

Table XI.2.5 Crop Water Requirement (4/5)

Crop : Mustard		Planting Date : Dec. 01			Unit :mm/day		
Month	10 day	Coeff.(Kc)	ETc	ETc ( mm /10 days)	Eff. Rain (mm/10days)	WR in Depth	
Dec	1	0.56	1.53	15.3	0.00	1.53	
	2	0.62	1.52	15.2	0.00	1.52	
	3	0.79	1.97	19.7	0.00	1.97	
Jan.	1	1.02	2.57	25.7	0.00	2.57	
	2	1.14	2.88	28.8	0.00	2.88	
	3	1.14	3.25	32.5	0.10	3.24	
Feb.	1	1.14	3.61	36.1	0.20	3.59	
	2	1.09	3.78	37.8	0.20	3.75	
	3	0.98	3.91	39.1	1.70	3.74	
<b>Total</b>				250.10	2.20	247.90	
Crop : Pulses		Planting Date: Dec. 10			Unit : mm/day		
Month	10 day	Coeff.(Kc)	ETc	ETc ( mm /10 days)	Eff. Rain (mm/10days)	WR in Depth	
Dec	2	0.64	1.57	15.7	0.00	1.57	
	3	0.64	1.59	15.9	0.00	1.59	
Jan.	1	0.72	1.80	18	0.00	1.80	
	2	0.88	2.21	22.1	0.00	2.21	
	3	1.03	2.94	29.4	0.10	2.93	
Feb.	1	1.11	3.51	35.1	0.20	3.50	
	2	1.11	3.86	38.6	0.20	3.84	
	3	1.11	4.45	44.5	1.70	4.28	
Mar.	1	1.05	4.83	48.3	2.60	4.57	
	2	0.92	4.78	47.8	3.80	4.40	
<b>Total</b>				315.5	8.60	307.00	
Crop : Wheat & Potato		Planting Date : Nov. 01			Unit : mm/day		
Month	10 day	Coeff.(Kc)	ETc	ETc ( mm /10 days)	Eff. Rain (mm/10days)	WR in Depth	
Nov.	1	0.58	2.01	20.1	0.00	2.01	
	2	0.58	1.89	18.9	0.00	1.89	
	3	0.63	1.89	18.9	0.00	1.89	
Dec.	1	0.79	2.16	21.6	0.00	2.16	
	2	1.00	2.47	24.7	0.00	2.47	
	3	1.11	2.76	27.6	0.00	2.76	
Jan.	1	1.11	2.78	27.8	0.00	2.78	
	2	1.11	2.81	28.1	0.00	2.81	
	3	1.11	3.16	31.6	0.10	3.15	
Feb.	1	1.06	3.35	33.5	0.20	3.33	
	2	0.96	3.32	33.2	0.20	3.30	
	3	0.85	3.42	34.2	1.70	3.24	
<b>Total</b>				320.2	2.20	318.00	
Crop : Onion		Planting Date : Nov. 01			Unit :mm/day		
Month	10 day	Coeff.(Kc)	ETc	ETc ( mm /10 days)	Eff. Rain (mm/10days)	WR in Depth	
Nov.	2	0.55	1.79	17.9	0.00	1.79	
	3	0.66	1.98	19.8	0.00	1.98	
Dec.	1	0.89	2.42	24.2	0.00	2.42	
	2	1.00	2.46	24.6	0.00	2.46	
	3	1.00	2.48	24.8	0.00	2.48	
Jan.	1	1.00	2.51	25.1	0.00	2.51	
	2	1.00	2.53	25.3	0.00	2.53	
	3	1.00	2.85	28.5	0.10	2.84	
Feb.	1	1.00	3.15	31.5	0.20	3.14	
	2	0.99	3.45	34.5	0.20	3.42	
	3	0.98	3.95	39.5	1.70	3.77	
<b>Total</b>				295.7	2.20	293.50	

Table XI.2.5 Crop Water Requirement (5/5)

Crop : Pulses		Planting Date : Nov. 10			Unit : mm/day		
Month	10 day	Coeff.(Kc)	ETc	ETc ( mm /10 days)	Eff. Rain (mm/10days)	WR in Depth	
Nov.	2	0.64	2.09	20.9	0.00	2.09	
	3	0.64	1.92	19.2	0.00	1.92	
Dec.	1	0.72	1.96	19.6	0.00	1.96	
	2	0.88	2.15	21.5	0.00	2.15	
	3	1.03	2.56	25.6	0.00	2.56	
Jan.	1	1.11	2.78	27.8	0.00	2.78	
	2	1.11	2.81	28.1	0.00	2.81	
	3	1.11	3.16	31.6	0.10	3.15	
Feb.	1	1.05	3.31	33.1	0.20	3.30	
	2	0.92	3.21	32.1	0.20	3.19	
Total				259.5	0.50	259.00	

Crop : Pulses		Planting Date : Oct. 10			Unit :mm/day		
Month	10 day	Coeff.(Kc)	ETc	ETc ( mm /10 days)	Eff. Rain (mm/10days)	WR in Depth	
Oct.	3	0.64	2.36	23.6	0.00	2.36	
Nov.	1	0.64	2.22	22.2	0.00	2.22	
	2	0.72	2.34	23.4	0.00	2.34	
	3	0.88	2.62	26.2	0.00	2.62	
Dec.	1	1.03	2.81	28.1	0.00	2.81	
	2	1.11	2.73	27.3	0.00	2.73	
	3	1.11	2.76	27.6	0.00	2.76	
Jan.	1	1.11	2.78	27.8	0.00	2.78	
	2	1.05	2.65	26.5	0.00	2.65	
	3	0.92	2.63	26.3	0.10	2.62	
Total				259	2.20	258.90	



Table XI.3.1 Comparison of Project Cost

Works	ALT-9		ALT-4		ALT-6		
	L.C.	F.C.	Total	Works	Total	Works	Total
I-1 Construction Cost							
(1) Head Work	59,235	61,600	120,835	Dharia Barrage		1,794,251	Pumping Station
(2) Irrigation Canal	71,408	15,274	88,682	Irrigation Channels		431,019	Irrigation Channels
a. Main Channel A	54,755	9,655	64,410	On-farm Facilities		234,344	On-farm Facilities
b. Main Channel B	40,812	11,501	52,313				
c. Main Channel C	16,175	5,555	21,730				
d. Main Channel D	22,750	8,886	31,636				
e. Main Channel E	3,139	1,204	4,343				
f. Main Channel F	62,844	0	62,844				
g. Secondary Channels & BtIs	217,292	65,106	282,398	LLP Development		93,261	LLP Development
(3) LLP Development	27,800	65,461	93,261	STW Development		7,454	STW Development
(4) STW Development	3,916	3,508	7,424	Demonstration Farm		7,454	Demonstration Farm
(5) Demonstration Farm	381,356	2,47,580	628,936	Sub-Total of I-1		2,560,329	Sub-Total of I-1
Sub-Total of I-1							1,282,102
I-2 Drainage Improvement							
(1) Katnai River Diversion Canal	1,944	0	1,944	Drainage Improvement		1,944	Drainage Improvement
(2) Katnai Regulator	9,084	6,103	15,187	Katnai River Diversion Canal		15,187	Katnai River Diversion Canal
(3) Hanchai Regulator	599	1,347	1,946	Katnai Regulator		1,946	Katnai Regulator
(4) Add. Regulators	16,964	15,412	32,376	Hanchai Regulator		32,376	Hanchai Regulator
(5) Pipe Sluices	2,331	1,164	3,495	Add. Regulators		3,495	Add. Regulators
(6) Desilting of Exis. Drain. Chls.	7,301	0	7,301	Pipe Sluices		54,181	Pipe Sluices
Sub-Total of I-2	38,223	23,026	61,249	Desilting of Exis. Drain. Chls.		109,129	Desilting of Exis. Drain. Chls.
Sub-Total of I-2							1,091,229
I-3 Flood Control & River Prot. Works							
(1) Katnai River Closure at Durakuti	2,458	1,408	3,866	Flood Control & River Prot. Works		3,866	Flood Control & River Prot. Works
(2) Breached Embankment	4,882	2,464	7,346	Rat. River Closure at Durakuti		7,346	Rat. River Closure at Durakuti
(3) Flood Embankment	1,284	0	1,284	Breached Embankment		1,284	Breached Embankment
Sub-Total of I-3	8,624	3,872	12,496	Flood Embankment		12,496	Flood Embankment
Sub-Total of I-3							12,496
I-4 Rural Infra. Improvement							
Rural Infra. Improvement	99,999	63,787	163,786	Rural Infra. Improvement		0	Rural Infra. Improvement
Total of Construction Cost	728,702	339,265	1,067,967	Total of Construction Cost		2,681,954	Total of Construction Cost
II Land Acquisition	62,427	0	62,427	Land Acquisition		62,539	Land Acquisition
III Consulting Service	69,608	93,419	163,027	C/S. Admi. M.C.O.M. of Demo. (III-VI)		638,651	C/S. Admi. M.C.O.M. of Demo. (III-VI)
IV Administration	30,465	23,595	54,060	(23.81% of I)			(23.81% of I)
V Maintenance Cost	29,675	0	29,675				
VI O&M Cost of Demo. Farm	7,552	0	7,552				
Sub-Total (II-VI)	196,727	117,014	313,741			702,190	
VII Physical Contingency	109,300	30,886	140,186	Physical Contingency		402,293	Physical Contingency
Sub-Total (I-VII)	1,037,729	507,165	1,544,894	(15.00% of I)		3,786,437	(15.00% of I)
VIII Price Escalation	741,269	182,282	923,551	Price Escalation		2,264,289	Price Escalation
Sub-Total (I-VIII)	1,779,298	689,447	2,468,745	(59.80% of I-VII)		6,050,726	(59.80% of I-VII)
GRAND TOTAL							
	1,779,298	689,447	2,468,745		6,050,726		3,215,325

Table XI.4.1 Annual Maximum Water Level

Year	Noonkawa	Chilmari	Bahadura bad	Taluk Simulbari	Kurigram	Kaunia	(m/PWD) Haripur
1960	-	-	19.475	-	26.485	29.575	-
1961	-	-	18.905	-	-	29.362	-
1962	28.065	25.065	19.990	30.424	27.020	29.606	-
1963	-	-	-	-	-	29.438	-
1964	27.710	-	19.840	-	26.700	29.377	-
1965	27.585	23.245	19.690	30.575	26.610	-	-
1966	27.445	23.805	19.615	30.775	26.350	29.980	-
1967	27.385	23.965	19.495	30.600	26.320	29.529	-
1968	27.525	24.040	19.795	30.845	26.525	30.520	-
1969	27.580	23.785	19.840	29.925	25.870	29.444	-
1970	27.875	24.185	20.195	29.970	26.275	29.691	-
1971	27.110	24.075	18.745	-	-	-	-
1972	27.935	24.090	19.980	29.900	27.035	29.804	-
1973	27.790	23.880	19.880	30.410	26.195	30.145	-
1974	27.985	24.460	20.255	30.510	26.715	29.926	-
1975	27.545	23.775	19.600	31.135	26.515	30.017	-
1976	27.630	23.895	19.865	30.965	26.305	30.099	-
1977	27.768	24.110	19.990	30.935	26.182	30.136	-
1978	27.411	23.677	19.630	30.989	25.832	29.992	22.510
1979	27.315	-	19.782	30.610	26.365	30.225	23.090
1980	27.935	24.245	20.102	31.195	26.579	30.023	23.800
1981	27.295	-	19.480	30.785	26.579	30.157	-
1982	-	-	19.420	30.850	26.480	29.986	-
1983	26.710	24.105	19.930	31.440	26.620	30.130	-
1984	26.450	24.260	20.110	31.740	27.380	30.080	-
1985	26.510	23.925	19.620	31.130	26.745	30.050	-
1986	26.195	23.440	19.150	30.730	25.910	29.990	-
1987	26.700	24.560	19.710	32.050	27.500	30.470	-
1988	28.100	25.060	20.620	31.200	27.410	30.430	-
1989	26.110	23.575	19.580	30.970	26.330	30.200	-
1990	25.990	23.690	19.390	30.530	25.900	30.100	-

Table XI.4.2 Annual Rainfall Data

Year	(mm/year)							
	Chilmari	Kaunia	Kurigram	Lalma nirhat	Pirgacha	Rangpur	Sundar ganj	Ulipur
1961	-	-	-	-	-	1,502	-	-
1962	-	2,372	-	-	-	1,527	1,909	1,687
1963	-	-	-	2,194	-	-	-	2,723
1964	-	2,216	2,260	3,195	2,293	1,999	1,974	3,006
1965	1,721	1,434	2,143	2,183	1,624	1,658	1,729	2,423
1966	1,751	1,817	1,937	-	1,799	1,496	1,764	2,178
1967	1,695	2,126	1,891	-	1,469	1,823	1,640	1,828
1968	2,341	2,374	2,274	2,961	2,316	2,080	1,884	2,659
1969	2,198	2,459	2,194	2,677	2,430	2,892	2,003	2,390
1970	-	2,327	-	-	-	2,017	-	-
1971	-	-	-	-	1,483	-	-	-
1972	-	-	1,864	1,592	887	1,256	1,482	-
1973	3,358	3,575	3,249	3,245	2,730	3,028	-	2,671
1974	3,838	4,901	3,355	4,071	2,779	3,009	2,938	2,978
1975	1,771	2,130	1,690	2,061	1,674	1,813	1,546	1,499
1976	1,943	1,654	2,228	1,677	1,964	2,399	1,497	1,765
1977	2,275	2,295	2,145	2,770	1,985	2,441	2,224	2,199
1978	1,784	1,735	1,707	2,127	1,888	2,047	1,356	1,591
1979	1,812	2,392	2,446	2,480	1,770	1,902	1,375	2,054
1980	1,729	1,841	1,835	1,995	2,228	2,114	2,038	1,998
1981	1,421	2,252	1,609	2,009	2,378	2,223	-	1,876
1982	-	-	2,365	2,453	-	2,115	-	1,965
1983	2,290	2,267	2,378	2,107	-	2,224	2,462	2,052
1984	2,778	3,002	2,851	3,354	2,502	3,278	2,295	2,667
1985	1,810	2,736	2,440	2,926	1,789	2,556	2,128	2,111
1986	2,559	2,434	2,486	2,364	2,013	2,360	2,464	2,572
1987	3,231	3,820	2,980	3,991	2,941	3,326	3,197	2,857
1988	2,989	2,549	3,173	-	2,603	2,111	1,777	3,024
1989	2,676	2,803	2,857	2,294	2,595	2,035	2,196	2,480
1990	2,699	2,526	2,733	2,657	2,674	-	1,759	2,518
Ave.	2,303	2,481	2,364	2,582	2,116	2,194	1,975	2,299

Table XI.4.3 H-A-V Relation Data

[Block : 1. Chilmarji]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
26.23	72.41	115793	72.41	119129
25.62	59.159	75664	59.159	79000
25.01	44.769	43966	44.769	47302
24.4	27.091	22049	27.091	25247
23.79	15.507	9057	15.507	11979
23.18	5.122	2765	5.122	5273
22.57	1.119	861	1.119	2995
21.96	0.7	306	0.7	1914
21.35	0.2	31	0.2	1081
21.03	0	0	0	0

[Block : 2. Bamni]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
26.84	65.812	105840	65.812	108874
26.23	55.865	68729	55.865	71763
25.62	42.611	38694	42.611	41728
25.01	23.68	18475	23.68	21357
24.4	10.953	7912	10.953	10491
23.79	3.494	3506	3.494	5630
23.18	2.2	1769	2.2	3438
22.57	1.4	671	1.4	1885
21.96	0.4	122	0.4	881
21.45	0	0	0	0

[Block : 3. Malbhanga]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
27.45	32.5	61710	32.5	63411
26.84	31.331	42242	31.331	43943
26.23	30.299	23445	30.299	25146
25.62	15.848	9370	15.848	11071
25.01	5.408	2887	5.408	4503
24.4	1.19	875	1.19	2321
23.79	0.5	360	0.5	1551
23.18	0.2	146	0.2	1082
22.57	0.1	54	0.1	735
21.96	0.05	8	0.05	434
21.8	0	0	0	0

[Block : 4. Palashbari]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
27.45	20	15114	20	15614
26.84	8.325	6475	8.325	6975
26.23	2.455	3187	2.455	3687
25.62	1.66	1932	1.66	2432
25.01	0.875	1159	0.875	1659
24.4	0.775	656	0.775	1156
23.79	0.5	267	0.5	769
23.18	0.25	38	0.25	538
22.85	0	0	0	0

[Block : 5. Ratnai]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
32	27	50000	27	50000
31.11	20.05	31417	20.05	32530
30.5	14.5	22252	14.5	23365
29.98	10	14779	10	15892
29.28	6.075	9876	6.075	10989
28.67	4.925	6521	4.925	7579
28.06	3.35	3997	3.35	4944
27.45	2	2365	2	4045
26.84	1.5	1297	1.5	1910
26.23	1	534	1	980
25.62	0.5	76	0.5	355
25.38	0	0	0	0

[Block : 6. Harichari]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
25.62	73.804	139878	73.804	143983
25.01	66.689	97028	66.689	101133
24.4	57.213	59238	57.213	63343
23.79	38.798	29955	38.798	34060
23.18	19.785	12087	19.785	16192
22.57	4.92	4552	4.92	7457
21.96	3	2136	3	3468
21.35	1.5	763	1.5	1829
20.74	0.5	153	0.5	819
20.12	0	0	0	0

[Block : 7. Kishorpur]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
28.67	56	86258	56	88817
28.06	40.883	43909	40.883	46468
27.45	28.042	22887	28.042	25446
26.84	14.311	9969	14.311	12528
26.23	3.997	4385	3.997	6835
25.62	2	2556	2	4787
25.01	1.5	1488	1.5	3390
24.4	1	725	1	2298
23.79	0.5	267	0.5	1511
23.18	0.25	30	0.25	953
22.77	0	0	0	0

[Block : 8. Gharialdanga]

Elevatiior (m)	Existing Condition		Improved Condition	
	Area (km <sup>2</sup> )	Volume (cu.m)	Area (km <sup>2</sup> )	Volume (cu.m)
30.5	19.91	25000	19.91	25000
29.89	16.5	18999	16.5	18999
29.28	9.854	10961	9.854	10961
28.67	6.384	6008	6.384	6008
28.06	2.98	3152	2.98	3152
27.45	1.144	1894	1.144	1894
26.84	1.001	1240	1.001	1240
26.23	0.75	686	0.75	686
25.62	0.5	305	0.5	305
25.01	0.25	76	0.25	76
24.38	0	0	0	0

**Table XI.5.1 SUMMARY OF DRAINAGE CALCULATION**  
(under Proposed Condition)

[Existing ]

Station	Area (sq.km)	External Water Level		Rain fall (mm)	Inundation [Max.]			Period (days)	
		[Max.] (m/PWD)	[Min.] (m/PWD)		W.L. (m/PWD)	Area (sq. km)	Depth (m)		
CHILMARI	80.8	24.80	19.79	1,601	25.05	45.79	56.7	3.09	62
BAMNI	73.4	25.26	20.32	1,601	25.57	41.01	55.9	2.39	44
MALBHANGA	128.8	25.75	20.87	1,708	26.69	31.07	24.1	3.51	48
PALASHBARI	25.0	27.45	22.52	1,708	27.17	14.61	58.4	3.38	68
HARICHAJ	81.6	25.07	20.32	1,797	24.80	63.39	77.7	2.84	89
RATNAI	66.9	30.37	26.07	2,543	30.86	17.74	26.5	4.02	69
KISHORPUR	85.0	27.96	24.59	2,402	28.18	43.88	51.6	2.56	63
GHARIALDANGA	19.9	29.58	26.92	2,402	29.78	15.30	76.9	2.94	111

[Proposed ]                      [new HV & add. Gate / Final ]

Station	Area (sq.km)	External Water Level		Rain fall (mm)	Inundation [Max.]			Period (days)	
		[Max.] (m/PWD)	[Min.] (m/PWD)		W.L. (m/PWD)	Area (sq. km)	Depth (m)		
CHILMARI	80.8	24.80	19.79	1,601	25.05	45.71	56.6	3.09	62
BAMNI	73.4	25.26	20.32	1,601	25.56	40.80	55.6	2.38	43
MALBHANGA	128.8	25.75	20.87	1,708	26.69	31.07	24.1	3.51	46
PALASHBARI	25.0	27.45	22.52	1,708	27.13	13.85	55.4	2.34	64
HARICHAJ	81.6	25.07	20.32	1,797	24.73	62.37	76.4	2.77	81
RATNAI	66.9	30.37	26.07	2,543	30.85	17.71	26.5	4.01	65
KISHORPUR	85.0	27.96	24.59	2,402	27.94	38.34	45.1	2.32	60
GHARIALDANGA	19.9	29.58	26.92	2,402	29.52	12.46	62.6	2.68	84

[Effect ]

Station	Area (sq.km)	External Water Level		Rain fall (mm)	Inundation [Max.]			Period (days)	
		[Max.] (m/PWD)	[Min.] (m/PWD)		W.L. (m/PWD)	Area (sq. km)	Depth (m)		
CHILMARI	—	—	—	—	0.00	-0.08	-0.1	0.00	0
BAMNI	—	—	—	—	-0.01	-0.21	-0.3	-0.01	-1
MALBHANGA	—	—	—	—	0.00	0.00	0.0	0.00	-2
PALASHBARI	—	—	—	—	-0.04	-0.76	-3.0	-0.04	-4
HARICHAJ	—	—	—	—	-0.07	-1.02	-1.0	-0.07	-8
RATNAI	—	—	—	—	-0.01	-0.03	0.0	-0.01	-4
KISHORPUR	—	—	—	—	-0.24	-5.54	-6.5	-0.24	-3
GHARIALDANGA	—	—	—	—	-0.26	2.84	-14.3	-0.26	-27

-10.48



**Table XI.5.2 SUMMARY OF DRAINAGE CALCULATION**  
(under Full Improvement Plan)

[Existing ]

Station	Area (sq.km)	External Water Level		Rain fall (mm)	Inundation [Max.]			Period (days)	
		[Max.] (m/PWD)	[Min.] (m/PWD)		W.L. (m/PWD)	Area (sq. km)	Depth (m)		
CHILMARI	80.8	24.80	19.79	1,601	25.05	45.79	56.7	3.09	62
BAMNI	73.4	25.26	20.32	1,601	25.57	41.01	55.9	2.39	44
MALBHANGA	128.8	25.75	20.87	1,708	26.69	31.07	24.1	3.51	48
PALASHBARI	25.0	27.45	22.52	1,708	27.17	14.61	58.4	3.38	68
HARICHAJ	81.6	25.07	20.32	1,797	24.80	63.39	77.7	2.84	89
RATNAI	66.9	30.37	26.07	2,543	30.86	17.74	26.5	4.02	69
KISHORPUR	85.0	27.96	24.59	2,402	28.18	43.88	51.6	2.56	63
GHARIALDANGA	19.9	29.58	26.92	2,402	29.78	15.30	76.9	2.94	111

[Proposed ]

[Gate Expand / w=6.0m ]

Station	Area (sq.km)	External Water Level		Rain fall (mm)	Inundation [Max.]			Period (days)	
		[Max.] (m/PWD)	[Min.] (m/PWD)		W.L. (m/PWD)	Area (sq. km)	Depth (m)		
CHILMARI	80.8	24.80	19.79	1,601	24.87	40.82	50.5	2.91	59
BAMNI	73.4	25.26	20.32	1,601	25.37	34.99	47.7	2.19	36
MALBHANGA	128.8	25.75	20.87	1,708	26.10	27.18	21.1	2.92	36
PALASHBARI	25.0	27.45	22.52	1,708	27.10	13.35	53.4	3.31	60
HARICHAJ	81.6	25.07	20.32	1,797	24.83	62.30	76.3	2.87	81
RATNAI	66.9	30.37	26.07	2,543	30.56	15.01	22.4	3.72	55
KISHORPUR	85.0	27.96	24.59	2,402	27.84	34.22	40.3	2.22	54
GHARIALDANGA	19.9	29.58	26.92	2,402	29.29	9.46	47.5	2.45	71

[Effect ]

Station	Area (sq.km)	External Water Level		Rain fall (mm)	Inundation [Max.]			Period (days)	
		[Max.] (m/PWD)	[Min.] (m/PWD)		W.L. (m/PWD)	Area (sq. km)	Depth (m)		
CHILMARI	—	—	—	—	-0.2	-5.0	-6.2	-0.2	-3
BAMNI	—	—	—	—	-0.2	-6.0	-8.2	-0.2	-8
MALBHANGA	—	—	—	—	-0.6	-3.9	-3.0	-0.6	-12
PALASHBARI	—	—	—	—	-0.1	-1.3	-5.0	-0.1	-8
HARICHAJ	—	—	—	—	0.0	-1.1	-1.4	0.0	-8
RATNAI	—	—	—	—	-0.3	-2.7	-4.1	-0.3	-14
KISHORPUR	—	—	—	—	-0.3	-9.7	-11.3	-0.3	-9
GHARIALDANGA	—	—	—	—	-0.5	-5.8	-29.4	-0.5	-40

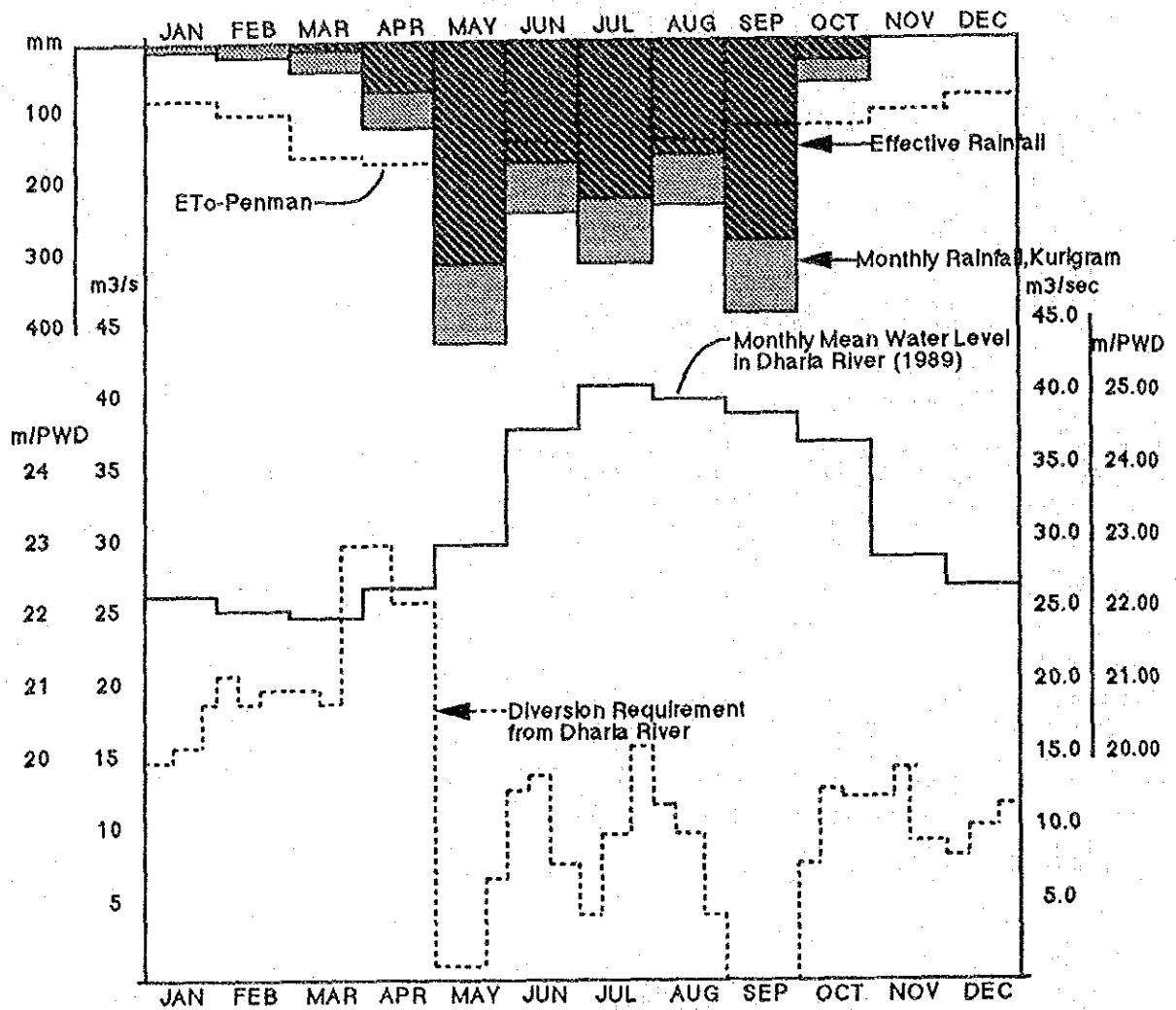


Fig. XI.2.1 MONTHLY RAINFALL, RIVER FLOW, AND DIVERSION REQUIREMENT

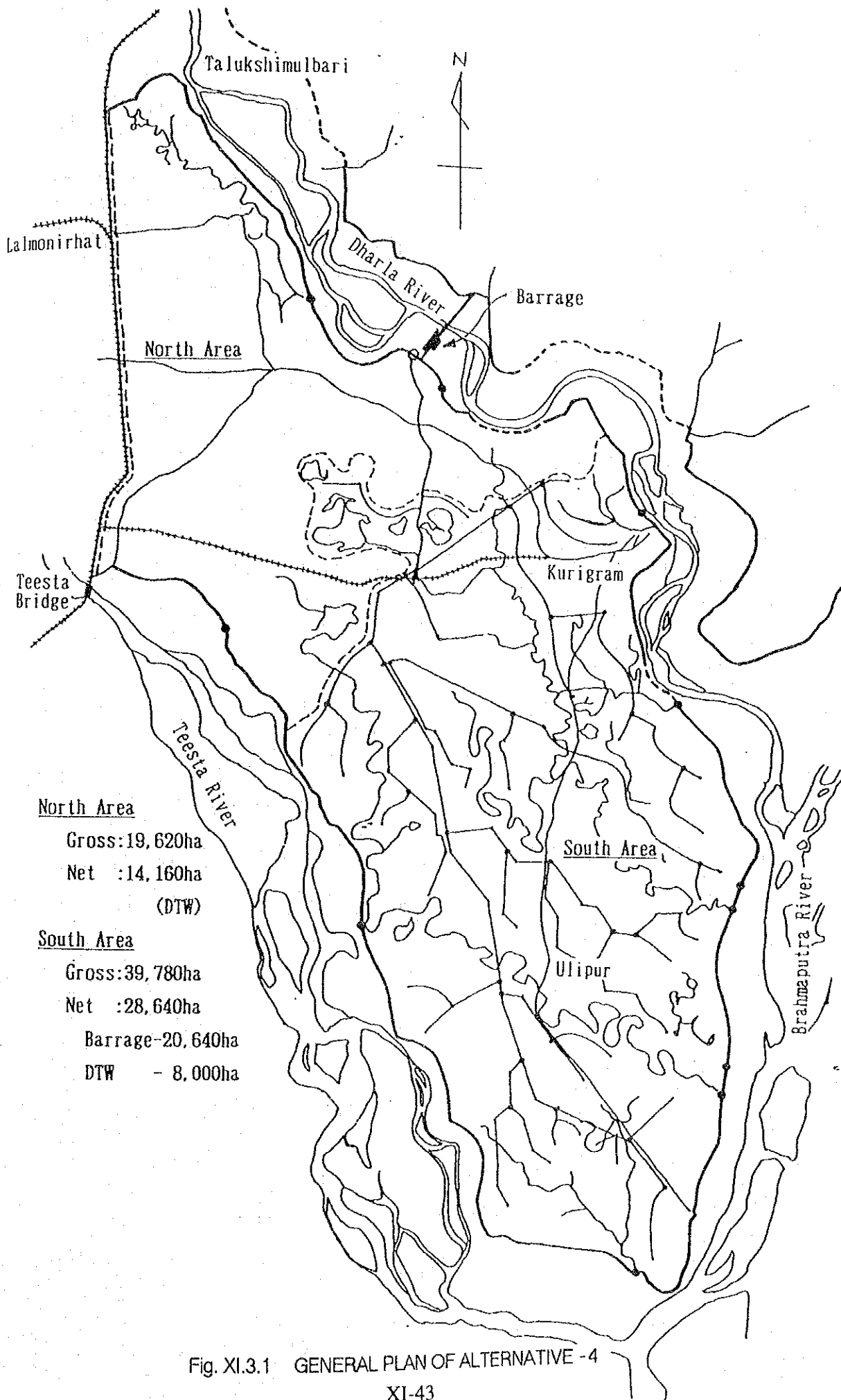


Fig. XI.3.1 GENERAL PLAN OF ALTERNATIVE -4  
XI-43

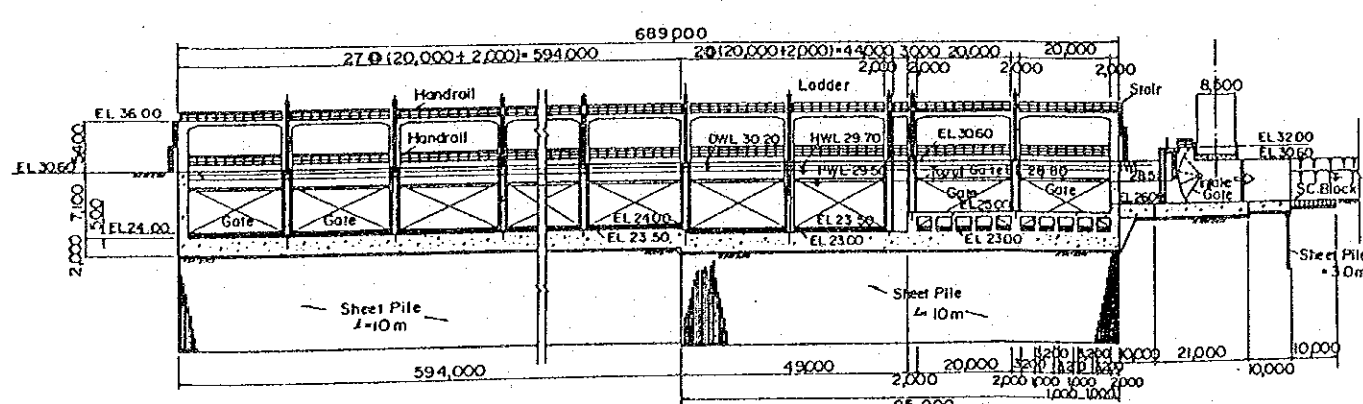
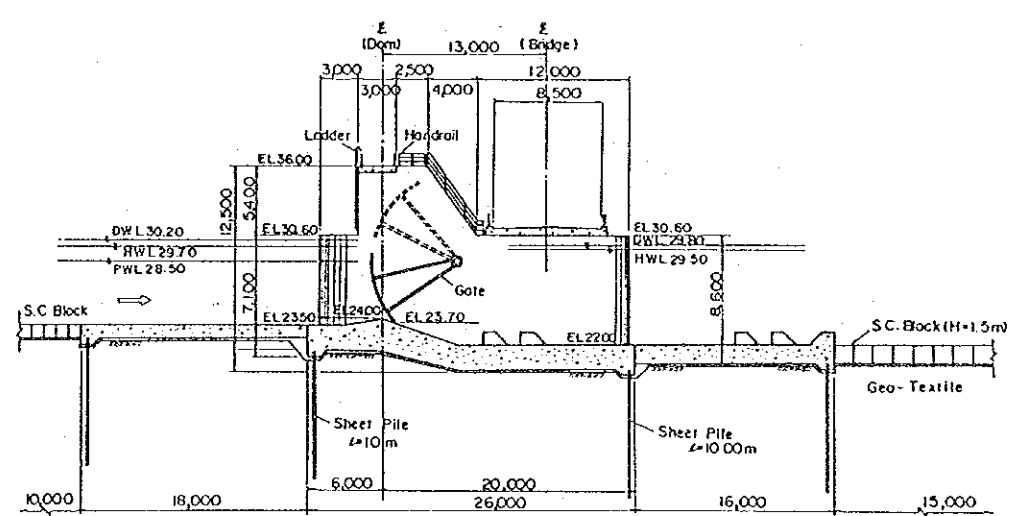
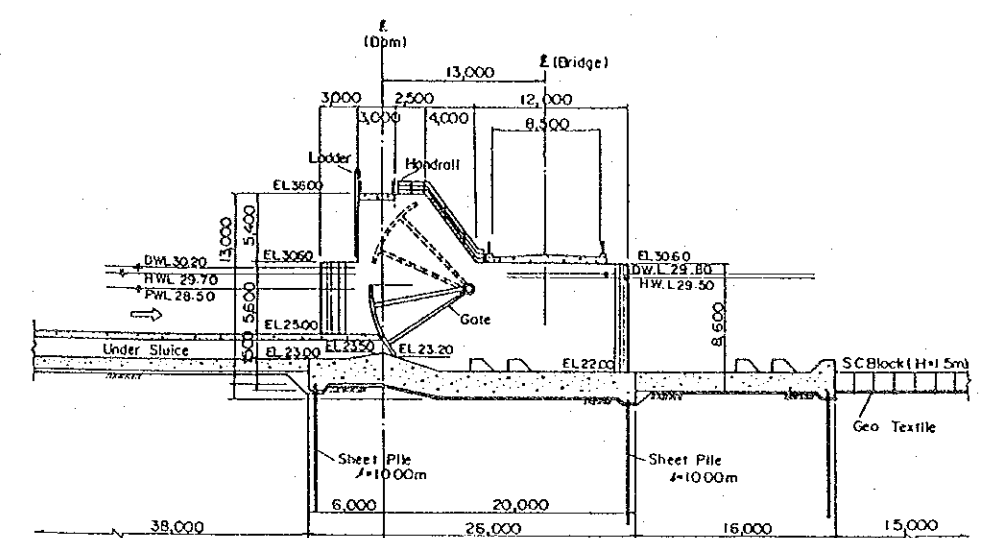
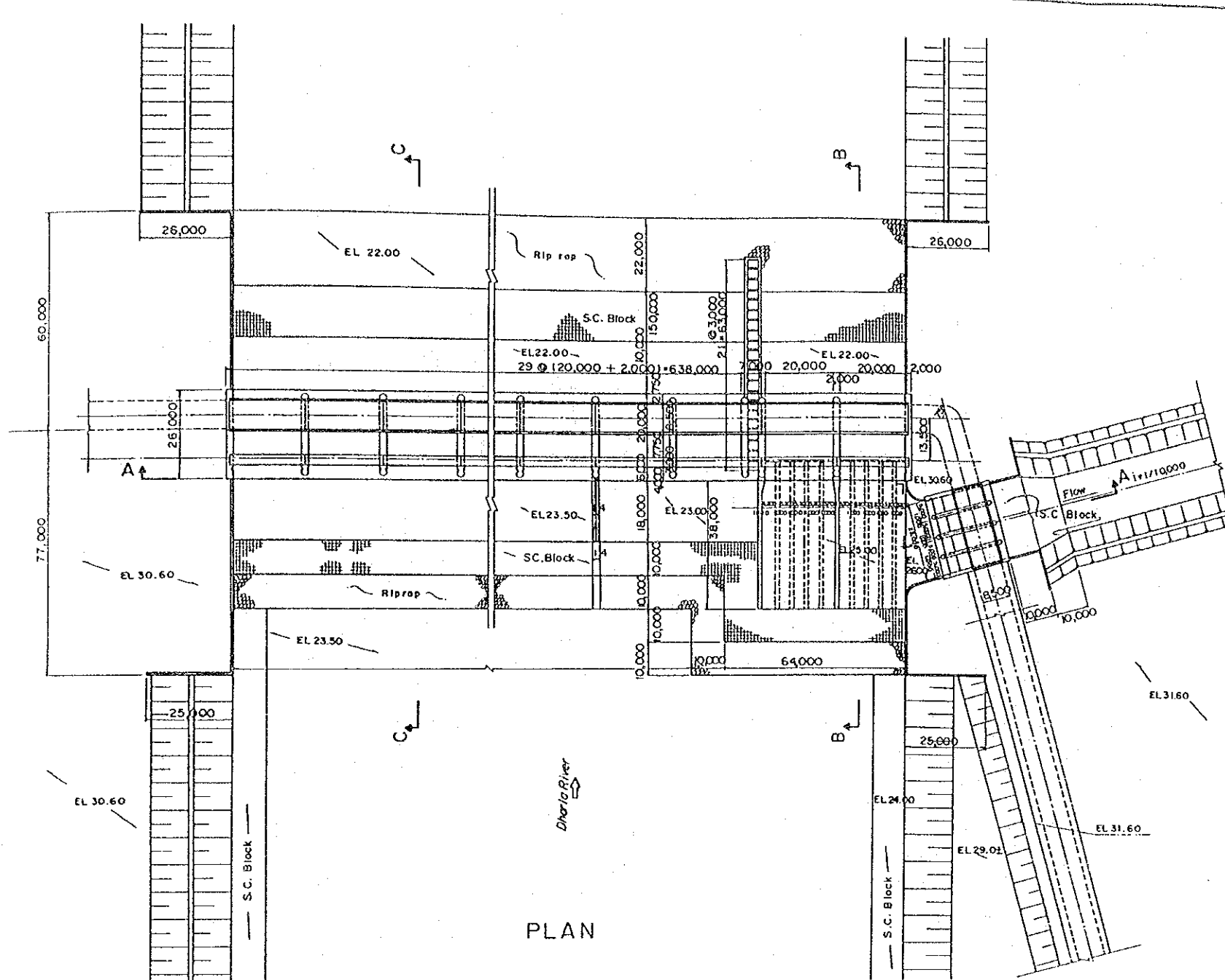


Fig. XI.3.2 GENERAL LAYOUT OF DHARLA BARRAGE

THE PEOPLE'S REPUBLIC OF BANGLADESH BANGLADESH WATER DEVELOPMENT BOARD THE KURIGRAM IRRIGATION AND FLOOD CONTROL PROJECT SOUTH UNIT		
ALTERNATIVE - 4 DHARLA BARRAGE		
JAPAN INTERNATIONAL COOPERATION AGENCY		
DATE	OCT. 1992	DRG. NO.



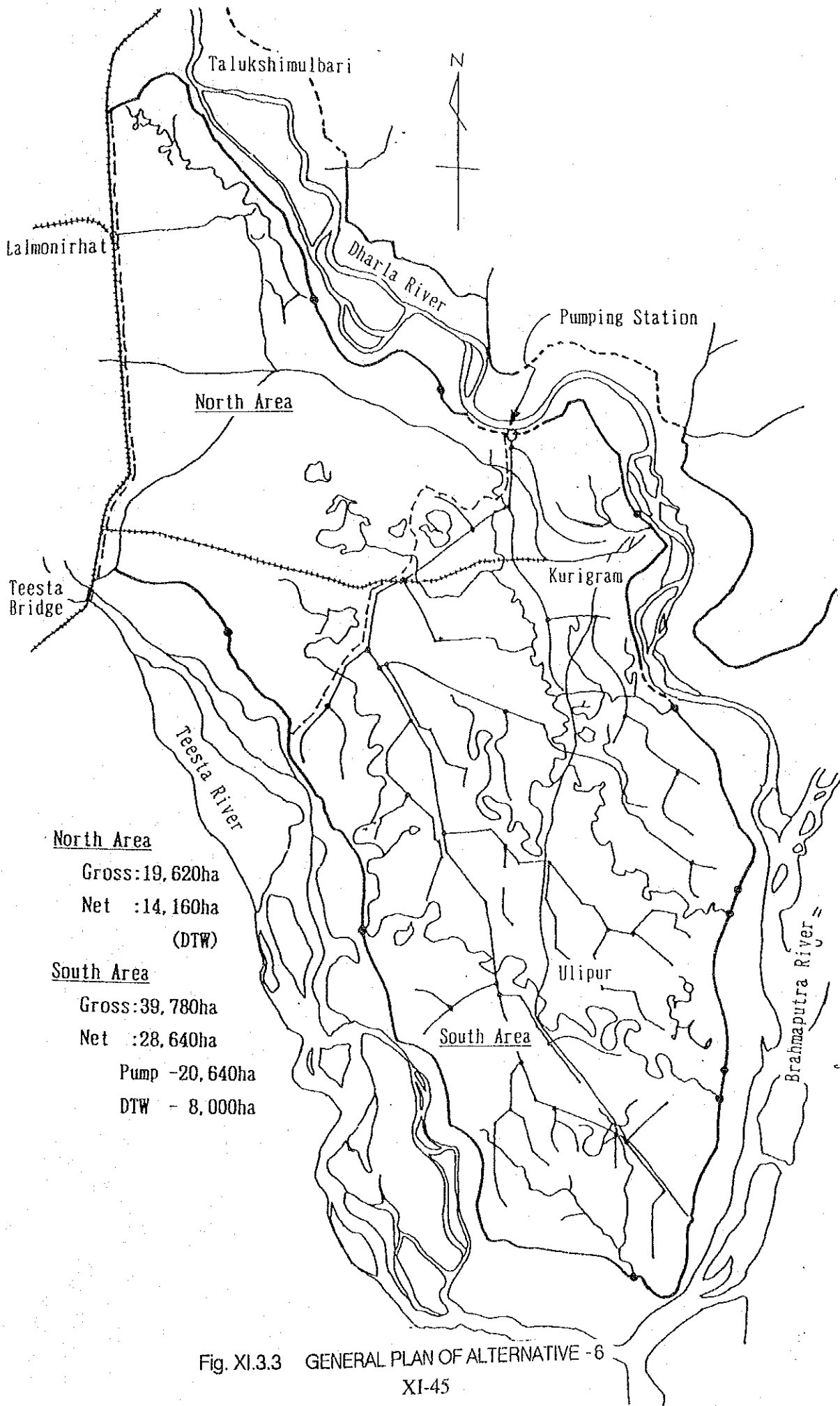
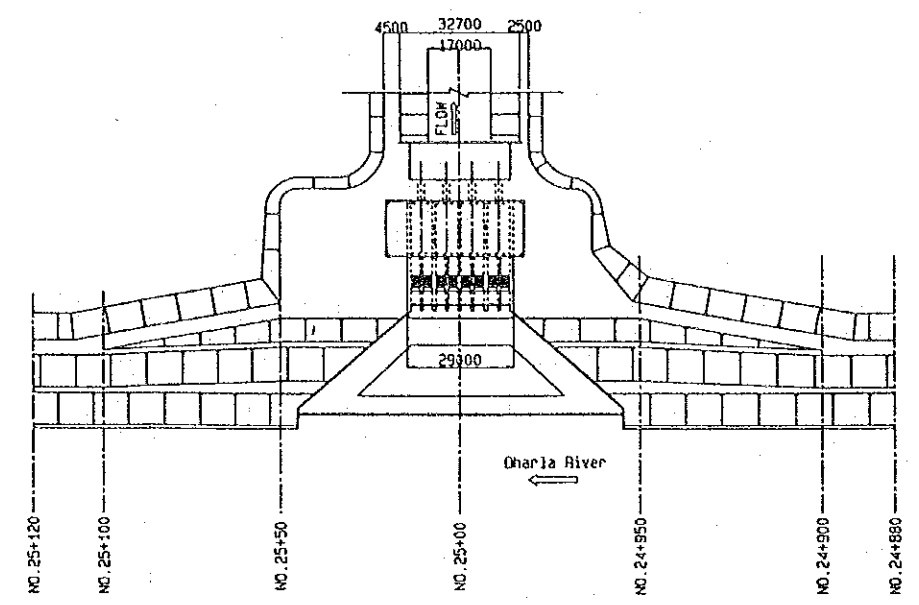
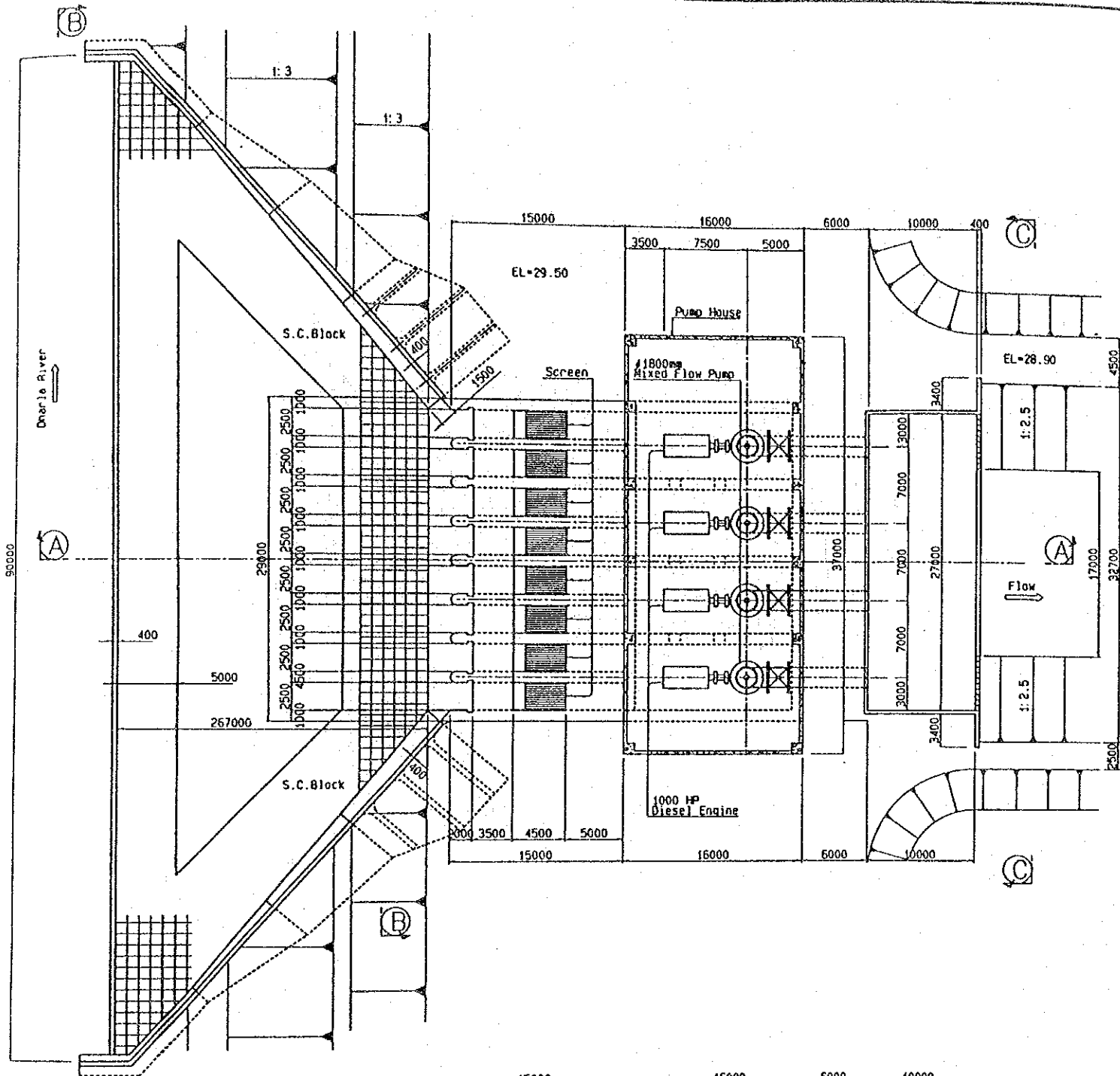
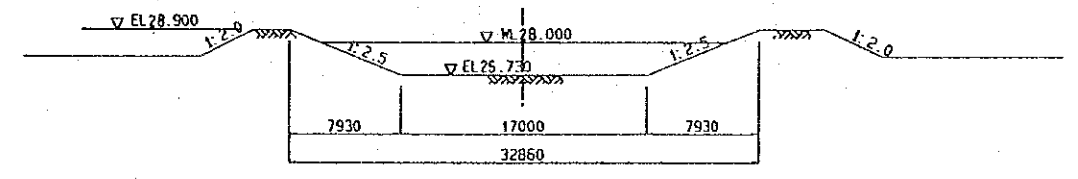


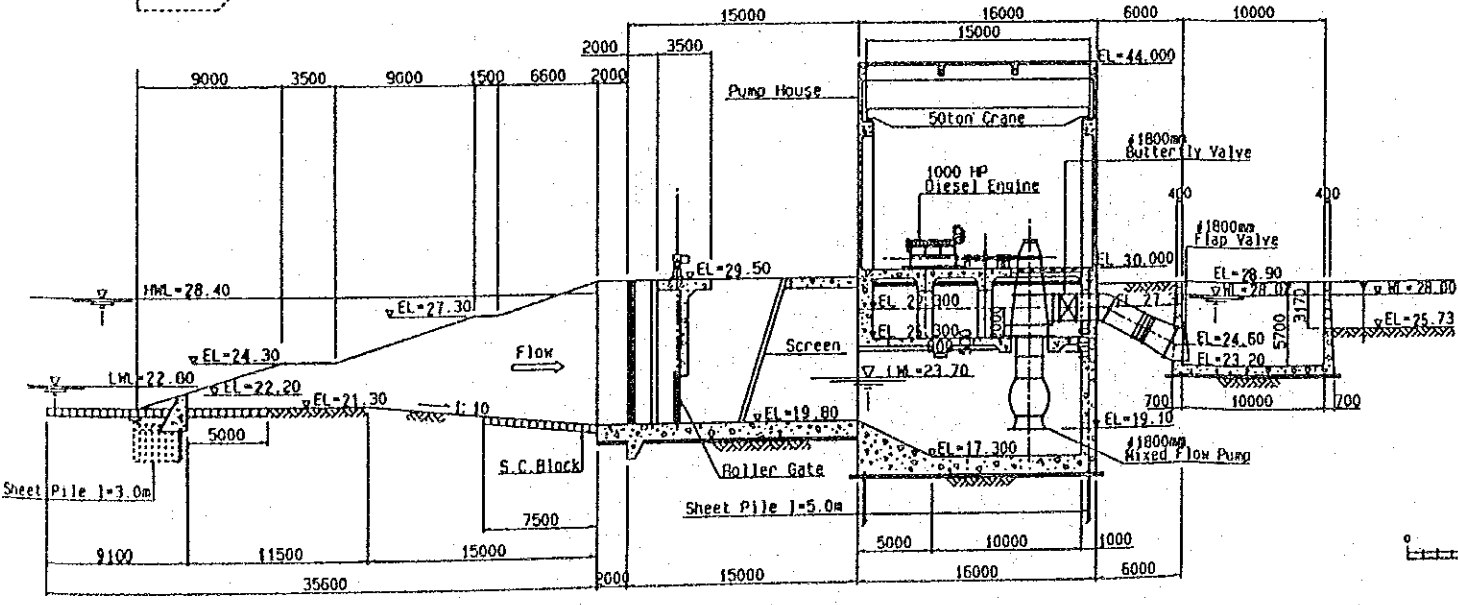
Fig. XI.3.3 GENERAL PLAN OF ALTERNATIVE -6  
XI-45



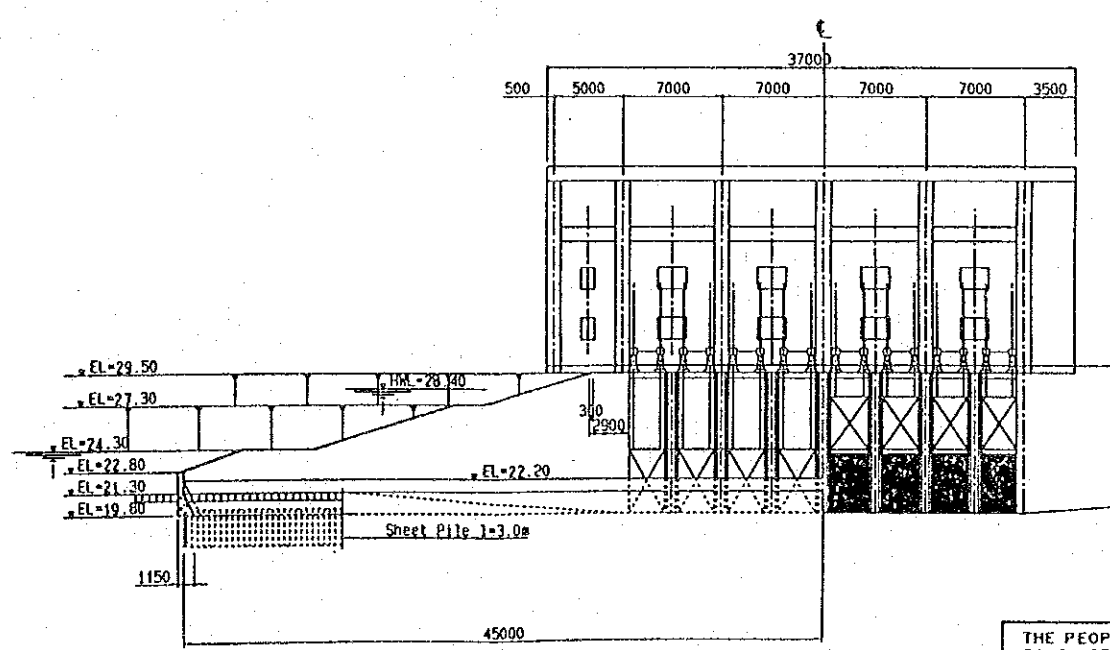
GENERAL PLAN



SECTION C-C



SECTION A-A



SECTION B-B

Fig. XI.3.4 GENERAL PLAN OF DHARLA PUMPING STATION XI-46

THE PEOPLE'S REPUBLIC OF BANGLADESH	
BANGLADESH WATER DEVELOPMENT BOARD	
THE KURIGRAM	
IRRIGATION AND FLOOD CONTROL PROJECT	
SOUTH UNIT	
ALTERNATIVE - 6	
PUMPING STATION	
JAPAN INTERNATIONAL COOPERATION AGENCY	
DATE	OCT. 1992
DRG. NO.	





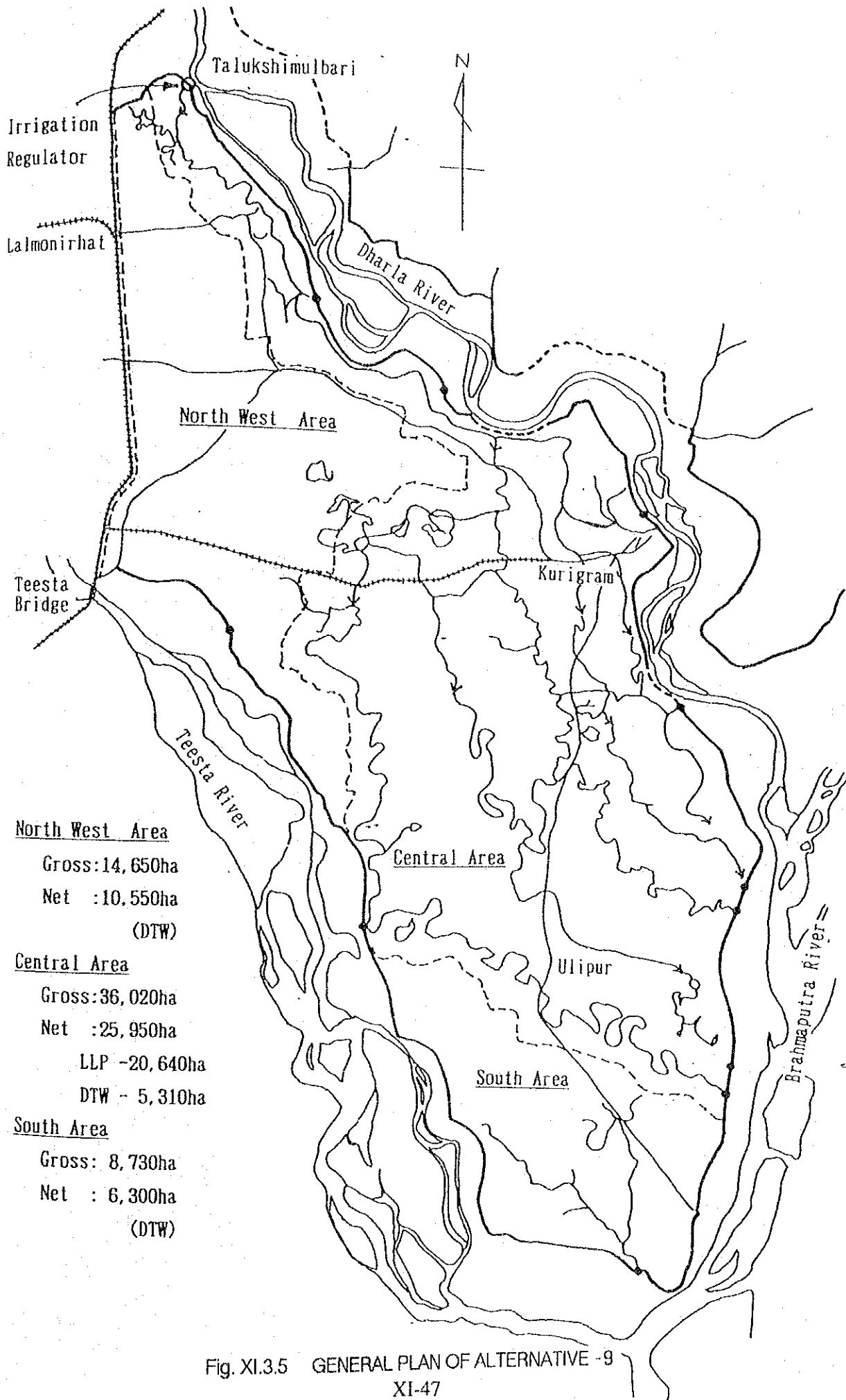
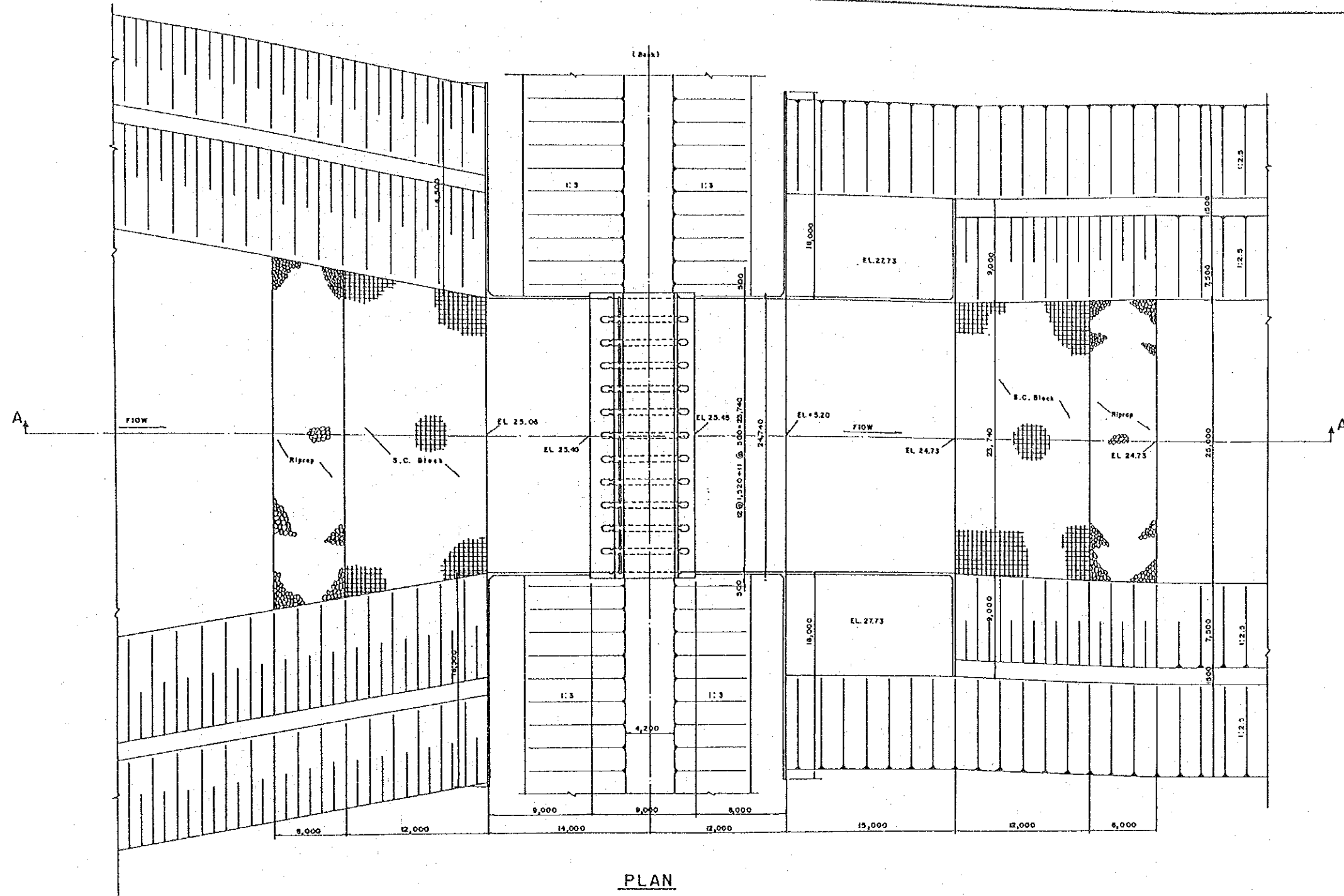
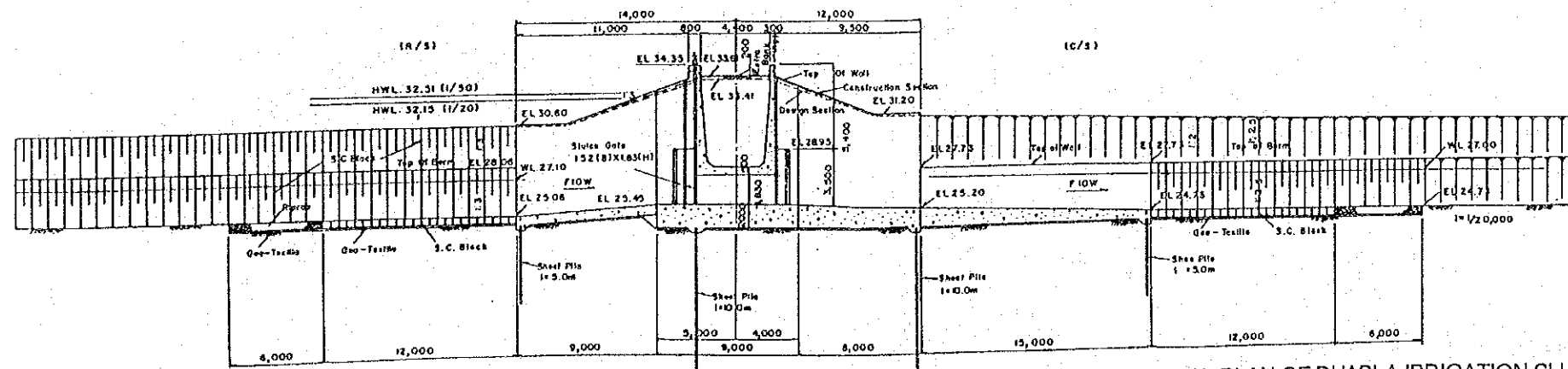


Fig. XI.3.5 GENERAL PLAN OF ALTERNATIVE -9  
XI-47



PLAN



SECTION A-A



Fig. XI.3.6 GENERAL PLAN OF DHARLA IRRIGATION SLUICE (REGULATION)

XI-48

THE PEOPLE'S REPUBLIC OF BANGLADESH BANGLADESH WATER DEVELOPMENT BOARD		
THE KURIGRAM IRRIGATION AND FLOOD CONTROL PROJECT SOUTH UNIT		
INTAKE REGULATOR PLAN AND SECTION		
JAPAN INTERNATIONAL COOPERATION AGENCY		
DATE	OCT. 1992	DRG. NO.



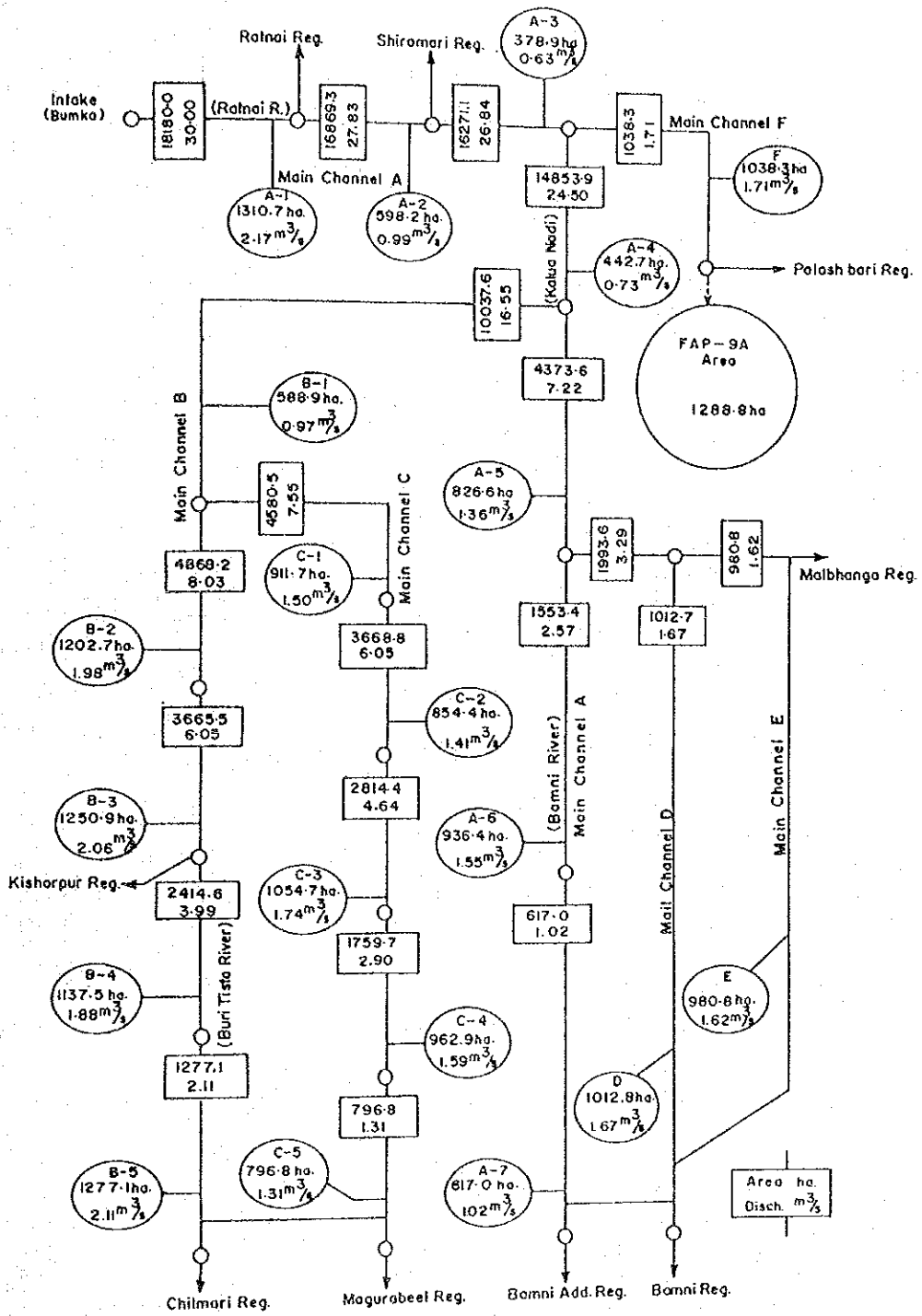


Fig. XI.3.7 PROPOSED IRRIGATION DIAGRAM

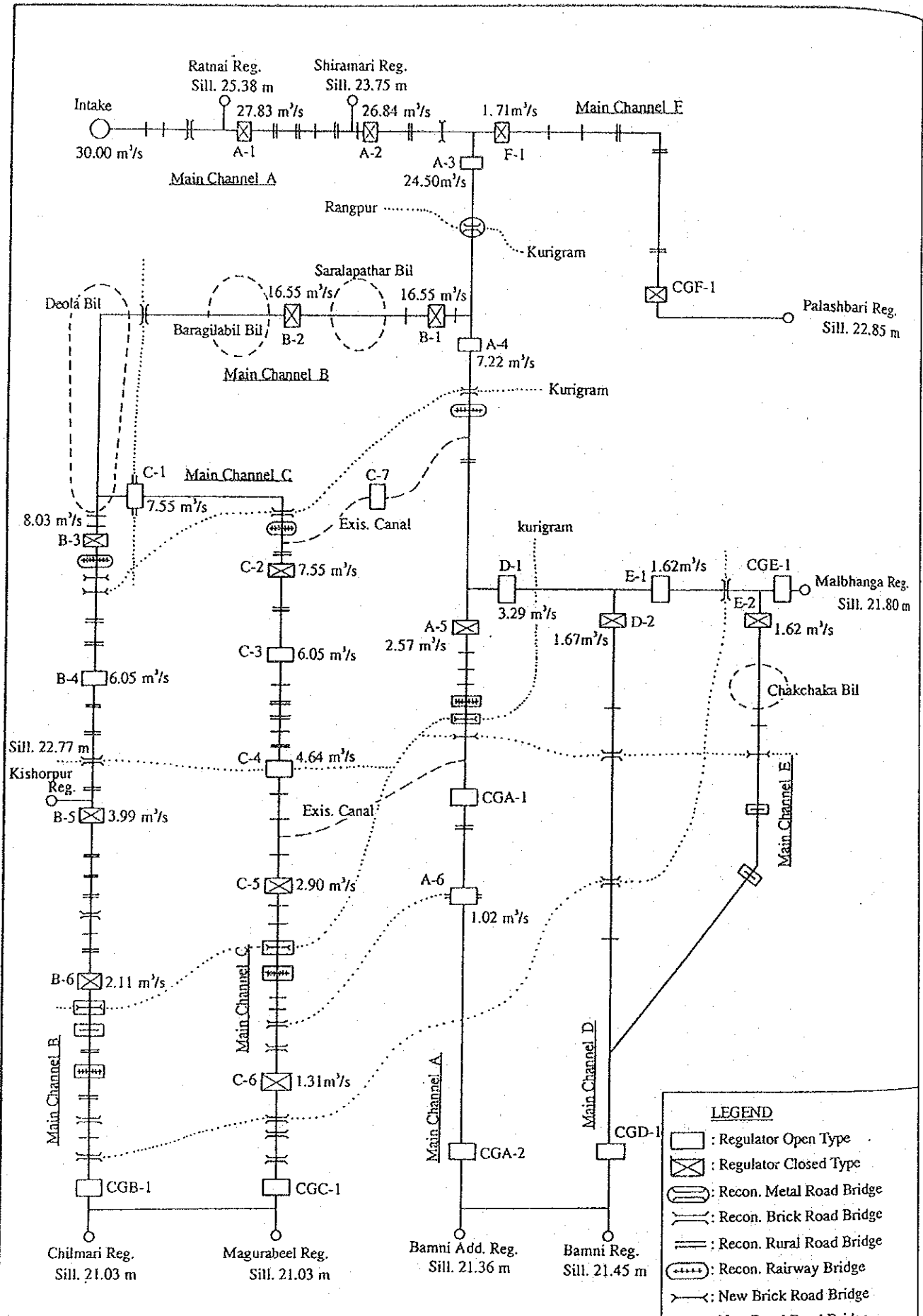


Fig. XI.3.8 LAYOUT OF IRRIGATION CHANNEL AND RELATED STRUCTURE

LEGEND	
	: Regulator Open Type
	: Regulator Closed Type
	: Recon. Metal Road Bridge
	: Recon. Brick Road Bridge
	: Recon. Rural Road Bridge
	: Recon. Railway Bridge
	: New Brick Road Bridge
	: New Rural Road Bridge
	: New Culvert (Metal Road)
	: New Culvert (Rural/Brick Road)
	: New Culvert (Railway)

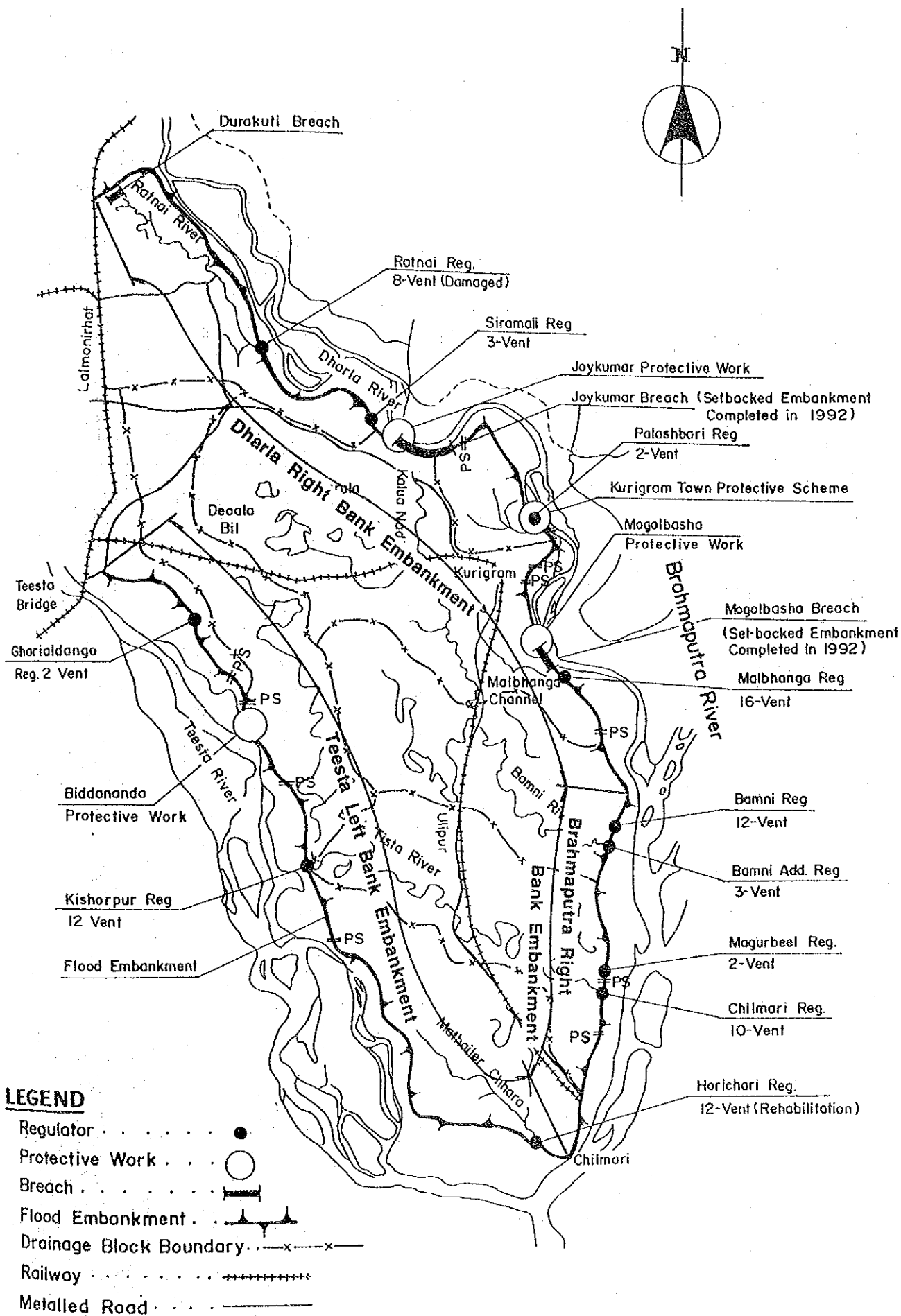


Fig. XI.4.1 (1/2) LOCATION OF EXISTING FCD FACILITIES (Jan.-1992)

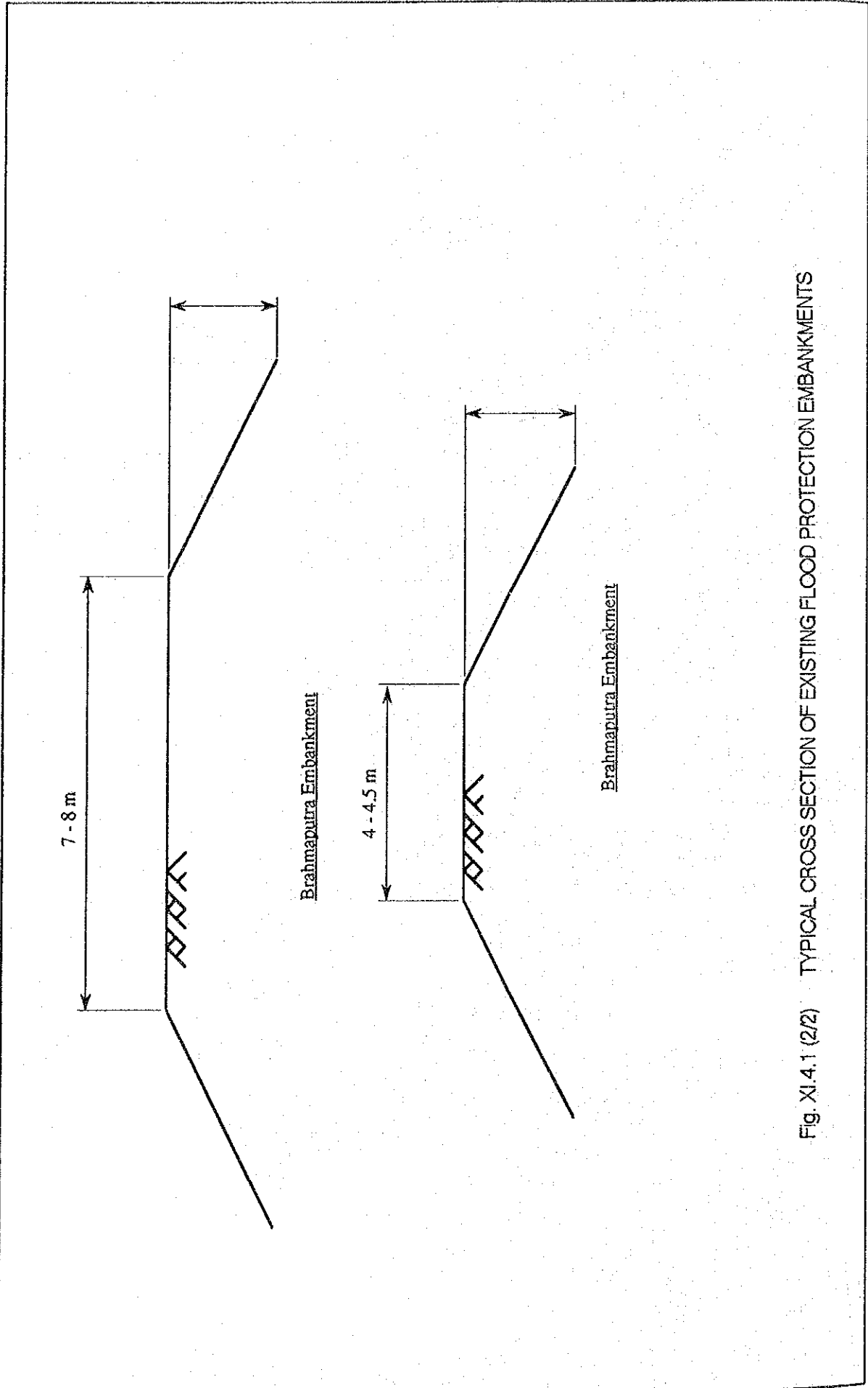
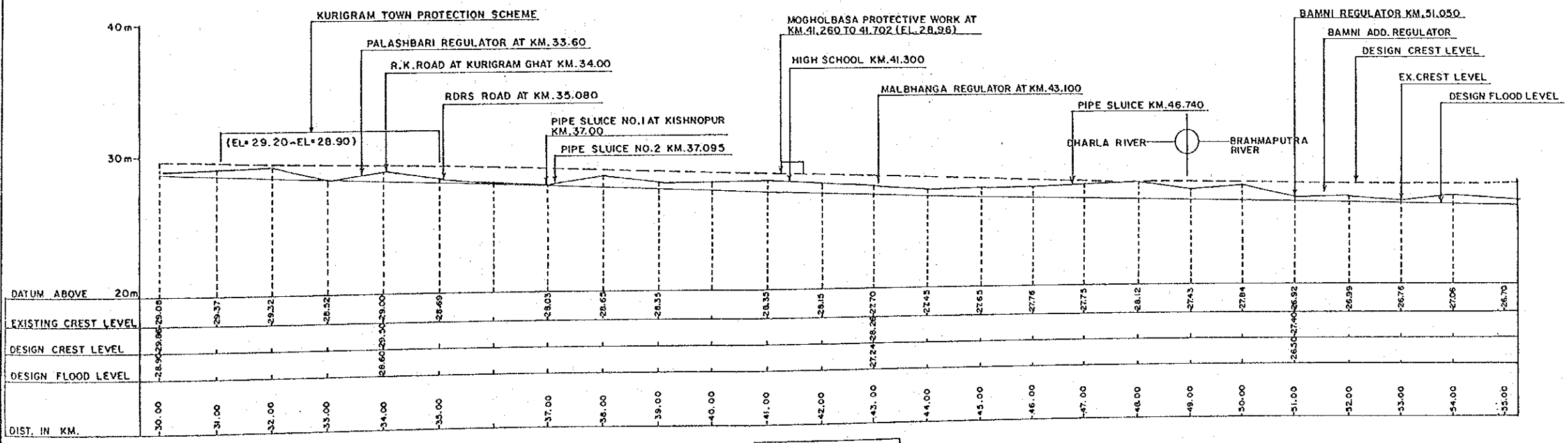
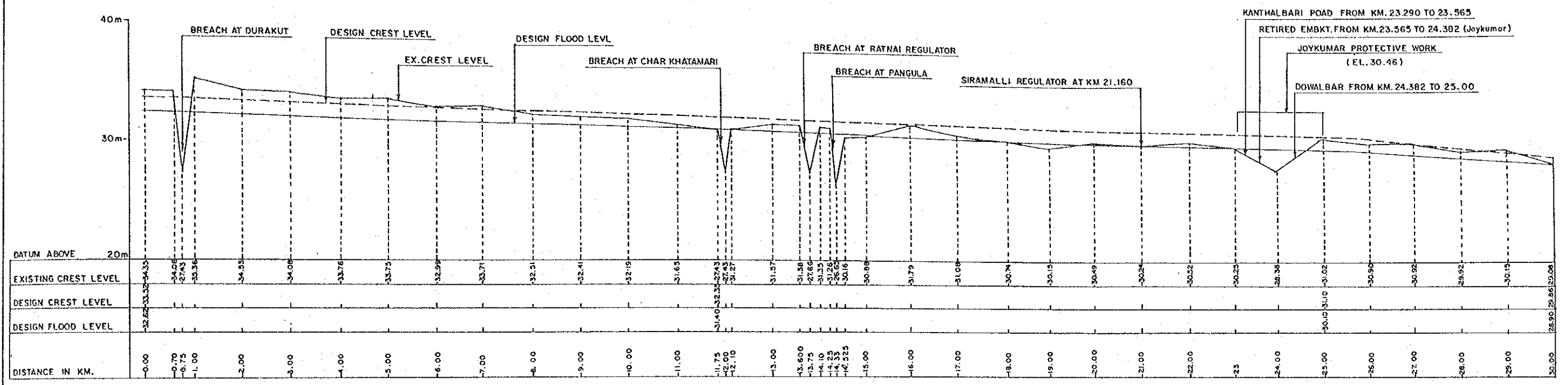


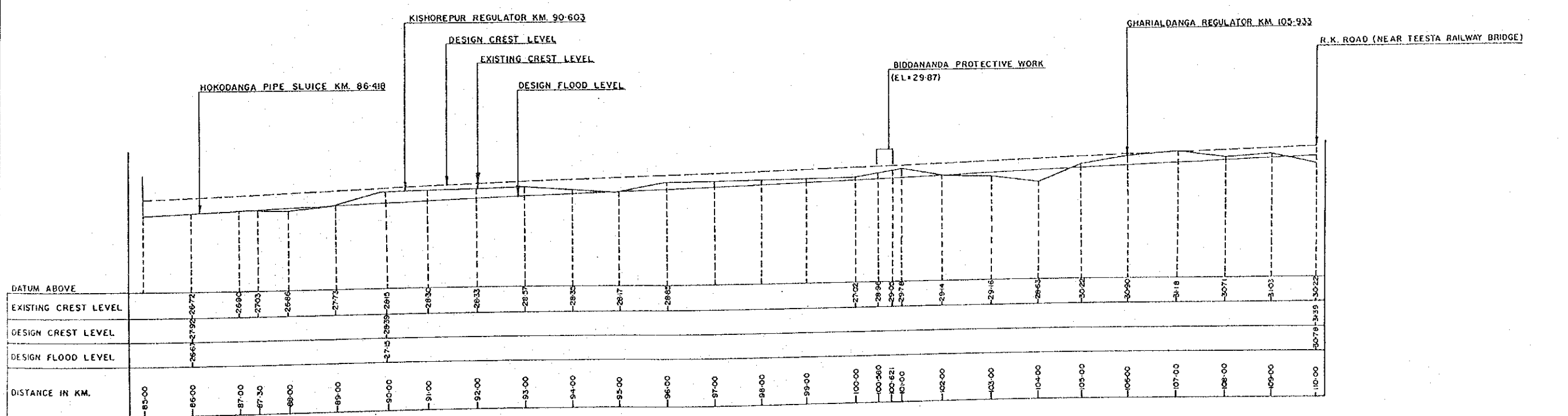
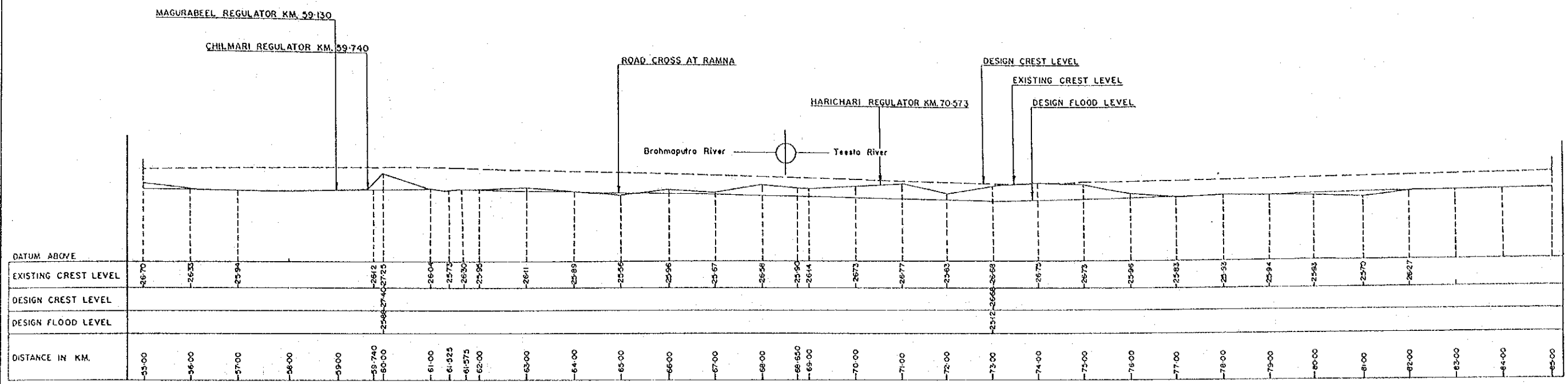
Fig. XI.4.1 (2/2) TYPICAL CROSS SECTION OF EXISTING FLOOD PROTECTION EMBANKMENTS



SCALE H-1cm = 500m  
V-1cm = 2m

Fig. XI.4.2 LONGITUDINAL SECTION OF EXISTING FLOOD PROTECTION DIKE (1/2)





SCALE: H. 1 cm = 500m  
V. 1cm = 2m

Fig. XI.4.2 LONGITUDINAL SECTION OF EXISTING FLOOD PROTECTION DIKE (2/2)



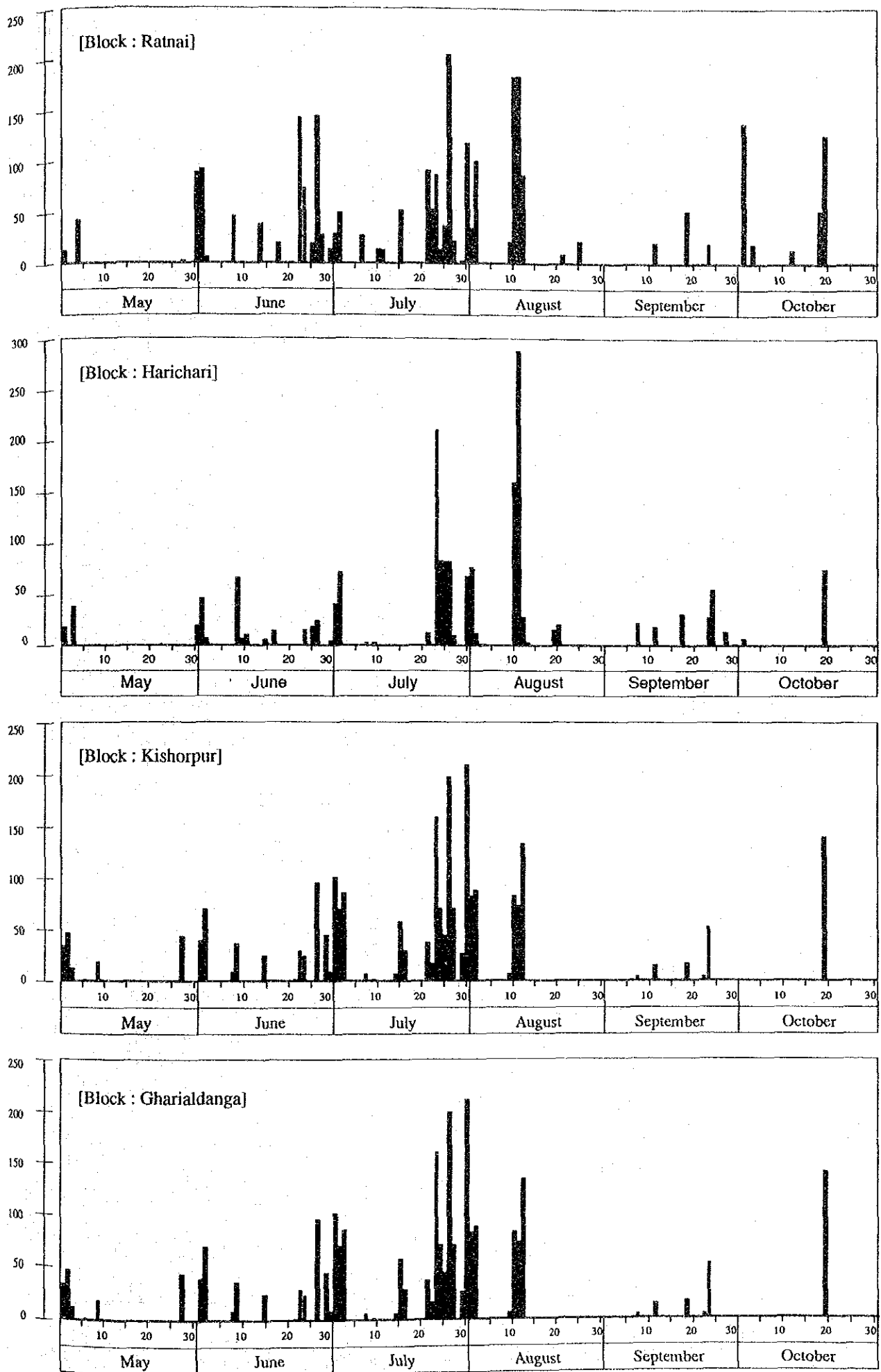


Fig.XI.4.3 RUNNOFF HYDROGRAPH IN THE BAISIC YEAR (1987)/(1/2)

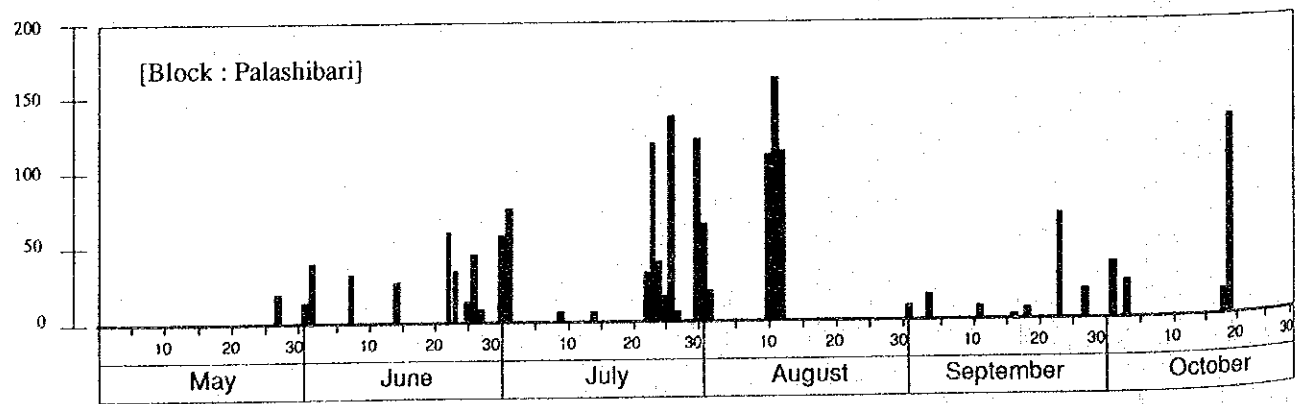
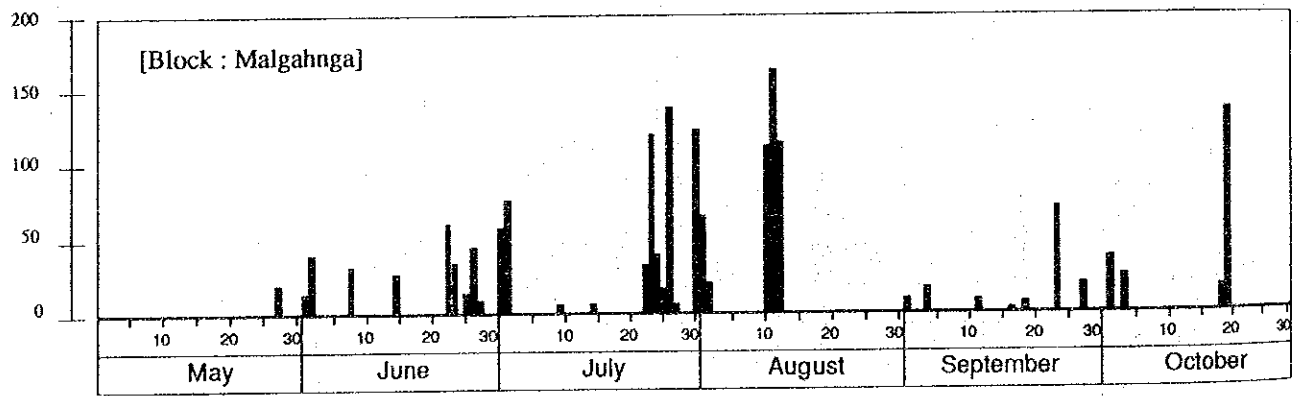
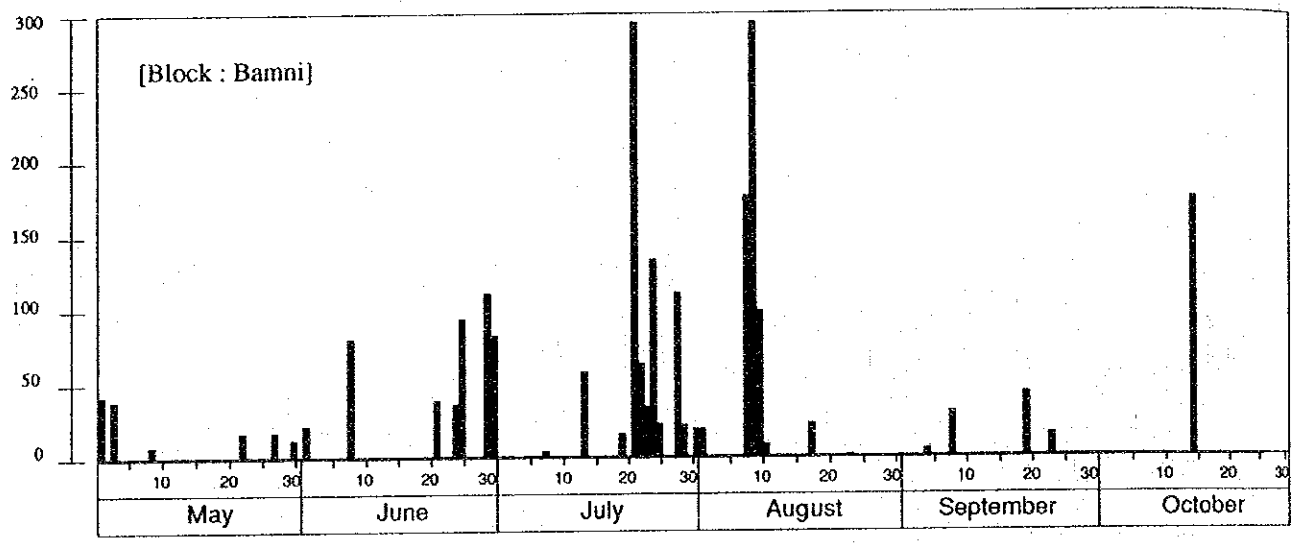
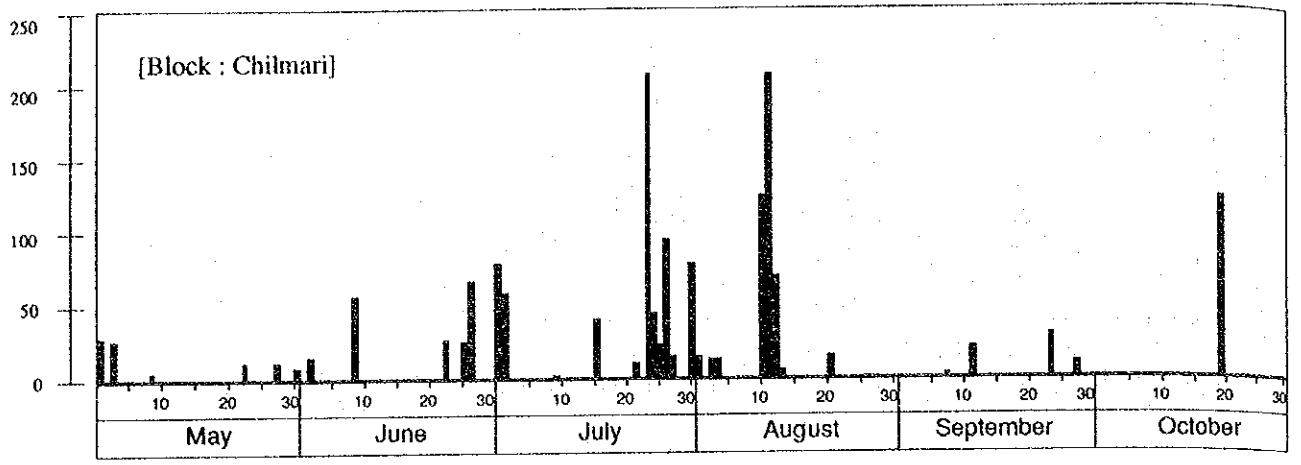
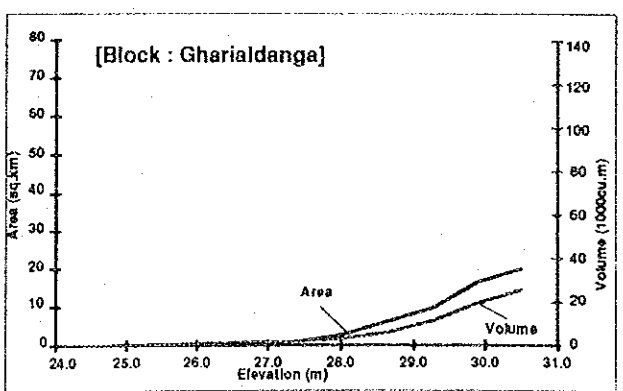
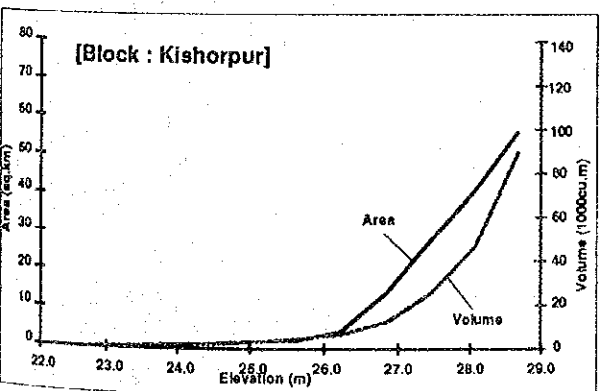
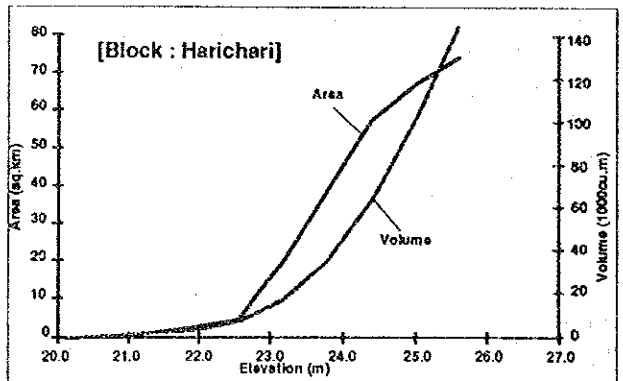
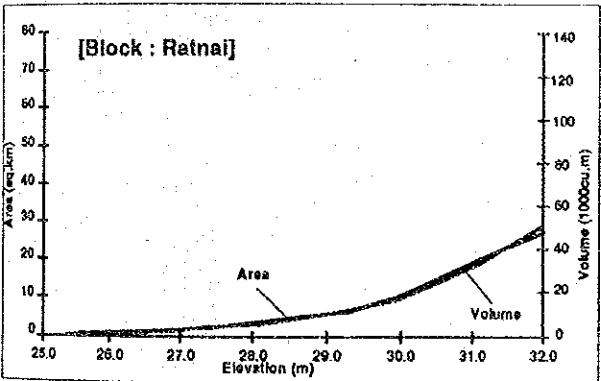
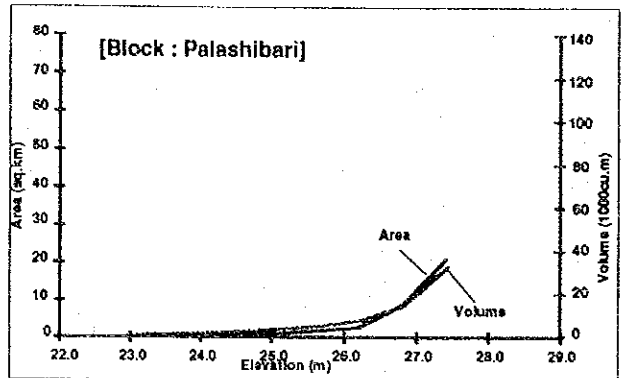
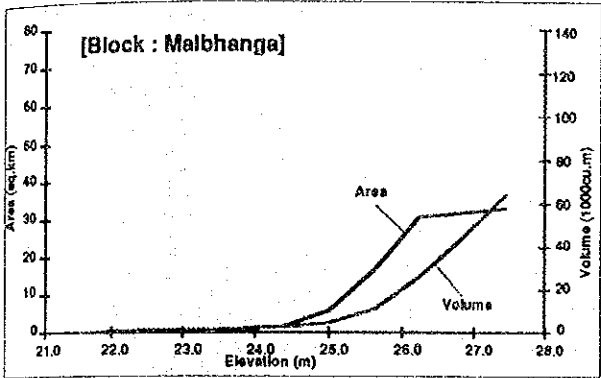
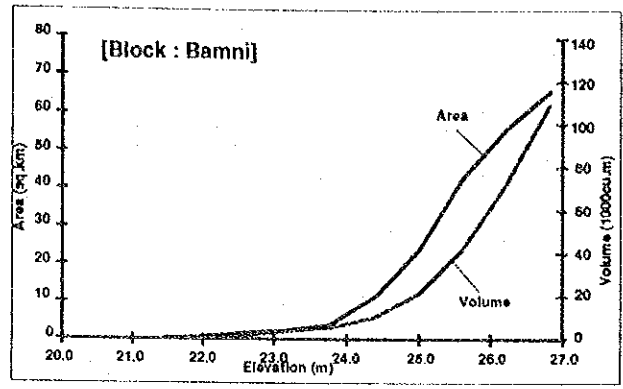
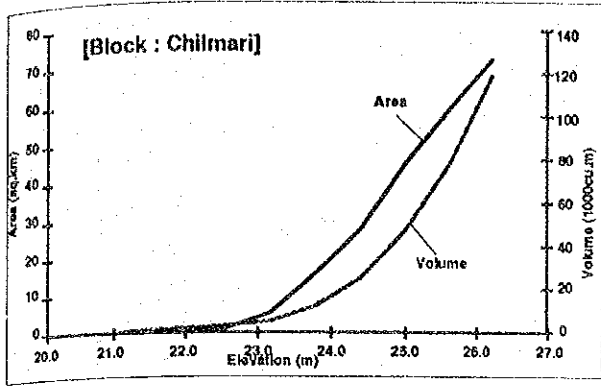


Fig.XI.4.3 RUNOFF HYDROGRAPH IN THE BASIC YEAR (1987) / (2/2)



**Fig. XI.4.4 HVA CURVE UNDER IMPROVED CONDITION**

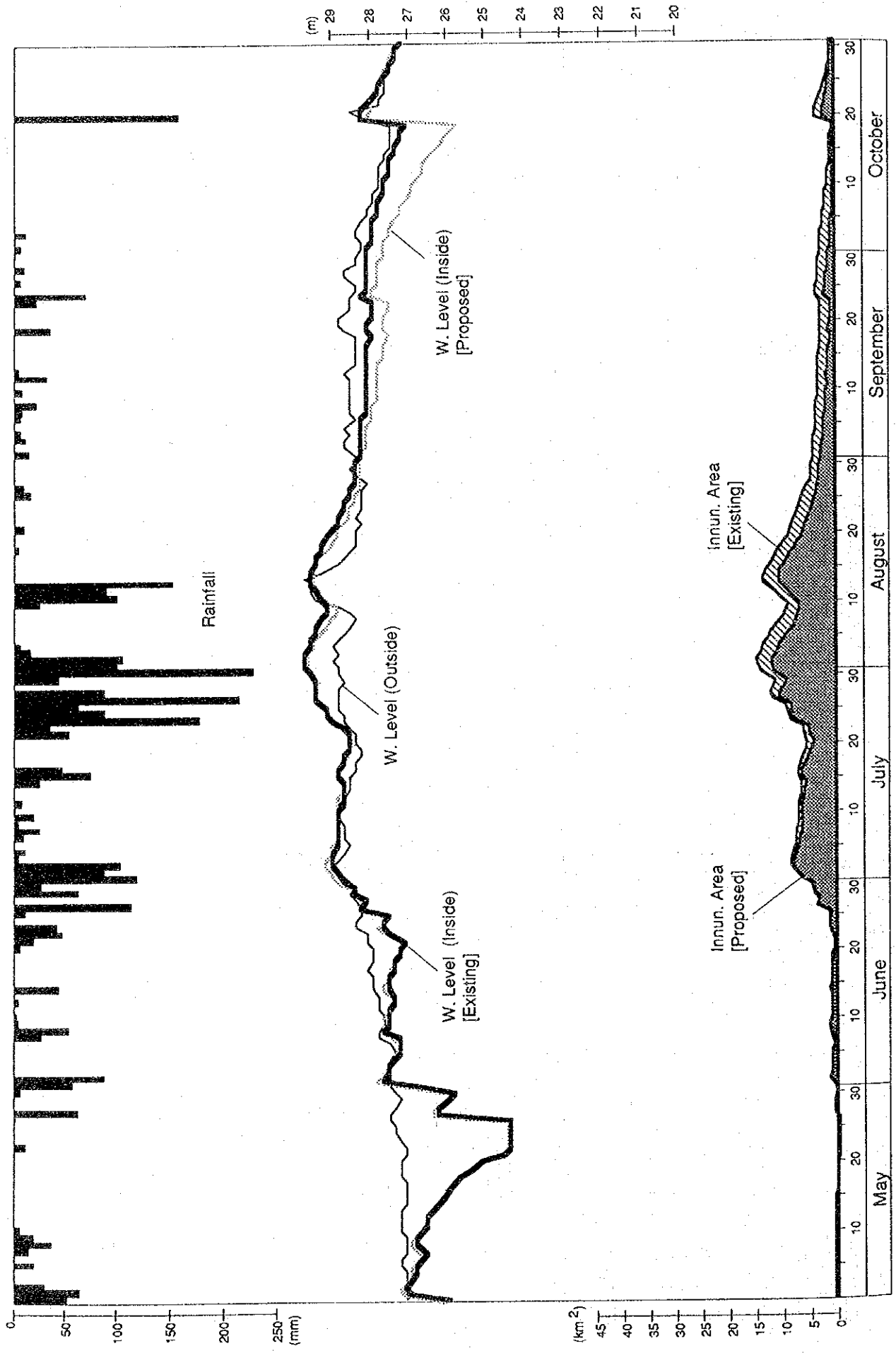


Fig. XI.4.5 (1/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [GHARIALDANGAI]

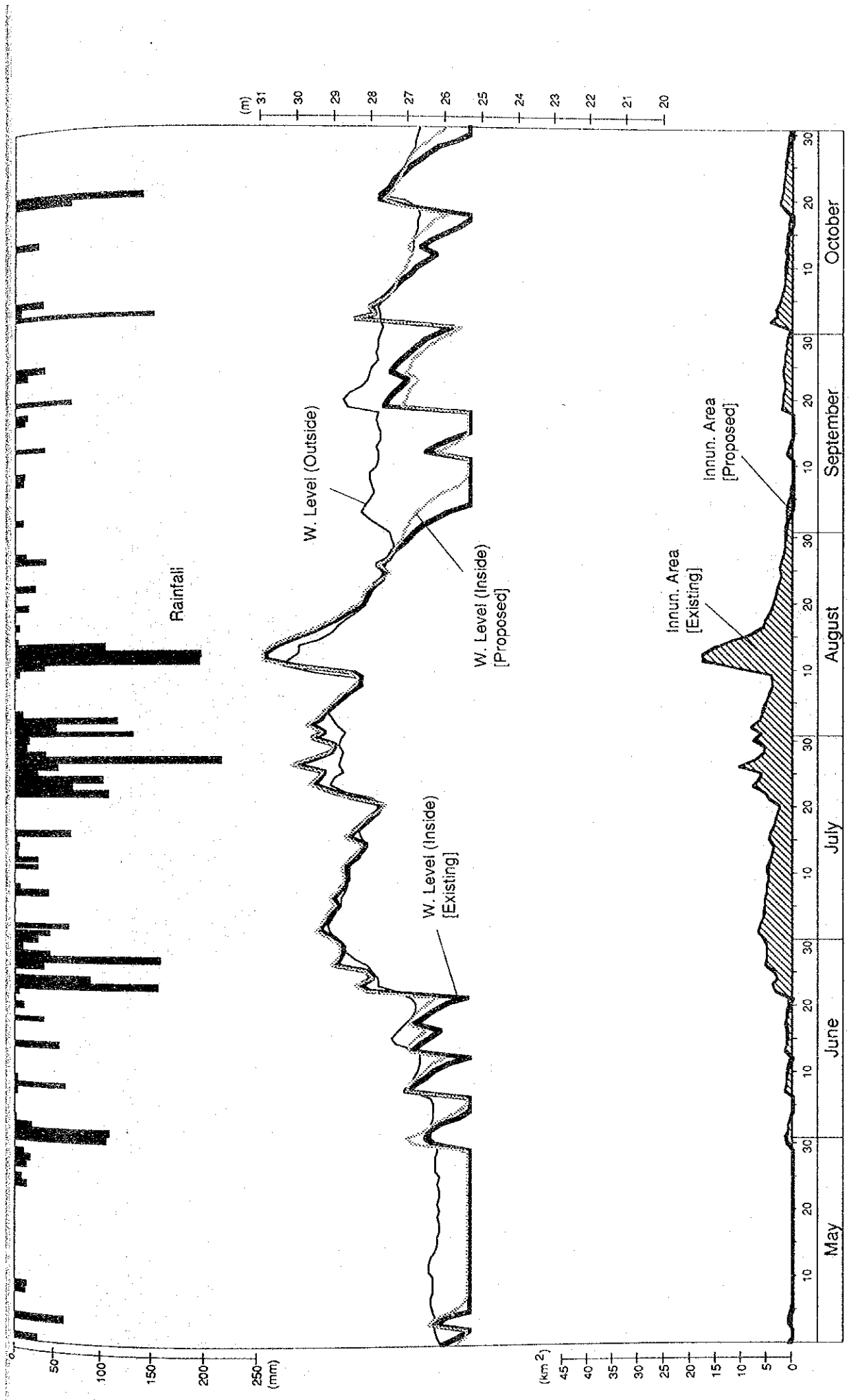


FIG. XI.4.5 (2/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [RATNAJ]

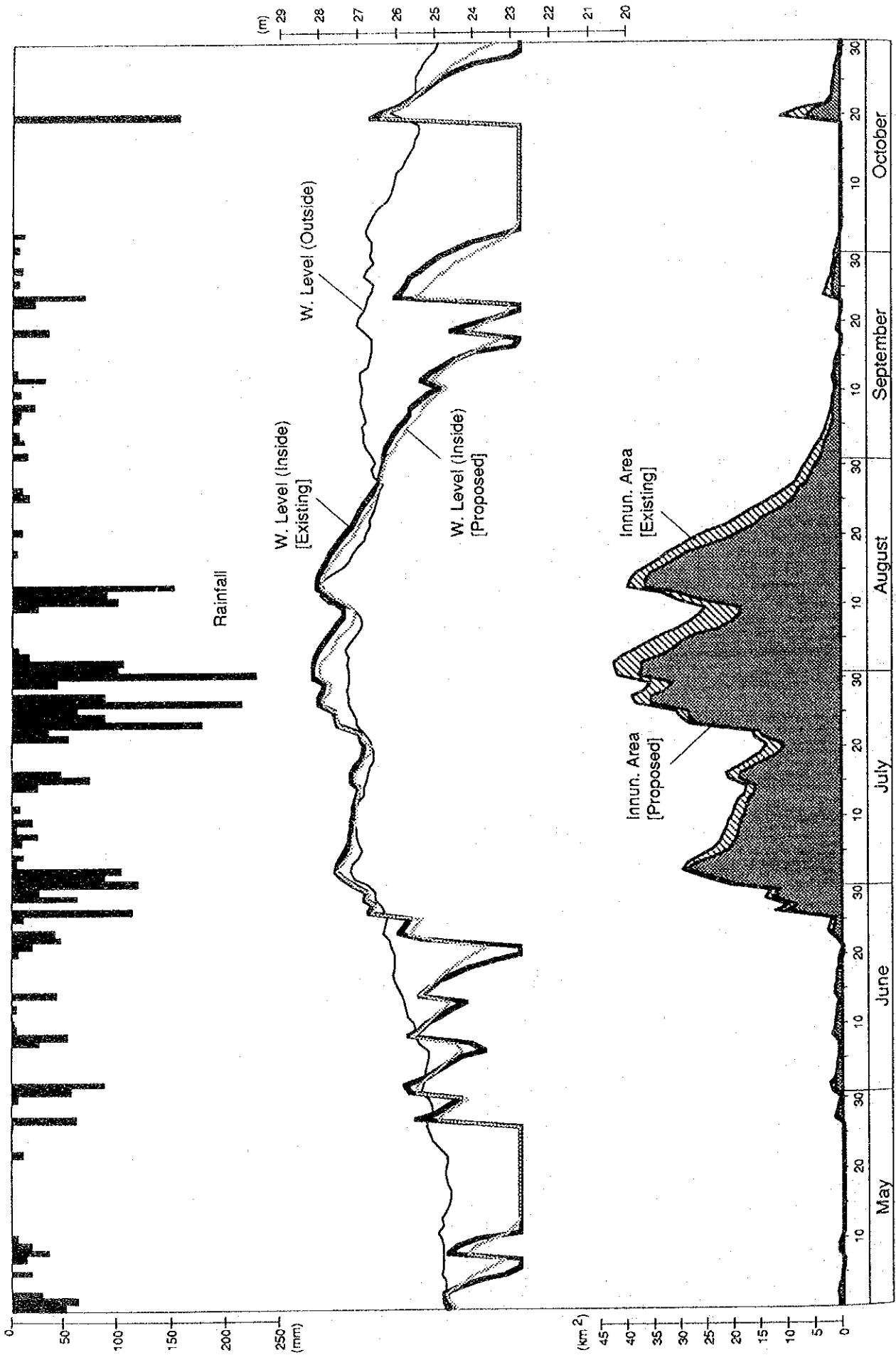


Fig. XI.4.5 (3/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [KISHORPUR]



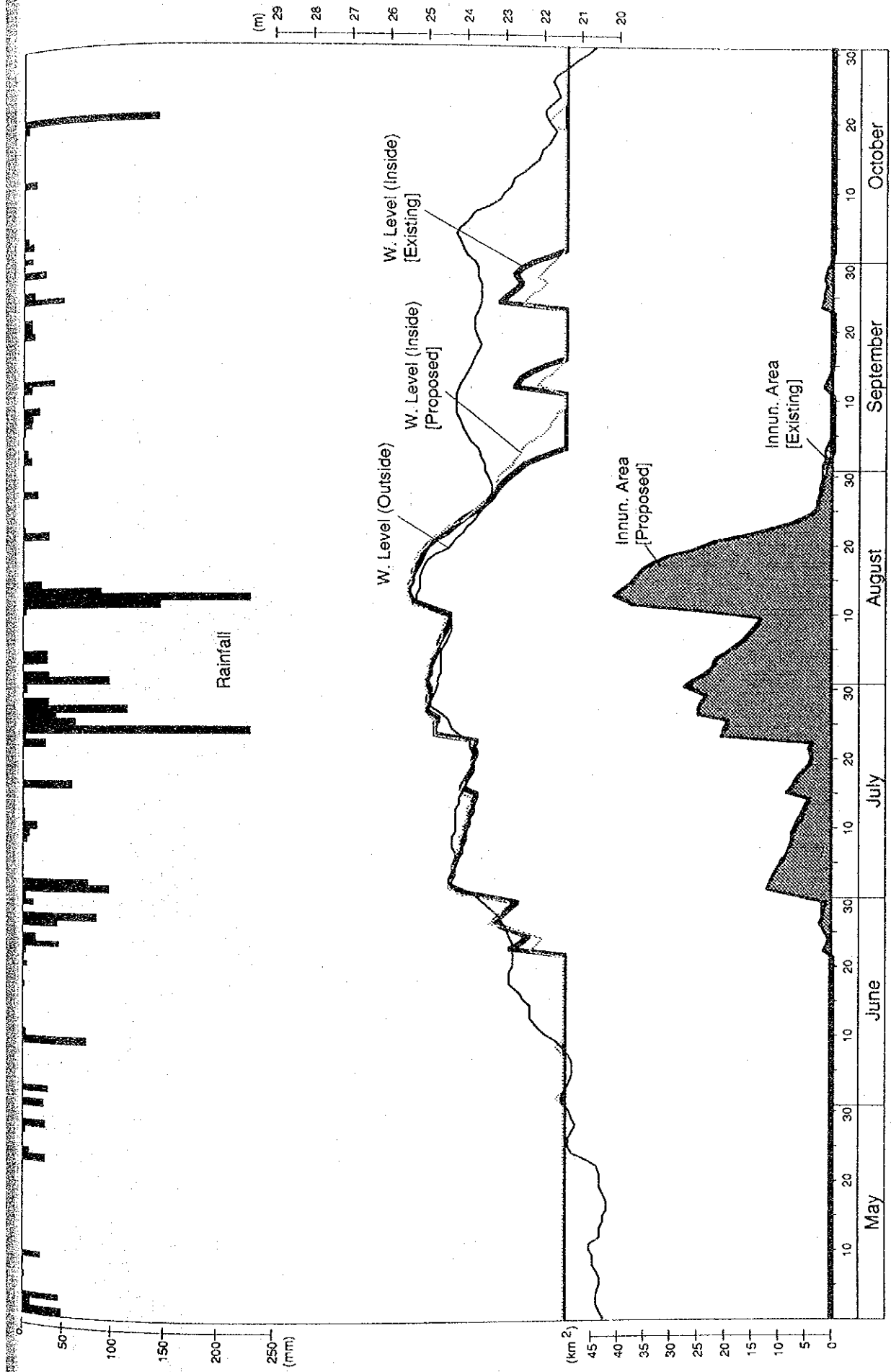


FIG. XI.4.5 (4/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [BAMNI]

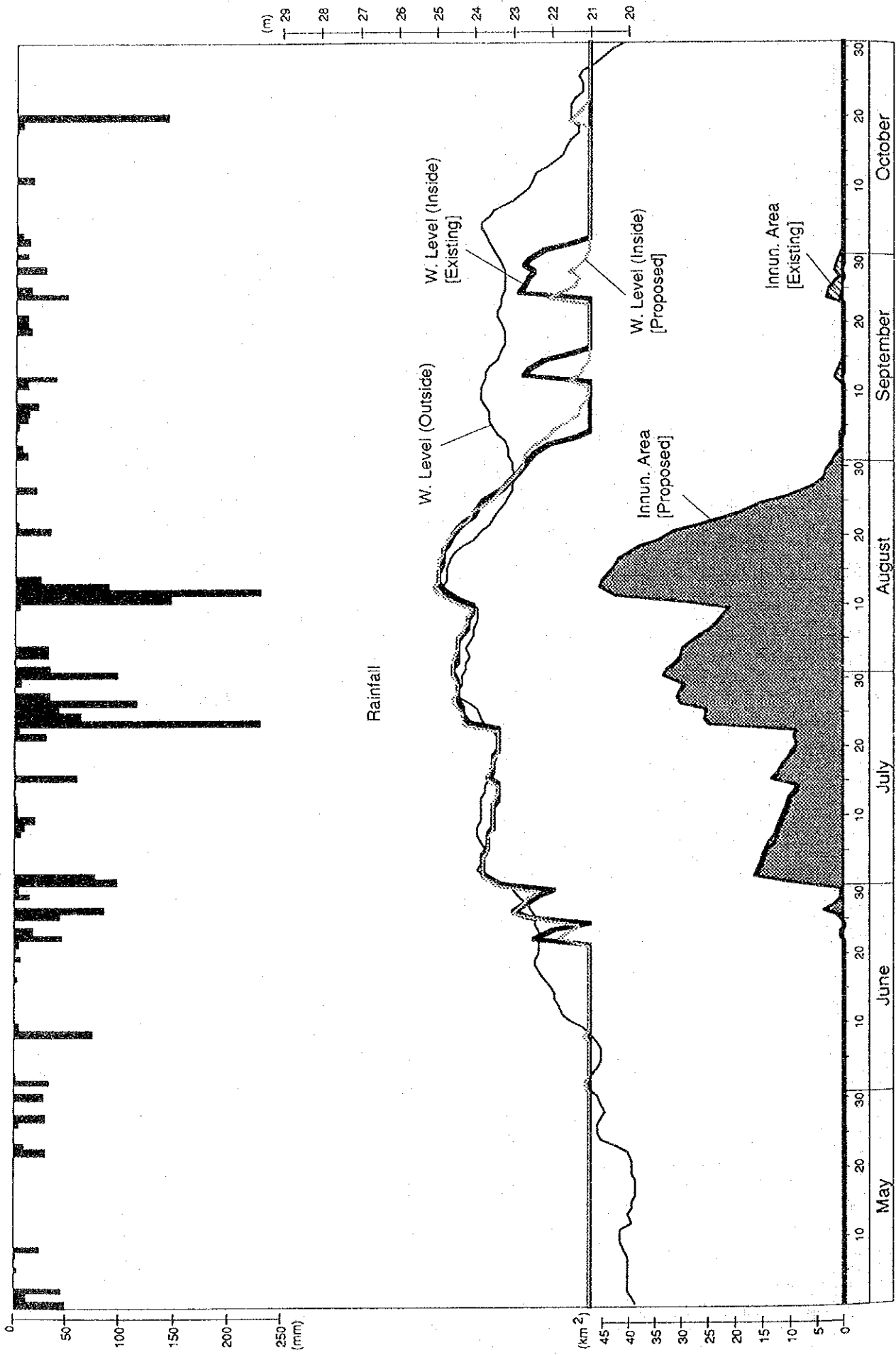


FIG. XI.4.5 (S/B) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [CHILMARI]

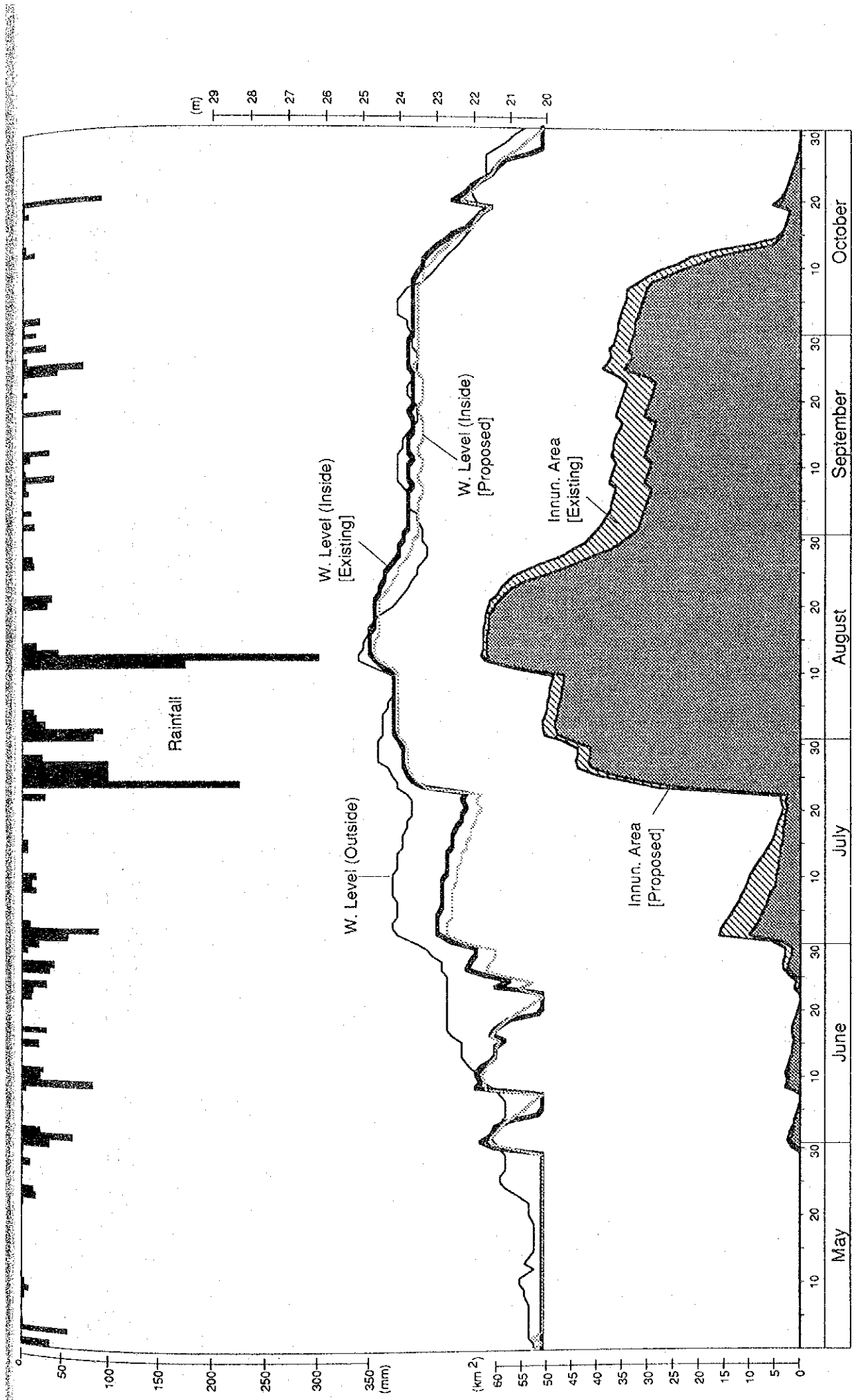


FIG. XI.4.5 (6/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [HARICHARI]

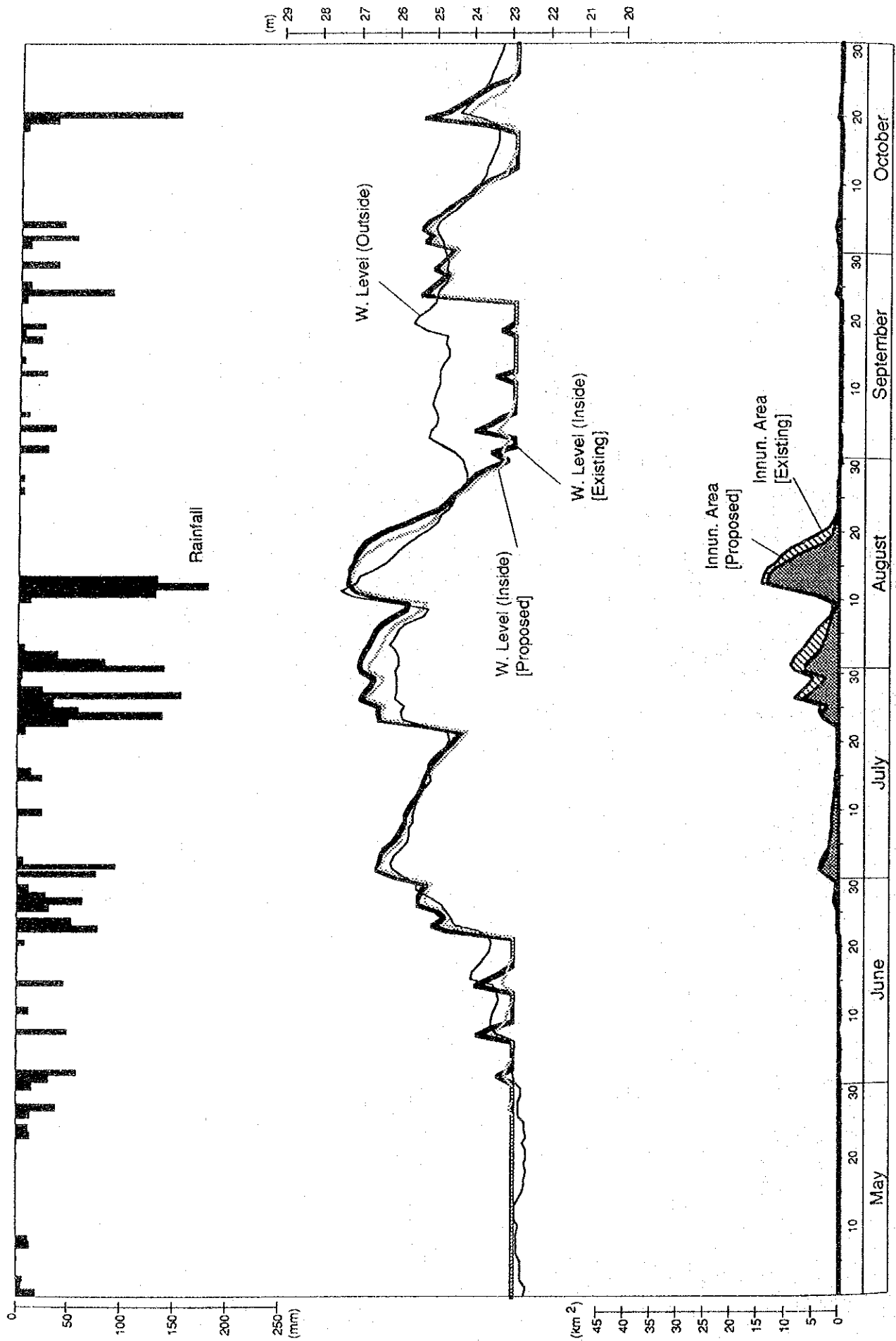


FIG. XI.4.5 (7/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [PALASHIBARI]

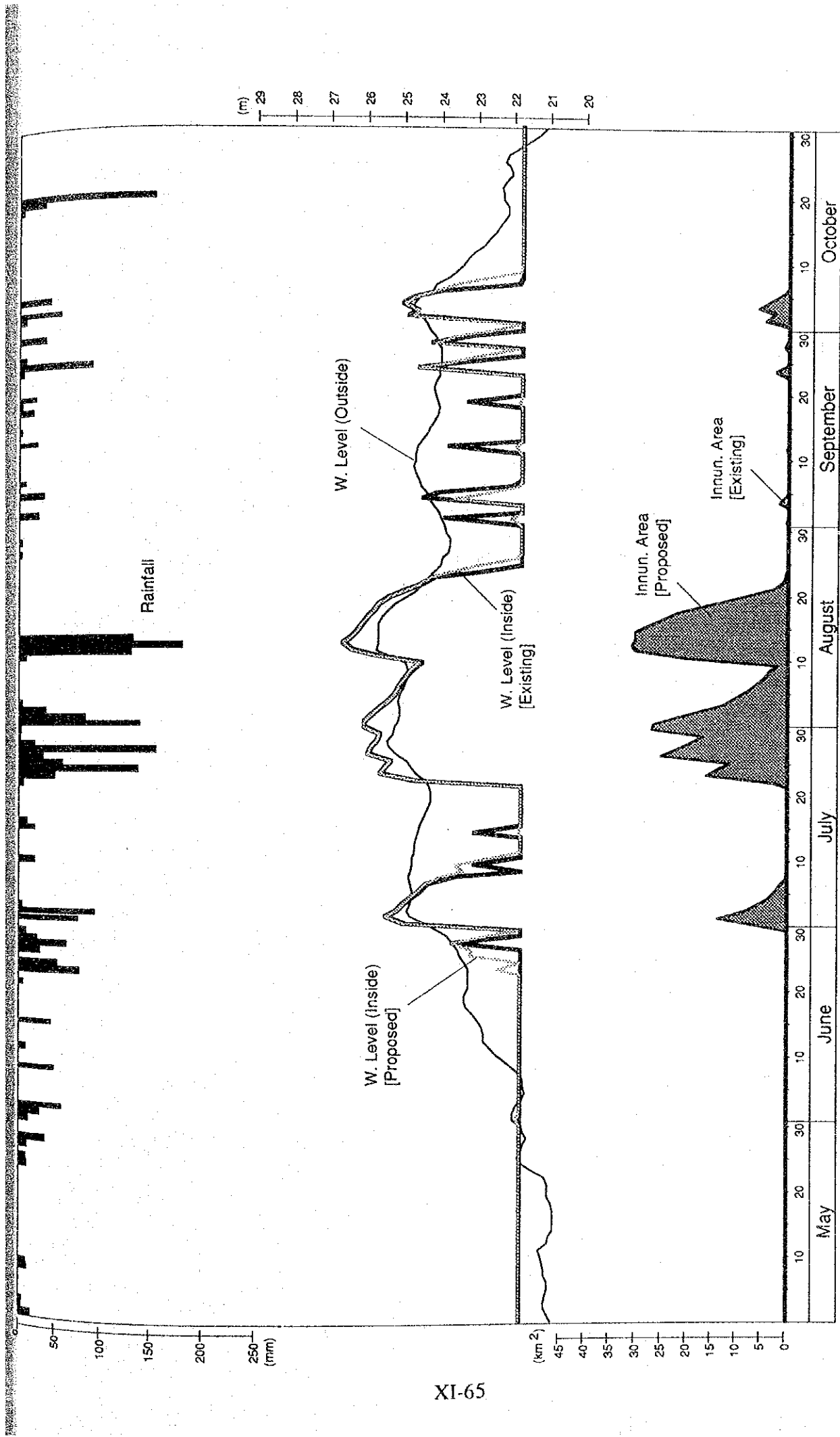


FIG. XI.4.5 (8/8) DRAINAGE CONDITION IN 1987 UNDER WITH AND WITHOUT PROJECT CONDITION [MALBHANGA]



**APPENDIX - XII**

**FACILITY PLANNING  
AND  
PRELIMINARY DESIGNS**





**FEASIBILITY STUDY ON  
KURIGRAM IRRIGATION AND FLOOD CONTROL PROJECT (SOUTH UNIT)**

**APPENDIX - XII FACILITY PLANNING AND  
PRELIMINARY DESIGN**

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## APPENDIX XII FACILITY PLANNING AND PRELIMINARY DESIGN

### 1. Irrigation Development Facilities

#### 1.1 Head Work

##### (1) Site Selection for Intake Regulator

The intake regulator diverts discharge by gravity flow, without weir or barrage construction. Diverted discharge is conveyed to the benefit area by means of existing drainage canals and river channels. Irrigation water is fed to the fields from the canals and rivers by low lift pump. Accordingly, discharge must be diverted at the highest possible elevation. The site selected is Bumka in the extreme north of the Project area.

##### (2) Intake Water Level and Intake Discharge

Intake discharge is to be 30 m<sup>3</sup>/sec, which is equivalent to the divertable discharge of the Dharla river. Low water discharge (355 day) with a return period of 10 years for the Dharla river is 50 m<sup>3</sup>/sec, which allows for diversion of 30 m<sup>3</sup>/sec applying criterion of 40% of available discharge for maintenance flow. Intake water level is computed at LWL 27.15 m, which is the low water level with a return period of 10 years on the basis of data from the Talukshimulbari gauging station.

##### (3) Design High Water Level and Embankment Crest Height

The intake regulator will cut across the right side embankment of the Dharla river. Accordingly, the structure must be sufficiently strong to withstand flood with a return period of 50 years. Design high water level is set at EL 32.51 on the basis of water level data from Talukshimulbari (roughly the same location as Bumka). Design embankment crest height is to be EL 33.41 m, with extra banking of 0.20 m.

##### (4) Intake Canal

An intake canal is planned as the right embankment is separated from the Dharla main channel by about 265 m (low flow portion). Intake mouth width is to be 100 m allow for an intake velocity of 0.3 m/sec and water depth of 1.0 m (in consideration of water depth during low water season). Intake sill elevation at the intake mouth is to be EL 26.13 m. From dimensions of 100 m width and 1.0 m water depth at its mouth, the intake canal will change to 25.0 m width and 2.0 m water depth before the intake regulator. Canal length will be 265.0 m. Flow velocity will accelerate from 0.3 m/sec at the intake mouth to 0.6 m/sec at the intake regulator.

##### (5) Intake Regulator

The intake regulator will be designed for inflow by free flow. Regulator structure will be the same as the existing regulator, with gate hoisting performed manually. Vent cross section (inner dimensions) will be 1.52 m width and 1.83 m height.

Number of vents and gate sill elevation will be determined so as to establish a roughly 1.0 m/sec flow velocity inside the vents. Accordingly, vent number will be as

follows:

$$n = 30.0 \text{ m}^3/\text{sec} / (1.6 \text{ m} \times 1.52 \text{ m} \times 1.0 \text{ m}/\text{sec}) = 12 \text{ gates.}$$

Gate sill elevation will be EL 25.450 m.

(6) Headwork Features

On the basis of the foregoing, headwork main features can be summarized as follows:

Intake mouth	intake velocity	0.3 m/sec
	width of mouth	100 m
	water depth	1.0 m
Intake canal	canal length	265 m
	width of canal	100 - 25 m
	water depth	1.0 - 2.0 m
Intake regulator	size of vent1.	52 m (W) x 1.83 m (H)
	nos. of vents	12 vents
	size and nos. of sluice gate	1.52 m (W) x 1.83 m (H) x 12gates
	elevation of gate sill	EL 25.45 m
	top of embankment	EL 33.41 m
	high water level	EL 32.51 m

(7) Water Level at Start Point of Main Canal

Water level at start point of main canal is set at WL 27.00 m, including 0.15 m to account for intake loss, cross-sectional change loss, friction loss, etc. of intake mouth, canal and intake regulator.

## 1.2 Irrigation Canal

(1) Selection of Canal Routes

Discharge diverted at the Bumka site is to be conveyed to the Project area by means of existing rivers and drainage canals. Relation of this with main canals A-F is as follows. (see Figure XII - 1.1)

(a) Main channel A:

Bumka intake regulator -> Ratnai river -> Kalua Nazi -> irrigation canal -> Bamni river -> Bamni regulators

(b) Main channel B:

Main channel A, Kalua Nazi -> new canal -> Deola Bil -> Buri Teesta river -> Chilmari regulator

(c) Main channel C:

Main channel B, Deola Bil -> irrigation canal -> new canal }-> Bamni river ->

new canal -> Dhelardhani Bil -> Magurabeel regulator

(d) Main channel D:

Main channel A -> irrigation canal -> Jamunc Bil -> Bamni Regulators

(c) Main channel E:

Main channel E -> irrigation canal -> Chakchake Bil -> new canal -> main channel E

(f) Main channel F:

Main channel A -> new canal -> Desrhatar chhera -> Palashbari regulator

(2) Design Discharge

Main canal design discharges are diagrammed in Figure XII 1.2. This is based on subdivision of the Project area into sections limited to around 1,000 ha, preparation of an irrigation system map and computation of unit design discharge at 1.65 l/sec.

(3) Canal Cross Section

(a) Canal Gradient

Gradient for new canals is to be 1/20,000 in consideration of the fact that (i) this is the gradient for existing canal, and (ii) a gradient producing excessively slow flow speed will encourage aquatic plant growth inside the canal.

(b) Roughness Coefficient

Manning's roughness coefficient is set at  $n = 0.025$  in consideration of the extremely slow flow speed, etc.

(c) Canal Cross Section

Type wise canal cross sections based on design discharge are shown in Table XII. Canal cross section types, water levels, etc. for each main channel are as shown in Table XII 1.2.

### 1.3 Irrigation Canal Regulator (Canal Structure)

(1) Irrigation Canal Regulator Layout

Turnouts are planned for canals. These will be connected to the main canals by means of irrigation canal regulator structures. Under the Project, existing rivers and drainage canals are to be used as main irrigation canals. Moreover, these rivers and drainage canals lack sufficient embankment, and as a result, it would be difficult to construct regulating gates both flush against the main channel and the turnout site. Regulating gate structures will accordingly be constructed at points where the embankment is stable or at points of higher elevation, and these structures will feature 2 gates separated by some distance: 1 flush against the main channel and 1 flush against the turnout intake.

(2) Regulator Type

Irrigation canal regulators will be constructed in principle at turnout sites. However, construction of new irrigation canals under the Project would alter the drainage system of the Project area. To avoid this, siting of regulators will take into consideration impact on the present drainage configuration of the area. It is also necessary that the regulator structures do not impede the water passing capacity of drainage canals during flooding.

On the basis of the above, both closed type and open type regulators are planned under the Project.

(3) Closed Type Regulator

(a) Gate is closed during flooding to prevent disturbance of the area's drainage system.

(b) Regulator cross section is determined on the basis of canal design discharge.

(c) As in the case of existing drainage regulators, sluice gates (water tight on 4 sides) are to be used. Gate operation is to be manual.

(d) Number of regulator vents will be determined such that flow speed within the vent is approximately 0.6 m/sec in view of (i) flow speed in the drainage canals during periods of irrigation is 0.3-0.4 m/sec, and (ii) the need for smooth connection between the canals on both sides of the regulator.

(e) Type wise regulator features on the basis of canal design discharge are indicated in Table XII 1.3

(4) Open Type Regulator

(a) Gate is raised during flooding so as not to impede drainage

(b) Design discharge is to be determined from canal cross section. Bridges are to be constructed along both sides of the structure to ensure envisioned drainage capacity.

(c) Gate operation is to be manual. Span is to be 3.0 m and gate height at a maximum 2.5 m. Gates are to be water tight on 3 sides.

(d) Type wise regulator features on the basis of design discharge and bridge length are indicated in Table XII 1.4

(5) List of Irrigation Canal Regulators and Check Gates

Irrigation canal regulators and check gates to be constructed under the Project are indicated in Table XII 1.5 along with main dimensions.

#### **1.4 LLP Development Facilities**

The policy of the Bangladesh government is to delegate responsibility for the establishment of LLP irrigation systems to the individual farmer or farmer groups. Nevertheless, it is necessary to adopt large scale LLP's to ensure that discharge under natural diversion irrigation schemes reaches areas relatively distant from the source river, thereby maximizing the effective utilization of water resources.

It is desirable in such cases that pump type is one for which main pump body and spare parts are either manufactured or readily procurable in Bangladesh. The largest pump presently manufactured in Bangladesh is a centrifugal type pump with capacity of 2 cusec (56 l/sec). As this pump type has a proven track record in Bangladesh, it is to be adopted under the Project. 2 units of 2 cusec pump will be installed at each envisioned pump site.

The necessary engine output to operate a pump for total head of 7.0 m is 12.5 hp. A manual pump will be installed for water feed at pump start up.

On farm water distribution is to be by field canal network with density of 50 m/ha. Field canal cross section is shown in Table XII 1.6.

#### **1.5 STW Development Facilities**

The standard in Bangladesh for interval between STW's is 245 m (800 ft). At this interval, one STW must service roughly 6 ha. However, under conditions of unit discharge of  $q = 1.650$  l/sec/ha and operating period of 10 hours per day, a STW can effectively service only 5 ha. In such case the appropriate pump capacity is 3/4 cusec (centrifugal type). Necessary engine output for pump operation is 6.0 hp.

Under the Project, STW's are planned at  $D = 100$  mm and 30 m depth. As well command area is small (5 ha), on farm field canals will be earthen (type C under LLP item).

#### **1.6 Demonstration Farm Plan**

Demonstration farms are planned at the following locations:

- a. Banagram LLP; distribution by open canal
- b. Pratap LLP; pipeline main canal; distribution by open canal
- c. Narikelbari LLP; main canal and distribution by pipeline

In line with the LLP development plan, field canal networks with density of 50 m/ha will be established for the above 3 demonstration farms.

Areas and water distribution facilities for the demonstration farms are summarized as follows:

	Area	Distribution Facilities	
Banagram	LLP = 70.0 ha DTW = 17.7 ha STW = 13.3 ha Total = 101.0 ha	LLP canal DTW canal STW canal Total 4,400 m :	3,340 m 560 m 500 m 44 m/ha
Pratap	LLP = 34.0 ha DTW = 24.8 ha STW = 10.5 ha Total = 69.3 ha	LLP canal DTW canal STW canal LLP pipe (O 250) Total 4,190 m	1,960 m 860 m 720 m 650 m 60.4 m/ha
Narikelbari	LLP = 69.1 STW = 19.8 ha (3 sites) Total = 88.9 ha	LLP canal (pipe) DTW canal (open) STW canal Total 4,190 m	3,070 m 770 m 720 m 47.1 m/ha

## 2. Drainage Improvement

### 2.1 Ratnai River Diversion Canal

#### (1) Design Discharge

The catchment area of the Ratnai river outside the flood embankment is approximately 115 km<sup>2</sup>. The diversion canal will safely convey the runoff from this catchment area into the Dharla river. The runoff from this 115 km<sup>2</sup> area is 88.6 m<sup>3</sup>/sec.

#### (2) Canal Section

Canal length is 3,280 m over topography for which little elevation differential can be obtained. However, with consideration to the issue of land acquisition as well, canal gradient of 1/3,500 and canal base width of 10.4 m will allow for flow into the Dharla river at a canal water depth of 4 m. Accordingly, the canal section is planned at base width of 10.0 m and side gradient of 1:2.0, with canal gradient of 1/3,500. Elevation at the canal start point from the Ratnai river is to be EL 26.408, and EL 26.00 at the Dharla river end point.

### 2.2 Ratnai Regulator

The Ratnai regulator was destroyed during the 1987 flood. It will be reconstructed under the Project to protect the Project area.

#### (1) Structure and Vent Number

The regulator structure will be the same as existing drainage regulators. Existing regulators have approximately 1 vent for every 7-8 km<sup>2</sup> of drained area. 8 vents are thus

necessary for the Ratnai regulator which will service a drainage catchment inside the Ratnai river embankment of 60 km<sup>2</sup>.

(2) Flood Level and Design Embankment Height

Floods at the Ratnai site with return periods of 20 and 50 years respectively are as follows:

1/20 return period flood level:	30.18 m
1/50 return period flood level:	30.48 m

The design embankment height is EL 31.38, which is 0.9 m higher than the flood level with return period of 50 years.

(3) Gate Sill Elevation

Gate sill elevation is to be EL 24.38, which is the same as the original structure.

(4) Embankment Cross Section

The design cross section is to be adopted for the embankment cross section.

**2.3 Additional Regulator**

Results of hydraulic analysis for drainage improvement indicate that expansion of these 4 regulator structures shown below will reduce flood damage by 1,048 ha (in the case of 1987 flood corresponding to flood with return period of 10 years).

Regulator structure will be the same as other existing structures. Main features of regulators to be expanded are as follows:

Items	Palashubari	Harichari	Kishorpur	Gharialdanga
Gate sill elevation	22.85	20.12	22.77	24.38
Dimension of gates	1.52 x 1.83	1.52 x 1.83	1.52 x 1.83	1.52 x 1.83
No. of vents	2	8	12	2
Design high water level	18.60	25.77	27.14	29.89
Crest height of embankment	29.50	26.67	28.04	30.79
Existing regulators (no. of vents)	2	12	12	2

**2.4 Pipe Sluice**

Pipe sluices supplement the drainage function of the main regulators, and are effective for facilitating drainage of those local areas during flood which suffer from more pronounced and lingering inundation. Accordingly, a new pipe sluice will be constructed at Lakhlarpara. In addition, flap gates will be replace for 6 existing pipe sluices which exhibit the most severe deterioration. There are existing pipe sluices at a total of 10 locations, some of which are without flap gates. This allows backwater and inundation to occur at some locations.



### **3. Rural Infrastructure Improvement**

#### **3.1 Road Network**

Road length in the 5 Thanas of the Project area is discussed in section 3.10 of Chapter 3 of the Main Report. According to this data, asphalt or brick paved road accounts for only 10% (139 km) of the total road length of 1,193 km. Calculated road densities are extremely low at 1.0 km/km<sup>2</sup> for Kurigram Sadar, 0.6 km/km<sup>2</sup> for Rajarhat and Lalmonirhat, and 0.3~0.4 km/km<sup>2</sup> for Ulipur and Chilmari.

Roads without asphalt surface have extremely weak structure, narrow width and are often highly winding. The present road network will be inadequate with increased farm production and the introduction of farm machinery anticipated as a result of the Project. Accordingly, it will be necessary to implement measures to increase road density, strengthen road structure and expand road width.

#### **3.2 Bridge and Culvert**

Since irrigation canals will be established by dredging existing rivers and drainage canals, almost all existing bridges and culverts will need to be reconstructed under the Project. Types and numbers of bridge and culvert are indicated in Table XII 3.1.

Bridge widths are as follows based on BWDB design standards:

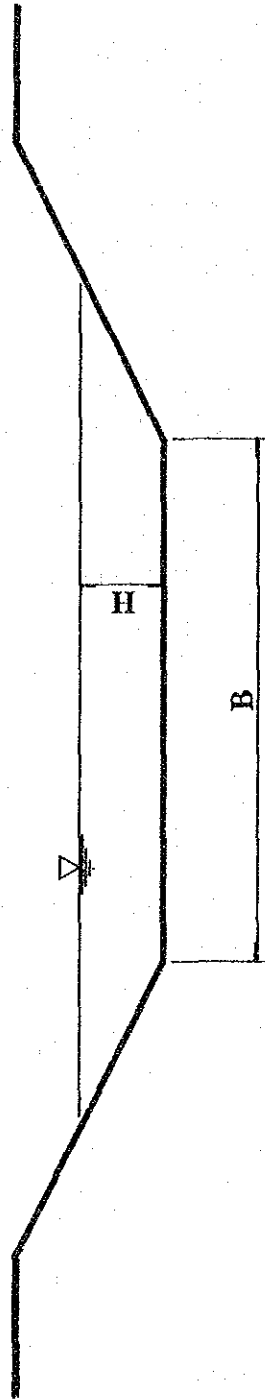
- a. Metaled road bridge : 7.5 m + footpath (0.45 m)
- b. Rural / brick road bridge : two types: 4.5 m and 3.0 m
- c. Railway bridge : 3.0 m (single track)
- d. Culvert (metaled road) : 7.5 m
- e. Culvert (rural / brick road) : 5.0 m \*
- f. Culvert (railway) : 5.0 m \*

\* : (although a width of 3~4.5 m would normally be sufficient, structures are close to 7 m high and a minimum width of 5.0 km/km<sup>2</sup> for is necessary for structure stability.)

Bridge and culvert structures are concrete. In some cases, wooden piles are seen at abutments and piers for bridges. However, wooden piles are not used for culverts.

Location and main features of bridges and culverts to be reconstructed under the Project are as shown in Table XII 3.2.

Table XII.1.1 Cross Section of Irrigation Canal



Type	Discharge Q (cu.m)	Slope 1 : z	Canal Slope I	Bed width B (m)	Water Depth H (m)	Velocity V (m/s)	Length of Main Channels (m)								
							A	B	C	D	E	F	Total		
I	30.00 ~ 26.84	1 : 2.5	1/20,000	25.0	2.28 ~ 2.15	0.430 ~ 0.416	27,630	-	-	-	-	-	-	-	27,630
II	24.50	1 : 2.5	1/20,000	23.0	2.14	0.412	3,995	-	-	-	-	-	-	-	3,995
III	16.55	1 : 2.0	1/20,000	14.0	2.23	0.405	-	8,100	-	-	-	-	-	-	8,100
IV	8.03 ~ 6.05	1 : 2.0	1/20,000	6.0	2.18 ~ 1.88	0.332 ~ 0.359	11,820	23,080	14,430	-	-	-	-	-	49,330
V	4.64 ~ 3.94	1 : 2.0	1/20,000	4.0	1.90 ~ 1.76	0.304 ~ 0.316	-	12,220	5,470	2,200	-	-	-	-	19,890
VI	2.90 ~ 1.02	1 : 1.5	1/20,000	3.0	1.76 ~ 1.01	0.221 ~ 0.294	20,977	12,476	15,948	11,000	10,000	7,832	-	-	78,233
Total (m)							64,422	55,876	35,848	13,200	10,000	7,832	-	-	187,178

Table XII.1.2 Canal Cross Section of Each Main Channel (1/2)

(Unit : m)

Main Chis	Station	Discharge (qu.m/s)	Canal Gradient	Canal Type	Bed Elevation	Water Elevation	Remarks
A	0+000				24.720	27.000	Intake Regulator
	14+400	30.00	1/20,000	AI-1	24.000	26.202	To Existing Ratnai Regulator
	14+700	(u/s)			23.985	26.185	A-1 Regulator (Closed Type)
	14+700	(d/s)			23.935	26.135	
	22+800	27.83	1/20,000	AI-2	23.530	25.681	To Existing Siramali Regulator
	23+020	(u/s)			23.519	25.669	A-2 Regulator (Closed Type)
	23+020	(d/s)			23.469	25.619	
	27+000	26.84	1/20,000	AI-3	23.270	25.308	B.P. of Channel - F (1.71 qu.m/s)
	27+630	(u/s)			23.239	25.259	A-3 Regulator (Open Type)
	27+630	(d/s)			23.069	25.209	
	30+000	24.50	1/20,000	AII	22.950	25.048	B.P. of Channel - B (16.55 qu.m/s)
	31+625	(u/s)			22.869	24.939	A-4 Regulator (Open Type)
	31+625	(d/s)			22.829	24.889	
	43+000	7.22	1/20,000	AIV	22.260	24.099	B.P. of Channel - D (3.29 qu.m/s)
	43+445	(u/s)			22.238	24.068	A-5 Regulator (Closed Type)
	43+445	(d/s)			22.368	24.018	
51+140	2.57	1/20,000	AVI-1	21.983	23.193	A-1 Check Gate (Open Type)	
54+460	(u/s)			21.817	22.837	A-6 Regulator (Open Type)	
54+460	(d/s)			21.767	22.787		
62+985	1.02	1/20,000	AVI-2	21.341	22.361	A-2 Check Gate (Open Type)	
64+422				21.269	22.289	Existing Bamni Add. Regulator	
B	0+000				22.770	25.000	
	1+000				22.720	24.950	
	1+100	16.56	1/20,000	BIII-1	22.715	24.945	B-1 Regulator (Closed Type)
	1+100	(d/s)			22.665	24.895	
	2+000				22.620	24.837	
	3+800	(u/s)			22.530	24.72	B-2 Regulator (Closed Type)
	3+800	(d/s)			22.480	24.670	
	6+500	16.00	1/20,000	BIII-2	22.345	24.504	B.P. of Channel - C (7.55 qu.m/s)
	8+100	(u/s)			22.265	24.405	B-3 Regulator (Closed Type)
	8+100	(d/s)			22.175	24.355	
	12+000	8.03	1/20,000	BIV-1	21.980	24.040	
	17+840	(u/s)			21.688	23.568	B-4 Regulator (Open Type)
	17+840	(d/s)			21.638	23.518	
	31+000	6.05	1/20,000	BIV-2	20.980	22.485	To Existing Kishorpur Regulator
	31+180	(u/s)			20.971	22.471	B-5 Regulator (Closed Type)
31+180	(d/s)			20.661	22.421		
38+000	3.99	1/20,000	BV	20.320	21.801		
43+400	(u/s)			20.050	21.310	B-6 Regulator (Closed Type)	
43+400	(d/s)			19.760	21.260		
52+762	2.11	1/20,000	BVI	19.292	20.792	B-1 Check Gate (Open Type)	
55+876				19.136	20.636	Existing Chilmari Regulator	

Table XII.1.2 Canal Cross Section of Each Main Channel (2/2)

(Unit : m)

Main Chls	Station	Discharge (qu.m/s)	Canal Gradient	Canal Type	Bed Elevation	Water Elevation	Remarks
C	0+000				22.350	24.450	
	0+482 (u/s)	7.55	1/20,000	CIV-1	22.326	24.426	C-1 Regulator (Open Type)
	0+482 (d/s)				22.276	24.376	
	4+000				22.100	24.103	To C-7 Regulator (Open Type)
	5+560 (u/s)				22.022	23.982	C-2 Regulator (Closed Type)
	5+560 (d/s)	6.55	1/20,000	CIV-2	21.972	23.932	
	7+000				21.900	23.777	
	8+330 (u/s)				21.834	23.634	C-3 Regulator (Open Type)
	8+330 (d/s)	6.05	1/20,000	CIV-3	21.784	23.584	
	11+000				21.650	23.362	
	14+430 (u/s)				21.479	23.079	C-4 Regulator (Open Type)
	14+430 (d/s)	4.64	1/20,000	CV	21.129	23.029	
	17+000				21.000	22.703	
	19+900 (u/s)				20.855	22.335	C-5 Regulator (Closed Type)
	19+900 (d/s)	2.90	1/20,000	CVI-1	20.525	22.285	
24+000	20.320				21.761		
27+620 (u/s)	20.139				21.299	C-6 Regulator (Open Type)	
27+620 (d/s)	1.31	1/20,000	CVI-2	20.089	21.249		
34+282				19.756	20.916	C-1 Check Gate (Open Type)	
55+876				19.136	20.636	Existing Magurbeel Regulator	
D	0+000				21.500	23.100	
	0+270 (u/s)	3.29	1/20,000	DV	21.487	23.087	D-1 Regulator (Open Type)
	0+270 (d/s)				21.437	23.037	
	1+750				21.363	22.595	B.P. of Channel - E (1.62 qu.m/s)
	2+200 (u/s)				21.340	22.460	D-2 Regulator (Closed Type)
	2+200 (d/s)	1.67	1/20,000	DVI	21.080	22.410	
12+430	20.569				21.899	D-1 Check Gate (Open Type)	
13+200				20.530	21.860	Existing Bamni Regulator	
E	0+000				21.252	22.562	
	0+380 (u/s)	1.62	1/20,000	EVI	21.233	22.543	E-1 Regulator (Open Type)
	0+380 (d/s)				21.183	22.493	
	2+880				21.058	22.368	E-1 Check Gate (Open Type)
	3+070 (u/s)				21.049	22.359	E-2 Regulator (Closed Type)
	3+070 (d/s)				20.999	22.309	
	7+000				20.802	22.112	
10+000				20.652	21.962	Channel -D St. 11+180	
F	0+000				23.540	24.890	
	0+315 (u/s)	1.71	1/20,000	FVI	23.524	24.874	F-1 Regulator (Closed Type)
	0+315 (d/s)				23.474	24.824	
	4+000				23.290	24.640	
7+832				23.098	24.448	F-1 Check Gate (Closed Type)	

**Table XII.1.3 Each Type of Irrigation Regulators**

**(Closed Type)**

Type	Discharge Q (cu.m/s)	Vent Numbers	Canal Type	Name of Regulator
A	30.00 ~ 26.84	12	I	A-1, A-2
B	16.55	7	III	B-1, B-2
C	8.03 ~ 7.55	4	IV	B-3, C-2
D	3.99	2	V/VI	A-5, B-5, C-5, D-2, E-2, F-1, CGF-1
E	2.11 ~ 1.30	2	VI	B-6, C-6

**Table XII.1.4 Each Type of Irrigation Regulators**

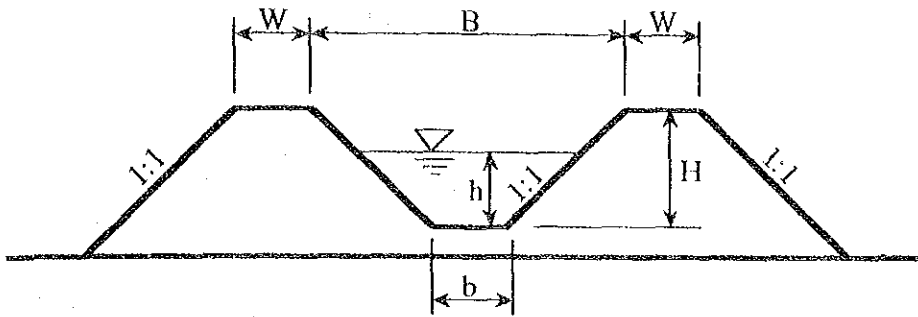
**(Open Type)**

Type	Discharge Q (cu.m/s)	Vent Numbers	Bridge Length (m)	Canal Type	Name of Regulator
A	24.50	6	44.3	II	A-3
B	7.22	2	46.7	IV	A-4
C	7.55	5	20.4	IV	C-1
D	6.05	3	12.8	IV	B-4
E	6.05 ~ 4.64	2	8.7	IV	C-3, C-4
F	3.29	6	30.3	V	D-1
G	1.62	7	35.7	VI	E-1, CGE,-1
H	1.02	2	18.1	VI	A-6, CGA-1, CGA-2, CGD-1
I	-	2	32.7	VI	CGB-1, CGC-1,
J	-	6	11.8	-	C-7

Table XII.1.5 Type & Main Feature of Prop.Irrigation Canal Regulator & Check Gate

Regulator/ Check Gate	Type	Bridge Width (m)	H (m)	h1 (m)	Sill Elevation (m)
A-1	Closed A	4.5	6.0		23.985
A-2	Closed A	4.5	7.0		23.519
A-3	Open A	4.5	6.0		23.239 (23.069)
A-4	Open B	4.5	5.6		22.869 (22.829)
A-5	Closed D	3.0	4.0		22.238 (22.368)
A-6	Open H	4.5	4.3		21.817
B-1	Closed B	4.5	6.5		22.715
B-2	Closed B	4.5	5.9		22.480
B-3	Closed C	4.5	6.7		22.265
B-4	Open D	4.5	6.8		21.688
B-5	Closed D	4.5	6.5		20.971 (20.661)
B-6	Closed E	3.0	5.2		20.050 (19.760)
C-1	Open C	4.5	7.7		22.326
C-2	Closed C	3.0	5.5		22.022
C-3	Open E	4.5	5.3		21.834
C-4	Open E	4.5	4.9		21.479 (21.129)
C-5	Closed D	4.5	5.6		20.855 (20.525)
C-6	Closed E	4.5	6.0		20.139
C-7	Open J	No Bridge	1.6		23.700
D-1	Open F	3.0	5.5		21.487
D-2	Closed D	3.0	4.8		21.340 (21.080)
E-1	Open G	3.0	5.2		21.233
E-2	Closed D	4.5	5.6		21.049
F-1	Closed D	3.0	5.3		23.524
CGA-1	Open H	4.5	4.5		21.982
CGA-2	Open H	4.5	5.0		21.341
CGB-1	Open I	3.0	6.6		19.292
CGC-1	Open I	4.5	5.7		19.756
CGD-1	Open H	4.5	3.2		20.569
CGE-1	Open G	3.0	3.2		21.058
CGF-1	Closed D	3.0	4.3		23.098
<b>TOTAL</b>		31 Nos.	-	-	-

Table XII.1.6 Cross Section of Field Canal



Type	Q (l/sec.)	Gradient	Lining	b (m)	B (m)	h (m)	H (m)	W (m)
A	56-112	1/1,500	Brick, Mortar	0.20	1.20	0.27-0.37	0.5	0.30
B	15-56	1/1,500	Brick, Mortar	0.15	0.95	0.15-0.29	0.4	0.30
C	0-15	1/1,000	Unlining	0.15	0.75	0.2	0.3	0.15

Table XII.3.1 Type of Bridge and Culvert

Bridge/ Culvert	Type		Main Channel		Length of Bridge			Numbers of Bridge			
	Road/Railway	Type	Bed Width (m)	1 Span (m)	Spans (Nos.)	Length (m)	Width (m)	Numbers (Nos.)	Width (m)	Numbers (Nos.)	Total (Nos.)
Bridge	Rural/Brick Road	A	25.0	12.0	3	38.0	3.0	3	4.5	9	12
		B	14.0	12.0	2	38.0	3.0	7	4.5	4	11
		C	6.0	8.0	2	25.0	3.0	5	4.5	11	16
		D	4.0/3.0	12.0	1	17.0	3.0	16	4.5	23	39
	Metal Road	MA	25.0	12.0	3	12.0	7.5	1	-	-	1
	Railway	RA	6.0	12.0	3	38.0	3.0	1	-	-	1
		RB	6.0	12.0	2	38.0	3.0	2	-	-	2
	Metal Road	CA	3.0	-	-	25.0	7.5	3	-	-	3
	Railway	CB	3.0	-	-	7.0	5.0	3	-	-	3
	Rural/Brick Road	CC	3.0	-	-	7.0	5.0	3	-	-	3
Total (Nos.)										91	



Table XII.3.2 List of Proposed Structures (1/7)

Channel-A (1/2)

(Unit : m)

Station	Structures	Existing Condition		Prop. Channel		Proposed Structures				Height (a)-(b)			
		Dimensions	Slab/Road/ Ground EL. (a)	Type	Bed Width	Bed EL. (b)	Structures	Type	Reg. Bridge		Rail	Culvert	Width
1+403	R.R. Crossing	-	R.EL= 30.67				24.650	New R.R. Bridge	A			3.00	6.020
5+000	Ferry Crossing	-	G.EL= 30.01				24.470	New R.R. Bridge	A			4.50	5.540
10+624	M.R. Bridge	Sill= 26.60, L= 56.70, W= 6.10	S.EL= 32.50				24.189	Rec. B.R. Bridge	A			4.50	8.308
14+700	R.R. Crossing	-	R.EL= 30.02				23.985	A-1 Reg. Closed	A			4.50	6.035
15+304	R.R. Bridge	Sill= 26.53, L= 10.40, W= 4.33	S.EL= 29.92				23.905	Rec. R.R. Bridge	A			4.50	6.010
16+800	R.R. Bridge	Sill= 27.95, L= 6.70, W= 3.82	S.EL= 30.65	AI	25.00		23.830	Rec. R.R. Bridge	A			4.50	6.820
17+800	R.R. Culvert	Sill= 28.96, B= 4.80, W= 2.70	S.EL= 30.61				23.780	New R.R. Bridge	A			3.00	6.827
19+936	R.R. Bridge	Sill= 26.95, L= 13.40, W= 4.29	S.EL= 30.45				23.673	Rec. R.R. Bridge	A			4.50	6.773
22+820	R.R. Bridge	Sill= 25.55, L= 6.40, W= 5.50	S.EL= 29.60				23.529	Rec. R.R. Bridge	A			4.50	6.072
23+020	R.R. Bridge	Sill= 27.30, L= 6.92, W= 4.87	S.EL= 30.49				23.519	A-2 Reg. Closed	A			4.50	6.966
24+400	R.R. Bridge	Sill= 26.79, L= 7.45, W= 4.13	S.EL= 29.39				23.400	Rec. R.R. Bridge	A			4.50	5.989
26+227	B.R. Crossing	-	R.EL= 29.77				23.309	New B.R. Bridge	A			3.00	6.461
27+630	R.R. Bridge	Sill= 24.98, L= 34.45, W= 3.72	S.EL= 29.20		(U/S)		23.239	A-3 Reg. Open	A			4.50	5.965
27+630					(D/S)		23.069						6.135
28+185	M.R. Bridge	Sill= 23.92, L= 32.20, W= 7.77	S.EL= 30.21	AII	23.00		23.041	Rec. M.R. Bridge	A			7.50	7.164
31+625	R.R. Bridge	Sill= 24.42, L= 33.85, W= 3.73	S.EL= 28.50		(U/S)		22.869	A-4 Reg. Open	B			4.50	5.626
31+625					(D/S)		22.829						5.666

Table XII.3.2 List of Proposed Structures (2/7)

Channel-A (2/2)

(Unit : m)

Station	Structures	Existing Condition		Prop. Channel		Proposed Structures			Width Height (a)-(b)			
		Dimensions	Slab/Road/ Ground EL.(a)	Type	Bed	Bed	Structures	Type				
33+855	B.R. Bridge	Sill= 25.20, L= 42.00, W= 4.26	S.EL= 28.72		22.717	Rec. B.R. Bridge	A		4.50	5.999		
33+880	Rail Bridge	Sill= 25.42, L= 42.40, W= 2.30	S.EL= 28.72	AIV	6.00	Rec. Rail Bridge		RA		3.00	5.999	
37+900	B.R. Bridge	Sill= 22.97, L= 34.55, W= 4.04	S.EL= 28.76			Rec. B.R. Bridge	A			4.50	6.241	
43+445	R.R. Crossing	-	R.EL= 26.39		(U/S)	A-5 Reg. Closed		D		3.00	4.152	
43+445			R.EL= 26.39		(D/S)						4.022	
44+600	R.R. Bridge	Sill= 24.89, B= 7.45, W= 4.35	S.EL= 27.49		22.310	Rec. R.R. Bridge		D		4.50	5.178	
46+065	R.R. Bridge	Sill= 23.75, B= 7.35, W= 4.02	S.EL= 26.32		22.237	Rec. R.R. Bridge		D		4.50	4.087	
47+200	R.R. Bridge	Sill= 24.20, B= 7.65, W= 3.67	S.EL= 26.47		22.180	Rec. R.R. Bridge		D		3.00	4.289	
47+632	Rail Bridge	Sill= 23.95, B= 8.40, W= 3.82	S.EL= 27.14		22.158	New Rail Culvert			CB	5.00	4.982	
47+752	M.R. Bridge	Sill= 24.56, L= 7.84, W= 5.63	S.EL= 26.90	AVI	3.00	New M.R. Culvert			CA	7.50	4.745	
48+000	B.R. Crossing	-	R.EL= 26.17		22.140	New B.R. Bridge		D		3.00	4.030	
51+140	R.R. Bridge	Sill= 23.53, L= 13.50, W= 4.38	S.EL= 26.48		21.982	A-1 Ch. Gate Open		H		4.50	4.498	
52+145	R.R. Bridge	Sill= 23.44, L= 13.80, W= 3.82	S.EL= 26.41		21.933	Rec. R.R. Bridge		D		3.00	4.475	
54+460	R.R. Bridge	Sill= 23.71, L= 13.65, W= 4.00	S.EL= 26.15		21.817	A-6 Reg. Open		H		4.50	4.332	
55+812	R.R. Bridge	Sill= 22.39, L= 13.59, W= 3.97	S.EL= 25.79		21.699	(Existing)				-	-	
58+200	B.R. Bridge	Sill= 21.99, L= 12.93, W= 4.58	S.EL= 25.48		21.580	(Existing)				-	-	
62+985	B.R. Bridge	Sill= 19.63, L= 23.50, W= 7.33	S.EL= 26.43		21.341	A-2 Ch. Gate Open		H		4.50	5.086	
Total (Nos.)									8	18	1	2

R.R.: Rural Road, B.R.: Brick Road, Reg.: Regulator, M.R.: Metal Road, Rec.: Reconstruction

Table XII.3.2 List of Proposed Structures (3/7)

Channel-B (1/2)  
(Unit : m)

Station	Structure	Existing Condition		Prop. Channel		Proposed Structures				
		Dimensions	Slab/Road Ground EL. (a)	Type	Bed Width	Bed EL. (b)	Structures	Type	Width	Height (a)-(b)
0+448	R.R. Crossing	-	R.EL= 28.09				New R.R. Bridge	B	3.00	5.342
1+100	R.R. Crossing	-	R.EL= 29.28				B-1 Reg. Closed	B	4.50	6.565
1+851	R.R. Crossing	-	R.EL= 28.99				New R.R. Bridge	B	3.00	5.763
3+800	R.R. Culvert	Sill= 26.28, L= 10.00, W= 5.05	S.EL= 28.34				B-2 Reg. Closed	B	4.50	5.855
5+361	B.R. Bridge	Sill= 26.20, L= 7.80, W= 4.56	S.EL= 29.35	BIII	14.00		Rec. B.R. Bridge	B	4.50	6.950
7+016	R.R. Culvert	Sill= 26.50, L= 3.60, W= 4.60	S.EL= 28.06				New R.R. Bridge	B	4.50	5.743
7+660	R.R. Crossing	-	R.EL= 27.44				New R.R. Bridge	B	3.00	5.153
8+100	R.R. Bridge	Sill= 26.48, L= 4.60, W= 7.50	S.EL= 28.93		(U/S)		B-3 Reg. Closed	C	4.50	6.663
8+100					(D/S)					6.753
8+414	Rail Bridge	Sill= 26.80, L= 5.80, W= 3.40	S.EL= 29.07				Rec. Rail Bridge		3.00	6.915
8+428	B.R. Bridge	Sill= 26.47, L= 4.65, W= 3.90	S.EL= 29.24				New B.R. Bridge	C	3.00	7.084
8+836	B.R. Culvert	Sill= 26.69, L= 4.00, W= 5.60	S.EL= 28.34				New B.R. Bridge	C	4.50	6.199
12+745	R.R. Bridge	Sill= 25.00, L= 8.50, W= 4.00	S.EL= 28.60				Rec. R.R. Bridge	C	4.50	6.660
14+669	R.R. Bridge	Sill= 25.56, L= 17.00, W= 3.50	S.EL= 28.81				Rec. R.R. Bridge	C	3.00	6.960
17+840	R.R. Bridge	Sill= 25.47, L= 13.75, W= 3.85	S.EL= 28.53	BIV	6.00		B-4 Reg. Open	D	4.50	6.845
19+695	R.R. Bridge	Sill= 25.29, L= 13.50, W= 3.40	S.EL= 29.97				Rec. R.R. Bridge	C	3.00	8.427
20+749	R.R. Bridge	Sill= 24.80, L= 13.00, W= 3.85	S.EL= 27.72				Rec. R.R. Bridge	C	3.00	6.227
21+748	B.R. Bridge	Sill= 24.83, L= 13.50, W= 4.76	S.EL= 28.06				Rec. B.R. Bridge	C	4.50	6.614
24+659	R.R. Bridge	Sill= 24.21, L= 23.81, W= 4.12	S.EL= 28.99				Rec. R.R. Bridge	C	4.50	7.696
31+180	B.R. Bridge	Sill= 24.53, L= 19.14, W= 4.93	S.EL= 27.49		(U/S)		B-5 Reg. Closed	D	4.50	6.521
31+180					(D/S)				4.50	6.831

Table XII.3.2 List of Proposed Structures (4/7)

Channel-B (2/2)

(Unit : m)

Station	Structure	Existing Condition		Prop. Channel		Proposed Structures					
		Dimensions	Slab/Road Ground EL.(a)	Type	Bed Width EL.(b)	Structures	Type		Width	Height	
34+188	R.R. Bridge	Sill= 23.58, L= 13.36, W= 4.42	S.EL= 27.11		20.551	Rec. R.R. Bridge	D		4.50	6.563	
36+579	R.R. Bridge	Sill= 23.82, L= 14.25, W= 4.22	S.EL= 26.85		20.391	Rec. R.R. Bridge	D		4.50	6.459	
39+260	R.R. Bridge	Sill= 23.33, L= 7.90, W= 4.05	S.EL= 26.01		20.757	Rec. R.R. Bridge	D		4.50	5.250	
39+982	B.R. Bridge	Sill= 23.00, L= 10.20, W= 5.60	S.EL= 26.15	BV	4.00	Rec. B.R. Bridge	D		4.50	5.929	
41+330	R.R. Crossing	-	R.EL= 25.80		20.153	New R.R. Bridge	D		3.00	5.647	
41+815	R.R. Bridge	Sill= 22.93, L= 13.95, W= 4.05	S.EL= 26.10		20.129	Rec. R.R. Bridge	D		4.50	5.970	
43+400	R.R. Crossing	-	R.EL= 25.31		20.050	B-6 Reg. Open	E		3.00	5.260	
43+400					(U/S)						
					(D/S)						
44+000	R.R. Crossing	-	R.EL= 25.20		19.730	New R.R. Culvert		CC	5.00	5.470	
44+100	M.R. Crossing	-	R.EL= 26.21		19.725	New M.R. Culvert		CA	7.50	6.485	
45+525	R.R. Bridge	Sill= 23.11, L= 13.71, W= 3.93	S.EL= 26.23		19.654	Rec. R.R. Bridge	D		3.00	6.573	
46+800	Rail Crossing	Sill= 22.02, L= 27.20, W= 3.80	R.EL= 26.31		19.590	New Rail Culvert		CB	5.00	6.717	
47+275	R.R. Bridge	Sill= 22.83, L= 10.40, W= 4.20	S.EL= 26.67	BVI	3.00	Rec. R.R. Bridge	D		4.50	7.103	
48+525	B.R. Bridge	Sill= 22.50, L= 13.76, W= 4.10	S.EL= 25.61		19.504	Rec. B.R. Bridge	D		4.50	6.104	
48+985	R.R. Culvert	Sill= 24.62, L= 12.40, W= 5.00	S.EL= 25.42		19.481	New R.R. Bridge	D		4.50	5.939	
51+714	B.R. Bridge	Sill= 21.69, L= 23.97, W= 7.26	S.EL= 26.75		19.344	Rec. B.R. Bridge	D		4.50	7.404	
52+762	R.R. Bridge	Sill= 21.18, L= 37.02, W= 2.74	S.EL= 25.92		19.292	B-1 Ch. Gate Open	I		3.00	6.623	
Total(Nos.)							7	24	1	3	

R.R.:Rural Road, B.R.:Brick Road, M.R.:Metal Road, Reg.:Regulator, Rec.:Reconstruction

Table XII.3.2 of Proposed Structures (5/7)

Channel-C (1/2)

(Unit : m)

Station	Structure	Existing Condition		Prop. Channel		Proposed Structures			Width		Height (a)-(b)		
		Dimensions	Slab/Road/ Ground EL.(a)	Type	Bed Width	Bed EL.(b)	Structures	Type	Reg.	Bridge		Rail	Culvert
0+482	B.R. Bridge	Sill= 22.82, L= 23.80, W= 3.68	S.EL= 30.00			22.326	C-1 Reg. Open	C				4.50	7.674
2+974	B.R. Bridge	Sill= 24.34, L= 5.76, W= 4.12	S.EL= 28.71			22.151	Rec. B.R. Bridge		C			4.50	6.558
3+089	Rail Bridge	Sill= 25.09, L= 21.50, W= 2.68	S.EL= 28.66			22.146	Rec. Rail Bridge			RB		3.00	6.511
4+149	R.R. Bridge	Sill= 24.25, L= 12.40, W= 4.44	S.EL= 28.85			22.093	Rec. R.R. Bridge		C			4.50	6.755
5+560	R.R. Crossing		R.EL= 27.52			22.022	C-2 Reg. Closed		C			3.00	5.498
6+120	R.R. Bridge	Sill= 25.47, L= 3.40, W= 7.70	S.EL= 28.33			21.944	Rec. R.R. Bridge		C			4.50	6.383
8+330	R.R. Bridge	Sill= 25.18, L= 4.00, W= 4.00	S.EL= 27.16		CIV	21.834	C-3 Reg. Open		E			4.50	5.325
9+152	R.R. Culvert	Sill= 25.61, L= 4.00, W= 5.12	S.EL= 27.29			21.742	New R.R. Bridge		C			4.50	5.552
9+773	R.R. Bridge	Sill= 25.25, L= 5.00, W= 6.10	S.EL= 28.33			21.711	Rec. R.R. Bridge		C			4.50	6.615
10+460	R.R. Bridge	Sill= 24.58, L= 7.15, W= 4.10	S.EL= 27.37			21.677	Rec. R.R. Bridge		C			4.50	5.690
11+146	R.R. Crossing		R.EL= 27.67			21.643	New R.R. Bridge		C			3.00	6.027
11+813	R.R. Bridge	Sill= 24.55, L= 5.90, W= 4.08	S.EL= 27.55			21.609	Rec. R.R. Bridge		C			4.50	5.940
14+430	R.R. Bridge	Sill= 24.39, L= 5.20, W= 5.46	S.EL= 26.34			21.479	C-4 Reg. Open		E			4.50	4.865
14+430						21.129							5.215
15+488	R.R. Culvert	Sill= 23.91, L= 5.90, W= 3.99	S.EL= 26.60			21.076	New R.R. Bridge			D		3.00	5.525
18+680	R.R. Bridge	Sill= 23.80, L= 11.60, W= 4.23	S.EL= 27.34			20.916	Rec. R.R. Bridge			D		4.50	6.425
19+430	R.R. Culvert	Sill= 24.47, L= 4.32, W= 4.24	S.EL= 26.98			20.879	New R.R. Bridge			D		4.50	6.104
19+900	B.R. Culvert	Sill= 24.80, L= 2.50, W= 5.02	S.EL= 26.47			20.855	C-5 Reg. Closed		D			4.50	5.619
19+900						20.525							5.949

Table XII.3.2 of Proposed Structures (6/7)

Channel-C (2/2)

(Unit : m)

Station	Structure	Existing Condition		Prop. Channel		Proposed Structures			Width Height (a)-(b)
		Dimensions	Slab/Road/ Ground EL.(a)	Type	Bed Width EL.(b)	Structures	Type	Culvert	
20+584	R.R. Culvert	Sill= 24.91, L= 2.80, W= 4.36	S.EL= 26.37		20.491	New R.R. Bridge	D		4.50 5.879
21+793	R.R. Crossing	-	R.EL= 26.62		20.430	New R.R. Bridge	D		3.00 6.190
22+412	M.R. Culvert	Sill= 24.84, L= 4.10, W= 9.70	S.EL= 26.67		20.399	New M.R. Culvert		CA	7.50 6.275
22+535	Rail Bridge	Sill= 24.70, L= 3.40, W= 3.80	S.EL= 26.77		20.393	New Rail Culvert		CB	5.00 6.380
23+100	R.R. Crossing	-	R.EL= 25.63		20.365	New R.R. Bridge	D		3.00 5.265
23+748	R.R. Culvert	Sill= 24.38, L= 2.27, W= 3.58	S.EL= 25.53	CVI	20.333	New R.R. Bridge	D		3.00 5.192
25+032	B.R. Bridge	Sill= 23.61, L= 5.80, W= 4.19	S.EL= 26.10		20.268	Rec. B.R. Bridge	D		4.50 5.831
27+296	B.R. Bridge	Sill= 23.28, L= 5.90, W= 4.20	S.EL= 25.91		20.155	Rec. B.R. Bridge	D		4.50 5.750
27+620	R.R. Bridge	Sill= 23.05, L= 11.39, W= 4.25	S.EL= 26.10		20.139	C-6 Reg. Closed	E		4.50 5.957
29+033	B.R. Bridge	Sill= 22.16, L= 8.82, W= 4.46	S.EL= 25.34		20.018	Rec. B.R. Bridge	D		4.50 5.326
30+800	R.R. Bridge	Sill= 21.91, L= 13.90, W= 4.36	S.EL= 24.85		19.930	Rec. R.R. Bridge	D		4.50 4.915
32+024	R.R. Bridge	Sill= 21.80, L= 12.38, W= 4.28	S.EL= 25.00		19.869	(Existing)			- -
33+637	B.R. Bridge	Sill= 21.76, L= 23.52, W= 4.30	S.EL= 26.48		19.788	Rec. B.R. Bridge	B		4.50 6.692
34+282	R.R. Bridge	Sill= 20.37, L= 13.50, W= 4.08	S.EL= 25.42		19.756	C-1 Ch. Gate Open	I		4.50 5.664
(4+000)	R.R. Crossing	-	R.EL= 25.10		(19.678)	C-7 Reg. Open	J		- 5.422
Total(Nos.)						8	20	1 2	- -

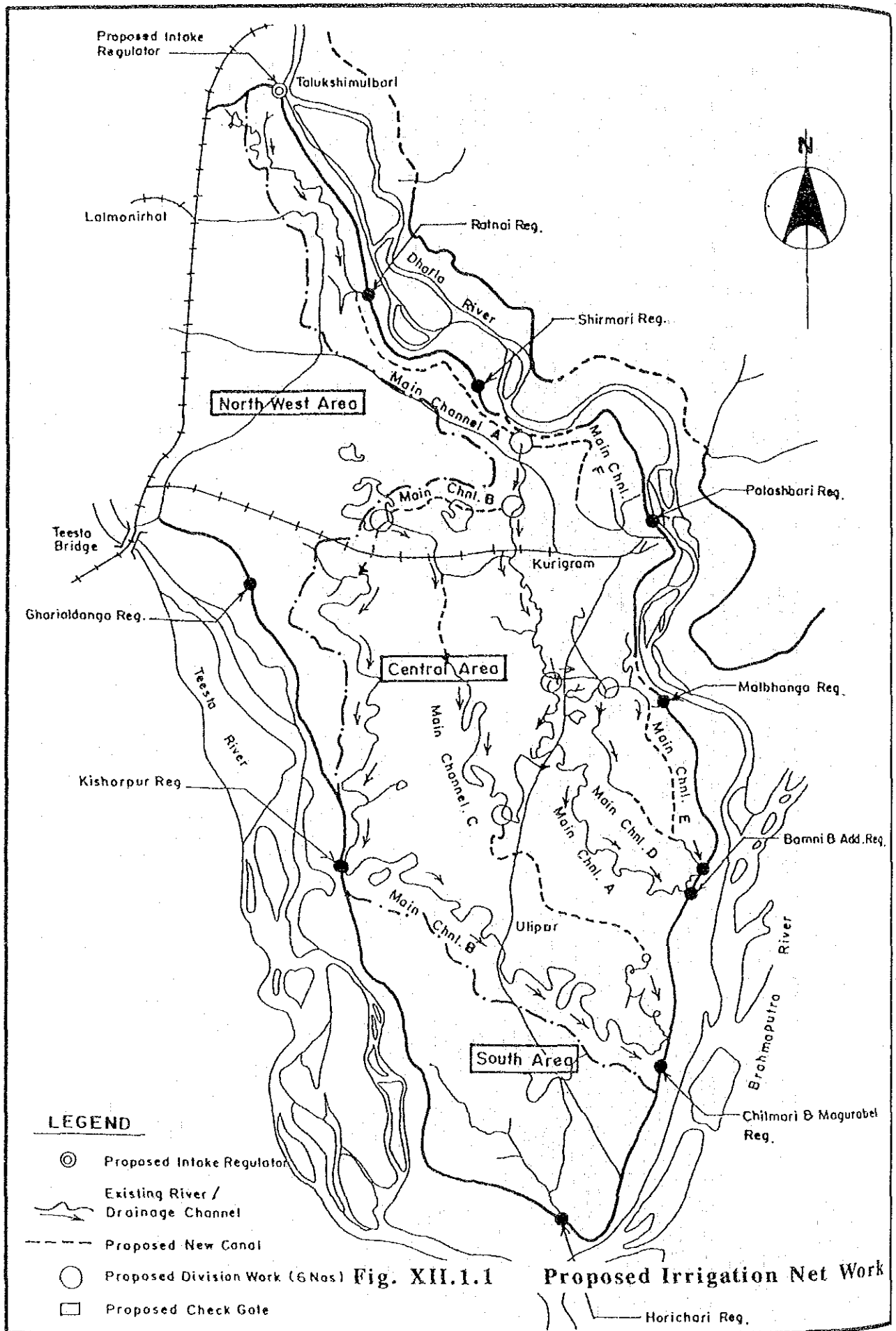
R.R.:Rural Road, B.R.:Brick Road, M.R.:Metal Road, Reg.:Regulator, Rec.:Reconstruction

Table XII.3.2 List of Proposed Structures (7/7)

Canal-D.E.And F  
(Unit : m)

Station	Structure	Existing Condition		Prop. Channel		Proposed Structures			Width					
		Dimensions	Slab/Road/ Ground EL.(a)	Type	Bed	Bed	Structure	Type	Reg. Bridge	Rail Culvert	(a)-(b)			
0+270	-		G.E.L. = 27.00								3.00	5.513		
0+325	Metal Bridge	Sill= 20.77, L= 23.80, W= 3.68	S.E.L. = 27.83			21.487	D-1 Reg. Open	F				-		
0+480	Railwz Bridge	Sill= 21.88, L= 5.76, W= 4.12	S.E.L. = 27.93	DV	4.00	21.434 21.426	(Existing) (Existing)					-		
2+200	R.R. Bridge	Sill= 23.82, L= 21.50, W= 2.68	S.E.L. = 26.13		(U/S)	21.340	D-2 Reg. Closed	D			3.00	4.790		
2+200					(D/S)	21.080						5.050		
3+350	R.R. Culvert	Sill= 25.52, L= 4.00, W= 5.10	S.E.L. = 27.02			21.023	New R.R. Bridge	D			4.50	5.997		
6+190	B.R. Bridge	Sill= 24.32, L= 5.80, W= 4.19	S.E.L. = 26.82			20.881	Reco B.R. Bridge	D			4.50	5.939		
7+690	B.R. Bridge	Sill= 24.00, L= 5.90, W= 4.20	S.E.L. = 26.50	DVI	3.00	20.806	Reco B.R. Bridge	D			4.50	5.694		
8+780	R.R. Culvert	Sill= 24.75, L= 5.90, W= 4.00	S.E.L. = 26.25			20.751	New R.R. Bridge	D			3.00	5.499		
11+720	R.R. Bridge	Sill= 20.59, L= 13.65, W= 3.97	S.E.L. = 24.09			20.604	(Existing)					3.486		
12+430	R.R. Bridge	Sill= 20.30, L= 13.59, W= 4.00	S.E.L. = 23.80			20.569	D-1 Ch. Gate Open	H			4.50	3.231		
Total(Nos)											3	4	0	0
0+380	-		G.E.L. = 26.41			21.233	E-1 Reg. Open	G			3.00	5.177		
2+000	B.R. Bridge	Sill= 21.29, L= 9.00, W= 3.70	S.E.L. = 25.36			21.102	Reco B.R. Bridge	D			3.00	4.258		
2+880	-		G.E.L. = 20.82			21.058	E-1 Ch. Gate Open	G			3.00	-0.238		
3+070	R.R. Bridge	Sill= 22.59, L= 10.00, W= 4.20	S.E.L. = 26.66			21.049	E-2 Reg. Closed	D			4.50	5.611		
5+500	R.R. Crossing		R.E.L. = 26.00	EI	3.00	20.877	New R.R. Bridge	D			3.00	5.123		
6+840	B.R. Bridge	Sill= 23.70, L= 5.90, W= 4.00	S.E.L. = 26.00			20.810	New B.R. Bridge	D			3.00	5.190		
8+790	R.R. Culvert	Sill= 22.10, L= 4.50, W= 3.30	S.E.L. = 24.10			20.713	New R.R. Culvert			CC	5.00	3.387		
9+770	R.R. Culvert	Sill= 21.55, L= 4.50, W= 3.30	S.E.L. = 23.50			20.664	New R.R. Culvert			CC	5.00	2.836		
Total(Nos)											3	3	0	2
0+315	-		G.E.L. = 28.87			23.524	F-1 Reg. Closed	D			3.00	5.341		
1+239	R.R. Culvert	Sill= 26.99, L= 5.00, W= 5.30	S.E.L. = 28.02			23.428	New R.R. Bridge	D			4.50	4.592		
2+025	R.R. Culvert	Sill= 26.06, L= 5.50, W= 4.00	S.E.L. = 27.07			23.389	New R.R. Bridge	D			3.00	3.681		
3+349	R.R. Bridge	Sill= 27.03, L= 7.40, W= 3.30	S.E.L. = 28.23	FI	3.00	23.323	Reco R.R. Bridge	D			3.00	4.907		
4+731	R.R. Bridge	Sill= 25.54, L= 13.80, W= 3.95	S.E.L. = 27.54			23.253	Reco R.R. Bridge	D			3.00	4.287		
7+532	R.R. Bridge	Sill= 26.13, L= 9.20, W= 6.30	S.E.L. = 28.92			23.113	Reco R.R. Bridge	D			4.50	5.807		
7+832	R.R. Culvert	Sill= 26.15, L= 26.15, W= 3.10	S.E.L. = 27.39			23.098	F-1 Ch. Gate Closed	D			3.00	4.292		
Total(Nos)											2	5	0	0

R.R.:Rural Road, B.R.:Brick Road, M.R.:Metal Road, Reg.:Regulator, Rec.:Reconstruction

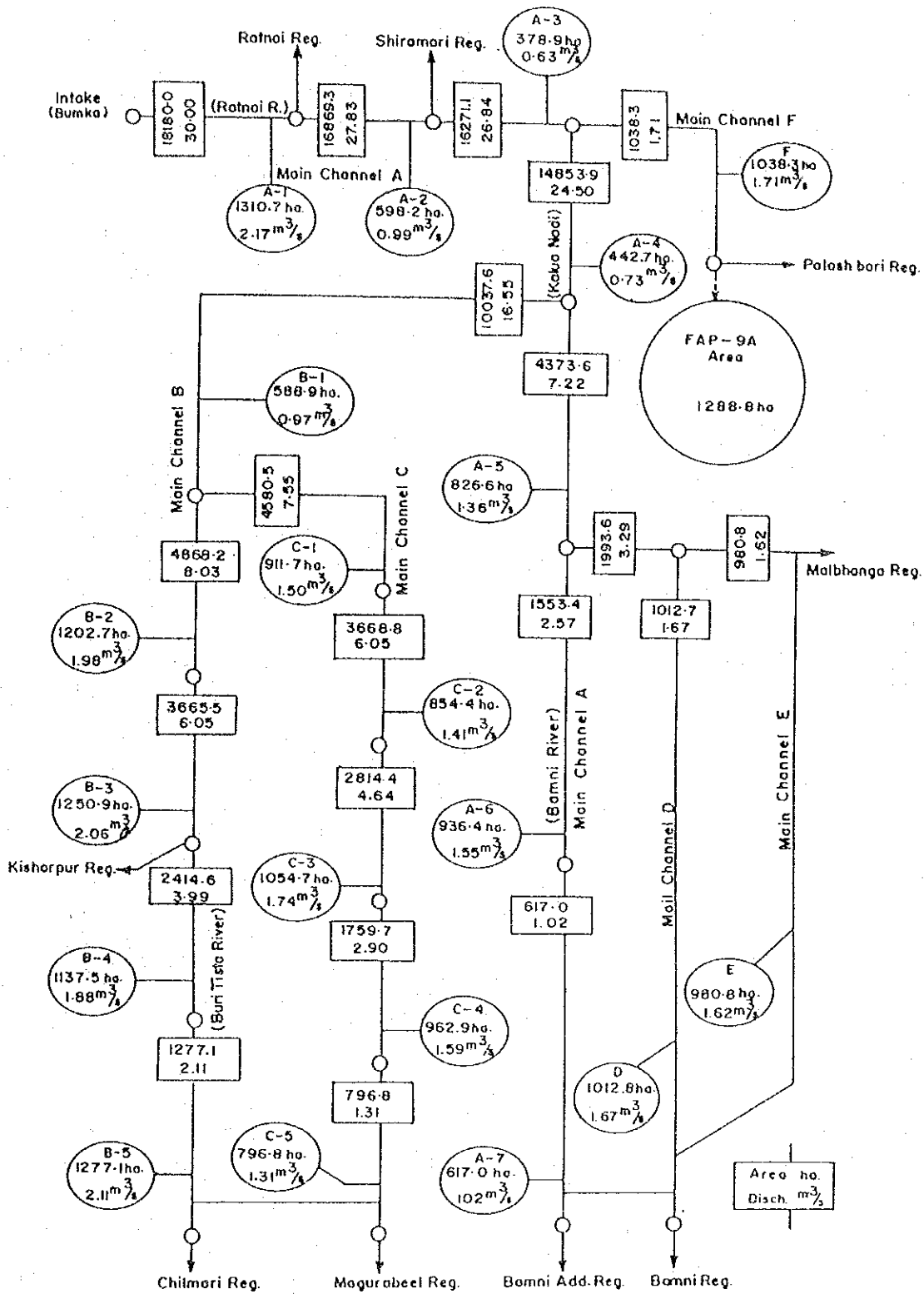


**LEGEND**

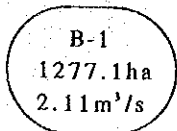
- ⊙ Proposed Intake Regulator
- Existing River / Drainage Channel
- - - Proposed New Canal
- Proposed Division Work (6 Nos)
- Proposed Check Gate

**Proposed Irrigation Net Work**

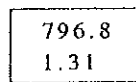




**Legend**



: Name of irrigation Block  
 : Command Area  
 : Water requirement



: Command Area  
 : Design Discharge for canal

**Fig. XII.1.2 Proposed Irrigation Diagram**



**APPENDIX - XIII**

**COST ESTIMATES  
AND  
IMPLEMENTATION  
SCHEDULE**



**FEASIBILITY STUDY ON  
KURIGRAM IRRIGATION AND FLOOD CONTROL PROJECT (SOUTH UNIT)**

**APPENDIX - XIII COST ESTIMATES AND  
IMPLEMENTATION SCHEDULE**

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## APPENDIX XIII COST ESTIMATES AND IMPLEMENTATION SCHEDULE

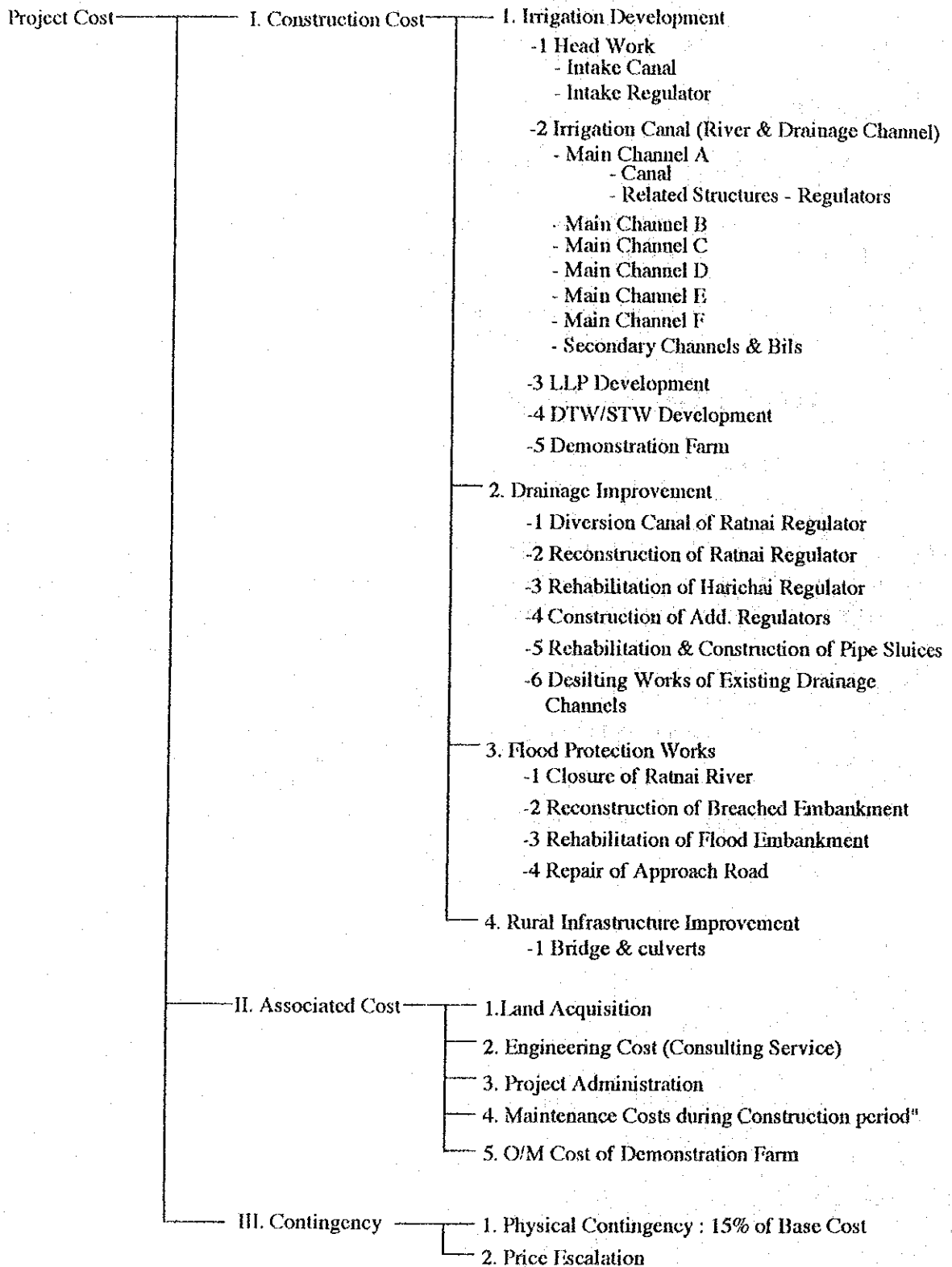
### 1. Cost Estimates

#### 1.1 Assumptions

Project costs are estimated under the following assumptions.

- (1) Unit costs for major construction works are based on the "Schedule Rate for Project VI" prepared by BWDB in October, 1989 and revised December, 1991.
- (2) Unit prices of the items which are not included in the "Schedule Rate for Project VI" are estimated on the basis of the prevailing market prices as of September, 1992.
- (3) The following exchange rates are used:  
  
US\$ 1.00 = Tk. 38.8 = ¥125, Tk. 1.00=¥3.2
- (4) Physical contingencies will be 15 % of the direct construction costs. Price contingency will be 10% for local currency portion and 7 % for foreign currency portion per annum during the construction period.
- (5) Land acquisition costs will be based on the latest actual compensation made by the BWDB's Kurigram Office; i.e., Tk 110,000 per ha for private land and Tk. 50,000 per ha for crop compensation on government lands such as drainage channels and creeks.
- (6) O&M costs during the construction period will be included in the project costs.

## 1.2 Project Cost Component





### 1.3 Unit Price

#### (1) Unit Price of Labours (8 hours per day)

No.	Description	Unit Price (Tk / day)
1	Head Labour	75
2	Skilled Labour	50
3	Semi-Skilled Labour	35
4	Un-Skilled Labour	30
5	Head Mason	75
6	Mason	60
7	Head Misty	75
8	Rod Misty	60
9	Head Carpenter	75
10	Carpenter	60
11	Plumber	75
12	Glaziar	60
13	Electrician	60
14	Painter	60
15	Blacksmith	75
16	Majhee	40
17 a.	Majhee with Bingi Boat	75
b.	Majhee with Boat upto 2 ton Capa	200
c.	Majhee with Boat upto 2 ton to 6 ton Capa	250
d.	Majhee with Boat upto 6 ton to 8 ton Capa	300
18	Bullock Cart with Cart-man	100

#### (2) Unit Price of Construction Materials (Kurigram Site)

(Unit : Tk)

No.	Materials	Specifications	Unit	Component (%)	Unit Price		
					L.C. / F.C.	L.C.	F.C.
1	Cement	Normal Portland	50 kg bag	25 / 75	62.5	187.5	250
2	Stone shingles		m <sup>3</sup>	100 / 0	710	0	710
3	Boulders	75-100 mm	m <sup>3</sup>	100 / 0	1,050	0	1,050
4	- do -	above 300 mm	m <sup>3</sup>	100 / 0	1,700	0	1,700
5	- do -	above 400 mm	m <sup>3</sup>	100 / 0	1,800	0	1,800
6	Sand	F.M. 0.5 (min)	m <sup>3</sup>	100 / 0	50	0	50
7	- do -	F.M. 1.0	m <sup>3</sup>	100 / 0	100	0	100
8	- do -	F.M. 1.5 - 1.8	m <sup>3</sup>	100 / 0	210	0	210
9	- do -	F.M. 1.8 - 2.0	m <sup>3</sup>	100 / 0	280	0	280
10	- do -	F.M. 2.0 - 3.0	m <sup>3</sup>	100 / 0	350	0	350
11	M.S. Road		M. ton	40 / 60	9,280	13,920	23,200
12	M.S. Angle / Plate		M. ton	40 / 60	10,000	15,000	25,000
13	Brick	First Class	100 Nos	100 / 0	2,100	0	2,100
14	- do -	Second Class	100 Nos	100 / 0	1,800	0	1,800
15	Picked Jhama Brick		100 Nos	100 / 0	2,100	0	2,100
16	Brick Bats	First Class	m <sup>3</sup>	100 / 0	632	0	632
17	Steel Sheet Pile		ton	0 / 100	0	30,000	30,000
18	Wood	Jack	m <sup>3</sup>	100 / 0	14,000	0	14,000
19	- do -	Jarul / Garjan	m <sup>3</sup>	100 / 0	12,350	0	12,350
20	- do -	Jam / Sheel Korai	m <sup>3</sup>	100 / 0	10,500	0	10,500

Source : Schedule of Rates for Project IV, BWDB Rangpur (Oct, 1989 and revised in Dec. 1991)

## (3) Unit Cost of Civil Works

code	Name of Work	Specification	Unit	Unit Price(L)	Unit Price(F)	Total
				(TK)	(TK)	(TK)
1	Backfilling in foundation		100 m3	1,136	0	1,136
2	Bailing water	by manual labour	100m3	197	0	197
3	Brick masonry	mortar 1:2	m3	1,354	596	1,950
4	Brick masonry	mortar 1:3	m3	1,292	446	1,738
5	Brick masonry	mortar 1:4	m3	1,256	363	1,619
6	Brick masonry	mortar 1:5	m3	1,229	296	1,525
7	Brick masonry	mortar 1:6	m3	1,212	258	1,470
8	Brick Pitching	t=12.7, mortar 1:3	m2	165	56	221
9	Brick Pitching	t=12.7, mortar 1:4	m2	161	46	207
10	Brick Pitching	t=12.7, mortar 1:5	m2	157	38	195
11	Brick Pitching	t=7.62, mortar 1:3	m2	102	34	136
12	Brick Pitching	t=7.62, mortar 1:4	m2	100	28	128
13	Brick Pitching	t=7.62, mortar 1:5	m2	98	22	120
14	Brickmattress /mesh w.	t=15cm,12x10cm	m2	329	0	329
15	Compaction		100 m3	407	0	407
16	Compensation	(govt. land)	m2	5	0	5
17	Concrete block	CC 1:3:6, Picked Jama	m3	2,091	0	2,091
18	Concrete block	CC 1:4:8, Picked Jama	m3	2,248	0	2,248
19	Concrete block	CC 1:5:10, Picked Jama	m3	2,486	0	2,486
20	Concrete lining	Mass con. t=10cm	m2	160	80	240
21	Dewatering	21 l/sec	W. hr.	38	0	38
22	Earth carrying by truck	(1km)	m3	56	0	56
23	Earth work	constructing closure	100 m3	1,281	0	1,281
24	Earth work	cross dam	100 m3	1,281	0	1,281
25	Embankment	canal bank	100 m3	1,164	0	1,164
26	Embankment	canal dyke	100 m3	1,767	0	1,767
27	Embankment	flood embankment by mc	100 m3	1,767	0	1,767
28	Embankment	repairing embankment	100 m3	1,164	0	1,164
29	Embankment	road	100 m3	1,164	0	1,164
30	Excavation	foundation, trenches	100 m3	1,499	0	1,499
31	Excavation	new canal	100 m3	1,281	0	1,281
32	Excavation	reexcavation of exit canal	100 m3	1,281	0	1,281
33	Flap gate	$\phi = 100$	nos	34,400	8,600	43,000
34	Geotextyile setting		m2	0	158	158
35	Handrail	$\phi = 80$ , gass drive	m	836	209	1,045
36	Ladder	$\phi = 50$ , pipe, l=5.5	nos	1,760	440	2,200
37	Land Acquisition	(private land)	m2	11	0	11
38	Local sand filling		100 m3	5,439	0	5,439
39	M.S. Iron work		ton	14,690	15,000	29,690
40	Mass concrete	Structure, 1:3:6	m3	1,601	795	2,396
41	Plastering	t=12.7, mortar 1:3	m2	42	25	67
42	Plastering	t=12.7, mortar 1:4	m2	40	20	60
43	Plastering	t=12.7, mortar 1:6	m2	39	14	53

## (3) Unit Cost of Civil Works

code	Name of Work	Specification	Unit	Unit Price(L)	Unit Price(F)	Total
				(TK)	(TK)	(TK)
44	Rail	30.081 kg/m	m	302	450	752
45	Reinforced concrete	1:1-1/2:3	m3	1,867	1,488	3,355
46	Reinforced concrete	1:2:4	m3	1,766	1,188	2,954
47	RCC Pile	(1:2:4), 30x30 cm	m	302	267	569
48	RCC Pile	(1:2:4), 35x35 cm	m	337	366	703
49	RCC Pile	(1:2:4), 40x40 cm	m	376	477	853
50	RCC Pipe setting	$\phi = 1000$	m	2,077	0	2,077
51	RCC Pipe setting	$\phi = 300$	m	344	0	344
52	RCC Pipe setting	$\phi = 600$	m	760	0	760
53	RCC Pipe setting	$\phi = 800$	m	1,349	0	1,349
54	Reinforcement	by wire binding	ton	13,050	13,920	26,970
55	Sand cement block	1:6	m3	949	926	1,875
56	Sand cement block	1:8	m3	874	761	1,635
57	Shuttering	for colum, steir case,...	m2	140	0	140
58	Shuttering	for deck slab, girder, ...	m2	205	0	205
59	Shuttering	for roof slab	m2	159	0	159
60	Shuttering	normal	m2	127	0	127
61	Sluice Gate incl. M.L.	1.52 x 1.83	nos	96,000	24,000	120,000
62	Sluice Gate incl. M.L.	2.0 x 1.2	nos	120,000	30,000	150,000
63	Sluice Gate incl. M.L.	3.0 x 1.7	nos	536,000	134,000	670,000
64	Sluice Gate incl. M.L.	3.0 x 2.0	nos	632,000	158,000	790,000
65	Sluice Gate incl. M.L.	3.0 x 2.2	nos	696,000	174,000	870,000
66	Sluice Gate incl. M.L.	3.0 x 2.3	nos	728,000	182,000	910,000
67	Steel Sheet Pile	U-II	m2	608	3,600	4,208
68	Stripping		100 m2	36	0	36
69	Timber Pile	$\phi = 150\text{mm}$	m	185	0	185
70	Timber Pile	$\phi = 200\text{mm}$	m	209	0	209
71	Turfing	including fine dressing	100m3	220	0	220
72	Water Stop	l=230 PVC	m	0	968	968
73	Wood work	jack	m3	19,874	0	19,874
74	Wood work	jam/sheel/korai	m3	15,731	0	15,731
75	Wood work	jarul/garjan	m3	17,924	0	17,924
81	Block Masonary		m2	314	90	404
83	Gravel	t=7cm	m3	164	0	164
84	Excavation		100 m3	6,881	0	6,881

**1.4 Summary of Project Cost**

Work	Total			Phase-I			Phase-II			Total
	L.C.	F.C.	Total	L.C.	F.C.	Total	L.C.	F.C.	Total	
I. Construction Cost										
I-1 Irrigation Development										
(1) Head Work Construction	59,235	61,600	120,835	59,235	61,600	120,835	0	0	0	0
(2) Irrigation Canal										
a. Main Channel A	73,408	15,274	88,682	73,408	15,274	88,682	0	0	0	0
b. Main Channel B	54,755	9,685	64,440	0	0	0	54,755	9,685	64,440	64,440
c. Main Channel C	40,812	11,501	52,313	0	0	0	40,812	11,501	52,313	52,313
d. Main Channel D	16,175	5,355	21,530	16,175	5,355	21,530	0	0	0	0
e. Main Channel E	22,750	8,886	31,636	22,750	8,886	31,636	0	0	0	0
f. Main Channel F	3,139	1,204	4,343	3,139	1,204	4,343	0	0	0	0
g. Secondary Channels & Bills Desilting works	62,544	0	62,544	31,272	0	31,272	31,272	0	31,272	31,272
h. Sub-Total	273,583	51,905	325,488	146,744	30,719	177,463	126,839	21,186	148,025	148,025
(3) LLP Development	217,292	65,106	282,398	97,185	29,118	126,303	120,107	35,988	156,095	156,095
(4) STW Development	27,800	65,461	93,261	13,900	32,732	46,632	13,900	32,729	46,629	46,629
(5) Demonstration Farm	3,946	3,508	7,454	2,725	1,679	4,404	1,221	1,829	3,050	3,050
(6) Sub-Total of Irrigation Development	581,856	247,580	829,436	319,789	155,848	475,637	262,067	91,732	353,799	353,799
I-2 Drainage Improvement										
(1) Ratnai River Diversion Canal	1,944	0	1,944	1,944	0	1,944	0	0	0	0
(2) Ratnai Regulator Construction	9,084	6,103	15,187	9,084	6,103	15,187	0	0	0	0
(3) Hanchai Regulator Rehabilitation	599	1,347	1,946	0	0	0	599	1,347	1,946	1,946
(4) Add. Regulators Construction	16,964	15,412	32,376	0	0	0	16,964	15,412	32,376	32,376
(5) Pipe Stuiices Rehabilitation	2,331	1,164	3,495	0	0	0	2,331	1,164	3,495	3,495
(6) Desilting Works of Existing Drainage Channels	7,301	0	7,301	0	0	0	7,301	0	7,301	7,301
(7) Sub-Total of Drainage Improvement	38,223	24,026	62,249	11,028	6,103	17,131	27,195	17,923	45,118	45,118
I-3 Flood Protection Works										
(1) Ratnai River Closure at Durakuti	2,458	1,408	3,866	2,458	1,408	3,866	0	0	0	0
(2) Breached Embankment	4,882	2,464	7,346	4,882	2,464	7,346	0	0	0	0
(3) Flood Embankment Rehabilitation	1,284	0	1,284	0	0	0	1,284	0	1,284	1,284
(4) Sub-Total of Flood Protection Works	8,624	3,872	12,496	7,340	3,872	11,212	1,284	1,284	2,568	2,568
I-4 Rural Infrastructure Improvement	99,999	63,787	163,786	53,332	34,020	87,352	46,667	29,767	76,434	76,434
I-5 Total of Construction Cost	728,702	339,265	1,067,967	391,489	199,843	591,332	337,213	139,422	476,635	476,635
II Land Aquisition	62,427	0	62,427	38,887	0	38,887	23,540	0	23,540	23,540
III Consulting Service	60,963	47,767	108,730	44,276	47,767	92,043	16,687	0	16,687	16,687
IV Administration	26,093	21,573	47,666	17,321	14,677	31,998	8,772	6,896	15,668	15,668
V Maintenance Cost during Construction Period	20,224	0	20,224	5,653	0	5,653	14,571	0	14,571	14,571
VI O&M Cost of Demonstration Farm	3,741	0	3,741	2,651	0	2,651	1,110	0	1,110	1,110
Sub-Total (II-VI)	173,448	69,340	242,788	108,768	62,444	171,212	64,680	6,896	71,576	71,576
VII Physical Contingency	109,300	50,885	160,185	58,720	29,974	88,694	50,580	20,911	71,491	71,491
Sub-Total (I-VII)	1,011,450	459,490	1,470,940	558,977	292,261	851,238	452,473	167,229	619,702	619,702
VIII Price Escalation	646,469	162,272	808,741	195,772	56,340	252,112	450,697	105,932	556,629	556,629
GRAND TOTAL	1,657,919	621,762	2,279,681	754,749	348,601	1,103,350	903,170	273,161	1,176,331	1,176,331

No: UC-Sum

v.4.0

## Item: Summary of Project Cost

(Unit : 1,000TK)

Work	Unit	Quantity	Local Currency		Foreign Currency		Total
			Unit Price	Amount	Unit Price	Amount	
I. Construction Cost							
I-1 Irrigation Development							
(1) Head Work	Unit	1	59,235	59,235	61,600	61,600	120,835
(2) Irrigation Canal							
a. Main Channel A	Unit	1	73,408	73,408	15,274	15,274	88,682
b. Main Channel B	Unit	1	54,755	54,755	9,685	9,685	64,440
c. Main Channel C	Unit	1	40,812	40,812	11,501	11,501	52,313
d. Main Channel D	Unit	1	16,175	16,175	5,355	5,355	21,530
e. Main Channel E	Unit	1	22,750	22,750	8,886	8,886	31,636
f. Main Channel F	Unit	1	3,139	3,139	1,204	1,204	4,343
g. Secondary Channels & Bils	Unit	1	62,544	62,544	0	0	62,544
h. Sub-Total				273,583		51,905	325,488
(3) LLP Development	ha.	17921	12.125	217,292	3.633	65,106	282,398
(4) STW Development	Unit	1496	18.583	27,800	43.758	65,461	93,261
(5) Demonstration Farm	No	1	3,946	3,946	3,508	3,508	7,454
(6) Sub-Total of Irrigation Development				581,856		247,580	829,436
I-2 Drainage Improvement							
(1) Rainai River Diversion Canal	Unit	1	1,944	1,944	0	0	1,944
(2) Rainai Regulator	Unit	1	9,084	9,084	6,103	6,103	15,187
(3) Harichai Regulator	Unit	1	599	599	1,347	1,347	1,946
(4) Add. Regulators	Unit	1	16,964	16,964	15,412	15,412	32,376
(5) Pipe Sluices	Unit	1	2,331	2,331	1,164	1,164	3,495

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Item: Summary of Project Cost										(Unit : 1,000TK)
Work	Unit	Quantity	Local Currency		Foreign Currency		Total			
			Unit Price	Amount	Unit Price	Amount				
(6) Desilting Works of Existing Drainage Channel	Unit	1	7,301	7,301	0	0	7,301	1250		
(7) Sub-Total of Drainage Improvement				38,223		24,026	62,249	999		
I-3 Flood Control & River Protection Works										
(1) Rainai River Closure at Durakuti	Unit	1	2,458	2,458	1,408	1,408	3,866	1310		
(2) Breached Embankment	Unit	1	4,882	4,882	2,464	2,464	7,346	1330		
(3) Flood Embankment	Unit	1	1,242	1,242	0	0	1,242	1340		
(4) Approach Road of Flood Embankment	Unit	1	42	42	0	0	42	1350		
(5) Sub-Total of Flood Control & River Protection Works				8,624		3,872	12,496	999		
I-4 Rural Infrastructure Improvement										
(1) RII for Main Channel A	Unit	1	34,196	34,196	21,972	21,972	56,168	1401		
(2) RII for Main Channel B	Unit	1	28,374	28,374	18,070	18,070	46,444	1402		
(3) RII for Main Channel C	Unit	1	21,290	21,290	13,507	13,507	34,797	1403		
(4) RII for Main Channel D	Unit	1	2,468	2,468	1,529	1,529	3,997	1404		
(5) RII for Channel E	Unit	1	4,147	4,147	2,727	2,727	6,874	1405		
(6) RII for Channel F	Unit	1	2,986	2,986	1,845	1,845	4,831	1406		
(7) RII for Rainai Diversion Canal	Unit	1	5,060	5,060	3,194	3,194	8,254	1407		
(8) Goknda Bridge	Unit.	1	1,478	1,478	943	943	2,421	1408		
(9) Sub-Total of Rural Infrastructure Improvement				99,999		63,787	163,786			
I-5 Total of Construction Cost				728,702		339,265	1,067,967	999		

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Item: Summary of Project Cost

(Unit : 1,000TK)

Work	Unit	Quantity	Local Currency		Foreign Currency		Total	
			Unit Price	Amount	Unit Price	Amount		
II Land Aquisition		1	62,427	62,427	0	0	62,427	999
III Consurting Survice		1	69,608	69,608	93,419	93,419	163,027	999
IV Administration		1	30,465	30,465	23,595	23,595	54,060	999
V Maintenance Cost		1	29,675	29,675	0	0	29,675	999
VI O&M Cost of Demonstration Farm		1	7,552	7,552	0	0	7,552	999
Sub-Toatal				199,727		117,014	316,741	999
VII Physical Contiguency		1	109,300	109,300	50,886	50,886	160,186	999
Sub-Total (I-VII)				1,037,729		507,165	1,544,894	999
VIII Price Escalation		1	741,569	741,569	182,282	182,282	923,851	999
VIII GRAND TOTAL				1,779,298		689,447	2,468,745	999