya River	Lounch terminal 1.524 m (5 ft) from the terminal.
19.	Deobhog Narayanganj	Deobhog pond	Near Deobhog mosque 6.097 m (20 ft) from the culvert 1.524 m (5 ft) from the bank
20.	Ghognagar bridge Munshiganj Road.	Dead channel of Sitalakhya	6.097 m (20 ft) from the bridge 1.524 m (5 ft) from the bank.
21.	Sutrapur Bridge, Dhaka	Dholai Khal	30.488 m (100 ft) from the bridge, 1.524 m (5 ft) from the bank. (1.5 ft)

Chemical Analyses of Groundwater from WASA Tubewells

(1)

Well ID	Well Name	Year Sunk	Model Coordinates E-W	Model Coordinates N-S	April 1989 E.C	April 1989 Alkalinity	April 1989 Chloride	April 1989 Calcium	April 1989 Hardness	April 1989 Coliforms	November 1989 E.C	November 1989 Alkalinity	November 1989 Chloride	November 1989 Calcium	November 1989 Hardness	November 1989 Coliforms
					uS/cm	(as CaCO3)	mg/l	mg/l	mg/l		uS/cm	(as CaCO3)	mg/l	mg/l	mg/l	
DW1/ 1	Basaboo	1970	78.00	53:23							220	90	30	35.27	152	45
DW1/ 2	Mugdapara (North)	1988	78.14	53.68							250	75	21	19.23	84	
DW1/ 3	Manik Nagar	1987	77.92	53:00							300	85	28	27.25	88	
DW1/ 4	Bangr Bhaban	1981	76.76	52.98												
DW1/ 5	D.I.T. Building	1984	76.72	53:14	280	80	58	29.65	95		270	65	30	20.04	80	
DW1/ 6	Hatkhola (Near OHT)	1975	77.20	52.24							280	85	35	20.04	78	10
DW1/ 7	Dayagonj		77:24	51:78							400	90	65	37.67	124	
DW1/ 8	Dhopkhola Math	1980	76.94	51:43												
DW1/ 9	Sajdabad	1981	77.76	51.30												
DW1/10	Dhonia	1981	79.22	50.82												
DW1/11	Jurain	1981	79.08	49.72												
DW1/12	Pagla (WASA)	1983														
DW1/13	LG. Bazar	1983	77.44	50.23							220	85	25	19.23	72	
DW1/14	LG. Gate	1961	77.26	50.22												
DW1/15	Millbarak		76.72	50.34												
DW1/16	Gandaria DIT Plot (Rly.)		77.56	50.82							460	85	80	39.27	140	
DW1/17	Gandaria Distilary Rd.	1982	76.79	51.38							230	75	23	19.23	62	
DW1/18	Lakhsmibazar (WASA)		76.54	51.50							380	105	63	43.28	162	86
DW1/19	Farashgonj	1980	76.40	51:40							280	90	34	22.44	84	
DW1/20	Banogram (Near OHT)		76.50	52:13							800	85	152	68.94	226	
DW1/21	Baldah Garden	1982	76.88	52.30							600	80	31	45.69	166	
DW1/22	Narinda		76.78	51.38							470	85	75	40.08	208	
DW1/23	Ahmedbag	1989	78.36	53:51												
DW2/ 1	Dhakeswari (WASA)		74.00	52.90												
DW2/ 2	Dhaka Water Works	1971	74:32	52.34							1000	155	192	76.15	220	27
DW2/ 3	Bakshibazar	1982	74.60	52.90							600	110	83	54.5	240	37
DW2/ 4	Rahmatullah High School	1977	73.66	52.96							460	120	73	48.09	194	
DW2/ 5	Nawabganj	1972	73:42	53.00							500	105	110	52.1	238	48
DW2/ 6	Azimpur Nr. 6	1975	73.50	53:64	600	90	101	48.09	180							
DW2/ 7	Azimpur Nr.7 (Near OHT)	1979	73.64	53.16	650	90	132	60.92	198							
DW2/ 8	Peel Khana Nr. 2	1970	72.75	53:42							640	95	36	28.05	148	14
DW2/ 9	Peel Khana Nr. 3		72.80	54.00							470	110	80	55.31	180	2
DW2/10	Hazaribagh Nr.4 (Near OHT)	1983	72:12	53.60							500	155	80	36.07	100	12
DW2/11	Hazaribagh Nr. 3	1980	71.90	54.00							600	95	98	36.87	132	
DW2/12	Hazaribagh Nr. 5	1986	72.18	53.78							500	150	80	44.08	120	
DW2/13	Abul Hasnat Road		75.00	52.60							700	140	199	30.46	100	90
DW2/14	Fulbaria (Near OHT)	1989	76.08	52.70							700	110	125	60.92	236	20
DW2/15	Jagannath College	1970	76.10	51.74							700	155	95	28.05	236	
DW2/16	Mitford Hospital (SMC)	1987	75.38	51.36							250	110	82	50.5	183	31
DW2/17	Simson Road	1989	75.96	51.40							390	100	42	48.09	136	35
DW2/18	Agamachi Lane	1985	75:10	52.86												
DW2/19	Dholaikhal (Nowabpur)		76:10	52.30							825	115	195	64.93	254	4
DW2/20	S.D. Park (Sirajuddowla)	1978	75.82	52.16							625	130	65	50.5	250	
DW2/21	Bangladesh Math	1977	75.30	52.30							700	135	68	45.69	446	0
DW2/22	Armanitola Math	1977	75.60	51.98							450	85	80	55.3	64	6

Source :
Dhaka Region Groundwater and Subsidence Model Study by IDA - 1991

Well ID	Well Name	Year Sunk	Model Coordinates E-W	Model Coordinates N-S	April 1989 E.C. uS/cm	April 1989 Alkalinity (as CaCO3)	April 1989 Chloride mg/l	April 1989 Calcium mg/l	April 1989 Hardness mg/l	April 1989 Coliforms	November 1989 E.C. uS/cm	November 1989 Alkalinity (as CaCO3)	November 1989 Chloride mg/l	November 1989 Calcium mg/l	November 1989 Hardness mg/l	November 1989 Coliforms
DWS/ 1	F.D.C.	1983	74.76	56.24												
DWS/ 2	Kawran Bazar	1970	74.48	56.02												
DWS/ 3	Old Assembly (R2)	1989	74.42	57.68												
DWS/ 4	Tejgaon Nr. 6 (BOL)	1970	75.50	57.50												
DWS/ 5	Tejgaon Nr. 3	1975	75.16	57.36												
DWS/ 6	Mohakhali T.B. Gate	1970	76.04	58.94												
DWS/ 7	Mohakhali (PHI Lab.)	1988	75.20	58.94							260	75	31	19.23	72	
DWS/ 8	Baridhara	1984	77.27	61.96	220	70	50	16.83	90	7	300	105	45	20.84	84	0
DWS/ 9	Gulshan Nr.4 (Near OHT)	1984	76.50	60.50							220	70	24	16.83	60	7
DWS/10	Gulshan Nr. 5	1972	76.96	59.46												
DWS/11	Banani Nr.3 (Rd. Nr. 1A)	1970	75.47	59.70							250	70	31	18.43	60	0
DWS/12	Banani Nr.4 (Rd. Nr. 8)	1977	75.46	60.14	180	50	41	16.03	82	10	210	60	27	15.23	54	
DWS/13	DOHS Mohakhali	1982	74.66	59.06							180	45	24	12.82	52	30
DWS/14	Uttara Nr. 1	1977			240	100	37	17.62	110	1	210	55	23	12.82	58	
DWS/15	Uttara Nr. 2	1982			260	100	26	19.23	100	6						
DW6/ 1	High Court	1974	75.46	53.58	500	75	110	40.08	184		360	75	77	40.08	144	
DW6/ 2	Dhaka Medical College	1986	74.61	53.18							650	120	90	48.09	440	
DW6/ 3	Jimkhana	1975	74.70	54.36	300	50	45	27.25	100	17	270	60	36	32.86	116	36
DW6/ 4	Elephant Road Nr. 2	1979	74.66	55.00							300	55	55	21.64	84	
DW6/ 5	Kakrail (Near OHT)	1971	75.20	55.06							250	65	45	19.23	64	
DW6/ 6	Lichubagan	1970	75.50	54.28	250	85	62	30.46	140	15	300	70	33	24.04	84	
DW6/ 7	Moghbazar	1989	75.78	56.78							290	85	32	36.07	106	
DW6/ 8	Madubagh	1989	76.35	56.86							270	85	24	28.05	98	20
DW6/ 9	Rajarbagh Nr. 1 (Old)	1975	76.36	54.88	360	85	71	28.06	112	10	250	95	35	21.64	70	8
DW6/10	*Rajarbagh Nr. 2 (New)*		76.50	54.50							320	105	52	26.45	102	
DW6/11	Khilgaon Nr. 3	1970	77.08	55.76							328	90	34	38.47	156	25
DW6/12	Khilgaon Nr. 4	1977	76.74	55.96							220	90	23	20.04	120	7
DW6/13	Khilgaon Nr. 5	1980	76.92	56.38							270	90	25	44.08	96	22
DW6/14	Madartek	1982	79.58	55.24							220	85	15	17.63	60	
DW6/15	Goran	1980	78.00	55.50							230	90	20	28.05	102	
DW6/16	Shahjahanpur	1972	77.24	54.34							290	75	42	32.06	106	
DW6/17	Fakirapool (Near OHT)	1981	76.70	53.76	300	90	82	25.65	98	22	290	70	35	24.04	100	
DW6/18	Bijoynagar (Near OHT)	1979	76.00	53.94							290	70	35	24.04	100	
DW6/19	Stadium	1988	76.48	53.50							370	75	50	27.65	118	
DW6/20	Malibagh D.I.T Road	1979	75.38	55.70							270	70	34	20.04	86	4
DW6/21	*Motijheel Pirganj Mazar*	1968	77.20	54.34							280	55	38	24.84	90	
DW6/22	Rampura	1983	77.40	57.44							310	95	44	23.24	98	
DW6/23	Motijheel A.G.B. Colony	1985	76.93	54.04												
DW6/24	P.G. Hospital	1986	74.56	54.60							320	115	39	26.45	96	7
DW6/25	New Eskaton	1986	74.64	55.40							350	60	52	29.25	104	
DW6/26	North Shahjahanpur	1989	77.56	55.20							330	60	60	25.65	94	11
DW6/27	Moghbazar Wireless Company	1989	76.46	56.12												

Source :
Dhaka Region Groundwater and Subsidence Model Study by IDA - 1991

3.2 Groundwater Quality Data - DWASA Wells by IDA

Well ID	Well Name	Year Sunk	Model Coordinates E-W	Model Coordinates N-S	April 1989 E.C	April 1989 Alkalinity (as CaCO3)	April 1989 Chloride	April 1989 Calcium	April 1989 Hardness	April 1989 Coliforms	November 1989 E.C	November 1989 Alkalinity (as CaCO3)	November 1989 Chloride	November 1989 Calcium	November 1989 Hardness	November 1989 Coliforms
					uS/cm	mg/l	mg/l	mg/l	mg/l		uS/cm	mg/l	mg/l	mg/l	mg/l	
DW3/ 1	Shamoli Ring Road	1988	71.10	58.46							250	70	25	29.65	78	3
DW3/ 2	Babar Rd. Mohammadpur 7	1970	71.48	58.00							290	35	35	23.24	80	2
DW3/ 3	Asad Gate Md. Pur	1971	72.34	56.78	260	80	56	23.25	76		265	55	15	20.84	80	
DW3/ 4	Salimullah Rd. Md.Pur 8	1988	71.58	57.14							250	65	32	20.84	72	
DW3/ 5	Nazrul Islam Rd. Md.Pur 9		71.30	56.50							240	60	35	20.04	90	
DW3/ 6	Lalmatia Nr. 4	1983	72.14	56.62							360	75	50	30.46	122	18
DW3/ 7	Lalmatia Nr. 2 (SOHT)		72.43	56.50							370	80	50	29.65	150	
DW3/ 8	Pangu Hospital	1980	72.12	58.50							210	65	18	15.23	64	
DW3/ 9	Indira Road	1980	73.38	56.60							280	70	41	20.04	84	55
DW3/10	Green Road Nr. 3	1974	73.60	55.60	380	100	77	39.27	158		400	75	53	33.66	120	32
DW3/11	Laboratory School	1980	73.18	54.00	330	75	65	40.08	145		320	80	43	24.04	96	4
DW3/12	Sukrabad	1981	72.76	56.46							320	105	40	29.65	94	
DW3/13	Green Road Nr. 4	1977	73.24	55.34							420	100	56	35.27	148	48
DW3/14	New Elephant Rd. Nr.3	1970	74.08	54.60												
DW3/15	Jhikatola	1974	72.54	54.64							1800	85	475	113.82	480	22
DW3/16	Rayer Bazar	1970	71.72	54.66												
DW3/17	Dhanmondi Nr.8 (Near OHT)	1972	72.32	55.76	470	95	125	36.07	174		490	100	70	41.68	138	
DW3/18	Tikkatoara, Md.Pur		71.22	57.80							210	85	17	19.27	60	
DW3/19	Dhanmondi Rd. Nr. 11	1986	73.35	54.46												
DW3/20	Nilkhet	1986	73.78	54.06							410	65	69	33.66	124	
DW3/21	Rayerbazar Sultangonj	1988	71.52	55.75							370	85	47	32.06	114	
DW3/22	Ershad Parade Square	1989	73.08	59.38												
DW4/ 1	Bangla College	1980	70.28	59.42												
DW4/ 2	Kallayanpur	1982	70.96	59.90							250	80	20	23.24	94	5
DW4/ 3	Pirer Bag	1985	71.39	60.08												
DW4/ 4	Mirpur Sec-2 (Zoo Road)	1978	70.34	62.00												
DW4/ 5	Mirpur, Sec-2 (Near OHT)		70.90	62.16												
DW4/ 6	Mirpur Sec-6 (Near OHT)	1988	71.60	62.34												
DW4/ 7	Mirpur Sec-7	1973	71.20	63.12												
DW4/ 8	Rupnagar	1983	70.68	63.36												
DW4/ 9	Pallabi Mirpur Sec-12	1980	71.32	64.06												
DW4/10	Mirpur Section 11	1977	72.20	63.18												
DW4/11	Mirpur Sec-12 (Near OHT)	1988	72.20	63.96												
DW4/12	Mirpur Sec-10 (Near OHT)	1978	72.00	64.38												
DW4/13	Mirpur Section 13	1983	73.18	61.76												
DW4/14	Mirpur, Section-14	1983	73.10	61.24												
DW4/15	Lalasorai	1980	73.86	59.94												
DW4/16	Sheorapara	1982	72.38	60.30												
DW4/17	Gudaraghat Mirpur Sec-1	1989	69.86	61.58												
DW4/18	Mirpur Sec-12, Block - C	1988	72.00	64.10												
DW4/19	Barbaro	1989	71.80	58.50												
DT4/20	Mirpur Section 10	1989	72.15	62.13												
DT4/21	Dhirypara		70.73	62.58												

Source :
Dhaka Region Groundwater and Subsidence Model Study by IDA - 1991

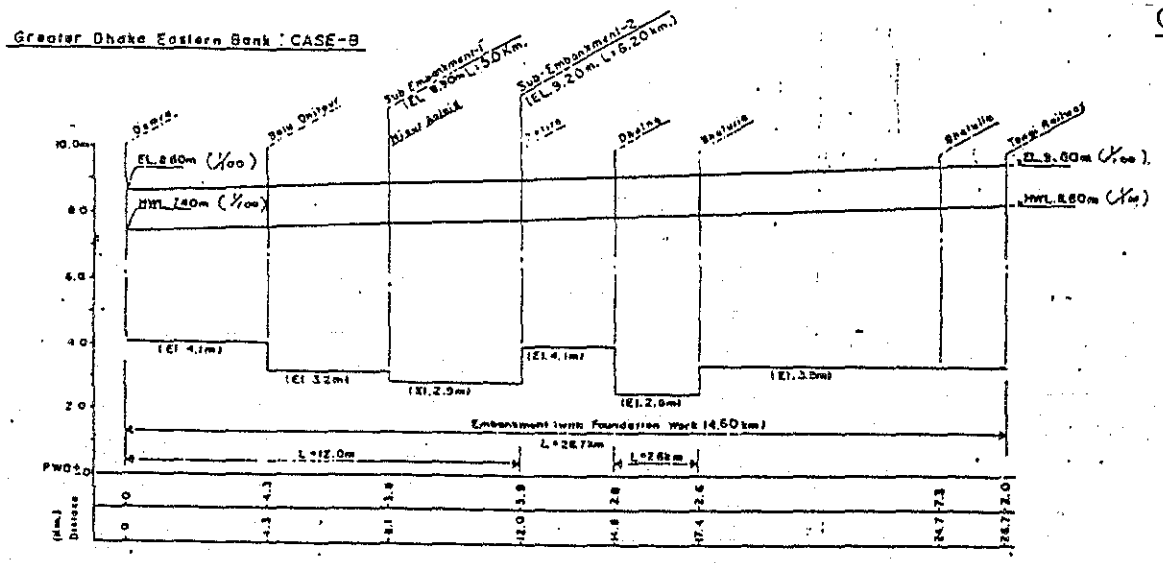
DATA BOOK II : Flood Mitigation

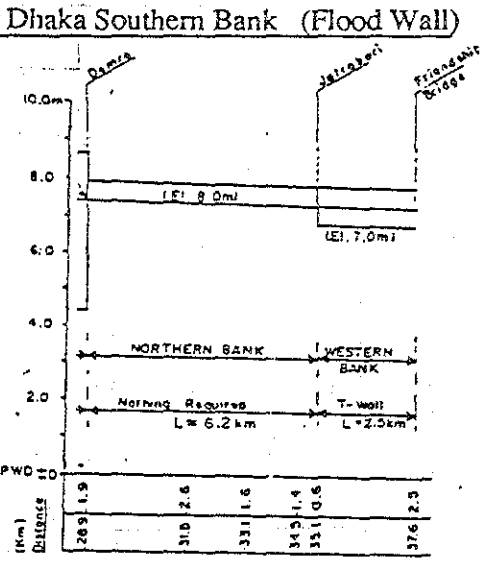
(Supporting Report G)

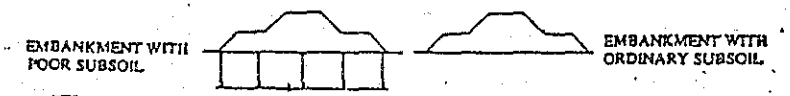
Table of Contents

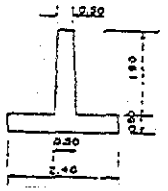
FLOOD FREQUENCY		EMBANKMENT					FLOOD WALL						TOTAL COST 10^3 Tk
		WEST BANK	EAST BANK	TOTAL V	UNIT COST	COST 10^3		WEST BANK	EAST BANK	TOTAL V	UNIT COST	COST 10^3	
1/10	MATERIAL	3,510	2,429	5,939	150	890,850	MATERIAL	6.0		6.0	5,500	33,000	6,093,180
	BANKING	3,510	2,429	5,939	500	2,969,500	FORM WORK				600		
	FOUNDATION	574	498	1,072	545	584,240							
	LAND AQU	2,890	1,726	4,616	350	1,615,600							
1/50	MATERIAL	4,771	3,168	7,939	150	1,190,850	MATERIAL	8.4	10.0	18.4	5,500	101,200	7,655,265
	BANKING	4,771	3,168	7,939	500	3,969,500	FORM WORK		26.1	26.1	600	15,660	
	FOUNDATION	623	566	1,189	545	648,005							
	LAND AQU	3,072	1,871	4,943	350	1,730,650							
1/100	MATERIAL	5,403	3,856	9,259	150	1,388,850	MATERIAL	10.2	12.4	22.6	5,500	124,300	8,641,335
	BANKING	5,403	3,856	9,259	500	4,629,500	FORM WORK		31.3	31.3	600	18,780	
	FOUNDATION	644	615	1,259	545	686,155							
	LAND AQU	3,149	1,976	5,125	350	1,793,750							
1/200	MATERIAL	5,833	3,915	9,748	150	1,462,200	MATERIAL	11.4	14.7	26.1	5,500	143,550	9,024,425
	BANKING	5,833	3,915	9,748	500	4,874,000	FORM WORK		36.5	36.5	600	21,900	
	FOUNDATION	659	626	1,285	545	700,325							
	LAND AQU	3,207	2,000	5,207	350	1,822,450							
1/500	MATERIAL	6,603	4,637	11,240	150	1,686,000	MATERIAL	13.2	17.1	30.3	5,500	166,650	10,111,500
	BANKING	6,603	4,637	11,240	500	5,620,000	FORM WORK		41.8	41.8	600	25,080	
	FOUNDATION	680	666	1,346	545	733,570							
	LAND AQU	3,287	2,085	5,372	350	1,880,200							

1) Design High Water Level (Tentative) and Top Level









Embankment

	Demra H.W.L	Demra EL	Tongi H.W.L	Tongi EL
1/10	6.6+1.2 = 7.8		7.2+1.2 = 8.4	
1/50	7.10+1.2 = 8.3		8.0+1.2 = 9.2	
1/100	7.40+1.2 = 8.6		8.6+1.2 = 9.8	
1/200	7.6+1.2 = 8.8		8.9+1.2 = 10.1	
1/500	7.9+1.2 = 9.1		9.4+1.2 = 10.6	

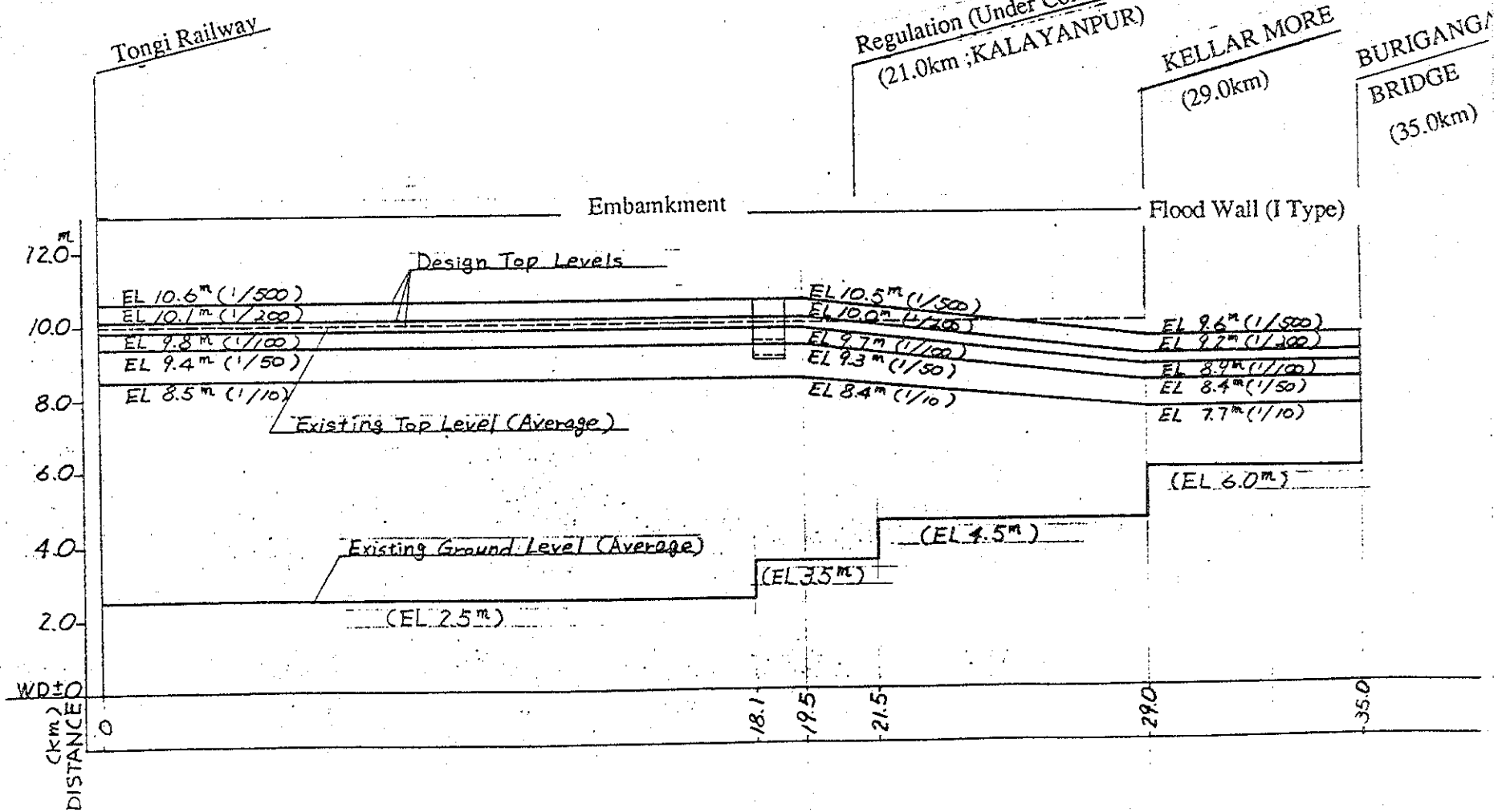
Flood Wall

	Demra H.W.L	Milbarak H.W.L	EL
1/10	6.6	6.7	6.7+0.6=7.3
1/50	7.1	7.4	7.3+0.6=7.9
1/100	7.4	7.8	7.6+0.6=8.2
1/200	7.6	8.1	7.9+0.6=8.5
1/500	7.9	8.5	8.2+0.6=8.8

2) Greater Dhaka Western Bank

Design High Water Level (Tentative)

	Mirpur	Mill Barak
1/10	7.30 m	6.70 m
1/50	8.20	7.40
1/100	8.60	7.80
1/200	8.90	8.10
1/500	9.40	8.50

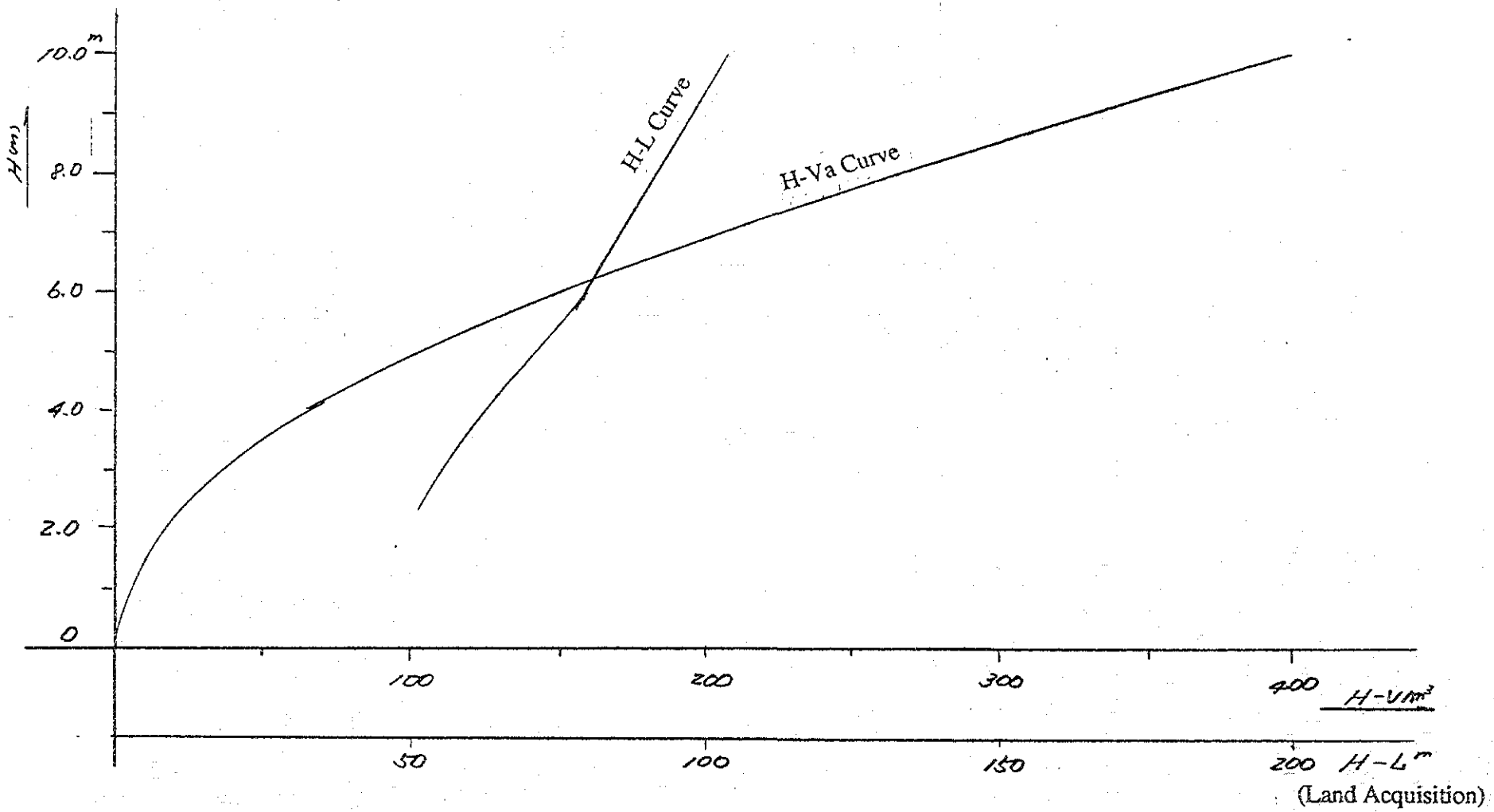


3) Greater Dhaka Proposed Embankment

(Eastern Bank-Case B) : 26.70km

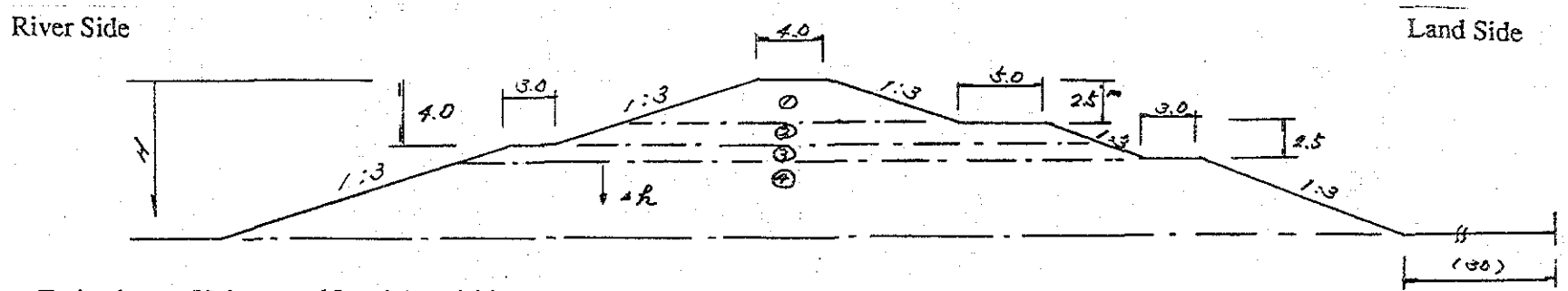
1) Embankment with Poor Soil : 14.60km

2) Embankment with Ordinary Soil : 12.10km



(Land Acquisition)

4) Embankment Volume and Land Acquisition (G.Dhaka Eastern Bank)



Embankment Volume and Land Acquisition

G-5

V : ① $(4+19)/2 \times 2.5 = 23.75$ $23.75\ m^2$ $(H=2.5)$

② $(24+33)/2 \times 1.5 = 42.75$ 66.50 $(H=4.0)$

③ $(36+42)/2 \times 1.0 = 39.00$ 105.50 $(H=5.0^m)$

④ $(45+45+6\times\Delta h)/2 \times \Delta h$ 105.50
$= \Delta h(45+3\times\Delta h)$ $+ \Delta h(45+3\times\Delta h)$

$\Delta h = 1.0$ $(H=6.0) \Rightarrow 48$ 153.5 $(H=6.0^m)$

$\Delta h = 2.0$ $(H=7.0) \Rightarrow 102$ 207.5 $(H=7.0)$

$\Delta h = 3.0$ $(H=8.0) \Rightarrow 162$ 267.5 $(H=8.0)$

$\Delta h = 4.0$ $(H=9.0) \Rightarrow 228$ 333.5 $(H=9.0)$

L : $33 + \overset{(30)}{\ } = \overset{(63)}{\ }$ $(H=4.0)$

$42 + \overset{(30)}{\ } = \overset{(72)}{\ }$ $(H=5.0)$

$51 + \overset{(30)}{\ } = \overset{(81)}{\ }$ $(H=6.0)$

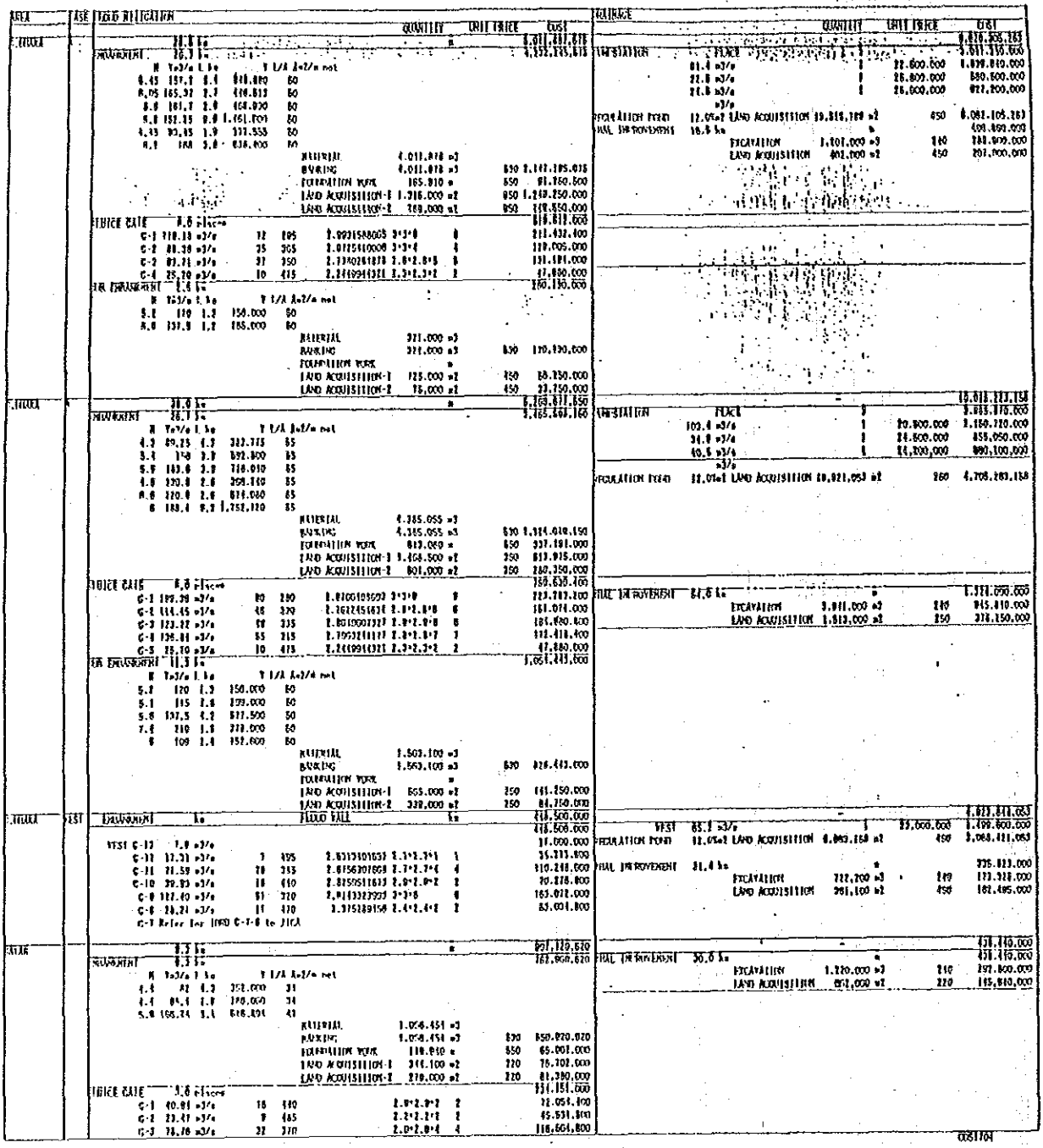
$57 + \overset{(30)}{\ } = \overset{(87)}{\ }$ $(H=7.0)$

$63 + \overset{(30)}{\ } = \overset{(93)}{\ }$ $(H=8.0)$

$69 + \overset{(30)}{\ } = \overset{(99)}{\ }$ $(H=9.0)$

.2 Quantity and Cost Estimates For Alignment Alternative

1)



2)

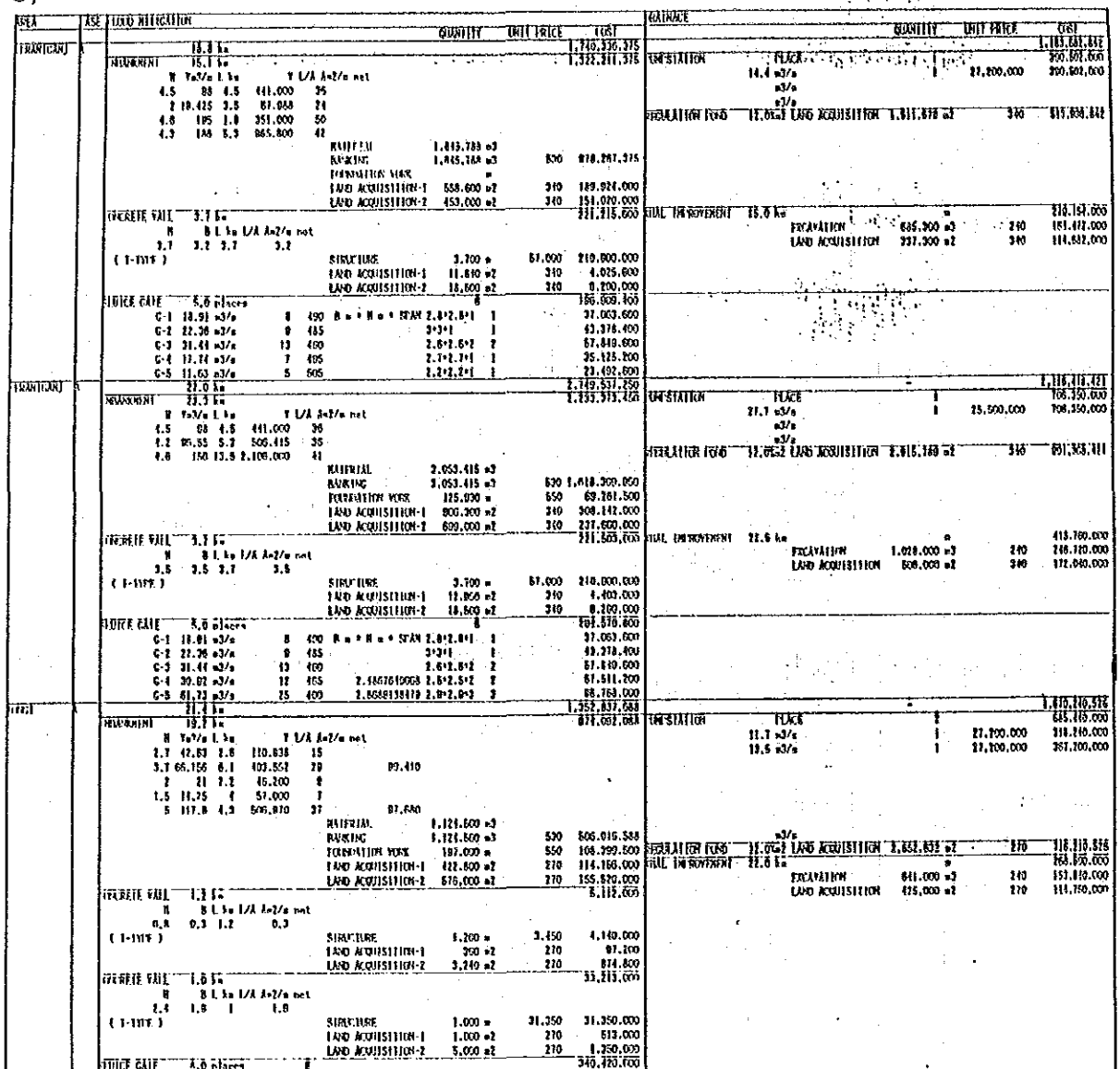
FLOOD MITIGATION

AREA	CASE	ITEM	SPECIFICATION		QUANTITY	UNIT PRICE	COST
NARAYANGANJ	A		28.9 km				1,441,648,600
		EMBANKMENT	8.2 km				353,134,000
			H V m3/m L km V L/A Am2/m net				
			2.9 32.55 1.8 58,590 15				
			4.1 57.75 2.5 144,375 20				
			4.2 76.65 1.9 145,635 32				
				MATERIAL	348,600 m3		
				BANKING	348,600 m3	530	184,758,000
				FOUNDATION WORK	m		
				LAND ACQUISITION-1	137,800 m2	520	71,656,000
				LAND ACQUISITION-2	186,000 m2	520	96,720,000
		CONCRETE WALL	5.3 km				97,467,000
			H B L km L/A Am2/m net				
			2.8 0.3 5.3 0.3				
			(I-TYPE)	STRUCTURE	5,300 m	16,830	89,199,000
				LAND ACQUISITION-1	1,590 m2	520	826,800
				LAND ACQUISITION-2	14,310 m2	520	7,441,200
		CONCRETE WALL	17.4 km				546,570,000
			H B L km L/A Am2/m net				
			2.4 2.4 8.0 2.4		8000 m	31,350	250,800,000
			2.0 2.0 9.4 2.0		9400 m	24,550	230,770,000
			(T-TYPE)	STRUCTURE	17,400 m		
				LAND ACQUISITION-1	38,000 m2	520	19,760,000
				LAND ACQUISITION-2	87,000 m2	520	45,240,000
		SLUICE GATE	6.0 places				444,477,600
			G-1 22.29 m3/s 9 485	B m * H m * SPAN 3*3*1	1		43,242,600
			G-2 27.57 m3/s 11 470	2.4*2.4*2	2		51,831,000
			G-3 9.01 m3/s 4 515	2*2*1	1		18,560,600
			G-4 20.41 m3/s 8 490	2.9*2.9*1	1		40,003,600
			G-5 105.57 m3/s 42 340	3*3*5	5		143,575,200
			G-6 113.28 m3/s 45 325	2.8*2.8*6	6		147,264,000
NARAYANGANJ	B		31.4 km				1,701,333,050
		EMBANKMENT	10.4 km				580,953,850
			H V m3/m L km V L/A Am2/m net				
			2.8 32.55 1.8 58,590 15				
			4.1 57.75 2.5 144,375 20				
			4.2 76.65 1.9 145,635 32				
			7.0 24.15 2.3 55,545 25				
			3.65 63 1.9 119,700 40				
				MATERIAL	523,845 m3		
				BANKING	523,845 m3	530	277,637,850
				FOUNDATION WORK	m		
				LAND ACQUISITION-1	271,300 m2	520	141,076,000
				LAND ACQUISITION-2	312,000 m2	520	162,240,000
		CONCRETE WALL	10.5 km				193,095,000
			H B L km L/A Am2/m net				
			2.8 0.5 10.5 0.5				
			(I-TYPE)	STRUCTURE	10,500 m	16,830	176,715,000
				LAND ACQUISITION-1	5,250 m2	520	2,730,000
				LAND ACQUISITION-2	26,250 m2	520	13,650,000
		CONCRETE WALL	10.5 km				352,059,000
			H B L km L/A Am2/m net				
			2.4 2.4 8.0 2.4		8000 m	31,350	250,800,000
			2.0 2.0 2.5 2.0		2500 m	24,550	61,375,000
			(T-TYPE)	STRUCTURE	10,500 m		
				LAND ACQUISITION-1	24,200 m2	520	12,584,000
				LAND ACQUISITION-2	52,500 m2	520	27,300,000
		SLUICE GATE	8.0 places				575,225,200
			G-1 22.29 m3/s 9 485	B m * H m * SPAN 3*3*1			43,242,600
			G-2 27.57 m3/s 11 470	2.4*2.4*2	2		51,831,000
			G-3 9.01 m3/s 4 515	2*2*1	1		18,560,600
			G-4 20.41 m3/s 8 490	2.9*2.9*1	1		40,003,600
			G-5 10.88 m3/s 4 515	2.1*2.1*1	1		22,412,800
			G-6 105.57 m3/s 42 340	3*3*5	5		143,575,200
			G-7 38.08 m3/s 15 445	2.8*2.8*2	2		67,782,400
			G-8 113.28 m3/s 45 325	2.8*2.8*6	6		147,264,000
			G-9 20.69 m3/s 8 490	2.9*2.9*1	1		40,552,400
[illegible]-BANDAR	GATE		18.5 km				575,881,750
		EMBANKMENT	6.5 km				354,961,750
			H V m3/m L km V L/A Am2/m net				
			3.5 45.15 6.5 293,475 28				
				MATERIAL	293,475 m3		
				BANKING	293,475 m3	530	155,541,750
				FOUNDATION WORK	m		
				LAND ACQUISITION-1	188,500 m2	520	98,020,000
				LAND ACQUISITION-2	195,000 m2	520	101,400,000
		CONCRETE WALL	12.0 km				220,920,000
			H B L km L/A Am2/m net				
			1.2 0.3 12 0.3				
			(I-TYPE)	STRUCTURE	12,000 m	16,850	202,200,000
				LAND ACQUISITION-1	3,600 m2	520	1,872,000
				LAND ACQUISITION-2	32,400 m2	520	16,848,000
[illegible]-BANDAR	RIVER		16.1 km				1,078,041,600
		EMBANKMENT	6.6 km				493,429,200
			H V m3/m L km V L/A Am2/m net				
			4 71.4 6.6 471,240 41				
				MATERIAL	471,240 m3		
				BANKING	471,240 m3	530	249,757,200
				FOUNDATION WORK	m		
				LAND ACQUISITION-1	270,600 m2	520	140,712,000
				LAND ACQUISITION-2	198,000 m2	520	102,960,000
		CONCRETE WALL	9.5 km				374,756,000
			H B L km L/A Am2/m net				
			2.6 2.4 9.5 2.4				
			(T-TYPE)	STRUCTURE	9,500 m	35,600	338,200,000
				LAND ACQUISITION-1	22,800 m2	520	11,856,000
				LAND ACQUISITION-2	47,500 m2	520	24,700,000
		SLUICE GATE	6.0 places		6		209,856,400
			G-1 28.23 m3/s 11 470	B m * H m * SPAN 2.4*2.4*2	2		53,072,400
			G-2 17.16 m3/s 7 495	2.7*2.7*1	1		33,976,800
			G-3 10.93 m3/s 8 490	2.9*2.9*1	1		39,052,800
			G-4 26.02 m3/s 10 475	2.3*2.3*2	2		49,419,000
			G-5 6.47 m3/s 3 520	1.7*1.7*1	1		13,467,600
			G-6 10.13 m3/s 4 515	2.1*2.1*1	1		20,867,800

DRAINAGE

AREA / CASE	ITEM	SPECIFICATION		QUANTITY	UNIT PRICE	COST
NARAYANGANJ A						6,717,845,263
	PUMP STATION	3.0 PLACE		3		1,799,100,000
		P-1 7.1 m3/s		1	28,000,000	198,800,000
		P-2 30.3 m3/s		1	25,000,000	757,500,000
		P-3 34.4 m3/s		1	24,500,000	842,800,000
	REGULATION POND	12.0%m2	LAND ACQUISITION	7,365,587 m2	520	3,830,105,263
	CANAL IMPROVEMENT	47.4 km		m		1,088,640,000
			EXCAVATION	1,988,200 m3	240	477,168,000
			LAND ACQUISITION	885,600 m2	520	611,472,000
NARAYANGANJ B				-		7,522,990,526
	PUMP STATION	5.0 PLACE		5		2,059,500,000
		7.1 m3/s		1	28,000,000	198,800,000
		30.3 m3/s		1	25,000,000	757,500,000
		34.4 m3/s		1	24,500,000	842,800,000
		2.8 m3/s		1	30,000,000	84,000,000
		6.3 m3/s		1	28,000,000	176,400,000
	REGULATION POND	12.0%m2	LAND ACQUISITION	8,515,789 m2	520	4,428,210,526
	CANAL IMPROVEMENT	41.4 km		m		1,035,280,000
			EXCAVATION	2,082,000 m3	240	499,680,000
			LAND ACQUISITION	1,030,000 m2	520	535,600,000
[illegible]-BANDAR GATE				-		
[illegible]-BANDAR RIVER				-		1,186,770,526
	PUMP STATION	4.0 PLACE		4		381,000,000
		1.2 m3/s		1	35,000,000	42,000,000
		4.4 m3/s		1	30,000,000	132,000,000
		2.7 m3/s		1	30,000,000	81,000,000
		4.2 m3/s		1	30,000,000	126,000,000
	REGULATION POND	12.0%m2	LAND ACQUISITION	1,315,789 m2	520	684,210,526
	CANAL IMPROVEMENT	7.4 km		m		121,560,000
			EXCAVATION	201,000 m3	240	48,240,000
			LAND ACQUISITION	141,000 m2	520	73,320,000

3)



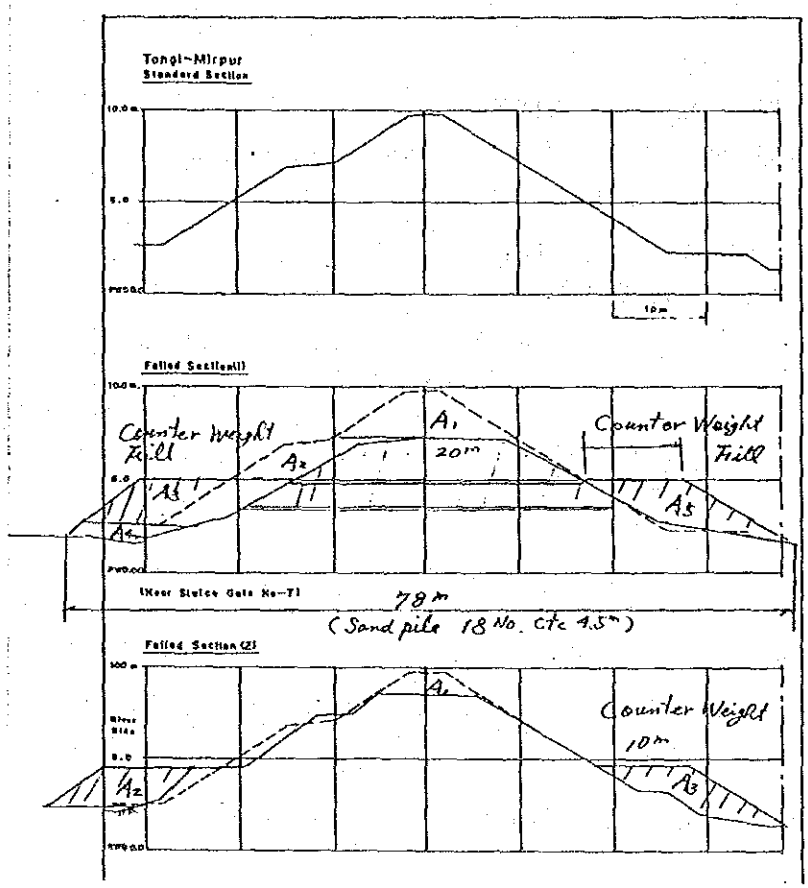
AREA	ASE	ROAD ALIGNMENT	QUANTITY	UNIT PRICE	COST
TRANSITION			18.8 ha		1,340,536,375
		EMBANKMENT	15.1 ha		1,322,211,575
		H Ys²/m L ha Y L/A A=Z²/m net			
		4.5 88 4.5 441.000 35			
		2 10.425 3.8 87.068 24			
		4.8 195 1.8 351.000 50			
		4.3 186 5.3 865.800 42			
		MATERIAL 1,845,788 m3			
		BANKING 1,845,188 m3	530	978,287,575	
		FOUNDATION WORK m			
		LAND ACQUISITION-1 558,600 m2	340	189,924,000	
		LAND ACQUISITION-2 453,000 m2	340	154,020,000	
		CONCRETE WALL 3.7 ha			221,215,000
		H B L ha L/A A=Z²/m net			
		3.7 3.2 3.7 3.2			
		(1-TYPE) STRUCTURE 3,700 m	61,000	219,800,000	
		LAND ACQUISITION-1 11,840 m2	340	4,025,600	
		LAND ACQUISITION-2 18,600 m2	340	6,200,000	
		CULVERT GATE 5.0 places	0		186,809,400
		G-1 18.91 m3/m 8 490 B m * H m * SPAN 2.0*2.0*1 1			37,063,600
		G-2 22.36 m3/m 8 485 3*3*1 1			43,376,400
		G-3 31.41 m3/m 13 460 2.0*2.0*2 2			57,849,600
		G-4 13.74 m3/m 7 405 2.7*2.7*1 1			35,125,200
		G-5 11.63 m3/m 5 505 2.2*2.2*1 1			23,402,600
TRANSITION	5		27.0 ha		2,749,537,950
		EMBANKMENT 23.3 ha			2,555,513,450
		H Ys²/m L ha Y L/A A=Z²/m net			
		4.5 88 4.5 441.000 36			
		4.2 95.55 5.2 506.415 35			
		4.8 150 13.9 2,108,000 41			
		MATERIAL 2,053,415 m3			
		BANKING 3,053,415 m3	530	1,618,309,950	
		FOUNDATION WORK 125,000 m	650	69,281,500	
		LAND ACQUISITION-1 800,300 m2	340	308,142,000	
		LAND ACQUISITION-2 609,000 m2	340	237,660,000	
		CONCRETE WALL 3.7 ha			211,503,000
		H B L ha L/A A=Z²/m net			
		3.5 3.5 3.7 3.5			
		(1-TYPE) STRUCTURE 3,700 m	61,000	210,000,000	
		LAND ACQUISITION-1 12,950 m2	340	4,403,000	
		LAND ACQUISITION-2 18,600 m2	340	6,200,000	
		CULVERT GATE 5.0 places	0		283,570,000
		G-1 18.91 m3/m 8 490 B m * H m * SPAN 2.0*2.0*1 1			37,063,600
		G-2 22.36 m3/m 8 485 3*3*1 1			43,376,400
		G-3 31.41 m3/m 13 460 2.0*2.0*2 2			57,849,600
		G-4 30.02 m3/m 12 465 2.5667610068 2.0*2.5*2 2			57,511,200
		G-5 21.73 m3/m 25 499 2.8688138479 2.0*2.0*3 3			88,769,000
TUNNEL	1		21.4 ha		1,359,857,588
		EMBANKMENT 19.7 ha			874,692,088
		H Ys²/m L ha Y L/A A=Z²/m net			
		2.7 42.83 2.8 110.838 15			
		3.7 66.156 6.1 403.552 29 99.410			
		2 21 2.2 46.200 8			
		1.5 11.25 6 51.000 7			
		5 117.8 4.3 506.870 37 87.680			
		MATERIAL 1,126,600 m3			
		BANKING 1,126,600 m3	530	806,016,588	
		FOUNDATION WORK 187,000 m	550	108,399,500	
		LAND ACQUISITION-1 422,800 m2	270	114,166,000	
		LAND ACQUISITION-2 676,000 m2	270	155,520,000	
		CONCRETE WALL 1.2 ha			5,115,000
		H B L ha L/A A=Z²/m net			
		0.8 0.3 1.2 0.3			
		(1-TYPE) STRUCTURE 1,200 m	3,450	4,140,000	
		LAND ACQUISITION-1 350 m2	270	97,200	
		LAND ACQUISITION-2 3,240 m2	270	874,800	
		CONCRETE WALL 1.0 ha			33,215,000
		H B L ha L/A A=Z²/m net			
		2.4 1.0 1 1.0			
		(1-TYPE) STRUCTURE 1,000 m	31,350	31,350,000	
		LAND ACQUISITION-1 1,000 m2	270	513,000	
		LAND ACQUISITION-2 5,000 m2	270	1,350,000	
		CULVERT GATE 4.0 places	0		340,420,000
		G-1 38.95 m3/m 18 450 2.7910571474 2.0*2.0*2 2			66,552,000
		G-2 33.73 m3/m 13 460 2.5913002908 2.0*2.0*2 2			62,063,200
		G-3 30.85 m3/m 12 465 2.4811510219 2.5*2.5*2 2			57,998,000
		G-4 35.12 m3/m 14 450 2.6502830934 2.7*2.7*2 2			63,216,000
		G-5 22.88 m3/m 9 485 2.1391587131 2.2*2.2*2 2			44,387,200
		G-6 13.53 m3/m 5 505 2.3263705638 2.4*2.4*1 1			27,330,000
		G-7 8.40 m3/m 3 520 1.833030278 1.9*1.9*1 1			17,472,000
TUNNEL	1		22.5 ha		1,774,657,088
		EMBANKMENT 20.5 ha			1,578,516,788
		H Ys²/m L ha Y L/A A=Z²/m net			
		2.7 42.83 2.8 110.838 15			
		3.7 66.156 6.1 403.552 29 99.410			
		2 21 2.2 46.200 8			
		5 117.8 9.4 1,106,240 37 87.680			
		MATERIAL 1,668,850 m3			
		BANKING 1,668,850 m3	530	884,490,288	
		FOUNDATION WORK 312,930 m	650	172,111,500	
		LAND ACQUISITION-1 582,500 m2	270	157,545,000	
		LAND ACQUISITION-2 609,000 m2	270	164,490,000	
		CONCRETE WALL 1.2 ha			5,115,000
		H B L ha L/A A=Z²/m net			
		0.8 0.3 1.2 0.3			
		(1-TYPE) STRUCTURE 1,200 m	3,450	4,140,000	
		LAND ACQUISITION-1 350 m2	270	97,200	
		LAND ACQUISITION-2 3,240 m2	270	874,800	
		CONCRETE WALL 1.0 ha			33,215,000
		H B L ha L/A A=Z²/m net			
		2.4 1.0 1 1.9			
		(1-TYPE) STRUCTURE 1,000 m	31,350	31,350,000	
		LAND ACQUISITION-1 1,900 m2	270	513,000	
		LAND ACQUISITION-2 5,000 m2	270	1,350,000	
		CULVERT GATE 4.0 places	0		357,756,200
		G-1 38.95 m3/m 18 450 2.7910571474 2.0*2.0*2 2			68,552,000
		G-2 33.73 m3/m 13 460 2.5913002908 2.0*2.0*2 2			62,063,200
		G-3 36.14 m3/m 14 450 2.6884910022 2.7*2.7*2 2			65,052,000
		G-4 41.42 m3/m 17 410 2.8781938781 2.0*2.0*2 2			72,800,200
		G-5 22.88 m3/m 9 485 2.1391587131 2.2*2.2*2 2			44,387,200
		G-6 13.53 m3/m 5 505 2.3263705638 2.4*2.4*1 1			27,330,600
		G-7 8.40 m3/m 3 520 1.833030278 1.9*1.9*1 1			17,472,000

GATEHOUSE	QUANTITY	UNIT PRICE	COST
			1,183,681,852
TOLL STATION PLACE	2		300,000,000
14.4 m3/m	1	83,200,000	300,000,000
m3/m			
m3/m			
EXCAVATION ROAD 17,052 LAND ACQUISITION 1,911,878 m2		340	819,850,852
FINAL IMPROVEMENT 15.0 ha	m		210,150,000
EXCAVATION	685,000 m3	240	181,447,000
LAND ACQUISITION	337,300 m2	340	114,682,000
			1,116,118,421
TOLL STATION PLACE	1		706,350,000
27.7 m3/m	1	25,500,000	706,350,000
m3/m			
m3/m			
EXCAVATION ROAD 12,052 LAND ACQUISITION 2,815,169 m2		340	891,368,411
FINAL IMPROVEMENT 22.6 ha	m		415,760,000
EXCAVATION	1,020,000 m3	240	244,800,000
LAND ACQUISITION	508,000 m2	340	172,960,000
			1,816,340,526
TOLL STATION PLACE	2		685,465,000
11.7 m3/m	1	27,700,000	318,360,000
19.5 m3/m	1	27,700,000	367,200,000
m3/m			
EXCAVATION ROAD 12,052 LAND ACQUISITION 3,852,832 m2		270	1,040,364,526
FINAL IMPROVEMENT 22.6 ha	m		268,850,000
EXCAVATION	841,000 m3	240	151,810,000
LAND ACQUISITION	425,000 m2	270	114,750,000
			1,816,340,526
TOLL STATION PLACE	2		780,000,000
11.7 m3/m	1	27,500,000	321,750,000
17.3 m3/m	1	28,500,000	458,150,000
m3/m			
EXCAVATION ROAD 12,052 LAND ACQUISITION 3,852,832 m2		270	1,040,364,526
FINAL IMPROVEMENT 25.0 ha	m		395,750,000
EXCAVATION	328,400 m3	240	174,810,000
LAND ACQUISITION	483,000 m2	270	130,410,000

4) Dhaka Western Part

1. Cost Estimate

1) Rehabilitation Work (Tongi to Mirpur)



(1) Foundation Treatment with Rebanking $L_1 = 3{,}000^{m}$

a. Foundation Treatment : Sand piling

$20^{m} \times 18^{Nos} \times 3{,}000^{m} \div 4.5 = 240{,}000^{m}$

$240{,}000 \times 626\ ^{TK/m} = 150.2$ million TK

b. Removing Earth $\Rightarrow$ Rebanking

$(4 + 40) / 2 \times 3^{m} \times 3000 = 198{,}000^{m3}$

$198{,}000 \times 530^{m3} = 104.9$ million TK

c. Rebanking $L = 850^{m}$ (Material Volume)

$\Sigma A_1 \sim A_5 = 124.4$

$124.4 \times 850 = 105{,}760^{m2}$

$105{,}760 \times 530^{TK/m3} = 56.1$ million TK

Rebanking $L = 2{,}150$ $V = 109{,}650^{m3}$

$51 \times 2{,}150 \times 530^{TK/m3} = 58.1$ million TK

$\Sigma V = 413{,}410m^3$

(2) Rebanking $L_2 = 3{,}850^{m}$

$\Sigma A_1 \sim A_3 = 51.0^{m2}$

$V = 51 \times 3{,}850 = 196{,}350^{m3}$

$196{,}350 \times 530 = 104.1$ million TK $(\Sigma v = 609{,}760^{m3})$

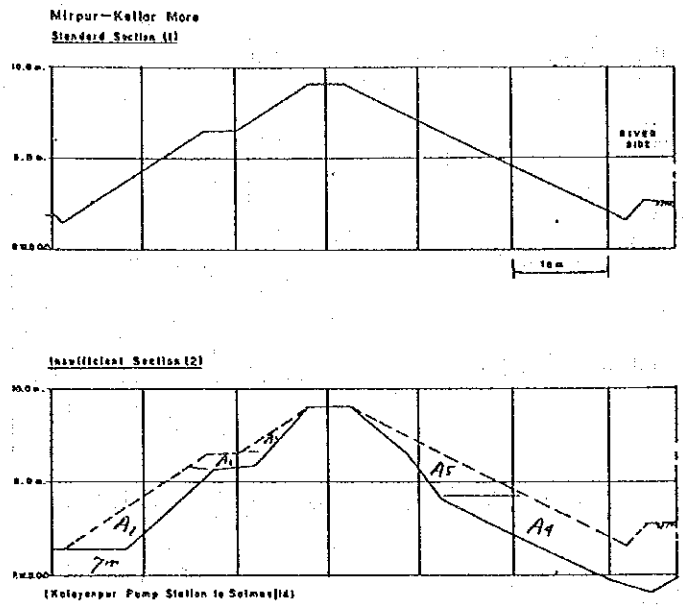
(3) Concrete Wall $L_3 = 850^{m}$

$850^{m} \times 6{,}000^{TK/m} = 5.1$ million TK

Total 478.5 million TK

$\Sigma L = L_1 + L_2 + L_3 = 7{,}700^{m}$

2) Rehabilitation Work (Mirpur to Kellar More)



(1) Rebanking

a_1 : $\Sigma A_1 \sim A_5 = 96.4^{m2}$ $L_1 = 1{,}500^{m}$

$V = 96.4 \times 1{,}500 = 144{,}600^{m3}$

$144{,}600 \times 530^{TK/m3}$ = 76.6 million TK

a_2 : $(4 + 21) / 2 \times 3.5 \times 250^{m} = 10{,}940^{m3}$ (L_2)

$10{,}940 \times 530$ = 5.8 million TK

a_3 : $(4 + 7) / 2 \times 0.5 \times 6{,}800^{m} = 18{,}700^{m3}$ (L_3)

$18{,}700 \times 530$ = 9.9 million TK

($\Sigma V_2 = 17{,}240^{m3}$)

($\Sigma V_1+V_2 = 784{,}000^{m3}$)

(2) Embankment of Incompleted Portion

L_4

$400^{m} \times 265^{m2}$

$106{,}000 \times 530^{TK} \Rightarrow$ 56.2 million TK

$\sum L = 1{,}500 + 250 + 6{,}800 + 400 = 8{,}950^{m}$

(3) Rehabilitation of Flood Wall

$L = 3{,}850^{m}$

Cost $= 3{,}850 \times 30{,}000^{TK/m} \times 0.2 =$ 23.1 million

Total of Rehabilitation Work 593.96 million TK

3) Construction Work (Kellar More to Buriganga Bridge)

(1) Embankment $L = 300^{m}$

a. Banking $V = 400^{m2} \times 300^{m} = 120{,}000^{m3}$ $(h = 10^{m} \quad A = 400^{m2})$

Cost $530 \times 120{,}000 = 63.6$

b. Foundation

$72^{m} \div 4.5 + 1 = 17^{No}$, $17 \times 15^{m} \times 300^{m} \div 4.5 = 17{,}000^{m}$

Cost $626 \times 17{,}000 = 10.64$

Total 74.24 million Tk

(2) Flood Wall

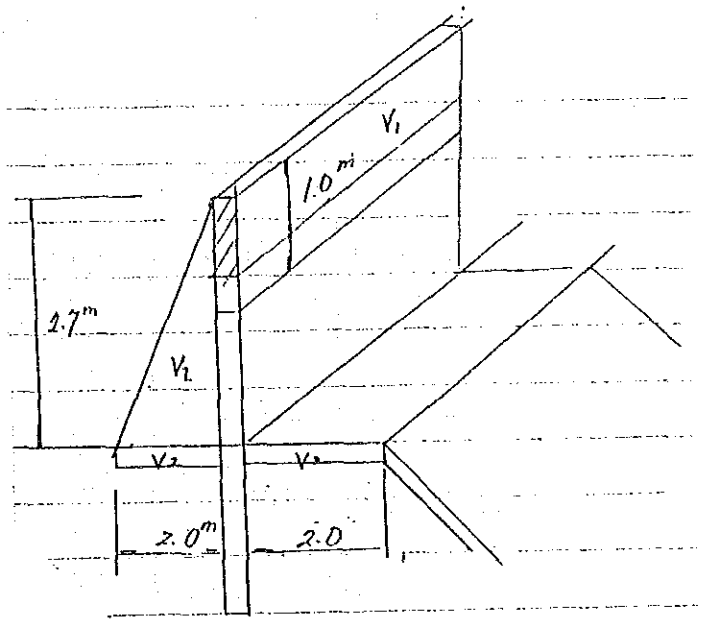
$27{,}000^{TK/m} \times 3{,}000^{m} =$ 81.0 million TK

$(L = 2.35^{km} \times 1.25 = 2.9400 \Rightarrow 3{,}000^{m})$

Total of Construction Work = 155.24 million TK

Rehabilitation Work of Flood Wall

1. Concrete Work



$V_1 = 0.2 \times 1.0 \times 3,850 = 770^{m3}$

$V_2 = 2.7 \times 2.0 \times 0.2 = 108$ (ctc 15.0m)

$3,850 \div 15 \times 1.08 = 277.2^{m3}$

$V_3 = 0.2 \times 4.0 \times 3,850 = 3,080.0^{m3}$

$\Sigma V = 4127.2^{m3}$

Cost = $4127.2 \times 5,000^{TK/m3}$ = 20.63 million TK

2. Earth Work

Grading and compaction : $150^{TK/m3}$

$0.2 \times 4 \times 3,850 = 3,080^{m3}$

Cost = $150^{TK} \times 3,080 = 462,000^{TK}$

= 0.46 million

3. Total 20.63 + 0.46 = 21.09 million

4. $21,090,000 / 3,850 = 5,477^{TK/m} \Rightarrow 6,000^{TK/m}$

5) Kamrangir Char

1 Case · A

Distance (m)	H (m)	V_A (m^2)	V ($\times 10^3 m^3$)	L (m)	LA ($\times 10^3 m^2$)
0.0 ~ 0.6	9.4 - 3.0	174	104	83	50
(0.6)	= 6.4				
0.6 ~ 2.0	9.3 - 4.5	96	134	70	98
(1.4)	= 4.8				
2.0 ~ 5.4	9.2 - 6.5	28	95	55	187
(3.4)	= 2.7				
5.4 ~ 6.0	9.1 - 4.0	108	65	73	44
(0.6)	= 5.1				
6.0 ~ 7.2	9.2 - 5.0	72	86	65	78
(1.2)	= 4.2				
7.2 ~ 8.3	9.3 - 5.5	58	64	63	69
(1.1)	= 3.8				
8.3 ~ 9.3	9.4 - 3.0	168	168	87	87
(1.0)	= 6.4				
			716 $\times 10^3 m^3$		613 $\times 10^3 m^2$

2. Case - B

Distance (km)	H (m)	V_A (m^2)	V ($\times 10^3 m^3$)	L (m)	L_A ($\times 10^3 m^2$)
0.0 ~ 0.6	9.4 - 3.0	174	104	83	50
(0.6)	= 6.4				
0.6 ~ 2.0	9.3 - 4.5	96	134	70	98
(1.4)	= 4.8				
2.0 ~ 6.0	9.2 - 6.5	28	112	55	220
(4.0)	= 2.7				
		計	350 $\times 10^3 m^3$		368 $\times 10^3 m^2$

3 Case - C

Distance (km)	H (m)	V_A (m^2)	V ($\times 10^3 m^3$)	L (m)	L_A ($\times 10^3 m^2$)
0.0 ~ 3.8	9.6 - 2.5	212	806	88	334
(3.8)	= 7.1				
3.9 ~ 4.9	9.5 - 2.0	238	238	90	90
(1.0)	= 7.5				
4.9 ~ 5.7	9.4 - 4.0	124	99	76	61
(0.8)	= 5.4				
5.7 ~ 7.1	9.3 - 4.5	96	134	70	98
(1.4)	= 4.8				
7.1 ~ 11.1	9.2 - 6.5	28	106	55	21
(3.4+0.4	= 2.7				
= 3.8)					
		計	1,381 $\times 10^3 m^3$		604 $\times 10^3 m^2$

	Volume ($\times 10^3 m^3$)	Land Acquisition ($\times 10^3 m^2$)
Case - C	1,381	604
- B	344	357
- A	716	613

4.3 Cost Estimates of Non-Structural Measures

1. Keraniganj Area

1) Buriganga/Dhaleswari flood plain (A = 143 km^2)

2) Population : 353,000 (2010)

(1) The people living nearby protected area:
353,000 x 1/3 = 117,700 to go protected area

(2) To be accommodated people:
353,000 x 1/3 x 0.1 = 23,500

a) accommodated by existing buildings, boats etc. : 12,000 people

b) " by evacuation center : 12,000 "

3) Structural facilities

(1) Evacuation Shelter

a) Size of building 32^m x 32^m x 2 storied = $2,000^{m2}$

b) Accommodation Capacity 2,000 x 0.9^{m2} ~ 1.0^{m2}/person = 2,000 people

c) No. of Shelter : 12,000/2000 = 6 No.

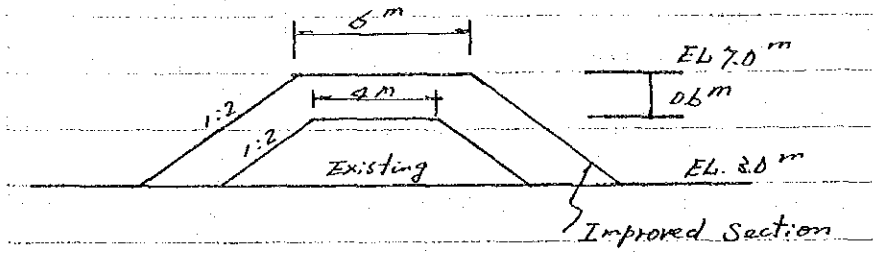
d) Construction Cost
Unit Cost : 10,000 $^{TK/m2}$ (Refer to JICA Project Managing house $9100^{TK/m2}$) 1 Storied Building

i) Construction Cost : 27 million/Shelter (Refer to Appendix A)
- 27 million TK x 6 = 162 million TK

ii) Land Acquisition
50^m x 60^m x $6^{No.}$ x $340^{TK/m2}$ = 6.2 million TK

(2) Improvement of Existing Roads

a) Distance of Improvement Roads L = 45Km



b) Improvement

i) Banking

V = (6 + 22) / 2 x 4 - (4 + 17.6) / 2 x 3.4 = 19.3m2/m

Cost = 19.3 x 45,000 x 530TK = 460,305,000TK (= 10 million/km)

ii) Land Acquisition

A = (22 - 17.6) x 45,000 = 198,000m2

Cost = 198,000 x 340 = 67,320,000 TK

2. Narayanganj West

1) Buriganga Lower Flood Plain area (A = 9.3 km2)

2) Population : 30,000 (2010)

3) Structural Facility

(1) Evacuation Roads : 2.5 km2

a) Construction Cost

2.5 x 10 million TK = 25 million TK

b) Land

4.4m x 2,500 x 520TK/m2 = 5.7 million TK

(11,000m2)

3. Savar

1) Savor South (A = 67.6km^2)
   Savar North (A = 9.6km^2)

2) Population (2010)
   Savor South : 183,000
   Savar North : 27,000

3) Evacuation Shelter : Savar South only

   (1) To the protected Area 18,300 x 1/3 = 61,000

   (2) To be accommodated

      a) Accommodated by existing buildings, boat, etc = 61,000

      b) " evacuation shelter = 61,000 x 0.1 = 6,000

4) Structural Facilities

   (1) Evacuation shelter : 3 Nos

      a) Cost

         i) 27 million TK x 3 = 81 million

         ii) Land
            60 x 50 x 3 x 220$^{TK/m}$ = 2.0 million TK
            (A = 9,000m^2)

      b) Improvement of Existing Roads : L = 27.0 km
                                        (Savar North & South)

         i) Banking
            10 million TK x 27.0 = 270 million TK

         ii) Land
            4.4 x 27,000 x 220^{TK} = 26.1 million TK
            (A = 118,800m^2)

4. Tongi

1) Turag Flood Plain (One portion only ; A = 3.7km^2)

2) Population : 33,000 (2010)

3) *Structural facility*

(1) Excavation Roads : L = 5km

(2) Const. Cost

i) Banking

5.0 x 10 = 50 million TK

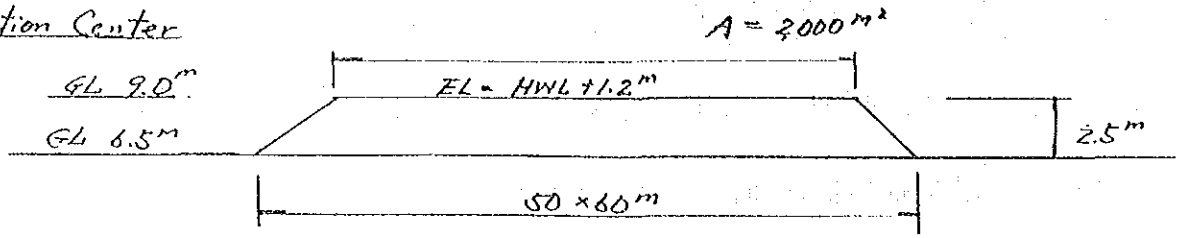
ii) Land

4.4 x 5,000 x 270$^{TK/m2}$ = 5.94 million TK

(A = 22,000m^2)

Appendix A

Evacuation Center



1. Banking Volume

$V = 50 \times 60 \times 2.5 = 7,500\ m^3$

Cost = 7,500 × 530 = 3,975,000 TK

⇒ 4,000,000 TK

2. Building

$A = 2000\ m^2$ (0.9 m²/person)

Cost = 2,000 m² × 10,000 TK/m² = 20,000,000 TK

(Refer to JICA Grant Report)

3. Necessary Equipments, etc

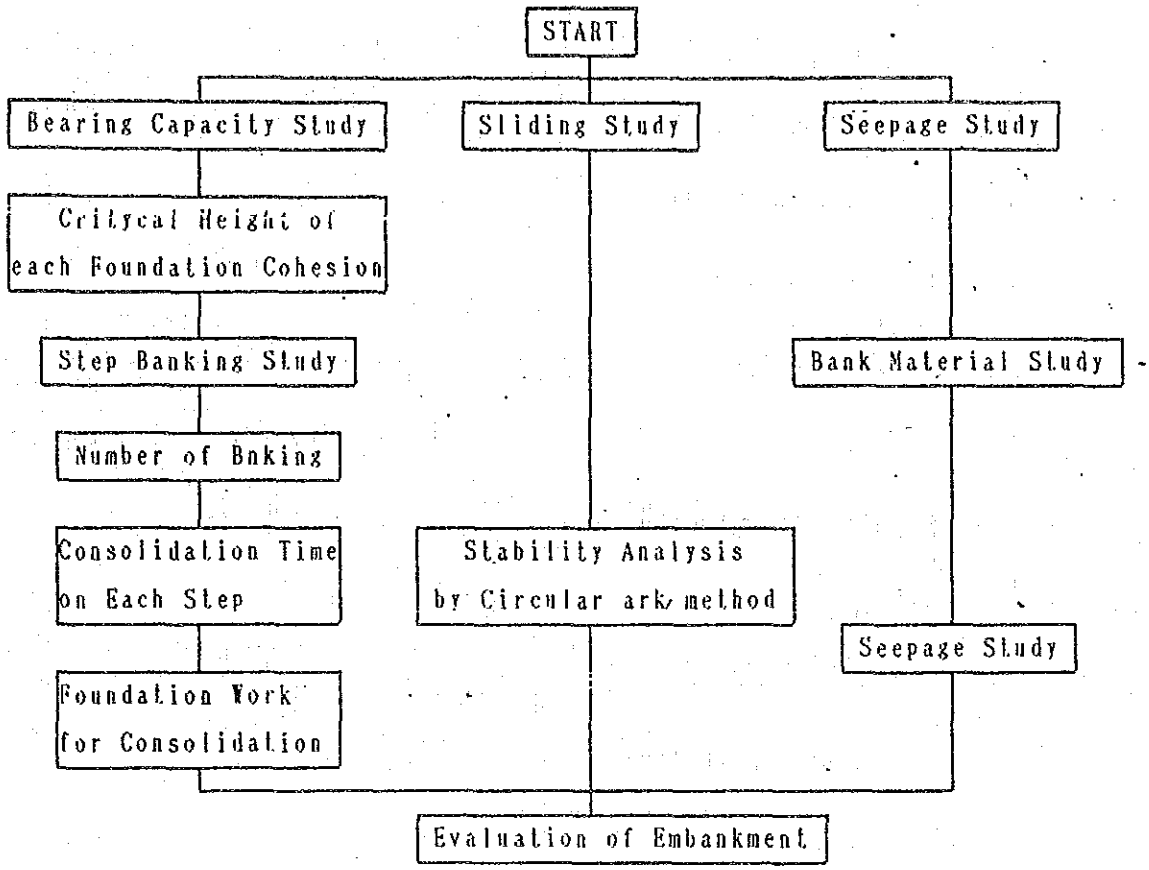
Building Cost × 15% = 3,000,000 TK.

Total Cost : 27,000,000 / center

4.4 Flowchart of Stability Analysis and Case Study

Stability Analisys Flowchart on Embankment

(for Pre-existing Bank & New Bank)



1 BEARING CAPACITY STUDY

(1) CRYTYCAL EMBANKMENT HEIGHT on EACH FOUNDATION COHESION

N	COHEISION C=0.6N	HEIGHT 3.6Cu/r
1	0.6	1.44
2	1.2	2.88
3	1.8	4.32
4	2.4	5.76
5	3.0	7.20
6	3.6	8.64
7	4.2	10.08
8	4.8	11.52
9	5.4	12.96
10	6.0	14.40
11	6.6	15.84
12	7.2	17.28

(2) CRITYCAL STEP BANKING HEIGHT which CONSOLIDATION XX% for EACH EMBANKMENT

CONSOLIDATION FOR 95 % E.B.rt=1.6

Co	Cr-H1	C1 Cr-H2	C2 Cr-H3	C3 Cr-H4	C4 Cr-H5	C5 Cr-H6
0.50	1.13	1.01 2.28	1.54 3.46	2.08 4.68	2.63 5.93	3.20 7.20
1.00	2.25	2.03 4.56	3.08 6.93	4.16 9.36		
1.50	3.38	3.04 6.84	4.62 10.39			
2.00	4.50	4.05 9.12				
2.50	5.63	5.07 11.40				

CONSOLIDATION FOR 90 % E.B.rt=1.6

Co	Cr-H1	C1 Cr-H2	C2 Cr-H3	C3 Cr-H4	C4 Cr-H5	C5 Cr-H6	C6 Cr-H
0.50	1.13	0.99 2.22	1.46 3.28	1.92 4.31	2.36 5.32	2.80 6.29	3.22 7.24
1.00	2.25	1.97 4.44	2.92 6.56	3.84 8.63			
1.50	3.38	2.96 6.66	4.38 9.84				
2.00	4.50	3.94 8.87					
2.50	5.63	4.93 11.09					

CONSOLIDATION FOR 80 % E.B.rt=1.6

Co	Cr-H1	C1 Cr-H2	C2 Cr-H3	C3 Cr-H4	C4 Cr-H5	C5	～	C12 Cr-H13
0.50	1.13	0.93 2.10	1.31 2.94	1.63 3.66	1.91 4.29	2.15	～	3.13 7.04
1.00	2.25	1.86 4.19	2.61 5.87	3.26 7.32				
1.50	3.38	2.80 6.29	3.92 8.81					
2.00	4.50	3.73 8.39						
2.50	5.63	4.66 10.49						

(3) CONSOLIDATION TIME for EACH STEP EMBANKMENT

(DRAIN LENGTH as SINGLE DRAINAGE)

Cv m2/d	DRAIN L	95% Tv	days	90% Tv	days	80% Tv	days
0.10	2.50	1.050	65.63	0.848	53.00	0.567	35.44
0.10	3.00	1.050	94.50	0.848	76.32	0.567	51.03
0.10	4.00	1.050	168.00	0.848	135.68	0.567	90.72
0.10	5.00	1.050	262.50	0.848	212.00	0.567	141.75
0.10	7.50	1.050	590.63	0.848	477.00	0.567	318.94
0.10	10.00	1.050	1050.00	0.848	848.00	0.567	567.00
0.01	5.00	1.050	2625.00	0.848	2120.00	0.567	1417.50
0.01	7.50	1.050	5906.25	0.848	4770.00	0.567	3189.38
0.01	10.00	1.050	10500.00	0.848	8480.00	0.567	5670.00

(4) CONSTRUCTION PERIOD INCLUDING CONSOLIDATION TIME

BANKING SPEED 5cm/day 7m/0.05= 140 days

FOUNDATION CONDITION		CONSOLI-DATION	INITIAL COHESION LEVEL of FOUNDATION & STEP BANKING TIME WITH XX% CONSOLIDATION				
	SINGLE	days	0.5	1.0	1.5	2.0	2.5
Cv	DRAIN L	U=0 to 95%	5	3	2	1	1
0.10	2.50	65.63	468.1	336.9	271.3	205.6	205.6
0.10	3.00	94.50	612.5	423.5	329.0	234.5	234.5
0.10	4.00	168.00	980.0	644.0	476.0	308.0	308.0
0.10	5.00	262.50	1452.5	927.5	665.0	402.5	402.5
0.10	7.50	590.63	3093.1	1911.9	1321.3	730.6	730.6
0.10	10.00	1050.00	5390.0	3290.0	2240.0	1190.0	1190.0
0.01	5.00	2625.00	13265.0	8015.0	5390.0	2765.0	2765.0
0.01	7.50	5906.25	29671.3	17858.8	11952.5	6046.3	6046.3
0.01	10.00	10500.00	52640.0	31640.0	21140.0	10640.0	10640.0
Cv	DRAIN L	U=0 to 90%	6	3	2	1	1
0.10	2.50	53.00	458.0	299.0	246.0	193.0	193.0
0.10	3.00	76.32	597.9	369.0	292.6	216.3	216.3
0.10	4.00	135.68	954.1	547.0	411.4	275.7	275.7
0.10	5.00	212.00	1412.0	776.0	564.0	352.0	352.0
0.10	7.50	477.00	3002.0	1571.0	1094.0	617.0	617.0
0.10	10.00	848.00	5228.0	2684.0	1836.0	988.0	988.0
0.01	5.00	2120.00	12860.0	6500.0	4380.0	2260.0	2260.0
0.01	7.50	4770.00	28760.0	14450.0	9680.0	4910.0	4910.0
0.01	10.00	8480.00	51020.0	25580.0	17100.0	8620.0	8620.0
Cv	DRAIN L	U=0 to 80%	12	3	2	1	1
0.10	2.50	35.44	565.2	246.3	210.9	175.4	175.4
0.10	3.00	51.03	752.4	293.1	242.1	191.0	191.0
0.10	4.00	90.72	1228.6	412.2	321.4	230.7	230.7
0.10	5.00	141.75	1841.0	565.2	423.5	281.8	281.8
0.10	7.50	318.94	3967.3	1096.8	777.9	458.9	458.9
0.10	10.00	567.00	6944.0	1841.0	1274.0	707.0	707.0
0.01	5.00	1417.50	17150.0	4392.5	2975.0	1557.5	1557.5
0.01	7.50	3189.38	38412.5	9708.1	6518.7	3329.4	3329.4
0.01	10.00	5670.00	68180.0	17150.0	11480.0	5810.0	5810.0

(5) FOUNDATION WORK

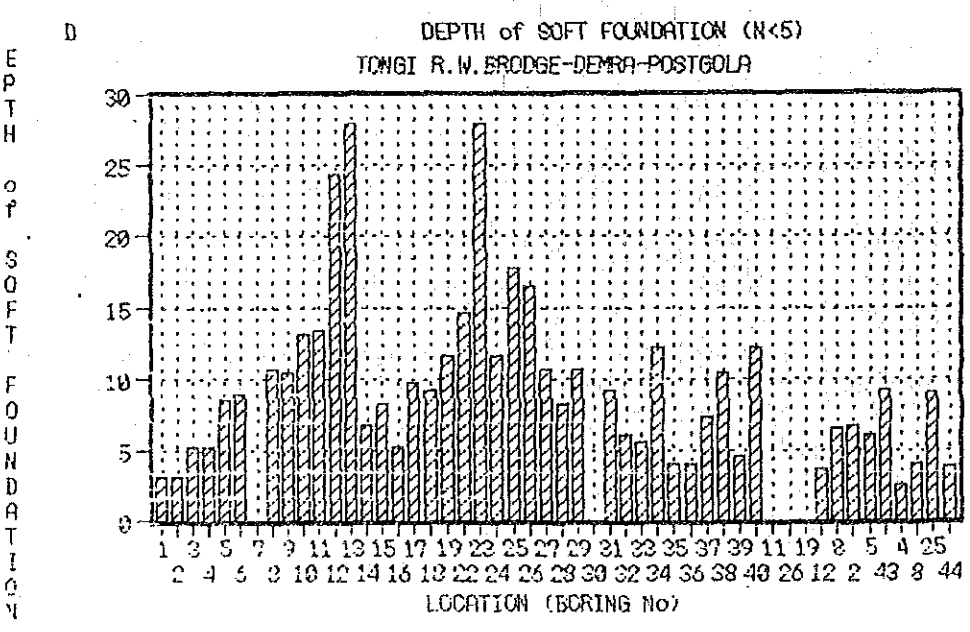
SAND DRAIN FOR CONSOLIDATION

PIRIOD	EMBANKING	TOTAL	Cons N. OF STEP BANKING & EACH CONSOLIDATING DAYS				
YEAR	days f. 7m	days	2	3	4	5	6
1	140	225	225	113	75	56	45
2	140	590	590	295	197	148	118
3	140	955	955	478	318	239	191

Ch	DRAINPILE	PICH	EFFECTIVE	n	Th 95%	C. TIME	Th 80%	C. TIME
m²/days	m	m	PICH m		C<1.0	days	C>1.0	days
0.1	0.4	2	2.26	5.65	0.35	18	0.23	11
0.1	0.4	3	3.39	8.47	0.62	71	0.26	30
0.1	0.4	4	4.52	11.30	0.72	147	0.35	72
0.1	0.4	5	5.65	14.13	0.80	255	0.40	128
0.1	0.4	7.5	8.48	21.19	0.95	682	0.48	345

EMBANKMENT CONSTRUCTION SPEC. AND IT'S FOUNDATION WORK

FOUDATION WORK FOR EMBANKMENT		STEP B. No	S. D. PITCH	S. D. DEPTH	LENGTH
EAST	NOTHING	1			1.4
EMBANKMENT	STEP BANKING	2			0.7
CASE A		3			2.1
		4			4.8
		6			2.8
	STEP BANKING	3	5.0	13.0	0.7
	& SAND DRAIN	4	5.0	11～25 M. 15.8	3.5
		6	4.5	6～29 M. 15.7	10.4
	SUB TOTAL				26.3



2 STABILITY ANALYSIS FOR SLIDING

(1)STABILITY ANALYSIS ON SEVERAL CONDITION

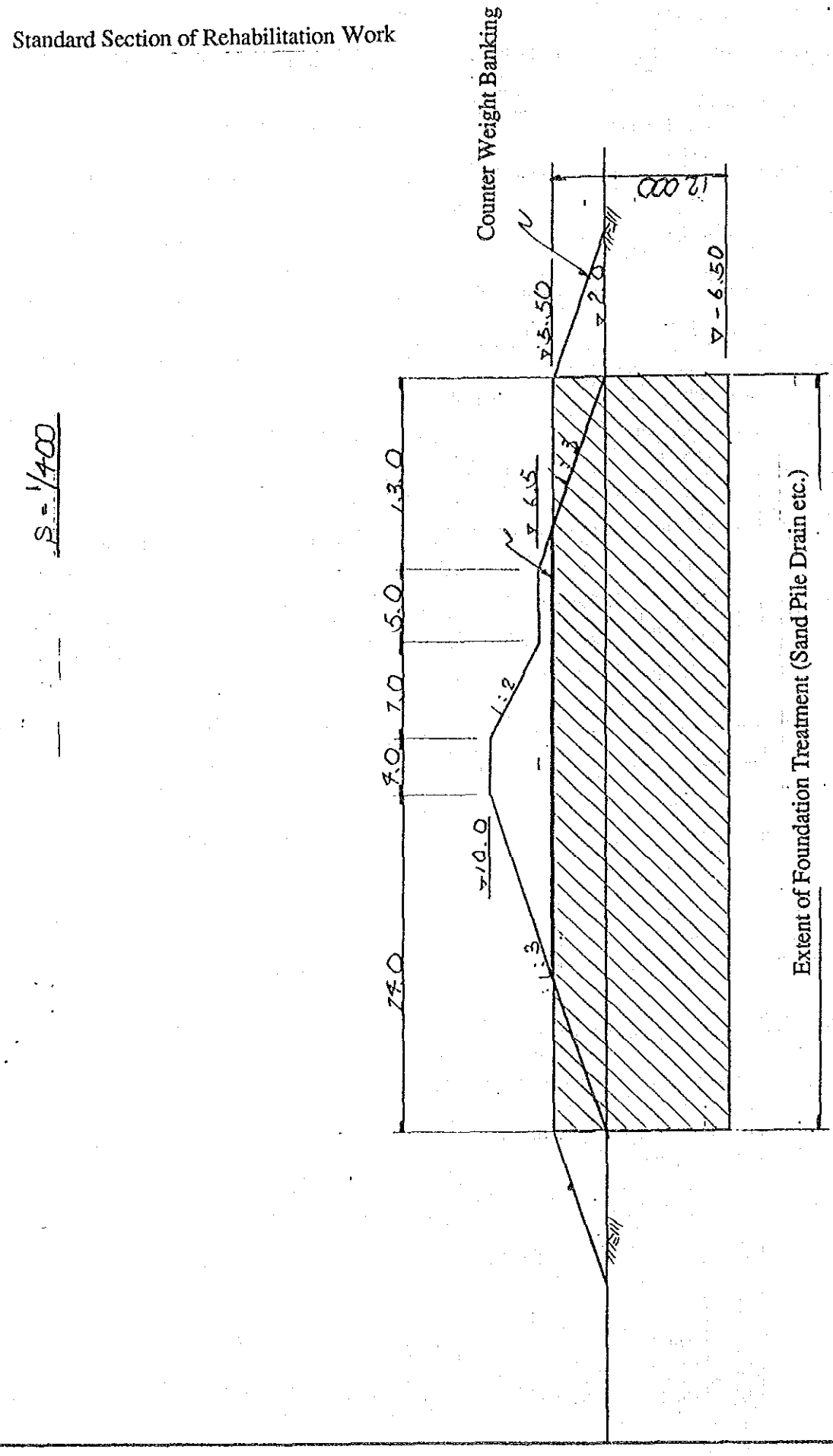
	EMBANKMENT COHESION	FOUDATION COHESION	FACTOR OF SAFETY
CASE1	1.0	0.6	0.65
CASE2	2.0	0.6	0.82
CASE3	2.0	1.0	1.10
CASE4	2.0	1.5	1.43
CASE5	4.0	1.5	1.85

for ex.CASE 4 STABILITY ANALYSIS BY CIRCULAR ARC SLIDING METHOD

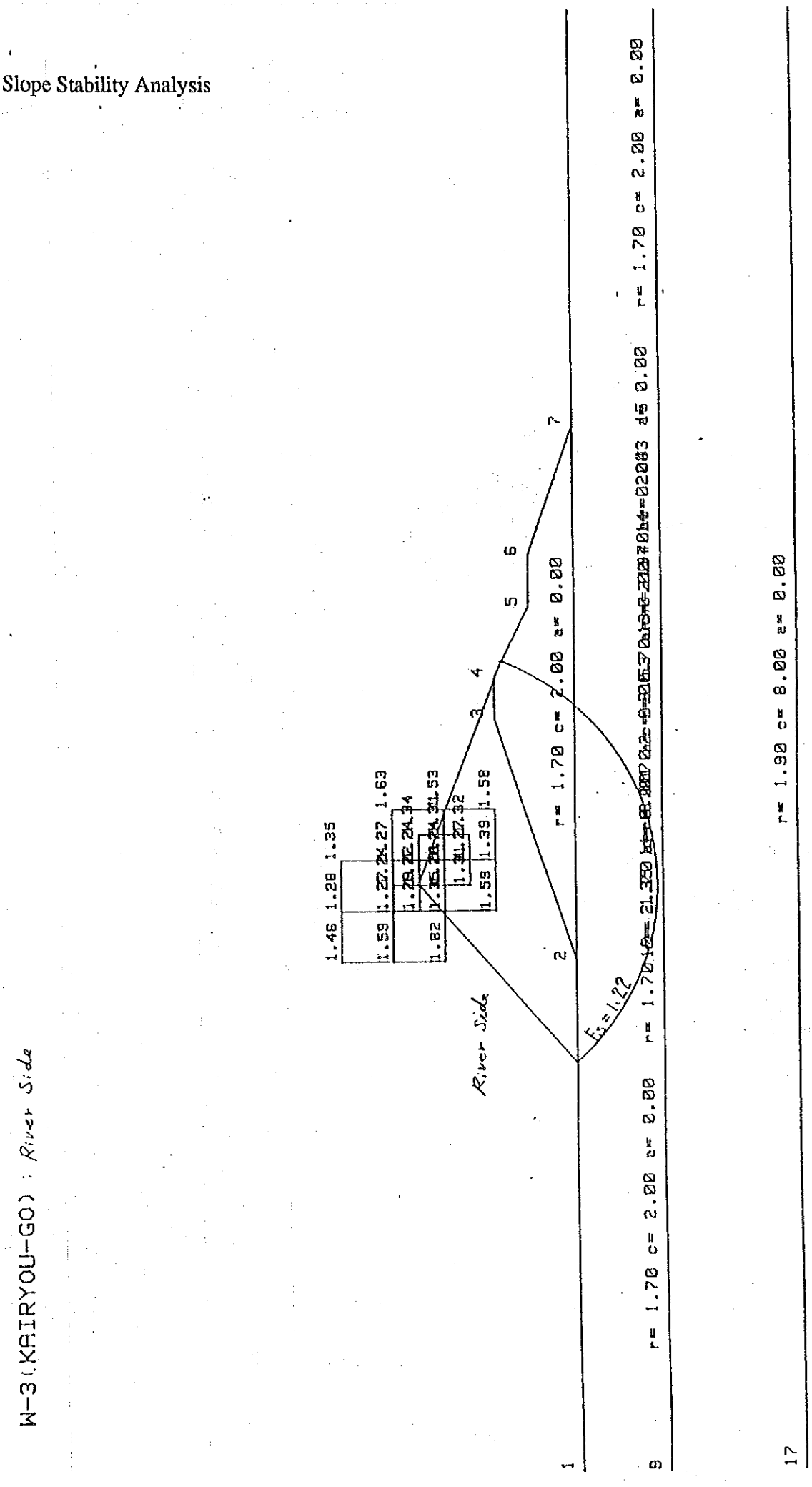
EMBANKMENT COHESION 2.0 t/m2 FOUNDATION COHESION 1.5 t/m2

No	h1	h2	b	W	ALPHA	WsinALPHA	L	C	C*L	SF
1	0.00	4.75	4.00	15.20	48.00	11.30	6.30	2.00	12.60	
2	4.75	6.00	3.00	25.80	39.00	16.24	6.00	2.00	12.00	
3	6.00	8.00	9.00	100.80	25.00	42.60	10.50	1.50	15.75	
4	8.00	8.40	3.00	39.36	13.00	8.85	3.20	1.50	4.80	
5	8.40	7.00	5.50	67.76	5.00	5.91	6.00	1.50	9.00	
6	7.00	6.00	3.50	36.40	-3.00	-1.91	3.50	1.50	5.25	
7	6.00	4.20	7.00	57.12	-13.00	-12.85	7.50	1.50	11.25	
8	4.20	0.00	7.50	25.20	-27.00	-11.44	9.00	1.50	13.50	
T				367.64		58.70	52.00		84.15	1.43

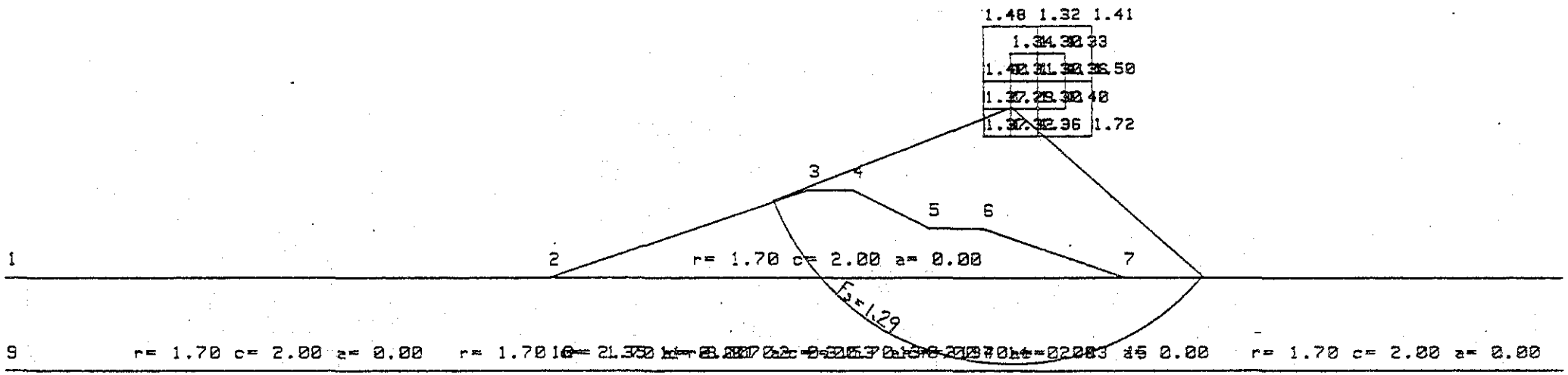
4.5 Standard Section of Rehabilitation Work



Result of Slope Stability Analysis



W-3(KAIRYOU-GO) : *Land Side*



Conditions of Stability Analysis

U-40%