Table 10.2.1 Result of Interview Survey for Potential and Practically Avoidable Damage by the Improved FFWS (Average of Total Answers)

(Unit: %)

Contents of Damage			Potential Avoidable Damage by the Improved FFWS in Total Damage of Each Category (A)	Practically Avoidable Damage by the Improved FFWS by This Project	
				Rate to Potential Avoidable Damage (B)	Rate toTotal Damage of Each Category {(A)/100} x (B)
Houses	Indoor Movables		83.0	67.2	55.8
Agric ulture	Crops		62.1	58.3	36.2
	Livestocks		84.3	73.3	61.8
	Fisheries		64.9	54.1	35.1
Infrastructure	Road		61.4	51.7	31.7
	BWDB Projects	Rehabiltation Cost	58.1	56.6	32.9
		Emergency Requirement	58.1	56.6	32.9
Human Lives	Injuries		88.2	72.3	63.8
	Death		91.0	77.8	70.8
Other Damage			52.2	54.3	28.4
Total Damage			56.8	50.8	28.8

Source: Interview Survey to the Staff of Divisional O&M Offices of BWDB conducted by the JICA Study Team during the period from August 9 to 26, 2003.

Note: The figures are the average of 29 samples of interviewees

Table 10.2.2 Total Flood Damage and Avoidable Damage by the Improved FFWS

Items	Unit	Houses			Agriculture				Infrastructure						Damage to Human Lives			Total Damage of All Assets	Other Damage	Grand Total
										BWDB Project										
		Building	Indoor Movables	Sub-Total	Crops	Livestock	Fisheries	Sub-Total	Road	Rehabilitation Cost	Emergency Requirement	Sub-Total	Telecommunication	Total	Injuries	Death	Sub-Total			
Flood Damage in 1998	Lakh Taka	403,083	125,013	528,096	551,186	1,225	21,990	574,401	99,011	81,144	10,363	91,507	2,809	193,327	83	2,282	2,364	1,295,824	259,165	1,557,354
Sructure of Flood Damage	%	25.9	8.0	33.9	35.4	0.1	1.4	36.9	6.4	5.2	0.7	5.9	0.2	12.4	0.0	0.1	0.2	83.2	16.6	100.0
Potential Avoidable Damage by the Improved FFWS	Lakh Taka	0	62,506	62,506	110,237	245	4,398	114,880	3,960	16,229	2,073	18,301	0	22,262	65	1,837	1,902	199,649	107,985	309,536
Practically Avoidable Damage by the Improved FFWS	Lakh Taka	0	56,256	56,256	88,190	196	3,079	91,464	79	3,246	415	3,660	0	3,739	45	1,378	1,423	151,460	53,993	206,875
Rate of Potential Avoidable Damage by the FFWS to the Total Flood Damage	%	0.0	50.0	50.0	20.0	20.0	20.0	20.0	4.0	20.0	20.0	20.0	0.0	11.5	78.3	80.5	80.4	15.4	41.7	19.9
Rate of Practically Avoidable Damage by the Improved FFWS to the Potential Avoidable Damage	%	0.0	90.0	90.0	80.0	80.0	70.0	79.6	2.0	20.0	20.0	20.0	0.0	16.8	70.0	75.0	74.8	75.9	50.0	66.8
Rate of Actually Avoidable Damage by the Improved FFWS to the Total Flood Damage	%	0.0	45.0	45.0	16.0	16.0	14.0	15.9	0.1	4.0	4.0	4.0	0.0	1.9	54.8	60.4	60.2	11.7	20.8	13.3

Note : The flood damage in 1998 are considered to be 50 year of return period in this Study.

Table 10.2.3 Present Values of Equipment and Facilties of Existing FFWS in Fianancial Price

Item	Division	Task	Item	Quantity	Rate	-100%	x	Book Value	(1-Depreciation Rate)	Present Value
Regional	Surface Water x20%	Gauge Reading	Computer	4	0.5	2.00	0.20	0.40	0.25	0.10
		Collectin of Read data and posting	Fax/Tel	12	0.2	2.40	0.20	0.48	0.25	0.12
		Discharge measurement	Desk	80	0.1	8.00	0.20	1.60	0.50	0.80
			Vehicle	12		260.00	0.20	52.00	0.50	26.00
			Air Conditioner etc	4	0.4	1.60	0.20	0.32	0.50	0.16
			Building				1.00	0.00	1.00	0.00
			Land				1.00	0.00	1.00	0.00
		(Sub Total)				274.00		54.80		27.18
Green Road	C&I x100%	HF Tranciever Operation	Computer	1+1		0.60	1.00	0.60	0.25	0.15
		HF Tranceiver maintenance	Fax/Tel	1*	*	0.05	1.00	0.05	0.25	0.01
		Correction of gauging tool (Discharge)	Desk	10+10*		1.00	1.00	1.00	0.50	0.50
		Making gauging tool (Stuff gauge, Rainfall gauge)	Tranciever	130		260.00	1.00	260.00	0.50	130.00
		Automatic gauge maintenance	Telemeter System(Eq)	TGS-14 TRS-5 TMS-1		15.88	1.00	15.88	0.00	0.00
		Telemeter system maintenance	Telemeter System(Civ)	9Nos		12.00	1.00	12.00	0.00	0.00
			Telemeter System(etc)	LS		10.00	1.00	10.00	0.00	0.00
			Automatic Gauge*	32	3	19.20	1.00	19.20	0.50	9.60
			Facility for correction of gauging tool	1*		20.00	1.00	20.00	0.50	10.00
			Facility for repare of tranciever	1		25.00	1.00	25.00	0.50	12.50
			Vehicle	1+1*		26.00	1.00	26.00	0.50	13.00
			Air Conditioner etc	2+1*		0.75	1.00	0.75	0.50	0.38
			Building			39.62	1.00	39.62	1.00	39.62
			Land			418	1.00	418.00	1.00	418.00
		(Sub Total)				848.10		848.10		633.76
	PFFC x20%	Store the cross section data	Computer	8 Nos	0.4	3.20	0.20	0.64	0.25	0.16
			Printer	2 Nos	0.12	0.24	0.20	0.05	0.25	0.01
			Fax/Tel	1+1		0.40	0.20	0.08	0.25	0.02
			Desk	15	0.06	0.90	0.20	0.18	0.50	0.09
			Vehicle	3 Nos		60.0	0.20	12.00	0.5	6.00
			Sate lite System							0.00
			Air Conditioner etc	8 Nos	0.35	2.80	0.20	0.56	0.50	0.28
			Building			36.13	0.20	7.23	1.00	7.23
			Land			381.20	0.20	76.24	1.00	76.24
		(Sub Total)				484.87		96.97		90.03
FFWC	FFWC x100%		Computer	9 Nos	0.45	4.05	1.00	4.05	0.25	1.01
			Pinter	9Nos	0.12	1.08	1.00	1.08	0.25	0.27
			Fax/Tel	Fax=1, Tel=2		1.52	1.00	1.52	0.25	0.38
		Collect the observed data	Desk	13	0.07	0.91	1.00	0.91	0.50	0.46
		Analysis	Vehicle	2 Nos		30.0	1.00	30.00	0.5	15.00
		Edit	Satelite System	Free						
		Modification of analysing model	Air Conditioner etc	9 Nos	0.355	3.195	1.00	3.20	0.500	1.60
		Modification of Hazard map								
			Building			18.54	1.00	18.54	1.00	18.54
			Land			188	1.00	188.00	1.00	188.00
		(Sub Total)				247.30		247.30		225.26
Total						1,854.3		1,247.17		976.2

Table 10.2.4 Present Values of Equipment and Facilties of Existing FFWS in Economicl Price

Item	Division	Task	Item	Quantity	Rate	-100%	x	Book Value	(1-Depreciation Rate)	Conversion Factor (SCF)	Present Value
Regional	Surface Water	Gauge Reading	Computer	4	0.5	2.00	0.20	0.40	0.25	0.926	0.09
	x20%	Collectin of Read data and posting	Fax/Tel	12	0.2	2.40	0.20	0.48	0.25	0.926	0.11
		Discharge measurement	Desk	80	0.1	8.00	0.20	1.60	0.50	0.926	0.74
			Vehicle	12		260.00	0.20	52.00	0.50	0.926	24.08
			Discharge Measurement								
			Air Conditioner etc	4	0.4	1.60	0.20	0.32	0.50	0.926	0.15
			Building				1.00	0.00	1.00	0.926	0.00
			Land				1.00	0.00	1.00	1.000	0.00
		(Sub Total)				274.00		54.80			25.17
Green Road	C&I	HF Tranciever Operation	Computer	1+1		0.60	1.00	0.60	0.25	0.926	0.14
	x100%	HF Tranceiver maintenance	Fax/Tel	1*	*	0.05	1.00	0.05	0.25	0.926	0.01
		Correction of gauging tool (Discharge)	Desk	10+10*		1.00	1.00	1.00	0.50	0.926	0.46
		Making gauging tool (Stuff gauge, Rainfall gauge)	Tranciever	130		260.00	1.00	260.00	0.50	0.926	120.38
		Automatic gauge maintenance	Telemeter System(Eq)	TGS-14 TRS-5 TMS-1		15.88	1.00	15.88	0.00		0.00
		Telemeter system maintenance	Telemeter System(Civ)	9Nos		12.00	1.00	12.00	0.00		0.00
			Telemeter System(etc)	LS		10.00	1.00	10.00	0.00		0.00
			Automatic Gauge*	32	3	19.20	1.00	19.20	0.50	0.926	8.89
			Facility for correction of gauging tool	1*		20.00	1.00	20.00	0.50	0.926	9.26
			Facility for repare of tranciever	1		25.00	1.00	25.00	0.50	0.926	11.58
			Vehicle	1+1*		26.00	1.00	26.00	0.50	0.926	12.04
			Air Conditioner etc	2+1*		0.75	1.00	0.75	0.50	0.926	0.35
			Building			39.62	1.00	39.62	1.00	0.926	36.69
			Land			418	1.00	418.00	1.00	1.000	418.00
		(Sub Total)				848.10		848.10			617.80
	PFFC	Store the cross section data	Computer	8 Nos	0.4	3.20	0.20	0.64	0.25	0.926	0.15
	x20%		Printer	2 Nos	0.12	0.24	0.20	0.05	0.25	0.926	0.01
			Fax/Tel	1+1		0.40	0.20	0.08	0.25	0.926	0.02
			Desk	15	0.06	0.90	0.20	0.18	0.50	0.926	0.08
			Vehicle	3 Nos		60.0	0.20	12.00	0.5	0.926	5.56
			Sate lite System							0.926	0.00
			Air Conditioner etc	8 Nos	0.35	2.80	0.20	0.56	0.50	0.926	0.26
			Building			36.13	0.20	7.23	1.00	0.926	6.69
			Land			381.20	0.20	76.24	1.00	1.000	76.24
		(Sub Total)				484.87		96.97			89.01
FFWC	FFWC		Computer	9 Nos	0.45	4.05	1.00	4.05	0.25	0.926	0.94
	x100%		Pinter	9Nos	0.12	1.08	1.00	1.08	0.25	0.926	0.25
			Fax/Tel	Fax=1, Tel=2		1.52	1.00	1.52	0.25	0.926	0.35
		Collect the observed data	Desk	13	0.07	0.91	1.00	0.91	0.50	0.926	0.42
		Analysis	Vehicle	2 Nos		30.0	1.00	30.00	0.5	0.926	13.89
		Edit	Satelite System	Free							
		Send Fax and E-mail									
		Store the discharge data									
		Modification of analysing model	Air Conditioner etc	9 Nos	0.355	3.195	1.00	3.20	0.500	0.926	1.48
		Modification of Hazard map									
			Building			18.54	1.00	18.54	1.00	0.926	17.17
			Land			188	1.00	188.00	1.00	1.000	188.00
		(Sub Total)				247.30		247.30			222.50
Total						1,854.3		1,247.17			954.5

Table 10.2.5 Daily Cost for Supporting the FFWS per Household

Activities for Supporting	Unit Cost (Taka)	Quantity	Cost (Taka)
1. Before Evacuation			
(1) Transport	30	5 times	150
(2)Case for Duck/hens	20	2 case	40
(3) Security for homestead	80	1 person	80
(4) Management of foods & food grant			50
(5) Others			190
Total			*510*
2. After Evacuation			
(1) Rice/wheat	15	4 kg	60
(2) Vegtables	15	1 kg	15
(3) Firewood/Fuel		L.S.	20
(4) Medicine of Medical Services		L.S.	50
(5) Food for Livestock		L.S.	50
(6) Shelter			Free
(7) Drinking Water (Boiled)			40
(8) Security			0
(9) Fish/Meat	100	1 kg	100
(10) Loss of labbours Day			200
(11) Others			100
Total			*635*

Note : 1. The cost is estimated roughly on the assumption that the family members are 6 per homestead.

2. The cost is estimated per day basis after evacuation.

Table 10.2.6 Estiamted Supporting Cost for the FFWS in 1998

Item	Fianancial Price	Economic Price
1. Supporting Cost for Family		
(1) Damaged Houses	3,429,886	3,429,886
(2) Rate of Evacuation(%)	40	40
(3) Period of Evacuation (day)	10	10
(4) Cost for Evacuation (Million Taka)	700	648
(5) Cost for After Evacuation (Million Taka)	8,712	8,067
Total Cost for Evacuation ((5) + (6)) (Million Taka)	*9,412*	*8,715*
2. Labor Cost For Dissemination		
(1) Average Labor Cost (Taka/Day)	100	90
(2) No. of Division	6	6
(3) No. of Districts (Zilla)	64	64
(5) No. of Upazilla	507	507
(6) No. of Union	4,484	4,484
(7) No.of Villages	87,319	87,319
(8) No. of Workers		
a. No. of Division	6	6
b. No. of Districts(Zilla)	192	192
c. No. of Upazilla	2,028	2,028
d. No. of Union	17,936	17,936
e. No.of Villages	174,638	174,638
f. Total	194,800	194,800
(9) Rate of Affected Area(%)	68	68
(10) Total Workers	132,269	132,269
(11) Period of Working	30	30
Total Cost of Workers	*397*	*357*
3. Labor Cost for Protection Work		
(1) Rehablitation Coast & Emergency Cost (Million Taka)	7,626	7,061
(2) Rate of Potential Avoidable Damage (%)	10	10
Avoidable Damage (Million Taka)	*763*	*706*
4. Labor Cost for Rescue Works		
(1) Average Labor Cost (Taka/Day)	90	81
(2) No. of Workers per Family (Person/Damaged Houses)	0.2	0.2
(3) Period of Working Days(Day)	50	50
(4) Total Workers (Person/Day)	274,391	274,391
Total Cost (Million Taka)	*1,235*	*1,111*
5. Sanitary Facility		
(1) Cots per Family	400	370
Total Cost	549	508
6. Relief Operation		0
(1) GOB	173	160
(2) NGO	353	326
Total	525	487
7. Telecommunication (L.S.) (Million Taka)	394	365
Sub-Total	***12,880***	***11,885***
8. Other Cost	1,288	1,188
Grand Total Cost (Million Taka)	***14,168***	***13,073***
Inflation Rate Per Annum (%)	4.00	
2002 Price in Million Taka	***16,572***	***15,291***

Source: Report on Bangaldesh Flood 1998 (Chronology, Damages and Response), compiled by Management Information & Monitoring (MIM) Div. Disaster Management Bureau.

Note : The conversion fasctors for economic price are 0.9 for labor cost and 0.926 for the costs except labor cost..

Table 10.2.7 Annual Average Supporting Cost of the Prposed Project

(Unit: Million Taka in 2002 Prices)

Return Period (Year)	Probability of Occurence	Supporting Cost	Average Supporting Cost	Probable Supporting Cost	Annual Average Supporting Cost
1	----------	0			
	(1/1)-(1/2)		296.5	148.3	148.3
2	----------	593.1			
	(1/2)-(1/5)		941.4	282.4	430.7
5	----------	1,289.8			
	(1/5)-(1/10)		1,805.7	180.6	611.3
10	----------	2,321.6			
	(1/10)-(1/25)		3,685.4	221.1	832.4
25	----------	5,049.1			
	(1/25)-(1/50)		10,170.1	203.4	1,035.8
50	----------	15,291.0			
	(1/50)-(1/100)		15,824.6	158.2	1,194.0
100	----------	16,358.1			

Table 10.2.8 Fianancial Cost of the Project

Investment Cost		Total			Foreign			Local				
		Foreign	Local	Total	Material	Labor	Total	Material	Labor (Skilled)	Labor (Unskilled)	Land Acquisition Cost	Total
A	Direct Installation Cost											
1.1	Equipment	494.6	0.0	494.6	494.6	0.0	494.6	0.0	0.0	0.0	0.0	0.0
1.2	Civil works	0.0	144.0	144.0	0.0	0.0	0.0	100.6	16.9	26.5	0.0	144.0
1.3	Installation	93.8	0.6	94.4	6.0	87.8	93.8	0.5	0.03	0.05	0.0	0.6
1.4	Maintenance tool	25.0	0.0	25.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
1.5	Spare parts	98.9	0.0	98.9	98.9	0.0	98.9	0.0	0.0	0.0	0.0	0.0
1.6	Ocean and inland transportation	44.5	4.9	49.5	44.5	0.0	44.5	4.9	0.0	0.0	0.0	4.9
1.7	Office Equipment	0.0	18.4	18.4	0.0	0.0	0.0	18.4	0.0	0.0	0.0	18.4
	Sub Total	*756.8*	*167.9*	*924.8*	*669.0*	*87.8*	*756.8*	*124.5*	*16.9*	*26.5*	*0.0*	*167.9*
B	Land Acquistion Cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	GOB management	0.0	9.2	9.2	0.0	0.0	0.0	9.2	0.0	0.0	0.0	9.2
D	Engineering	129.5	9.2	138.7	129.5	0.0	129.5	9.2	0.0	0.0	0.0	9.2
E	Training	5.3	0.6	5.9	5.3	0.0	5.3	0.6	0.0	0.0	0.0	0.6
F	Contingency	46.7	4.4	51.1	46.7	0.0	46.7	4.4	0.0	0.0	0.0	4.4
G	Price Escalation	3.8	14.7	18.5	-	-	-	-	-	-	-	-
	Total	*942.2*	*206.0*	*1,148.2*	*850.5*	*87.8*	*938.3*	*147.9*	*16.9*	*26.5*	*0.0*	*191.4*

Table 10.2.9 Economic Cost of the Project

Investment Cost		Total			Foreign			Local				
		Foreign	Local	Total	Material	Labor	Total	Mterial	Labor (Skilled)	Labor (Unskilled)	Land Acquisition Cost	Total
A	Direct Installation Cost											
1.1	Equipment	494.6	0.0	494.6	494.6	0.0	494.6	0.0	0.0	0.0	0.0	0.0
1.2	Civil works	0.0	132.6	132.6	0.0	0.0	0.0	93.2	16.9	22.5	0.0	132.6
1.3	Installation	93.8	0.5	94.3	6.0	87.8	93.8	0.4	0.0	0.0	0.0	0.5
1.4	Maintenance tool	25.0	0.0	25.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
1.5	Spare parts	98.9	0.0	98.9	98.9	0.0	98.9	0.0	0.0	0.0	0.0	0.0
1.6	Ocean and inland transportation	44.5	4.6	49.1	44.5	0.0	44.5	4.6	0.0	0.0	0.0	4.6
1.7	Office Equipment	0.0	17.0	17.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	17.0
	Sub Total	*756.8*	*154.7*	*911.6*	*669.0*	*87.8*	*756.8*	*115.3*	*16.9*	*22.5*	*0.0*	*154.7*
B	Land Acquistion Cost	0.0	7.6	7.6	0.0	0.0	0.0	0.0	0.0	0.0	7.6	7.6
C	GOB management	0.0	8.6	8.6	0.0	0.0	0.0	8.6	0.0	0.0	0.0	8.6
D	Engineering	129.5	8.6	138.0	129.5	0.0	129.5	8.6	0.0	0.0	0.0	8.6
E	Training	5.3	0.5	5.8	5.3	0.0	5.3	0.5	0.0	0.0	0.0	0.5
F	Contingency	46.7	4.1	50.7	46.7	0.0	46.7	4.1	0.0	0.0	0.0	4.1
G	Price Escalation	-	-	-	-	-	-	-	-	-	-	-
	Total	*938.3*	*184.1*	*1,122.3*	*850.5*	*87.8*	*938.3*	*137.0*	*16.9*	*22.5*	*7.6*	*184.1*

Table 10.2.10 Cash Flow of Economic Cost and Benefits by the Proposed Project

(Unit : Million Taka)

No.	Year	Total Project Cost	Existing Assets	Cost for Supporting Activities	O&M Cost	Total	Benefit	Net Benefit
-1	2006	1,122	95			1,218	0	-1,218
1	2007			1,194	66	1,260	1,615	356
2	2008			1,194	66	1,260	1,615	356
3	2009			1,194	66	1,260	1,615	356
4	2010			1,194	66	1,260	1,615	356
5	2011			1,194	66	1,260	1,615	356
6	2012			1,194	66	1,260	1,615	356
7	2013			1,194	66	1,260	1,615	356
8	2014			1,194	66	1,260	1,615	356
9	2015			1,194	66	1,260	1,615	356
10	2016			1,194	66	1,260	1,615	356
Total		1,122	95	11,940	656	13,814	16,154	2,340

EIRR = **26.41%**
(Discount Rate 12%)
B/C = **1.10**
NPV = **708**

Table 11.4.1 Unit Prices Applied for Estimation of Annual O&M Cost of the Pilot Project (1/2)

Item	Unit		Price	Quantity
1 Transportation cost	Executive staff	x 1	88,000	
1.1 By air				
a) Number of trips				2 trip/y
b) unit fare				10,000 Tk
1.2 By land				
a) Number of trips				24 trip/y
b) unit fare				500 Tk
1.3 By ship				
a) Number of trips				24 trip
b) unit fare				500 Tk
1.4 Travel allowance,etc				44,000 Tk/y
2 Communication cost				
2.1 BTTB line (Central Office)	Central and Regional office	x 1	2,379,800	
1) Fix charge				
a) Charge for Fix line				150 Tk/Month
b) Month				12 Month
(Sub total)				1,800 Tk/y
2) Call charge :Rainy season				
a) Month				6 month
b) Day				183 day
c) Call,Fax,E-mail (between Ct-Rg :far)				0 times/day
d) Charge for call (far)				50.0 Tk/times
e) Call,Fax,E-mail (for dissemination :near)				240 times/day
f) Charge for call (near)				50.0 Tk/times
(Sub total)				2,196,000 Tk/y
3) Call charge:Dry season				
a) Month				6 month
b) Day				182 day
c) Call,Fax,E-mail (between Ct-Rg :far)				0 times/day
d) Charge for one call (far)				50.0 Tk/times
e) Call,Fax,E-mail (for dissemination :near)				20 times/day
f) Charge for one call (near)				50.0 Tk/times
(Sub total)				182,000 Tk/y
2.1' BTTB line (Regional Office :Sylhet)	Central and Regional office	x 1	386,016	
1) Fix charge				
a) Charge for Fix line				150 Tk/Month
b) Month				12 Month
(Sub total)				1,800 Tk/y
2) Call charge :Rainy season				
a) Month				6 month
b) Day				183 day
c) Call,Fax,E-mail (between Ct-Rg :far)				24 times/day
d) Charge for call (far)				50.0 Tk/times
e) Call,Fax,E-mail (for dissemination :near)				480 times/day
f) Charge for call (near)				1.7 Tk/times
(Sub total)				368,928 Tk/y
3) Call charge:Dry season				
a) Month				6 month
b) Day				182 day
c) Call,Fax,E-mail (between Ct-Rg :far)				1 times/day
d) Charge for one call (far)				50.0 Tk/times
e) Call,Fax,E-mail (for dissemination :near)				20 times/day
f) Charge for one call (near)				1.7 Tk/times
(Sub total)				15,288 Tk/y

Table 11.4.1 Unit Prices Applied for Estimation of Annual O&M Cost of the Pilot Project (2/2)

Item	Unit		Price	Quantity
2.2 Mobile	Manual gauging station	x 1	5,060	
a) Month				12 month
b) Days				365 day
c) Fix charge				300 Tk/month
d) Call charge				4.0 Tk/day
2.3 Post, mail etc.	Central and Regional station	x 1	1,000	
a) Post, mail etc.				1,000 Tk/y
2.4 BRTC				
Payment for BRTC	Central	x1	1,500,000	
3 Vehicle operation cost	Vehicle	x 1	255,000	
3.1 Fuel				120,000 Tk/y
3.2 Wages to driver				120,000 Tk/y
3.3 Repairment				15,000 Tk/y
4 Boat operation cost	Boat	x 1	25,000	
4.1 Fuel				10,000 Tk/y
4.2 Wages to driver				10,000 Tk/y
4.3 Restoration				5,000 Tk/y
5 Repair & maintenance cost				
5.1 Telemeter Equipment	Telemeter Equipment Cost	each	0.5%	
5.2 Computer Equipment	Computer Equipment Cost	each	10.0%	
5.3 Civil Works	Civil Work Cost	each	2.0%	
5.4 Civil Works (Existing)	Civil Works (Existing) Cost	each	5.0%	
6 Light,fuel,water cost	Official staff cost	each	5.0%	
7 Consumables				
Paper, ink, office stationary etc.	Official staff cost	each	3.0%	
8 Advertisement	Official staff cost	each	2.0%	
9 Social expenses	Official staff cost	each	2.0%	
10 Social welfare	Official staff cost	each	1.0%	
11 House & land rental	Central office	xl	330,000	
11.1 unit price per Area(feet square)				150 Tk/sq.ft
11.2 Rental Area (Dhaka)				2,200 sq.ft
12 Training cost	Number of Official staff	x	5,000	
12.1 Number of training days				10 day
12.2 Fee				500 Tk/day
13 Insurance	Total OM	x	1.0	
14 Sundry	Total OM	x	5.0	

Table 11.4.2 Breakdown of Annual Operation and Maintenance Cost for the Pilot Project

(Unit: Taka)

Items	Unit	Quantity		rate	Annual O&M Cost
A.Staff					
1 Official staff (SE,XEN,SDE,AE,Technical Staff, Support Staff)					14,280,700
2 *Other staff (Gauge Reader)*					6,300,000
(sub total)					20,580,700
B.Operation and Maintenance					
1 Transportation cost	Executive staff (SE,XEN,SDE,AE)	30	x	88,000	2,675,200
2 Communication cost					
BTTB line	Central and Regional Office				2,765,816
Mobile	Mobile station	42	x	5,060	212,520
Post, mail etc.	Central and Regional Office	6	x	1,000	6,000
BRTC rental	Central Office	1	x	1,500,000	1,500,000
(sub total)					*4,484,336*
3 Vehicle operation cost	Vehicle	6	x	255,000	1,530,000
4 Boat operation cost	Boat	2	x	25,000	50,000
5 Repair & maintenance cost					
Telemeter Equipment	(Telemeter Equipment x 0.5%)				1,041,685
Computer Equipment	(Computer Equipment x 10%)				11,945,000
Civil Works	(Civil work x2.0%)				2,140,300
Civil Works (Existing)	(Civil(existing) x 5.0%)				2,175,000
(sub total)					*17,301,985*
6 Light,fuel,water cost	(Official Staff cost x 5.0%)				714,035
7 Consumables	(Official Staff cost x 3.0%)				428,421
8 Advertisement	(Official Staff cost x 2.0%)				285,614
9 Social expenses	(Official Staff cost x 2.0%)				285,614
10 Social welfare	(Official Staff cost x 1.0%)				142,807
11 House & land rental	Central Office				330,000
12 Training cost	Official staff	130.9	x	5,000	654,500
(Sub total 1-12)					*28,882,512*
13 Insurance	Sub total of (1-12) x 1.0%				288,825
14 Sundry	Sub total of (1-12) x 5.0%				1,444,126
(Sub total cost of B)					*30,615,463*
C.Depreciation Cost					
Computer depreciation cost	computer/5(year) x 0.9				4,587,750
Equipment depreciation cost	equipment/10(year) x 0.9				82,956,861
Civil depreciation cost	civil/30(year) x 0.9				3,210,450
(Sub total cost of C)					*90,755,061*
Total(A+B+C)					**141,951,000**

Table 11.5.1 Implementation Schedule

Pilot Project

Work Item	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*Local*	*Foreign*
Completion of F/S							BWDB	
Financial Arrangement								
Design							BWDB	Foreign Assistance
Implementation and supervising of Pilot Project							BWDB	Foreign Assistance
Guidance Period							BWDB	Foreign Assistance

Priority Study

Work Item	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*Local*	*Foreign*
1) Formulation of O&M Plan							BWDB	
2)Clarification of River management								
National Water Code							MOWR	
3) Strengthen of dissemination and evacuation (Response)								
FFWS is to be included in NWMP							MOWR and MDMR	UNDP
FFWS is to be included in CDMP							MOWR and MDMR	UNDP
4) Institutional study								
Institutional study							BWDB	Foreign Assistance
Regional organization plan for pilot project							BWDB	Foreign Assistance
Operating and Monitoring of Pilot project							BWDB	Foreign Assistance
5)Collecting the information on river management and review of danger level								
Collecting the information of river structures							BWDB	Foreign Assistance
Preparation of Operation manual							BWDB	Foreign Assistance
Preparation of DEM							BWDB, Survey of Bangladesh, and LGED	
Preparation of Flood Hazard map							BWDB	
Review / identification of danger level							BWDB	Foreign Assistance
Survey the river cross-sections							BWDB	

FIGURES

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.4.1

Overall Workflow

Position	Name	FY2002 10	11	12	1	2	3	FY2003 4	5	6	7	8	9	10	11
Team Leader / River and Flood Control Expert	Hideki SATO														
Deputy Team Leader / Telecommunication System Expert	Masato OKUDA														
Flood Forecasting and Warning System Expert	Gregory HOOKEY														
Radio Transmission Expert	Masahiro SAKAGAMI														
Hydrologist	Kensuke SAKAI														
Economist / Finantial Analyst	Kiminari TACHIYAMA														
Institutional Expert	Nurul ISLAM														
Expert of International Cooperation	Naoko ANZAI														
Administrative Coordinator	Hiroto NAKAGAWA / Tadahiro FUKUDA														
Report			△ IC/R				△ P/R(1)			△ IT/R		△ P/R(2)	△ DF/R		△ F/R
Workshop / Seminar										△				△	
Stage		Phase I : Basic Study										Phase II : Feasibility Study on Selected Option(s)			

LEGEND ■ : Works in Bangladesh □ : Works in Japan

IC/R : Inception Report P/R(1) : Progress Report (1) IT/R : Interim Report

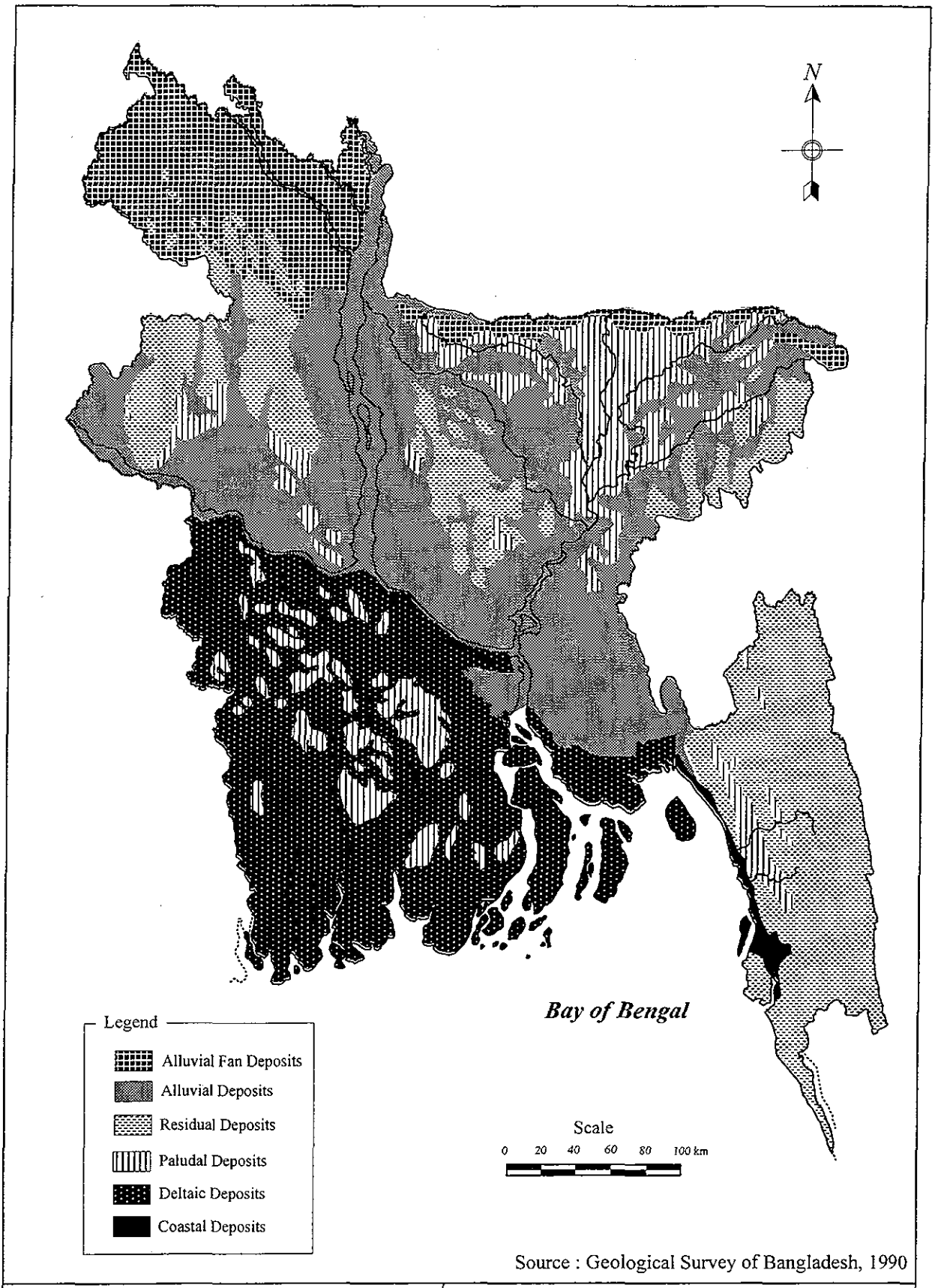
P/R(2) : Progress Report (2) DF/R : Draft Final Report F/R : Final Report

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.5.1

Staffing Schedule



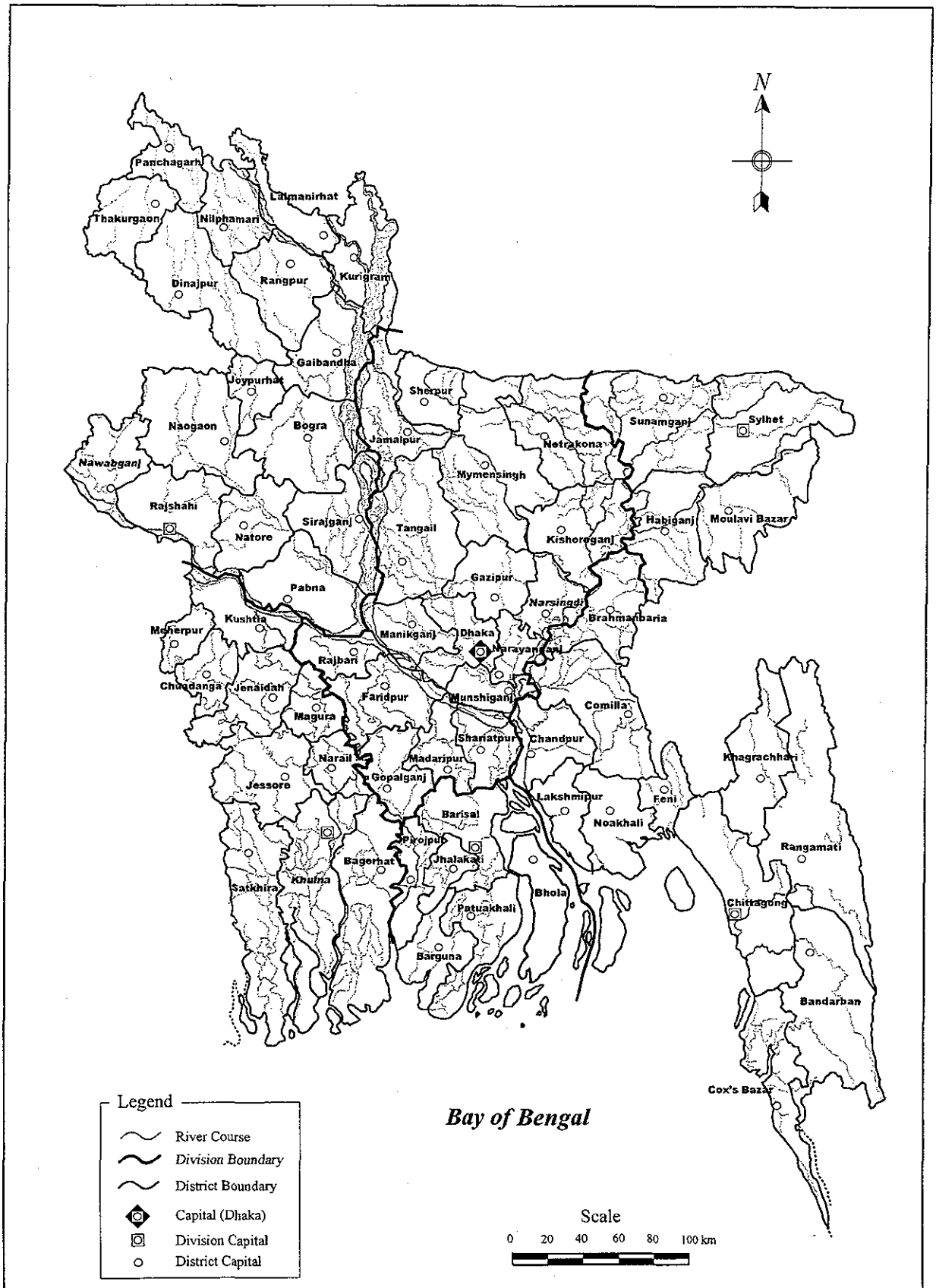
Source : Geological Survey of Bangladesh, 1990

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.1.1

Geological Map of Bangladesh

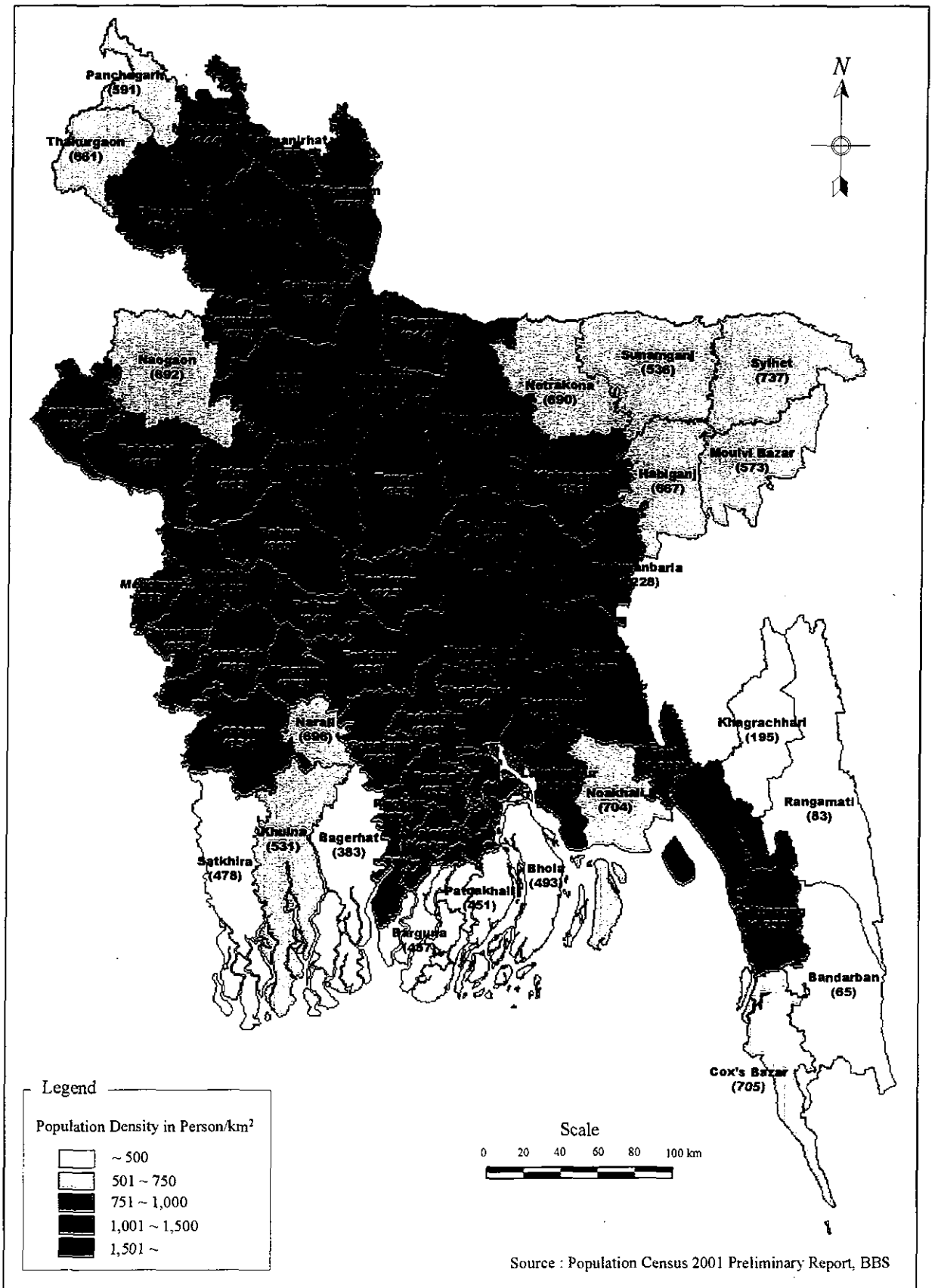


Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

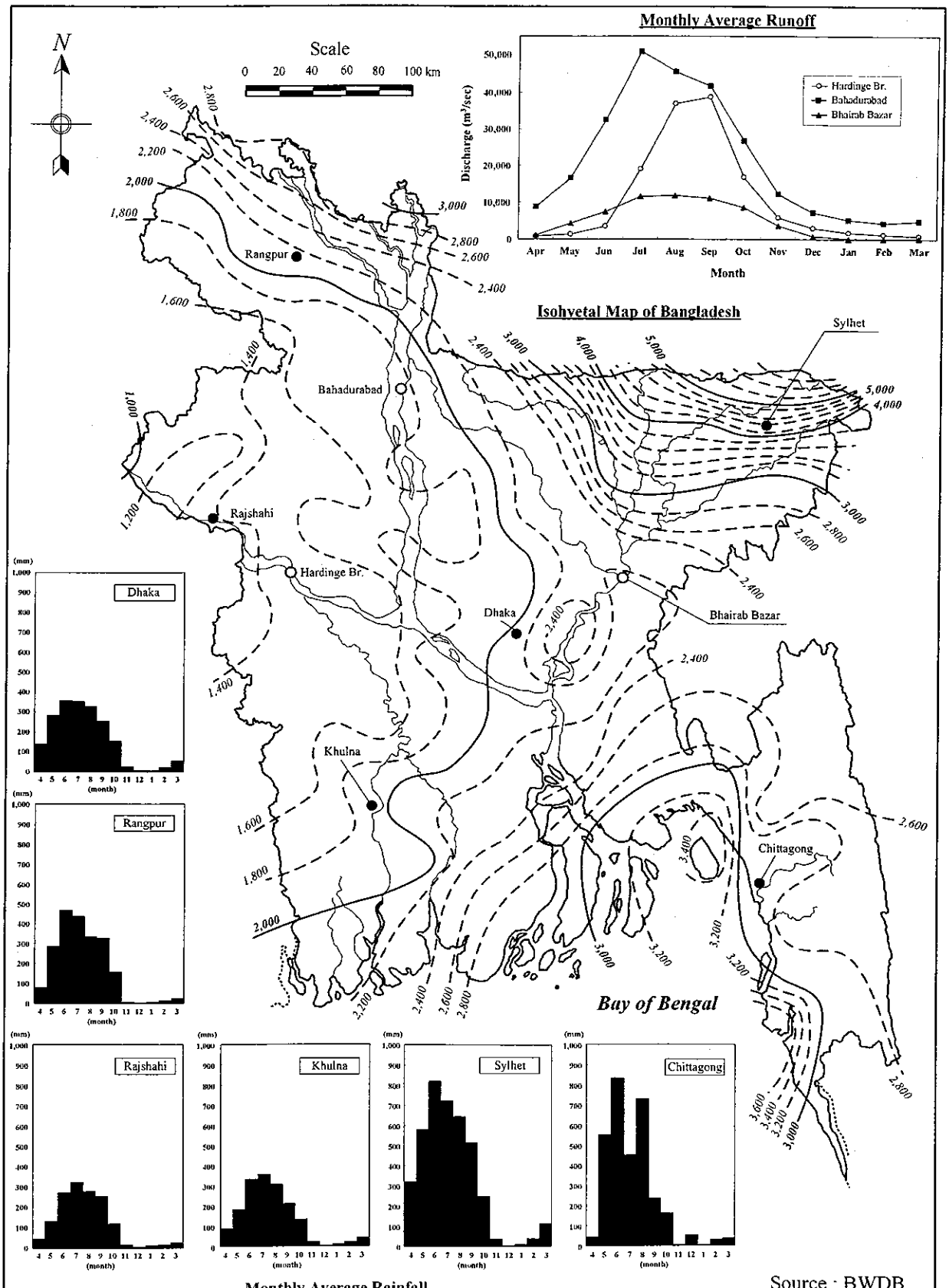
Figure 2.2.1

Administrative Boundary of Bangladesh



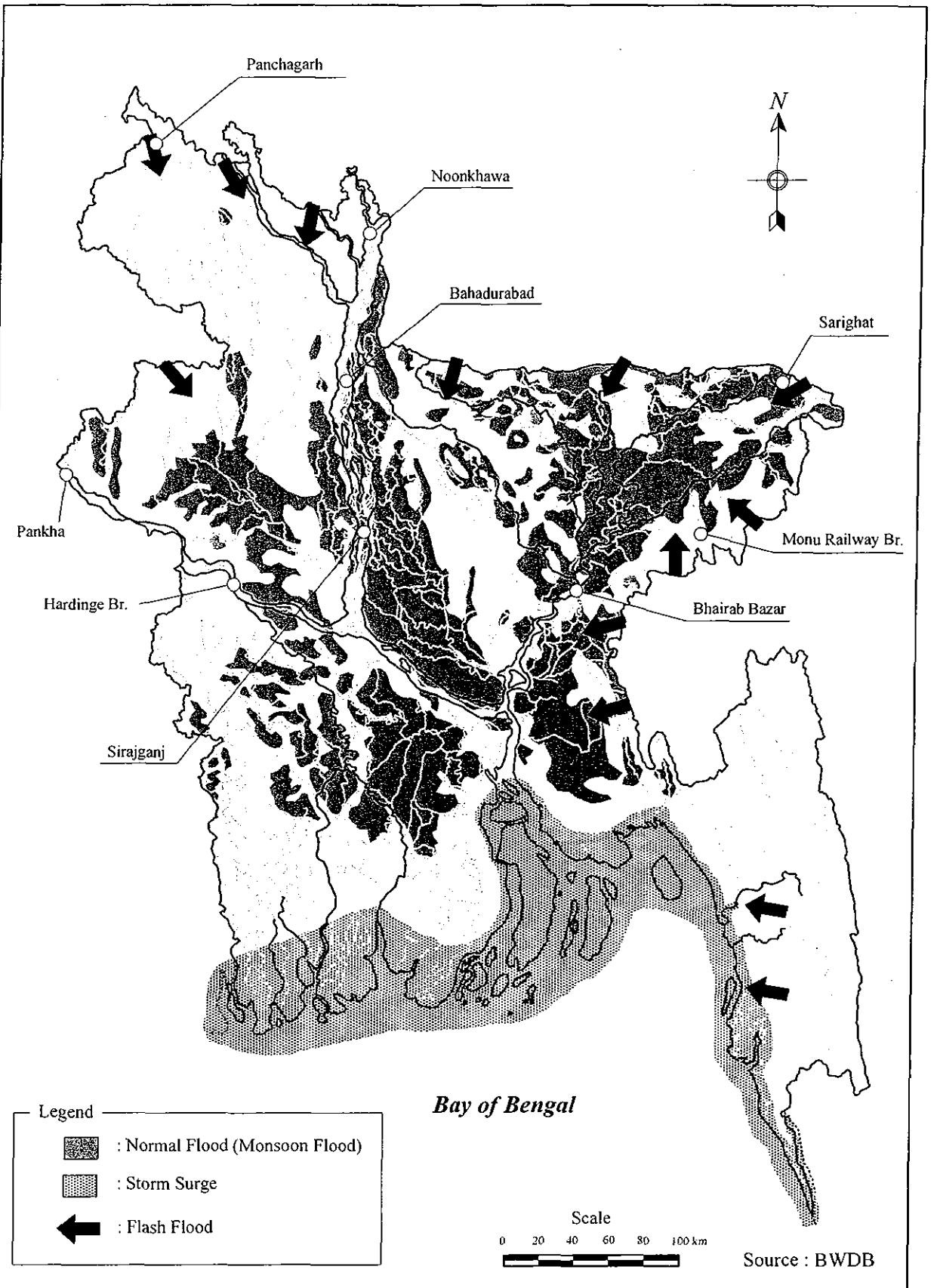
Source : Population Census 2001 Preliminary Report, BBS

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.2.2
JAPAN INTERNATIONAL COOPERATION AGENCY	Population Density by District (2001)



Source : BWDB

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.1 Hydrometeorological Condition in Bangladesh
JAPAN INTERNATIONAL COOPERATION AGENCY	

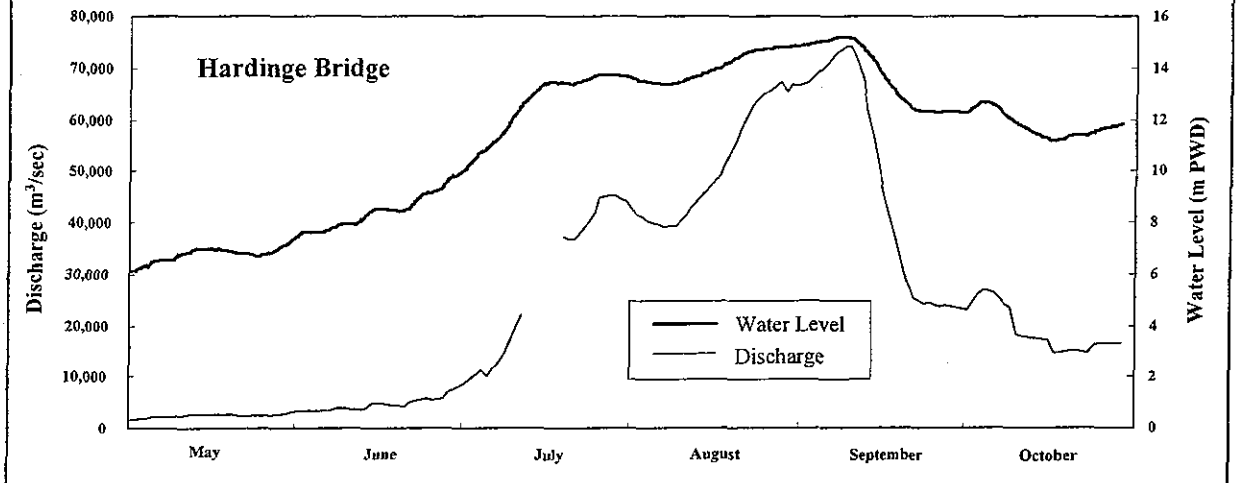


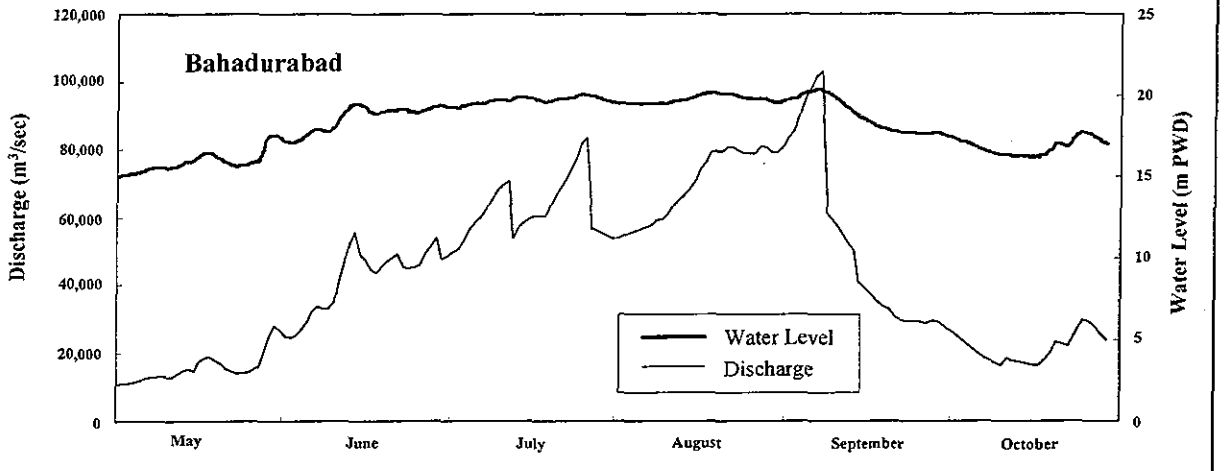
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 2.4.2 Flood Types in Bangladesh

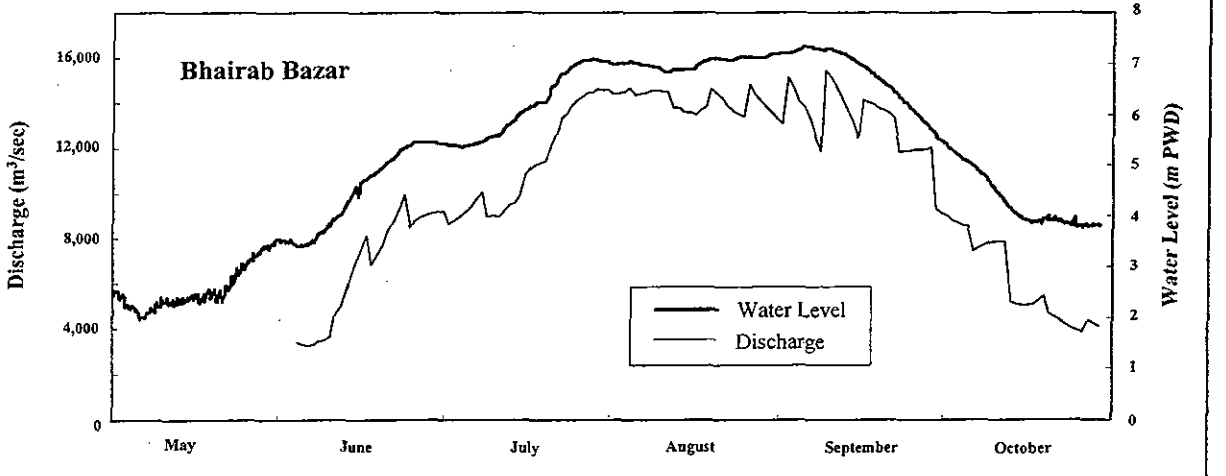
1998 Flood (Source : SWMC)

1988 Flood (Source : BWDB)

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.3 Flood Affected Area for Past Large-scale Events
JAPAN INTERNATIONAL COOPERATION AGENCY	



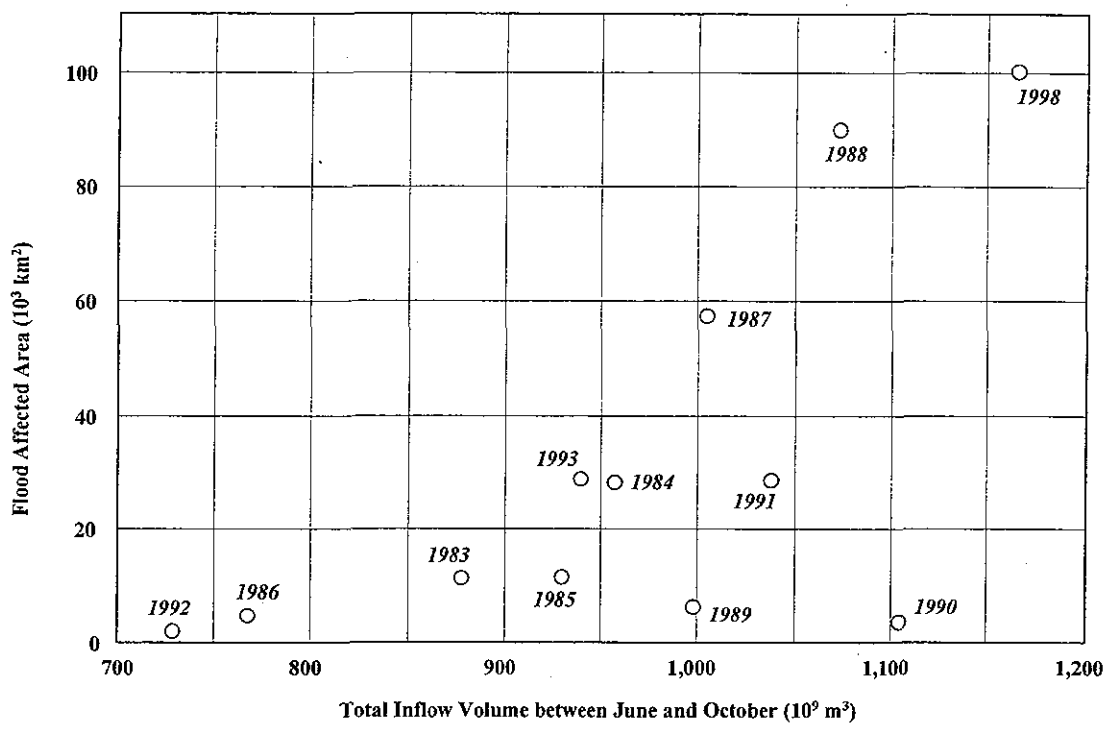




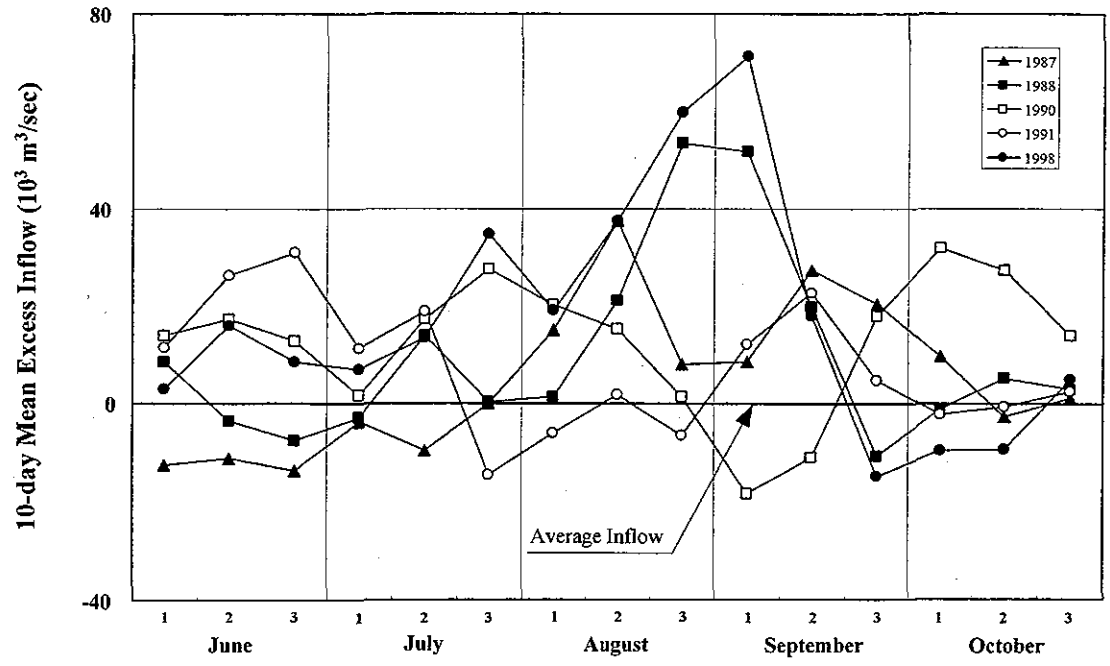
Note: The fluctuations of discharge record seem to be unnaturally large compared to those of water level. It is recommended for BWDB to review the discharge record as well as the method of conversion from water level to discharge.

Data Source : BWDB

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.4
JAPAN INTERNATIONAL COOPERATION AGENCY	Hydrographs of 1998 Flood

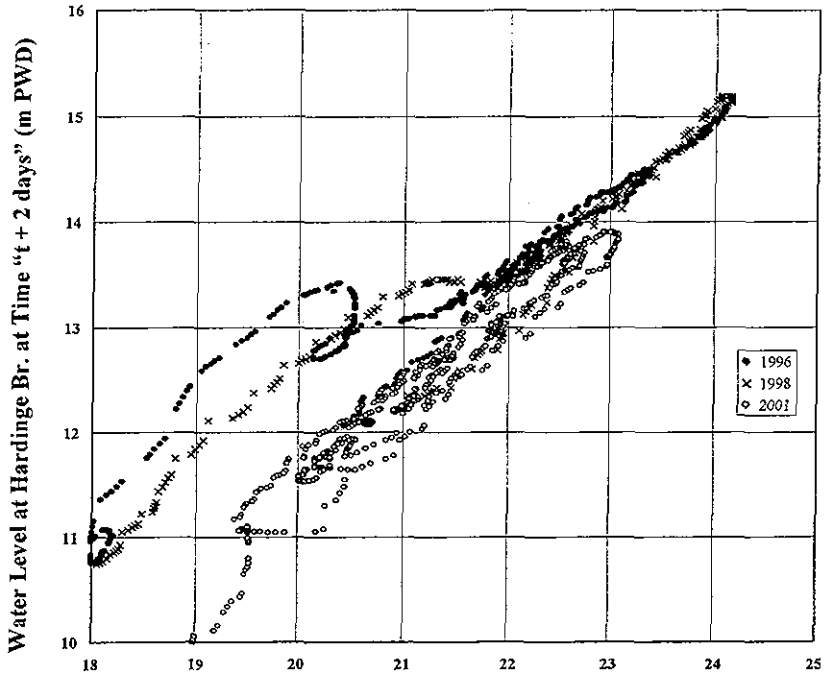


(1) Flood Affected Area by Total Inflow Volume between June and October

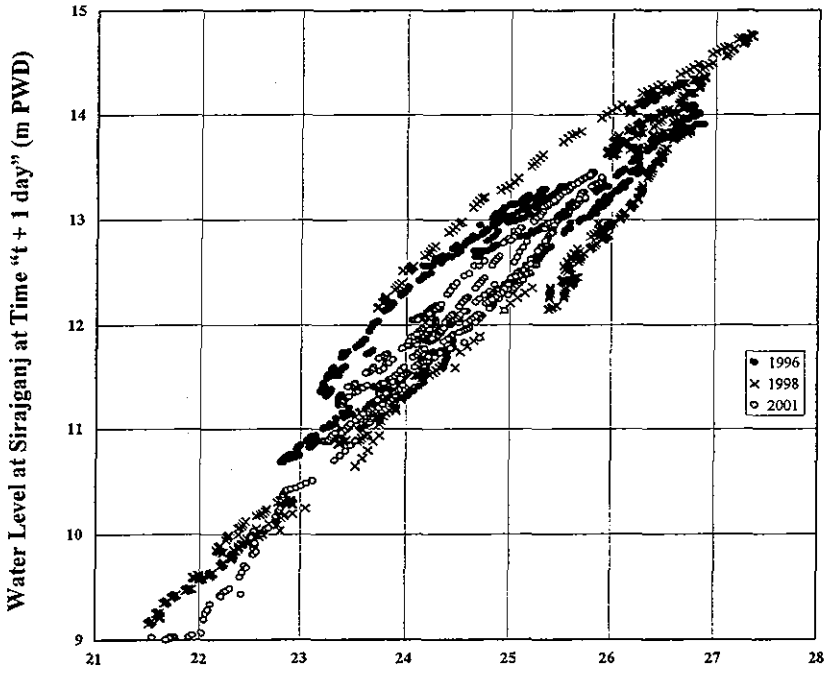


(2) 10-day Mean Excess Inflow Hydrographs

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.5
JAPAN INTERNATIONAL COOPERATION AGENCY	Total Inflow and Flood Affected Area



(1) Water Level Correlation between Pankha and Hardinge Br.

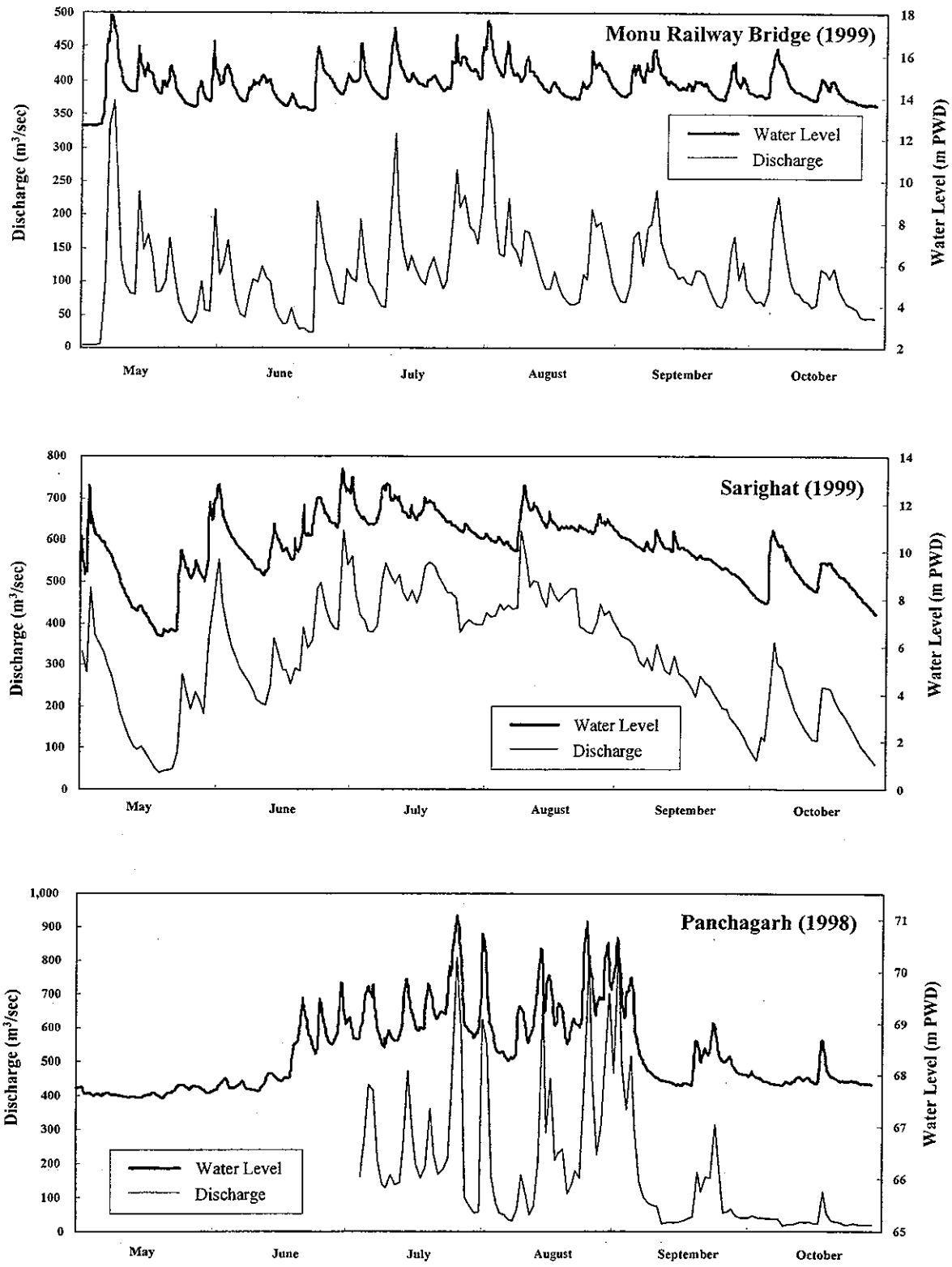


(2) Water Level Correlation between Noonkhawa and Sirajganj

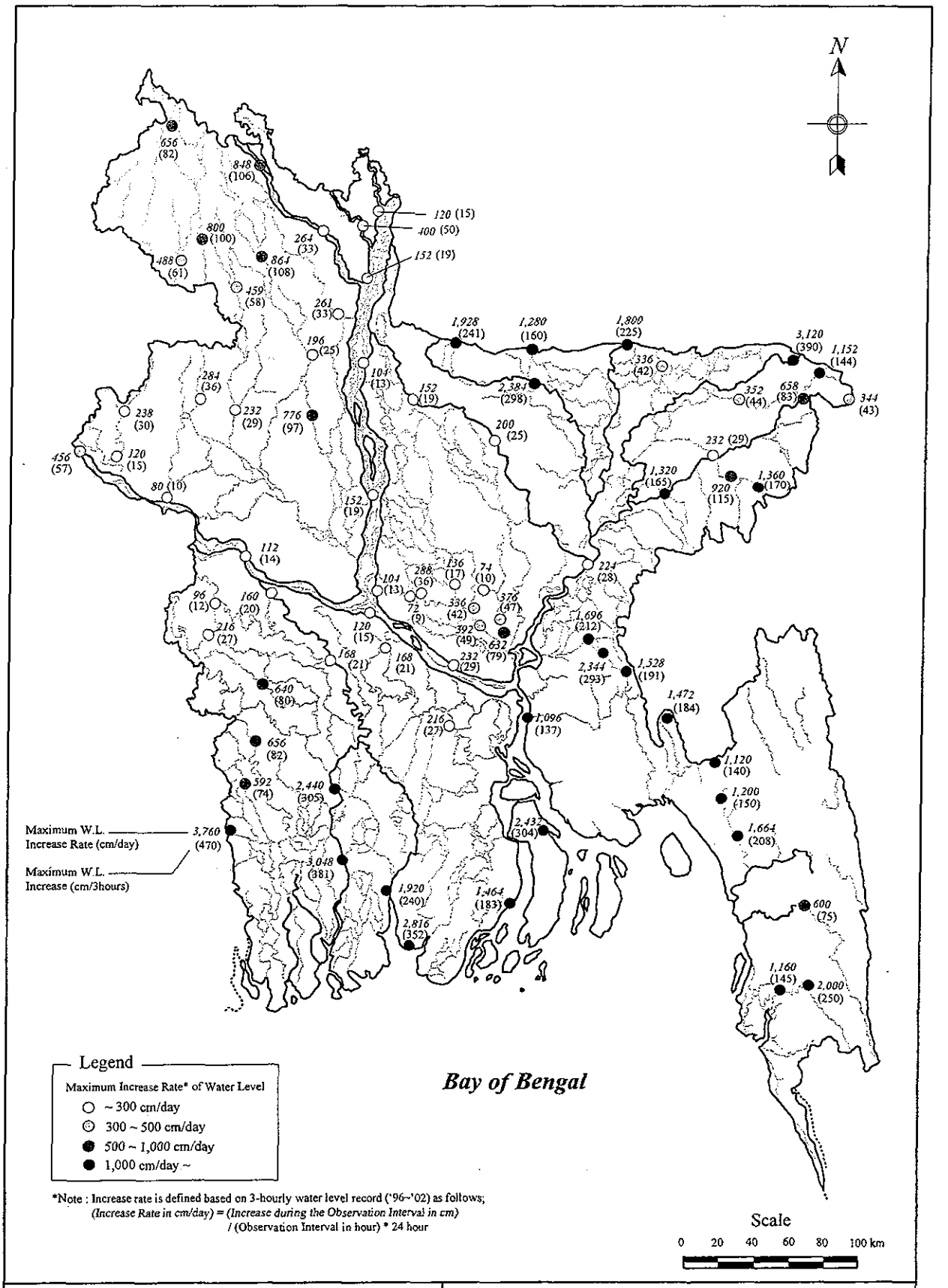
Note: Lag time is set to compress the loop around the highest water level built up due to the difference of the water level situation (rising or lowering).

Data Source: BWDB

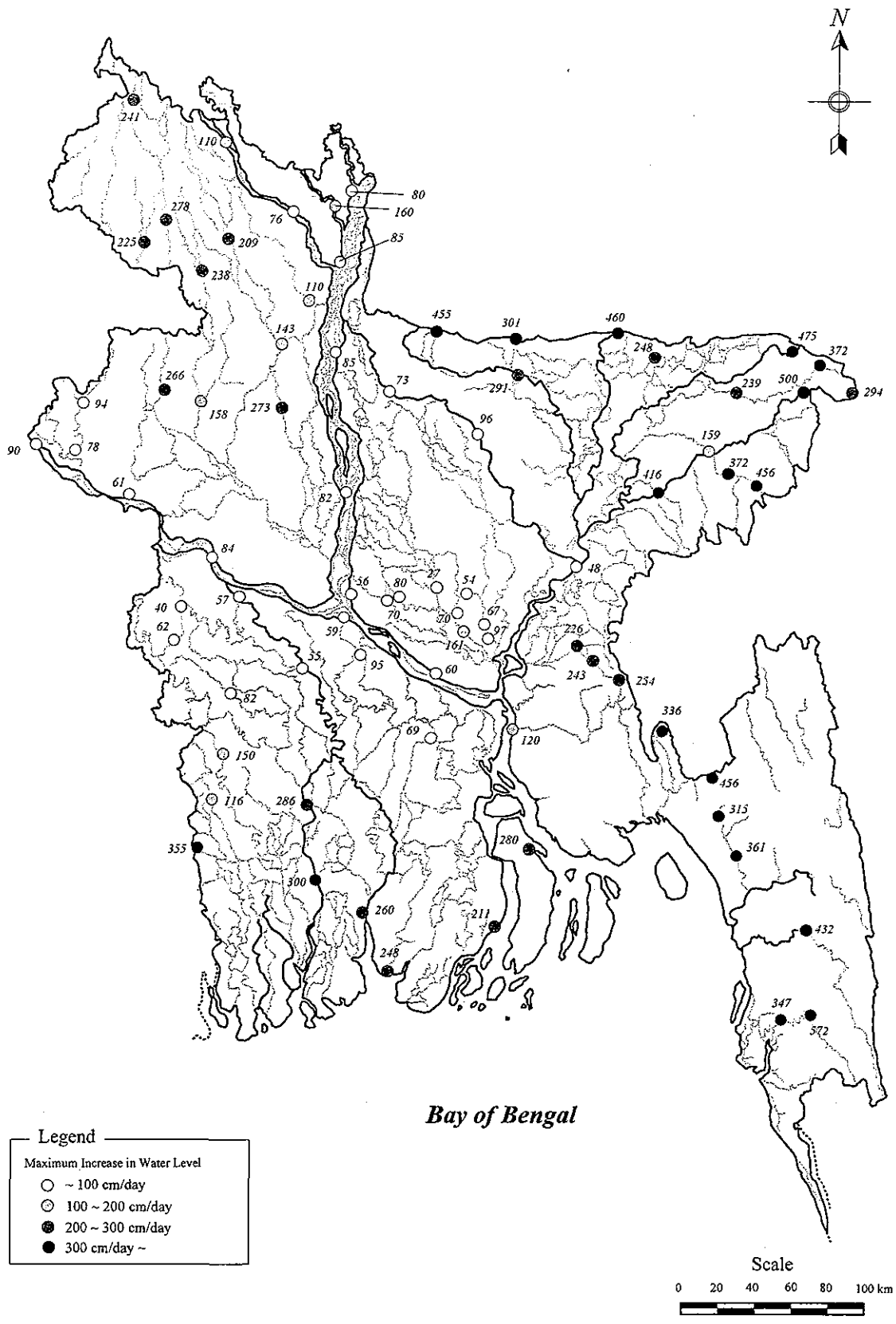
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.6
JAPAN INTERNATIONAL COOPERATION AGENCY	Water Level Correlations along Major Rivers



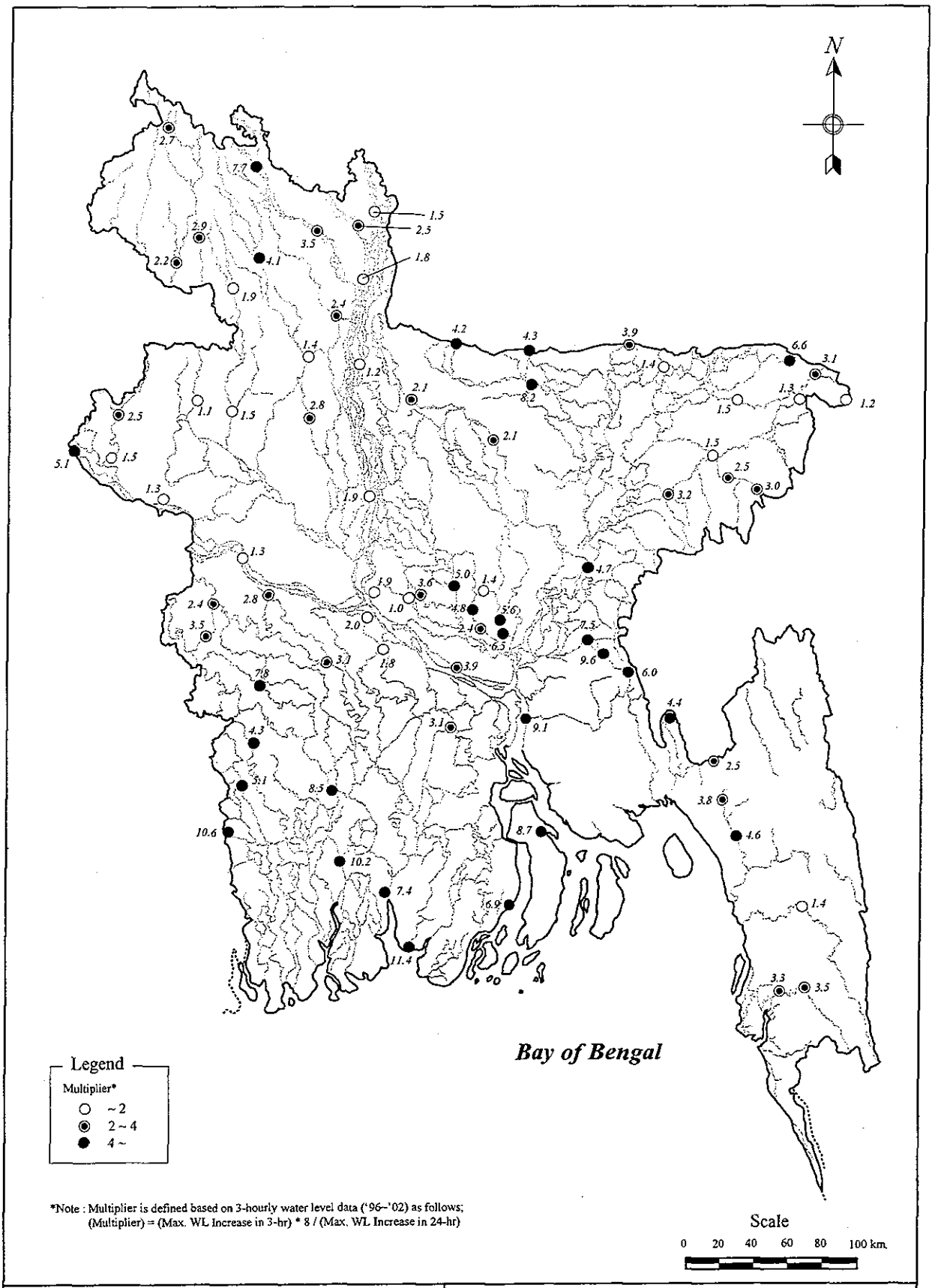
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 2.4.7 Hydrographs of Flashy Rivers



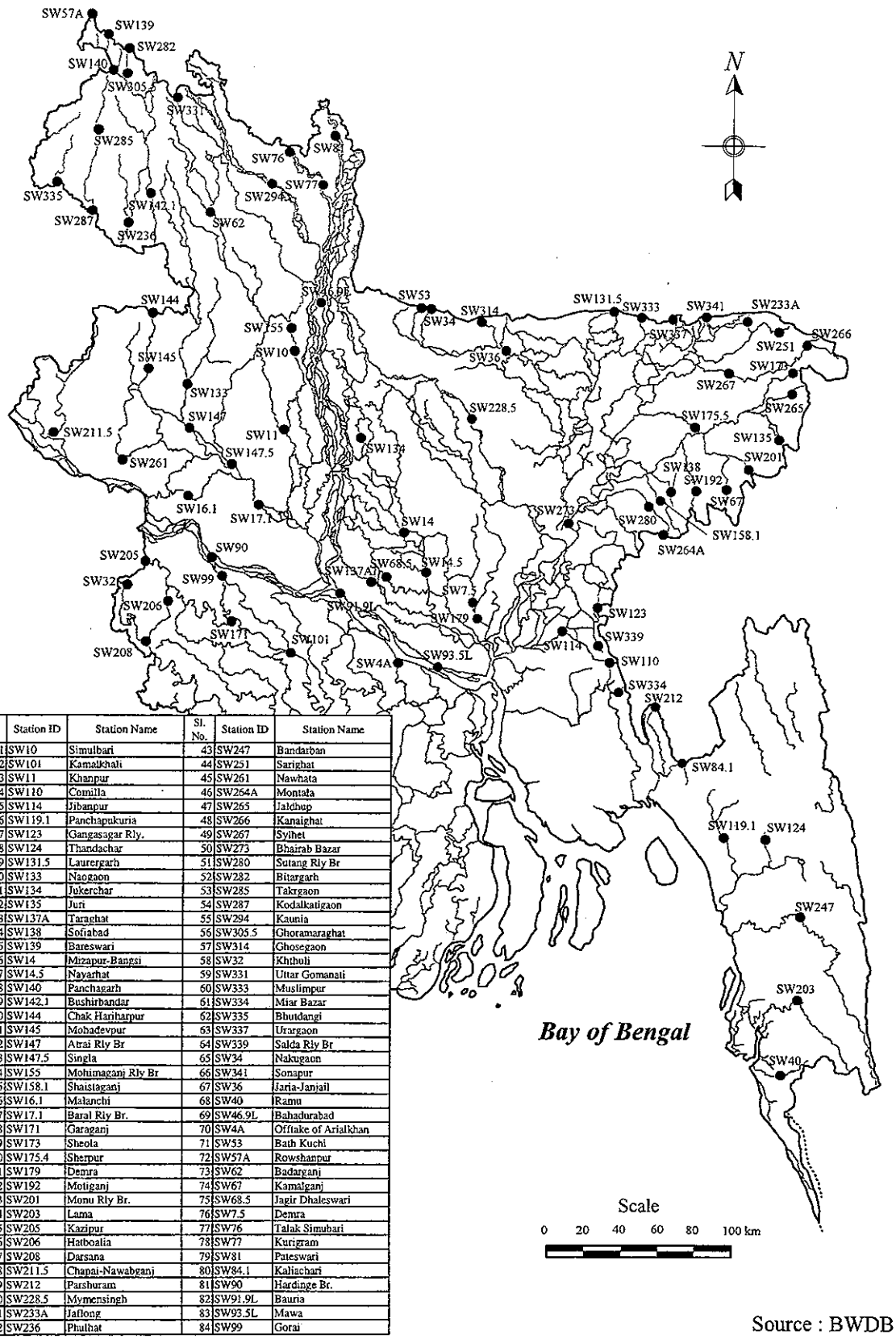
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.8
JAPAN INTERNATIONAL COOPERATION AGENCY	Maximum Water Level Increase in 3 Hours



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.9
JAPAN INTERNATIONAL COOPERATION AGENCY	Maximum Water Level Increase in 24 Hours



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.10 Difference of Recorded Water Level Increase Due to the Sampling Interval
JAPAN INTERNATIONAL COOPERATION AGENCY	

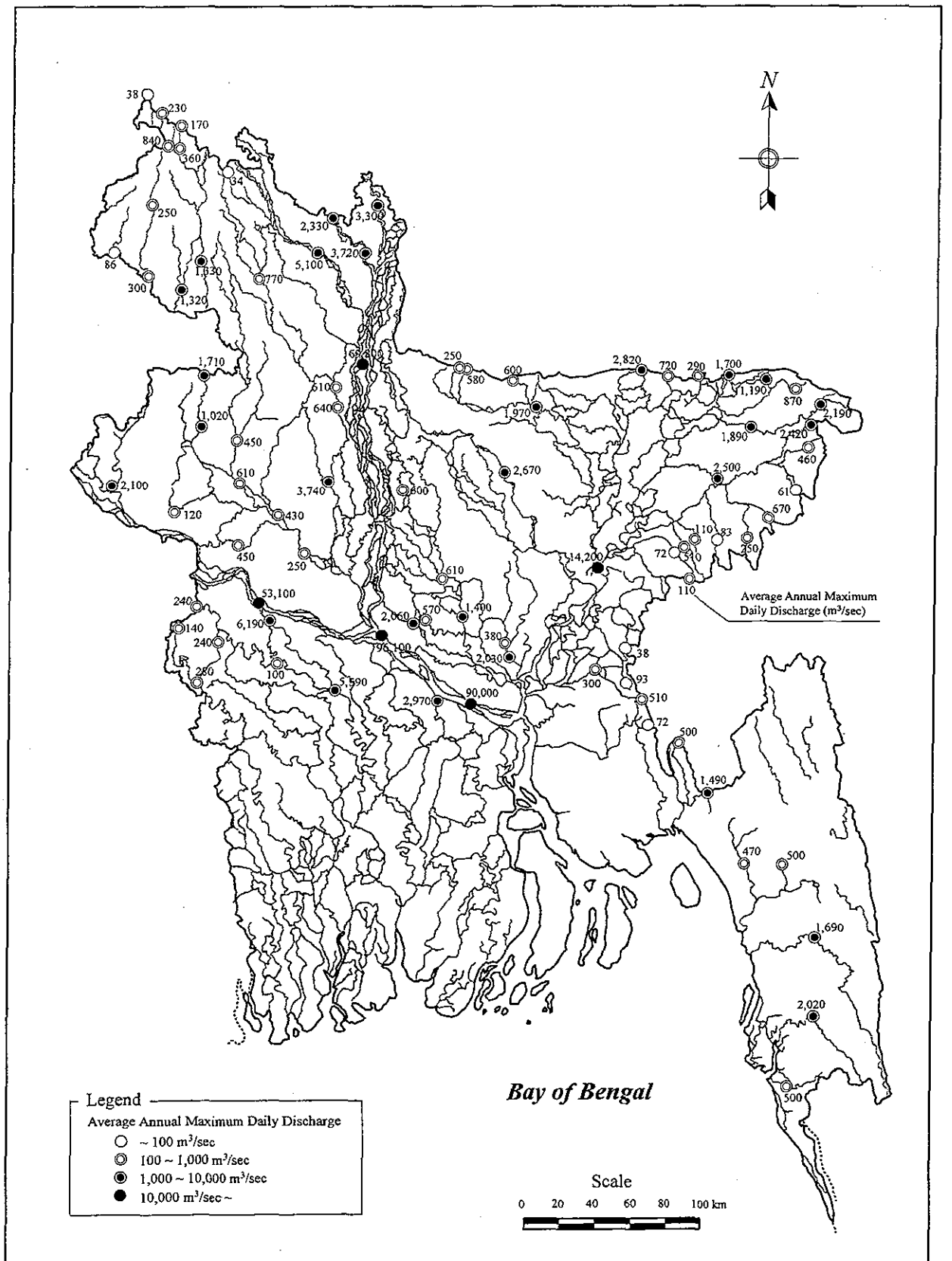


Sl. No.	Station ID	Station Name	Sl. No.	Station ID	Station Name
1	SW10	Simulbari	43	SW247	Bandarban
2	SW101	Kamalkhali	44	SW251	Sarighat
3	SW11	Khanpur	45	SW261	Nawhata
4	SW110	Comilla	46	SW264A	Montala
5	SW114	Jibanpur	47	SW265	Jaldhup
6	SW119.1	Panchapukuria	48	SW266	Kanaighat
7	SW123	Gangasagar Rly.	49	SW267	Sylhet
8	SW124	Thandachar	50	SW273	Bhairab Bazar
9	SW131.5	Laurergarh	51	SW280	Sutang Rly Br
10	SW133	Naogaon	52	SW282	Bitargarh
11	SW134	Jukerchar	53	SW285	Takrgaon
12	SW135	Juri	54	SW287	Kodalkatigaon
13	SW137A	Taraghat	55	SW294	Kaunia
14	SW138	Sofiabad	56	SW305.5	Ghoramaraghat
15	SW139	Bareswari	57	SW314	Ghosegaon
16	SW14	Mirzapur-Bangsi	58	SW32	Khthuli
17	SW14.5	Nayarhat	59	SW331	Uttar Gomanati
18	SW140	Panchagarh	60	SW333	Muslimpur
19	SW142.1	Bushirbandar	61	SW334	Miar Bazar
20	SW144	Chak Hariharpur	62	SW335	Bbuidangi
21	SW145	Mohadevpur	63	SW337	Urargaon
22	SW147	Atrai Rly Br	64	SW339	Salda Rly Br
23	SW147.5	Singla	65	SW34	Nakugaon
24	SW155	Mohimaganj Rly Br	66	SW341	Sonapur
25	SW158.1	Shaistaganj	67	SW36	Jaria-Janjail
26	SW16.1	Malanchi	68	SW40	Ramu
27	SW17.1	Baral Rly Br.	69	SW46.9L	Bahadurabad
28	SW171	Garaganj	70	SW4A	Offtake of Arialkhan
29	SW173	Sheola	71	SW53	Bath Kuchi
30	SW175.4	Sherpur	72	SW57A	Rowshanpur
31	SW179	Demra	73	SW62	Badarganj
32	SW192	Motiganj	74	SW67	Kamalganj
33	SW201	Monu Rly Br.	75	SW68.5	Jagir Dhaleswari
34	SW203	Lama	76	SW7.5	Demra
35	SW205	Kazipur	77	SW76	Talak Simubari
36	SW206	Hatboalia	78	SW77	Kurigram
37	SW208	Darsana	79	SW81	Pateswari
38	SW211.5	Chapai-Nawabganj	80	SW84.1	Kaliachari
39	SW212	Parshuram	81	SW90	Hardinge Br.
40	SW228.5	Mymensingh	82	SW91.9L	Bauria
41	SW233A	Jaflong	83	SW93.5L	Mawa
42	SW236	Phulbat	84	SW99	Gorai

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

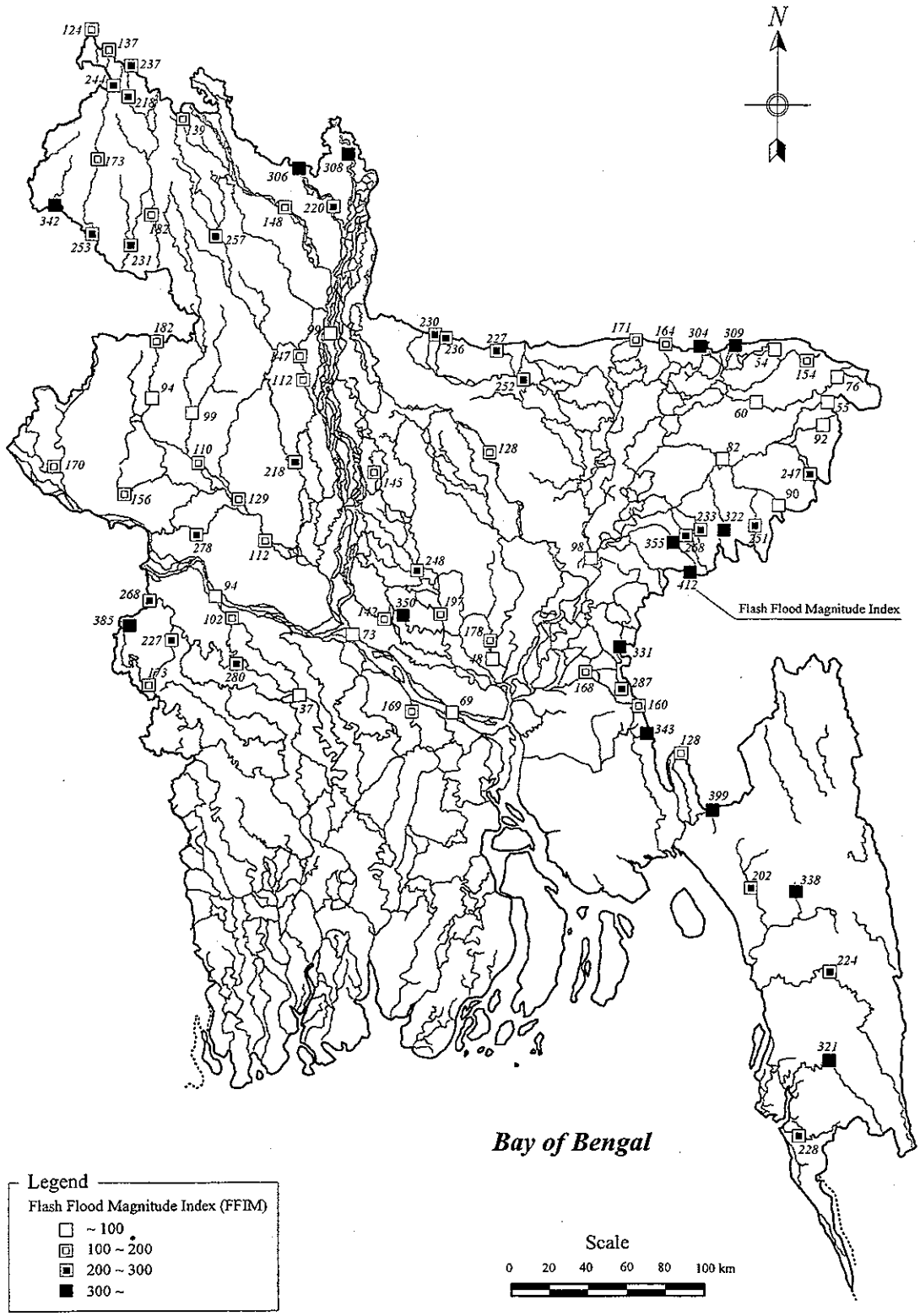
Figure 2.4.11
BWDB's Discharge Stations Taken up for FFMI Analysis



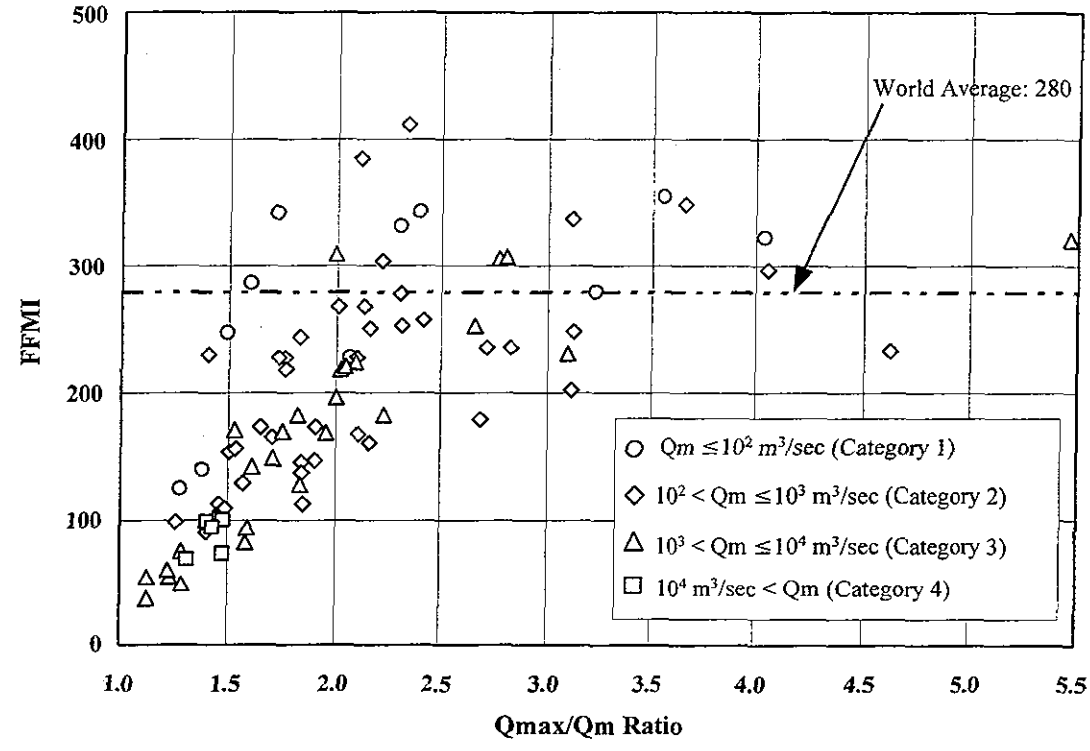
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

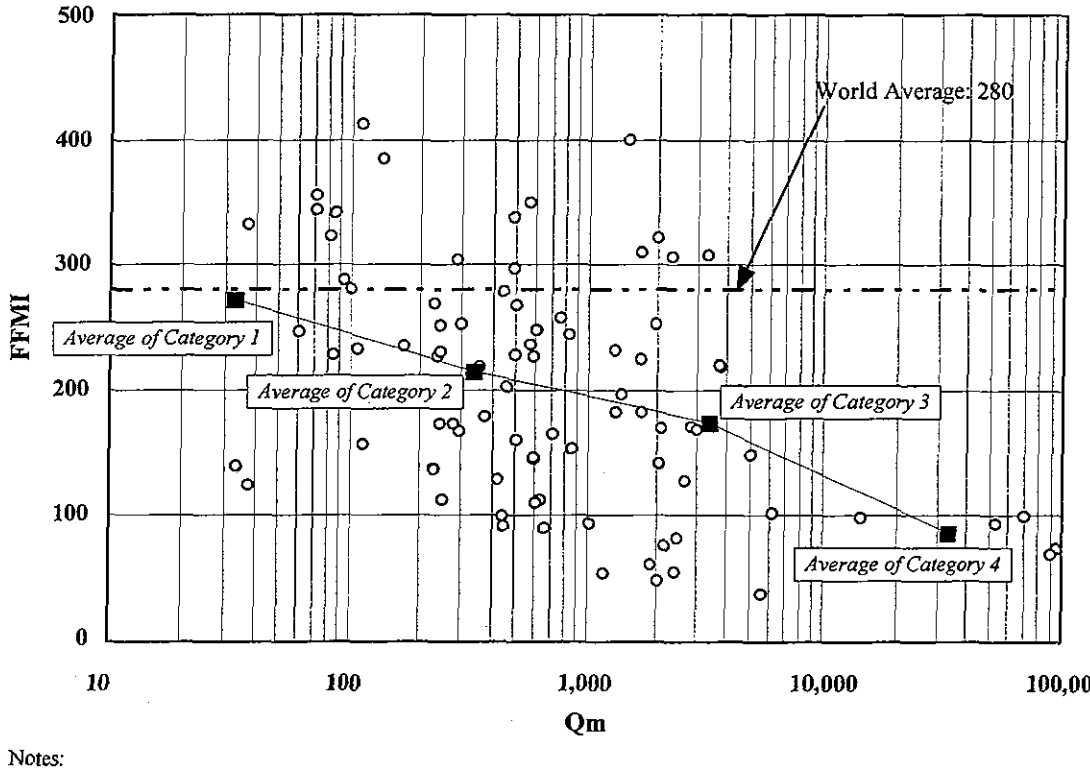
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.4.12
Average Annual Maximum Daily Discharges at BWDB Observatories



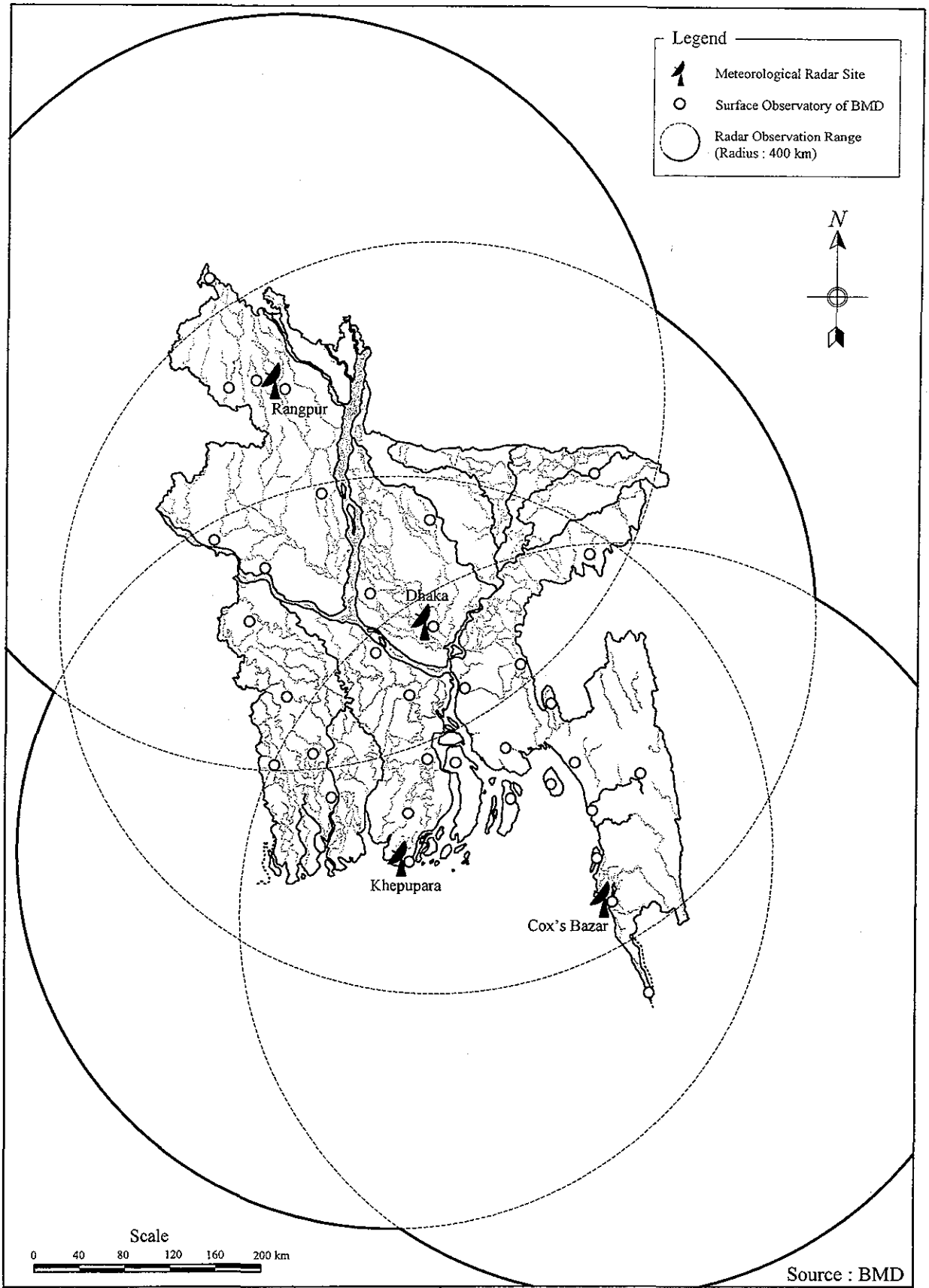
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.13 Flash Flood Magnitude Index at BWDB Discharge Stations
JAPAN INTERNATIONAL COOPERATION AGENCY	



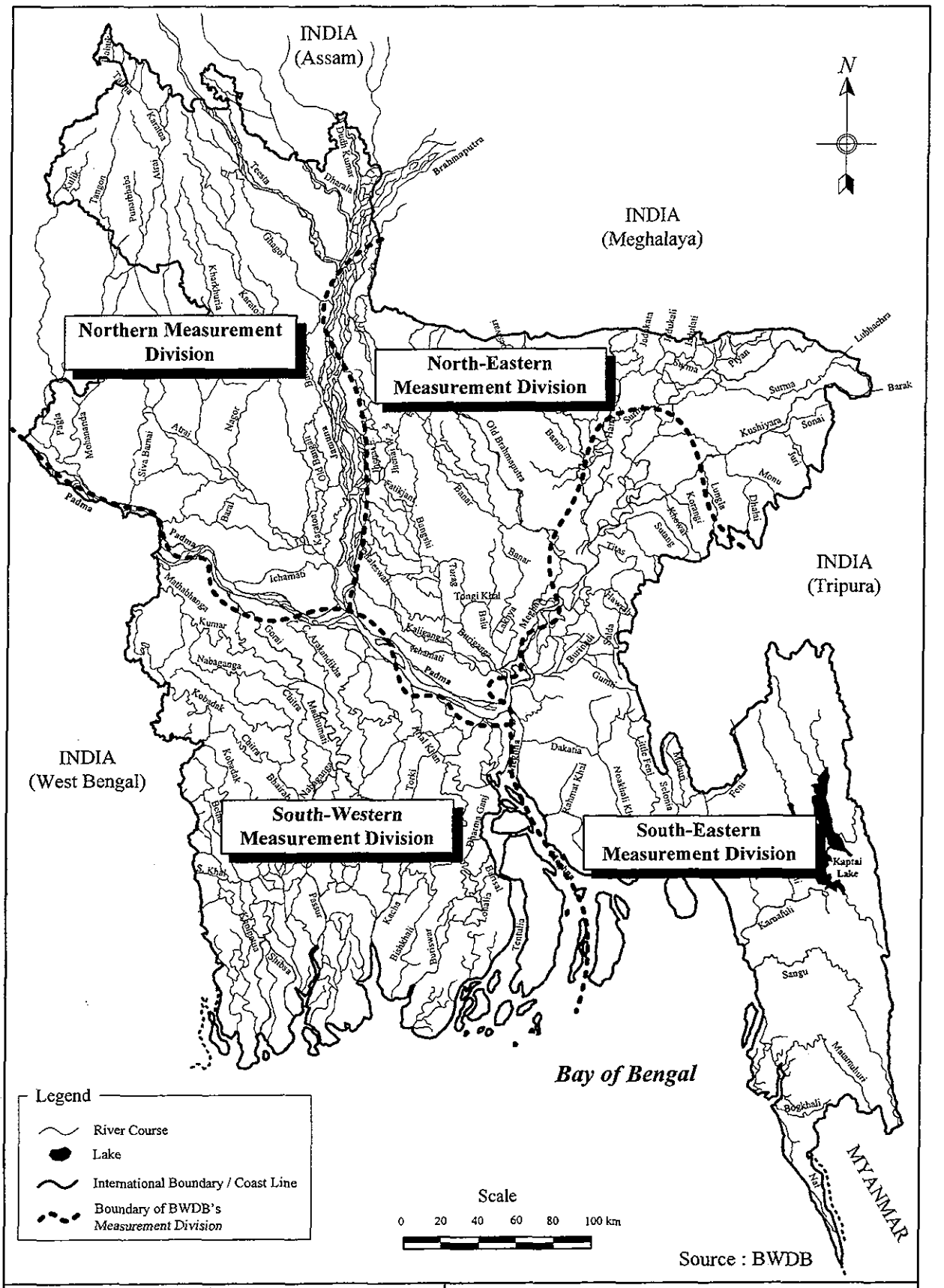


Notes:
Qm: Average Annual Maximum Daily Discharge
Qmax: Recorded Maximum Daily Discharge
FFMI: Flash Flood Magnitude Index

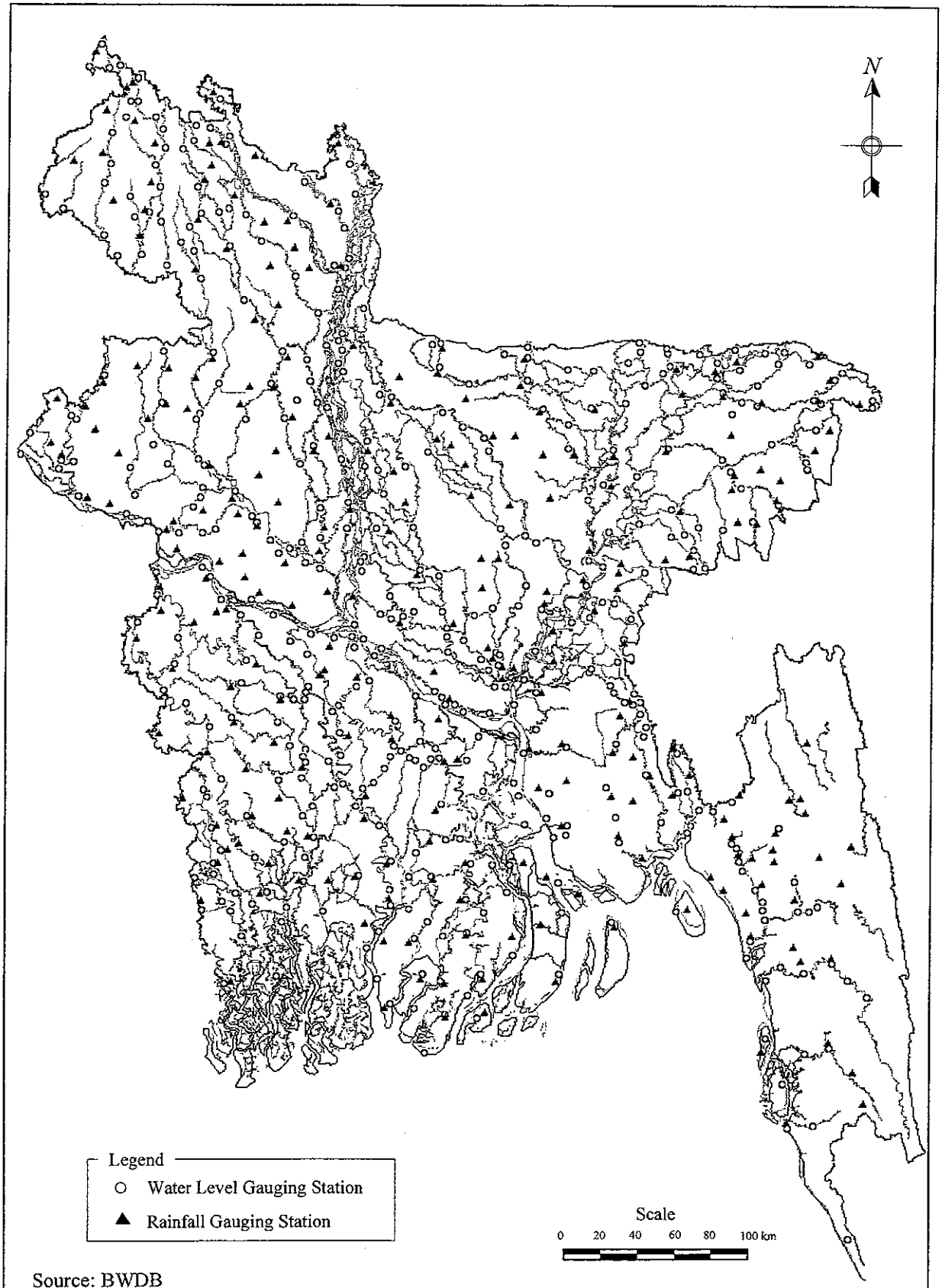
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 2.4.14 FFMI by Average Annual Maximum Daily Discharge



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.15
JAPAN INTERNATIONAL COOPERATION AGENCY	Radars and Surface Observatories of BMD

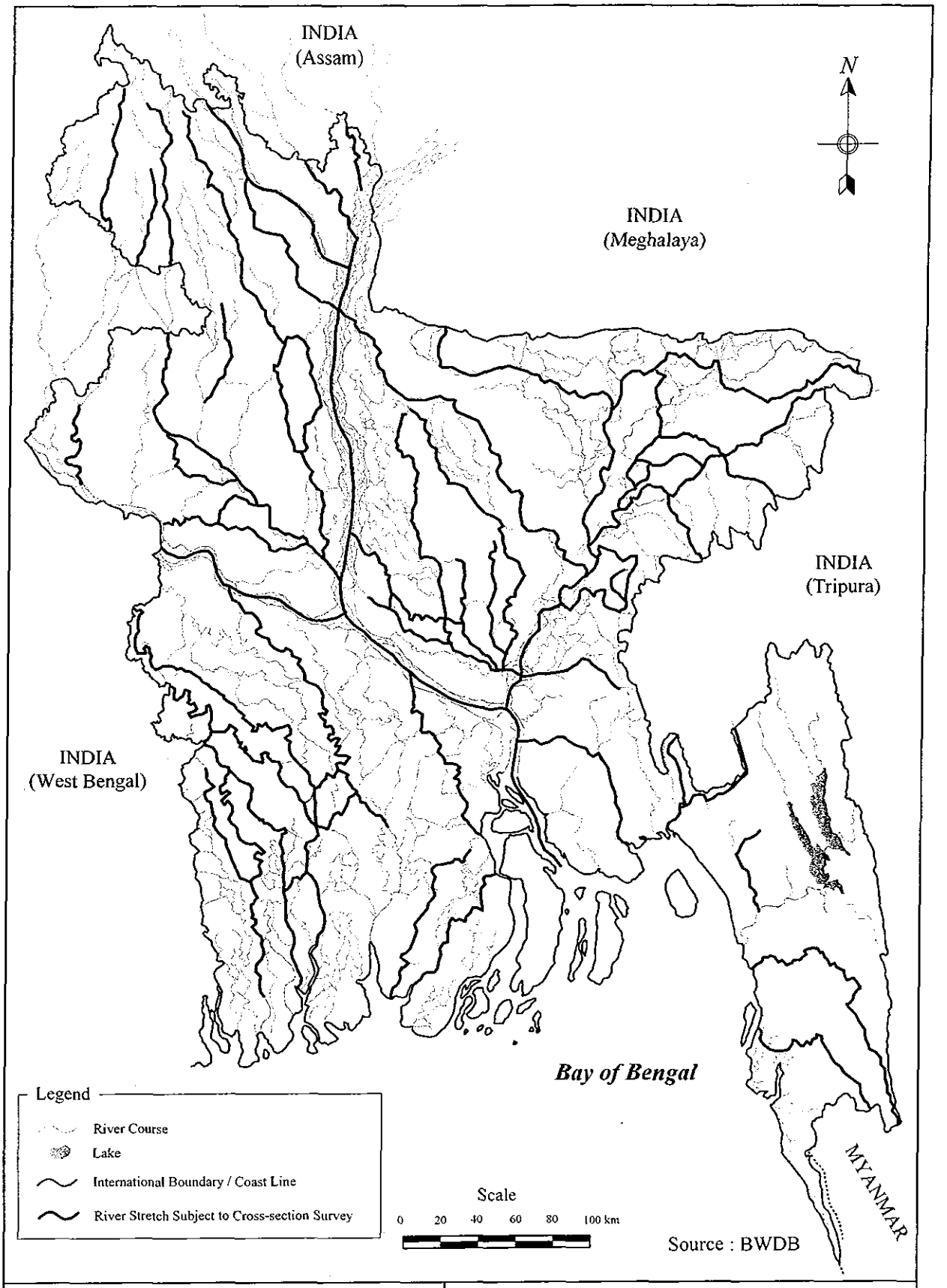


Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.16
JAPAN INTERNATIONAL COOPERATION AGENCY	Measurement Division of BWDB (SW)

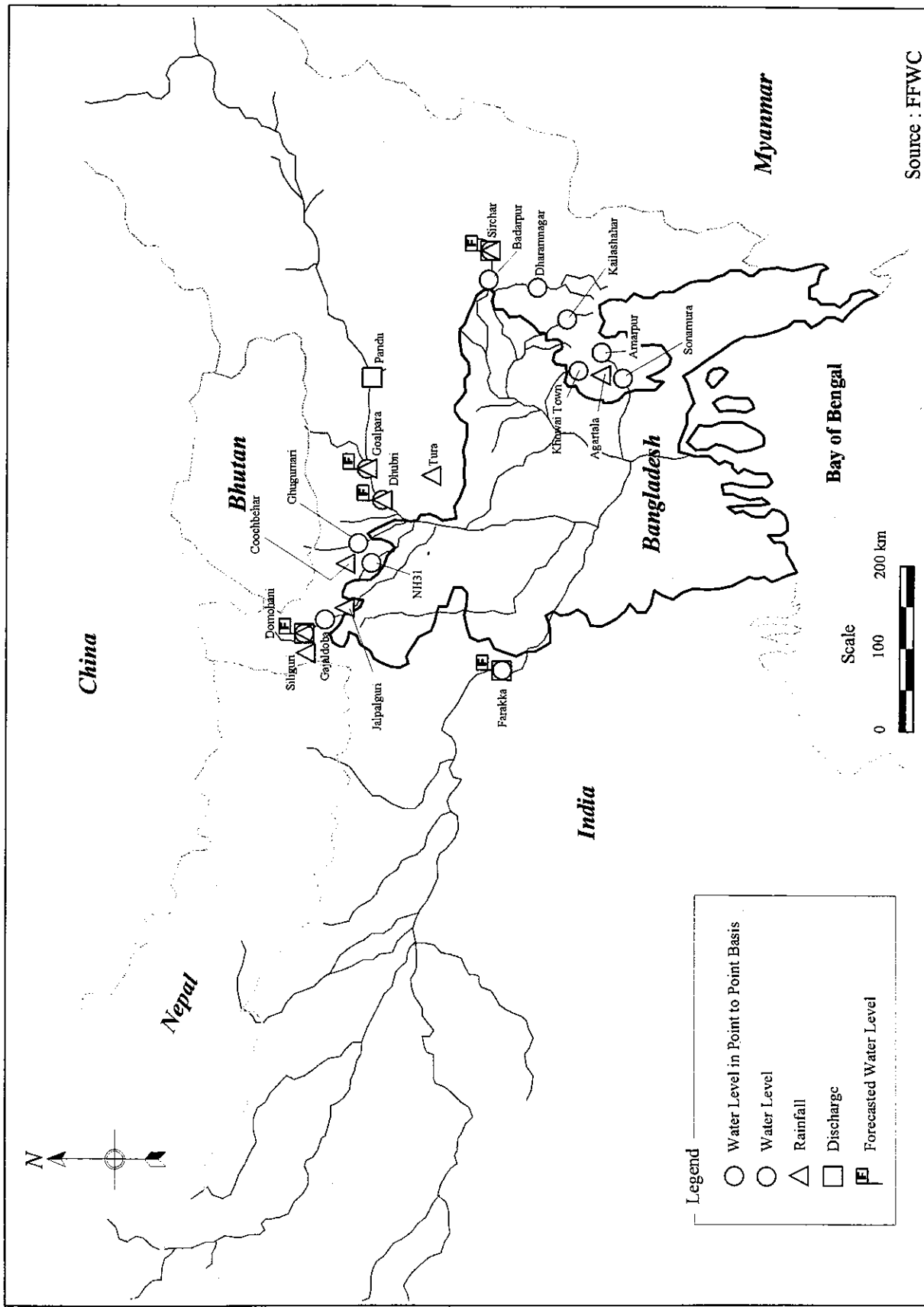


Source: BWDB

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 2.4.17 Water Level and Rainfall Gauging Stations of BWDB



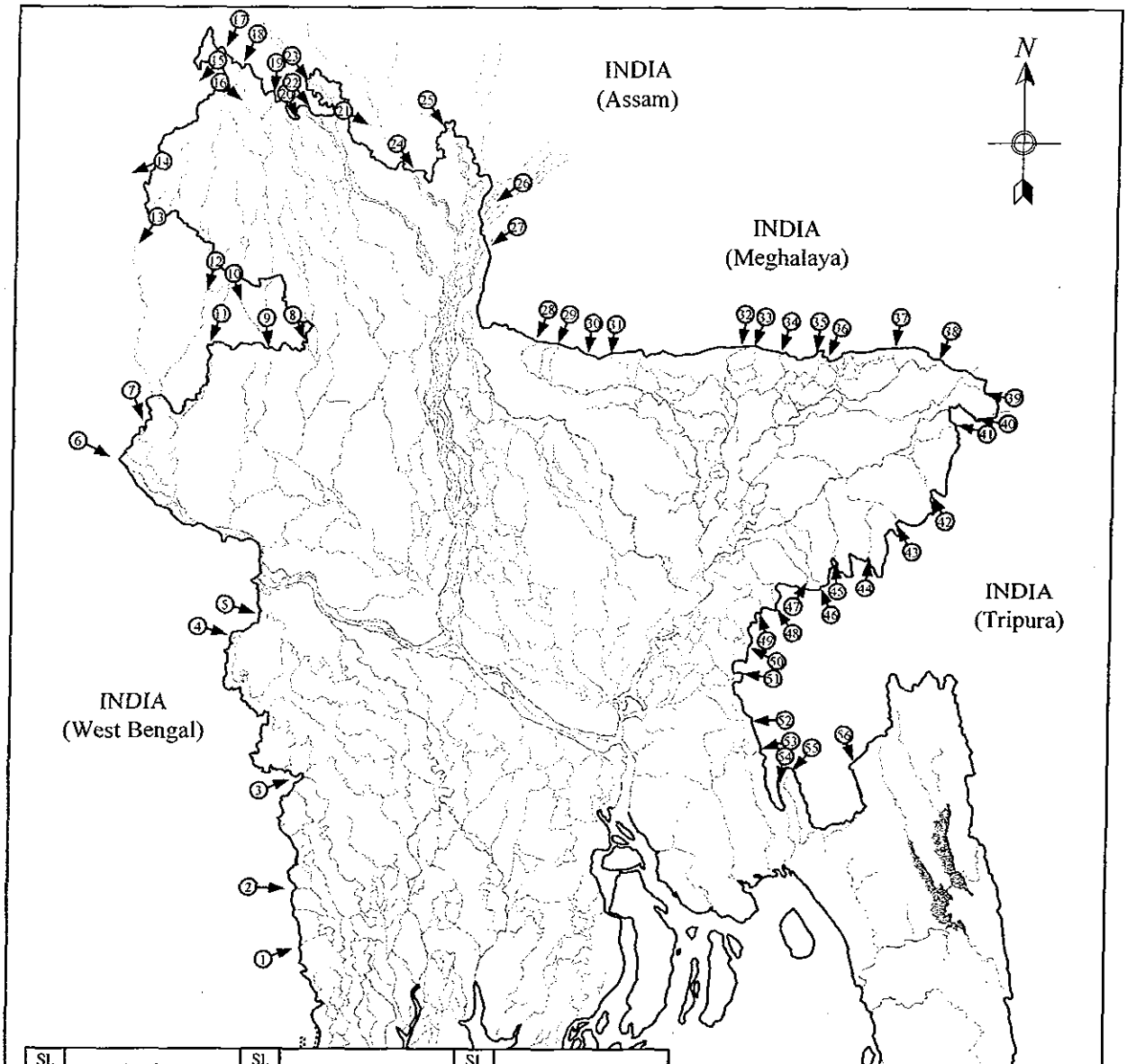
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.4.18 River Cross Section Survey Network of BWDB
JAPAN INTERNATIONAL COOPERATION AGENCY	



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.4.19
Flood Related Data Sharing Agreed in 1972 and Subsequent JRC Meetings



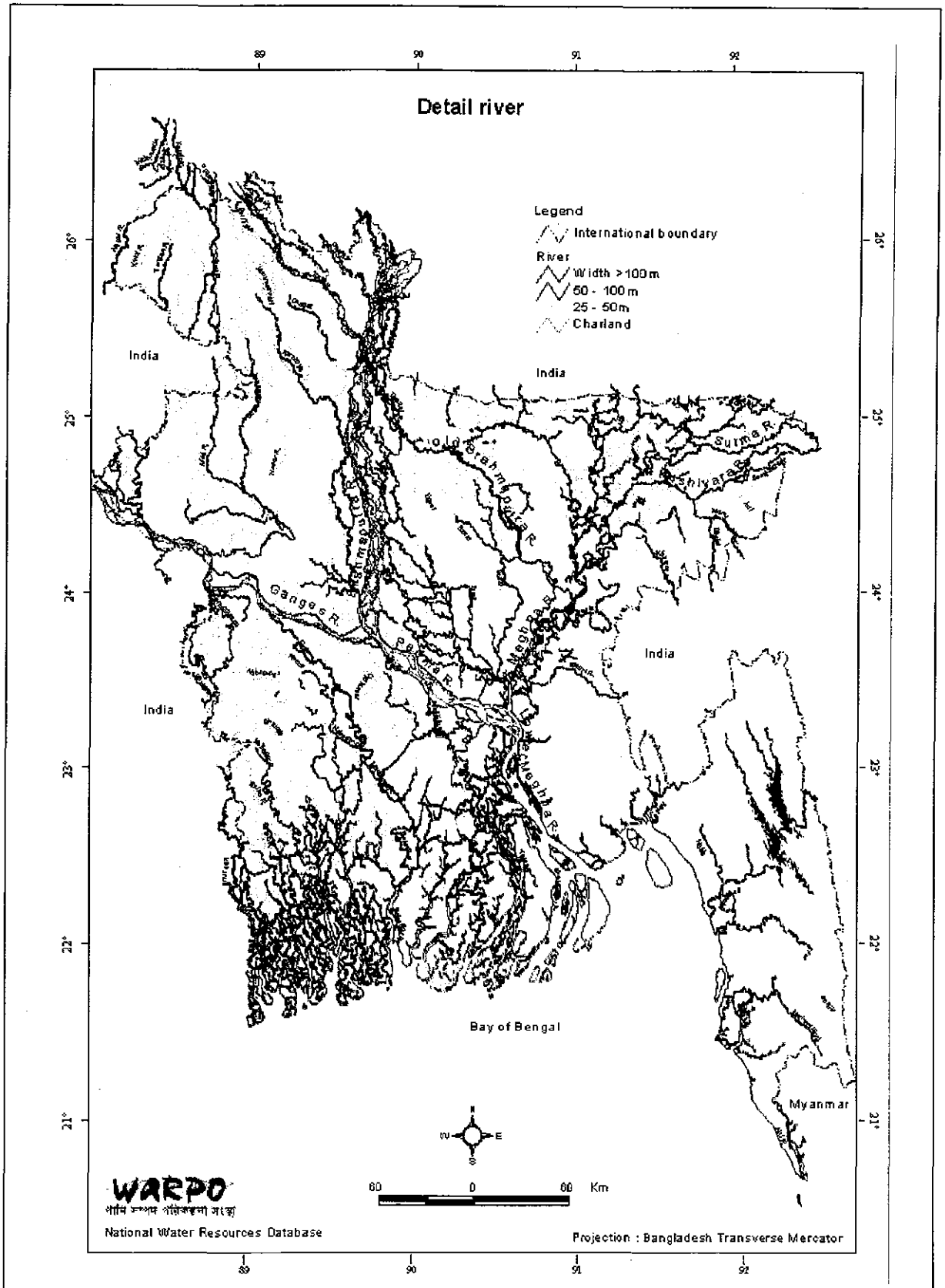
Sl. No.	River Name	Sl. No.	River Name	Sl. No.	River Name
1	Ray Mangal	21	Buri Teesta	41	Sonai Bardal
2	Ichamati-Kalindi	22	Teesta	42	Juri
3	Benta-Kodalia	23	Sangil	43	Monu
4	Bhairab-Kabodak	24	Dharla	44	Dhalai
5	Mathabhanga	25	Dudhkumar	45	Langola
6	Ganges (Padma)	26	Brahmaputra	46	Khowai
7	Pagla	27	Jinjiran	47	Sutang
8	Khukshi	28	Chilakhali	48	Sonai
9	Atrai	29	Bhogai	49	Howra
10	Punarbhaba	30	Nitai	50	Bijni
11	Tentulia	31	Semeswari	51	Salda
12	Tangon	32	Jadukata	52	Gomti
13	Kulic	33	Dhamalia	53	Feni-Dakatia
14	Nagar	34	Nawagang	54	Selonia
15	Mahananda	35	Eusium	55	Muhuri
16	Dahuk	36	Dhala	56	Feni
17	Karatoa	37	Piyan	57	Sangu
18	Talma	38	Sarigowain	58	Matamuhuri
19	Ghoramara	39	Surma	59	Naf
20	Deonai-Jamuneshwari	40	Kushiyara		

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

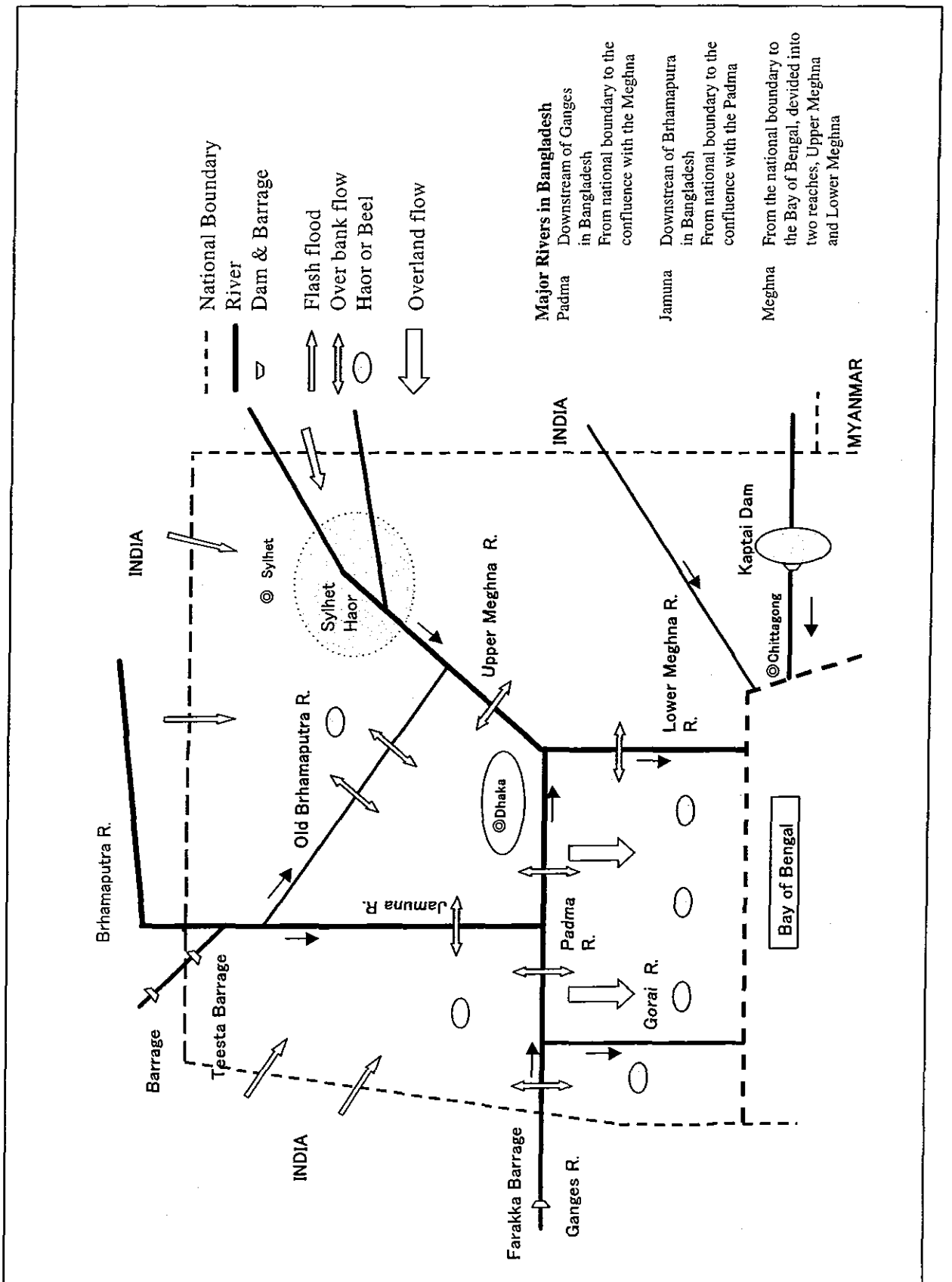
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.4.20

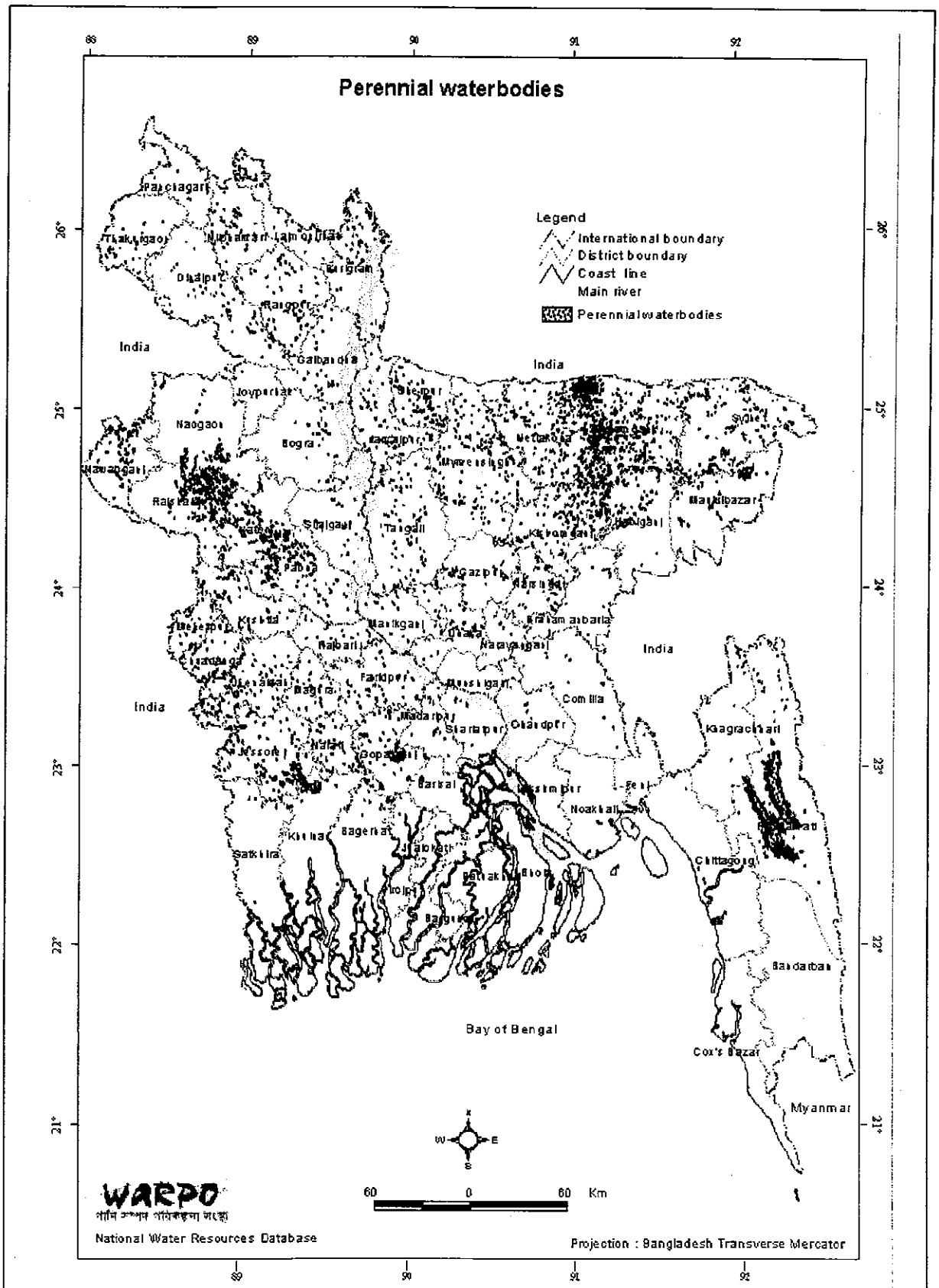
International Rivers Related to Bangladesh



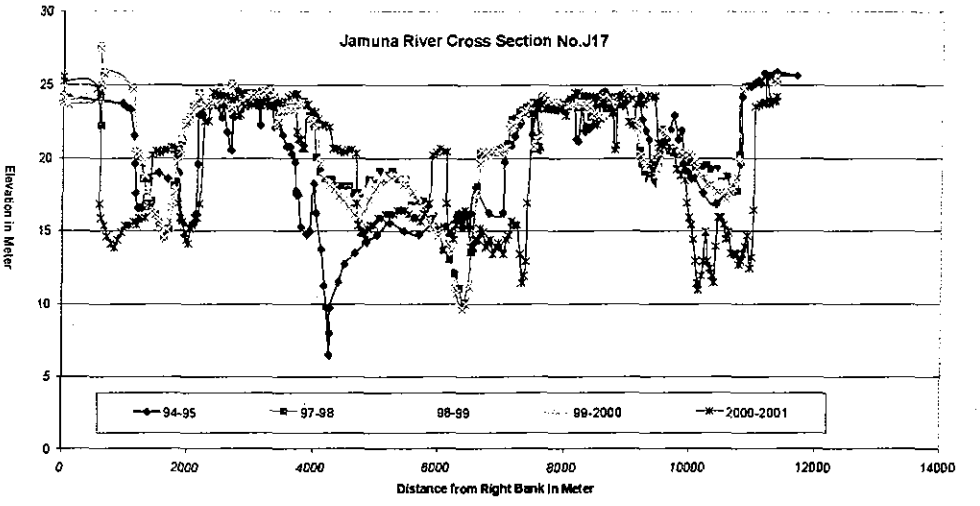
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.5.1
JAPAN INTERNATIONAL COOPERATION AGENCY	River System in Bangladesh

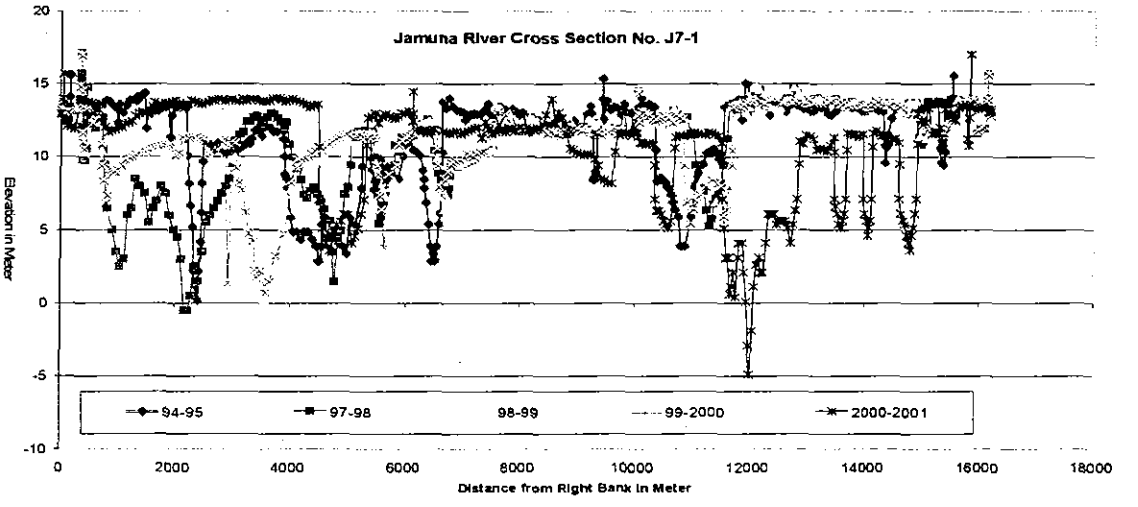


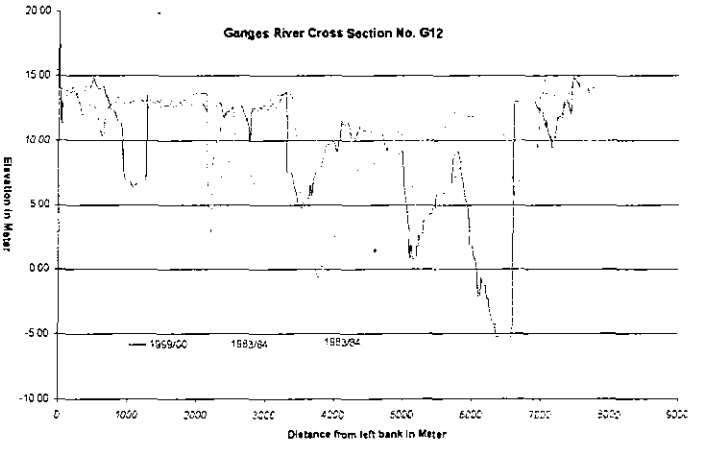
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.5.2 Schematic Diagram of River System in Bangladesh
JAPAN INTERNATIONAL COOPERATION AGENCY	



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.5.3
JAPAN INTERNATIONAL COOPERATION AGENCY	Water Bodies in Bangladesh

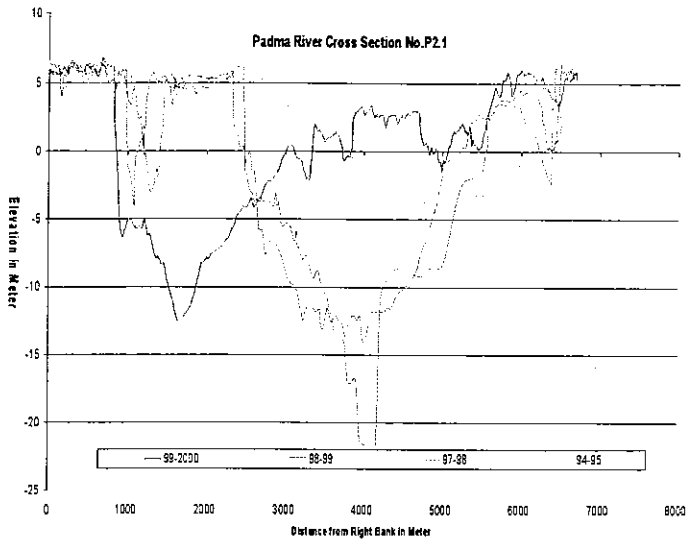


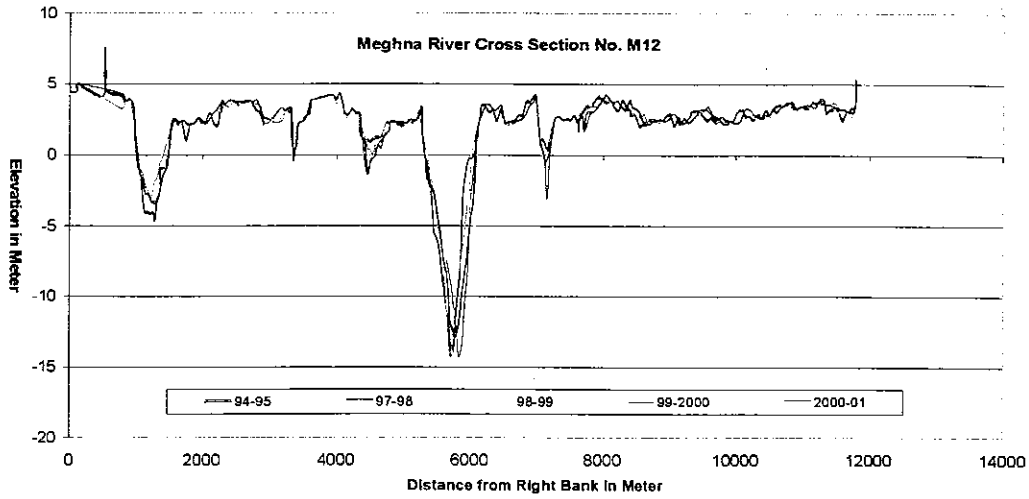


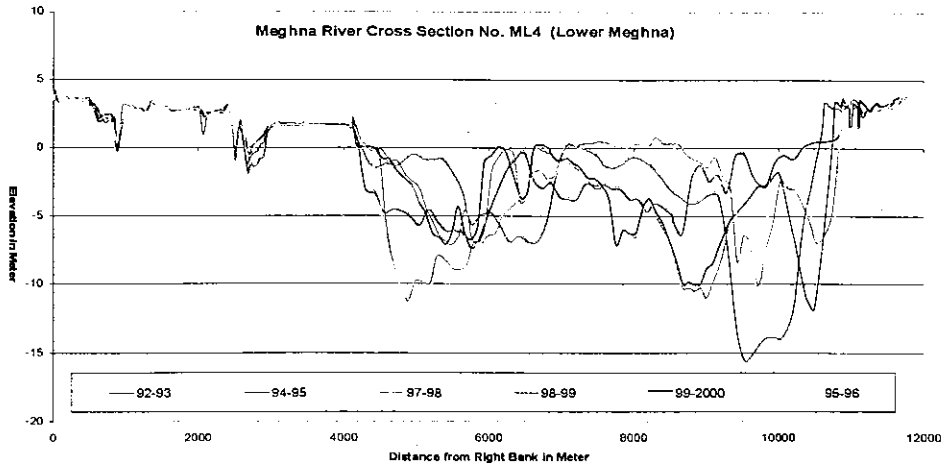


Source : BWDB

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 2.5.4 Typical River Cross-sections of the Jamuna, Ganges/Padma and Meghna Rivers (1/2)

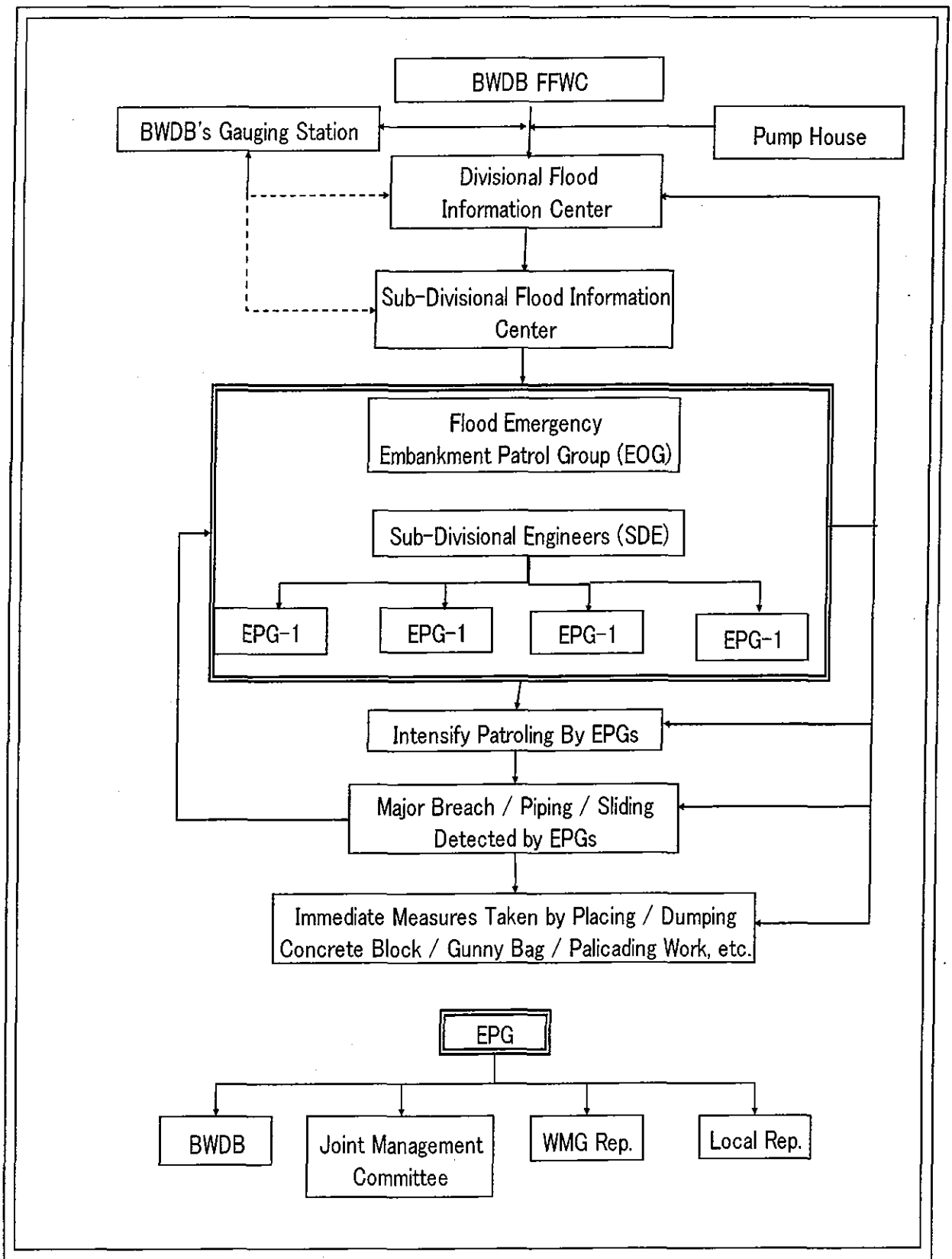






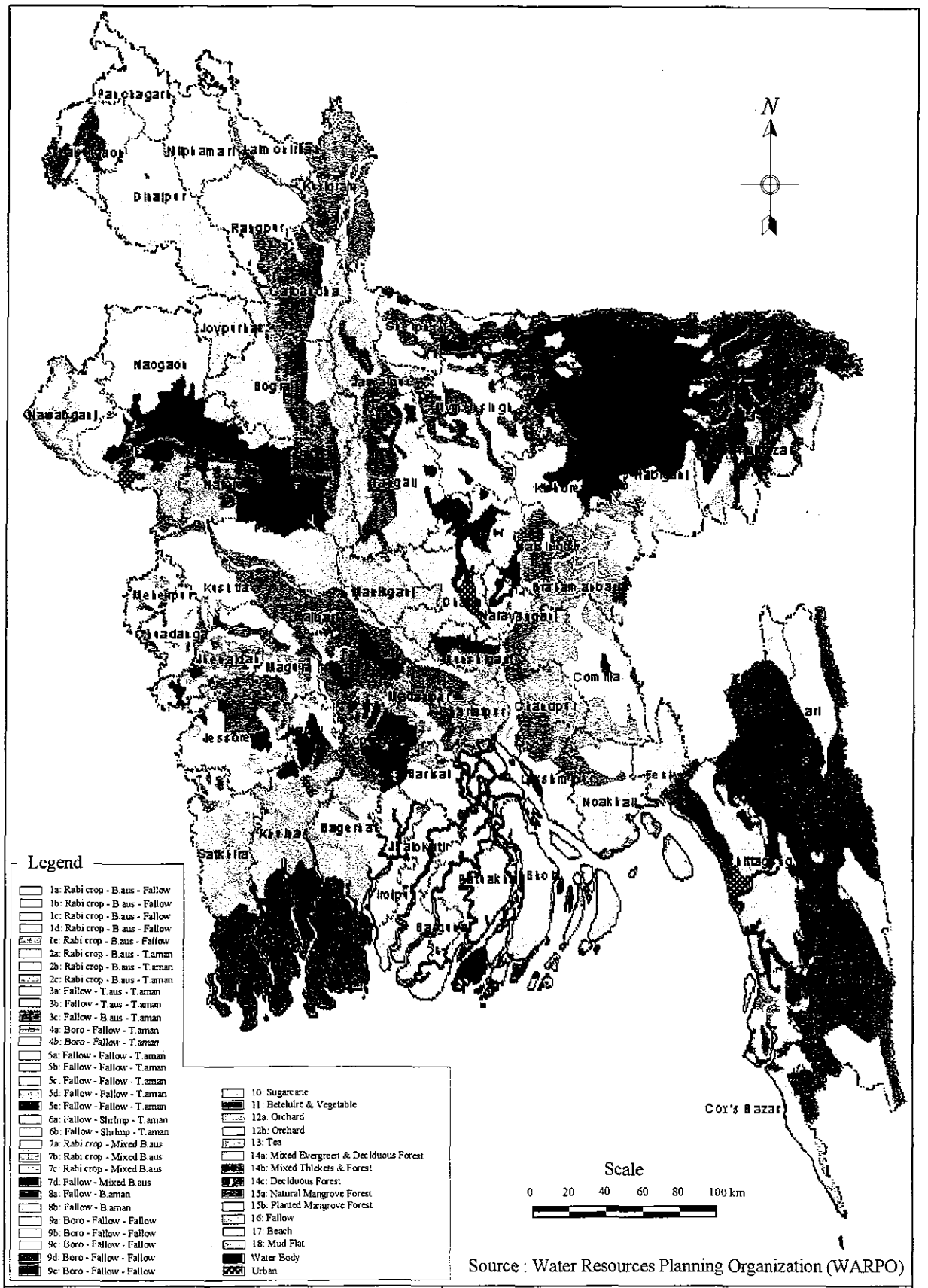
Source : BWDB

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 2.5.4 Typical River Cross-sections of the Jamuna, Ganges/Padma and Meghna Rivers (2/2)



Prepared by Meghna-Dhonagoda IrrigationProject

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.5.5
JAPAN INTERNATIONAL COOPERATION AGENCY	Operation of River Structures in Emergency



Source : Water Resources Planning Organization (WARPO)

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.6.1

Land Use of Bangladesh (1996)

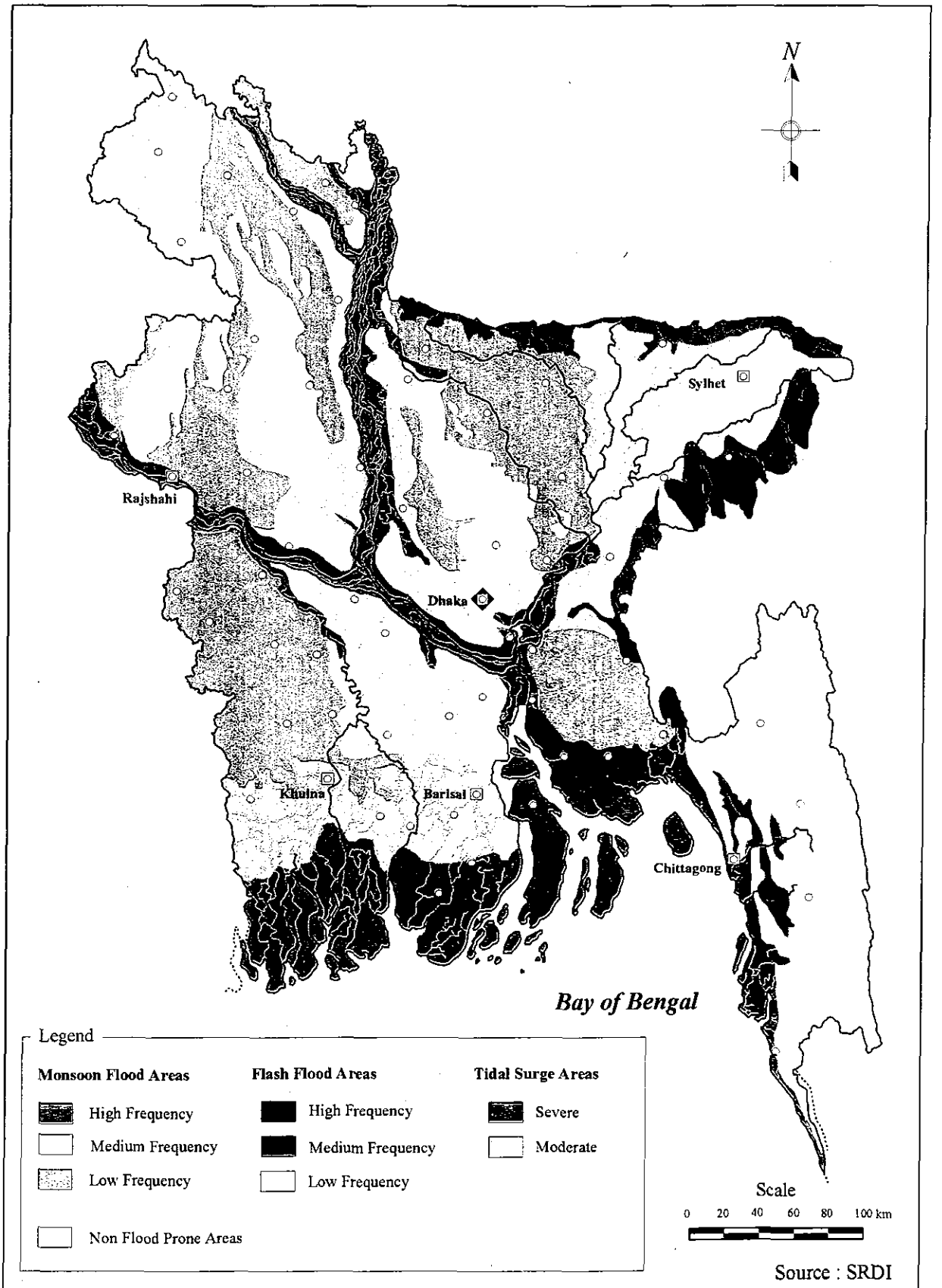


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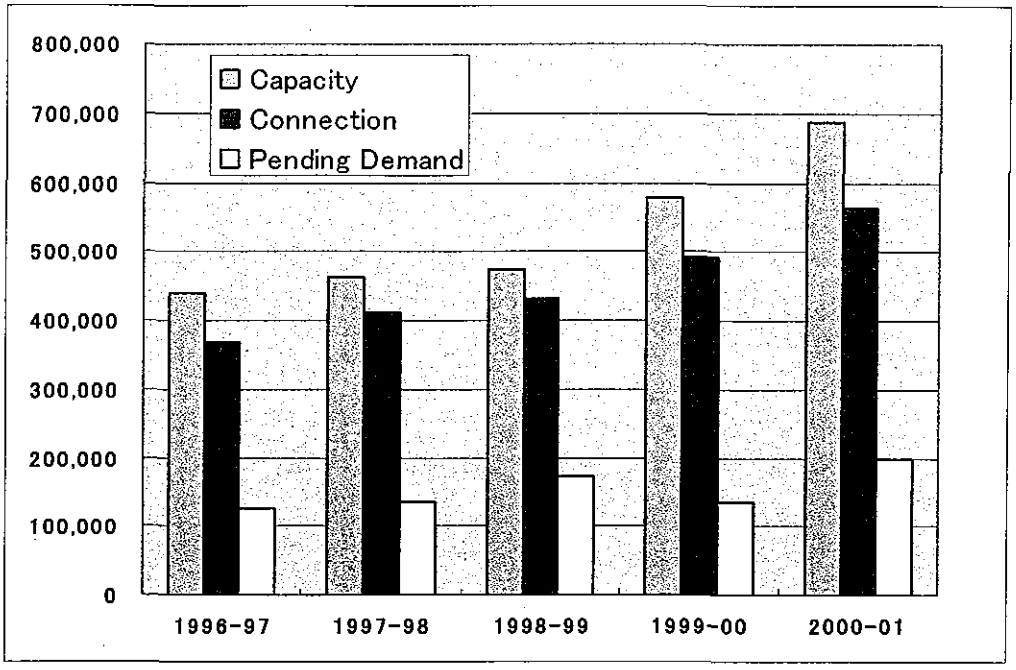
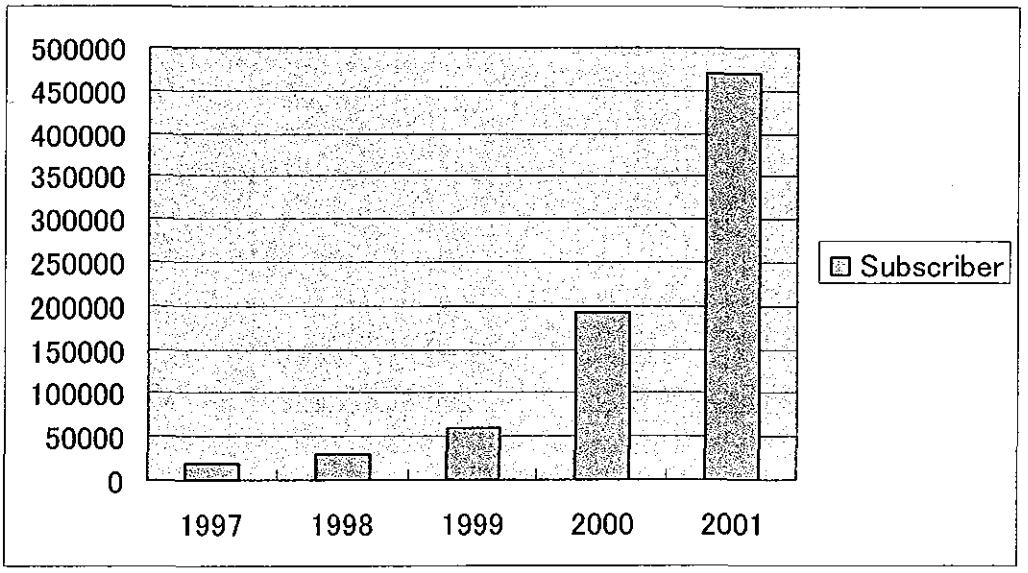
Figure 2.6.2
Delineation of Flood Prone Areas Based on Long Term Flood Information

Growth of Telephone line

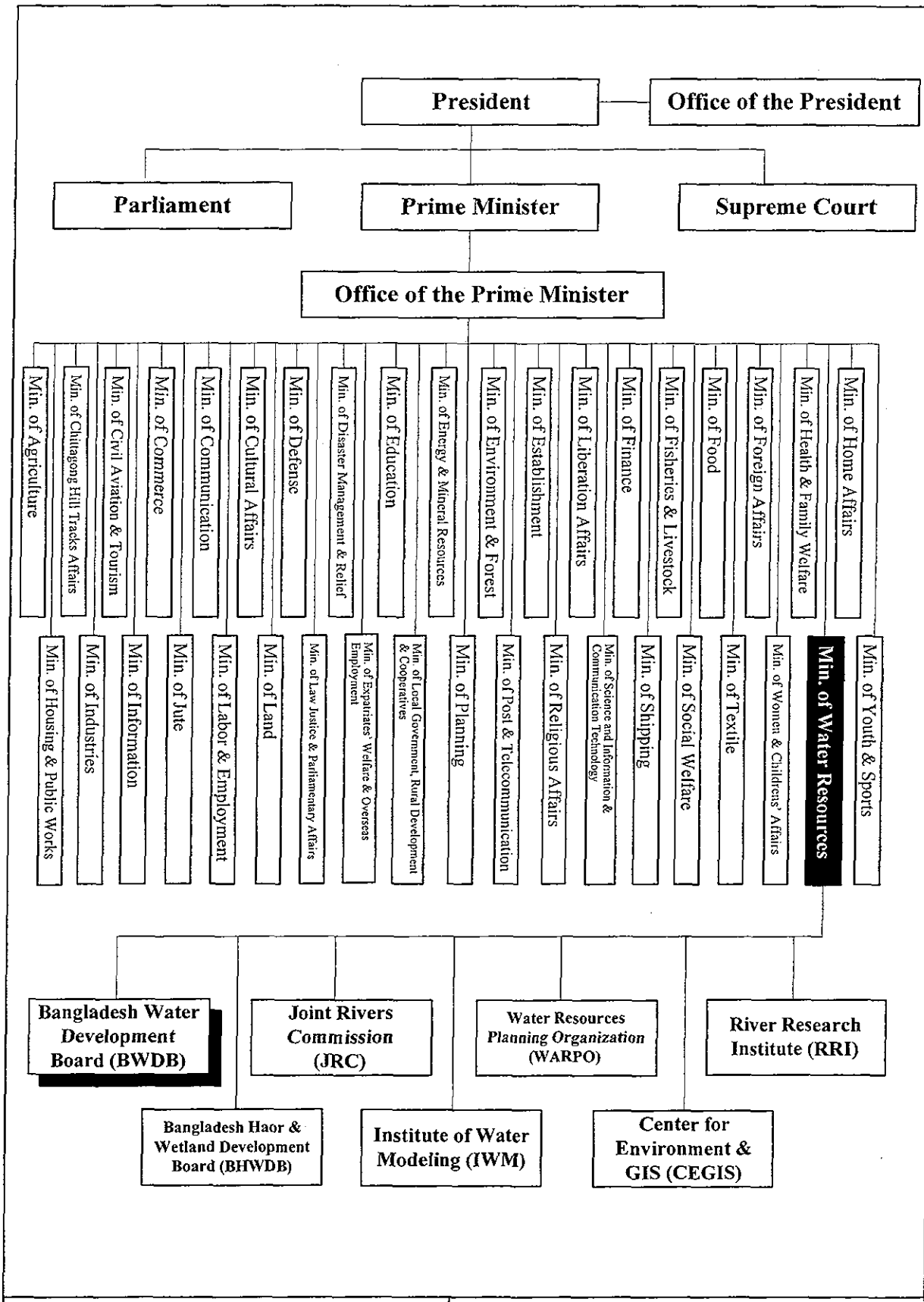


Growth of Mobile phone(Subscriber)



Source : BTTB

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 2.7.1
JAPAN INTERNATIONAL COOPERATION AGENCY	Growth of Telecommunications

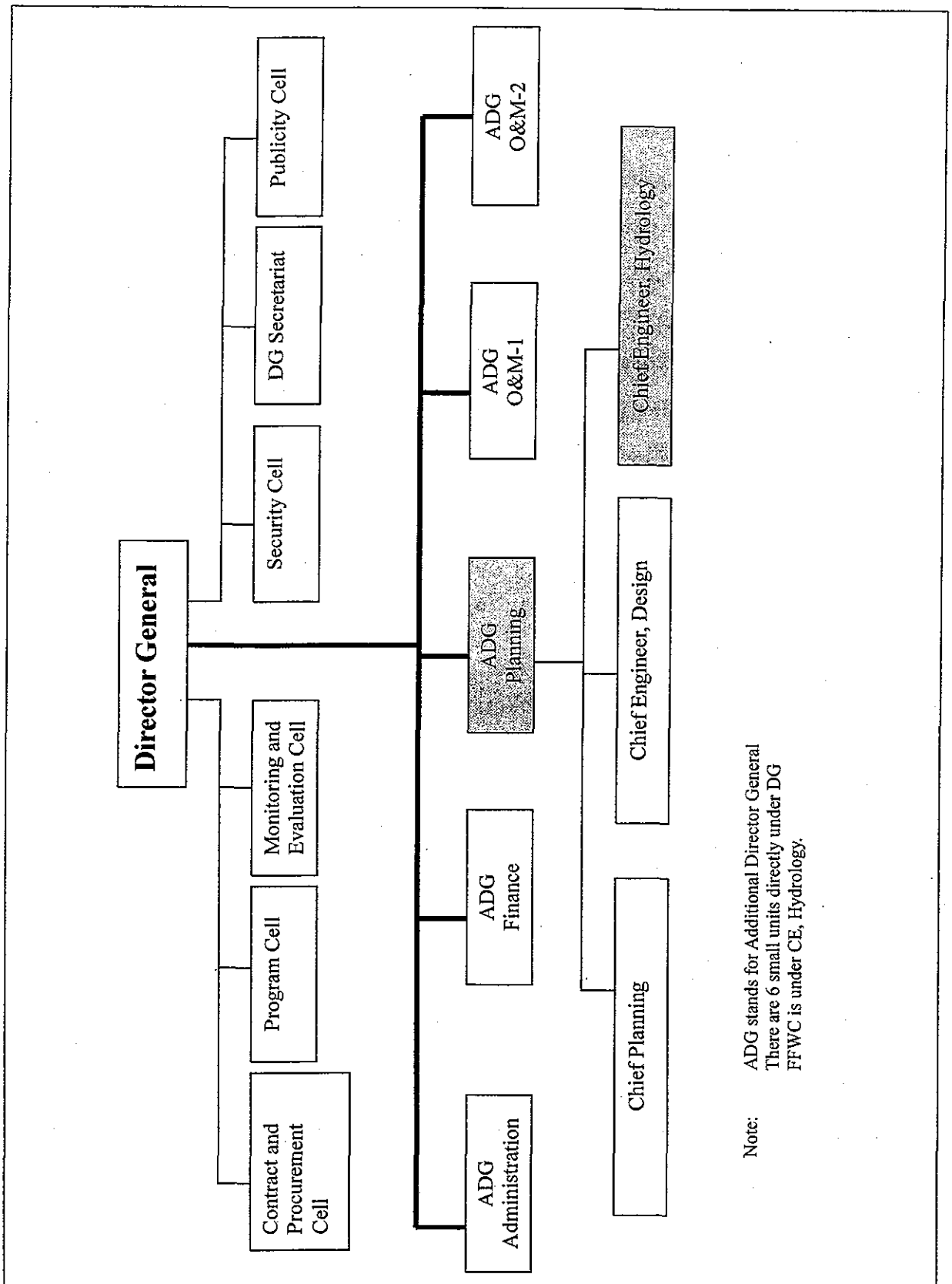


Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.8.1

Organogram of GOB and MOWR

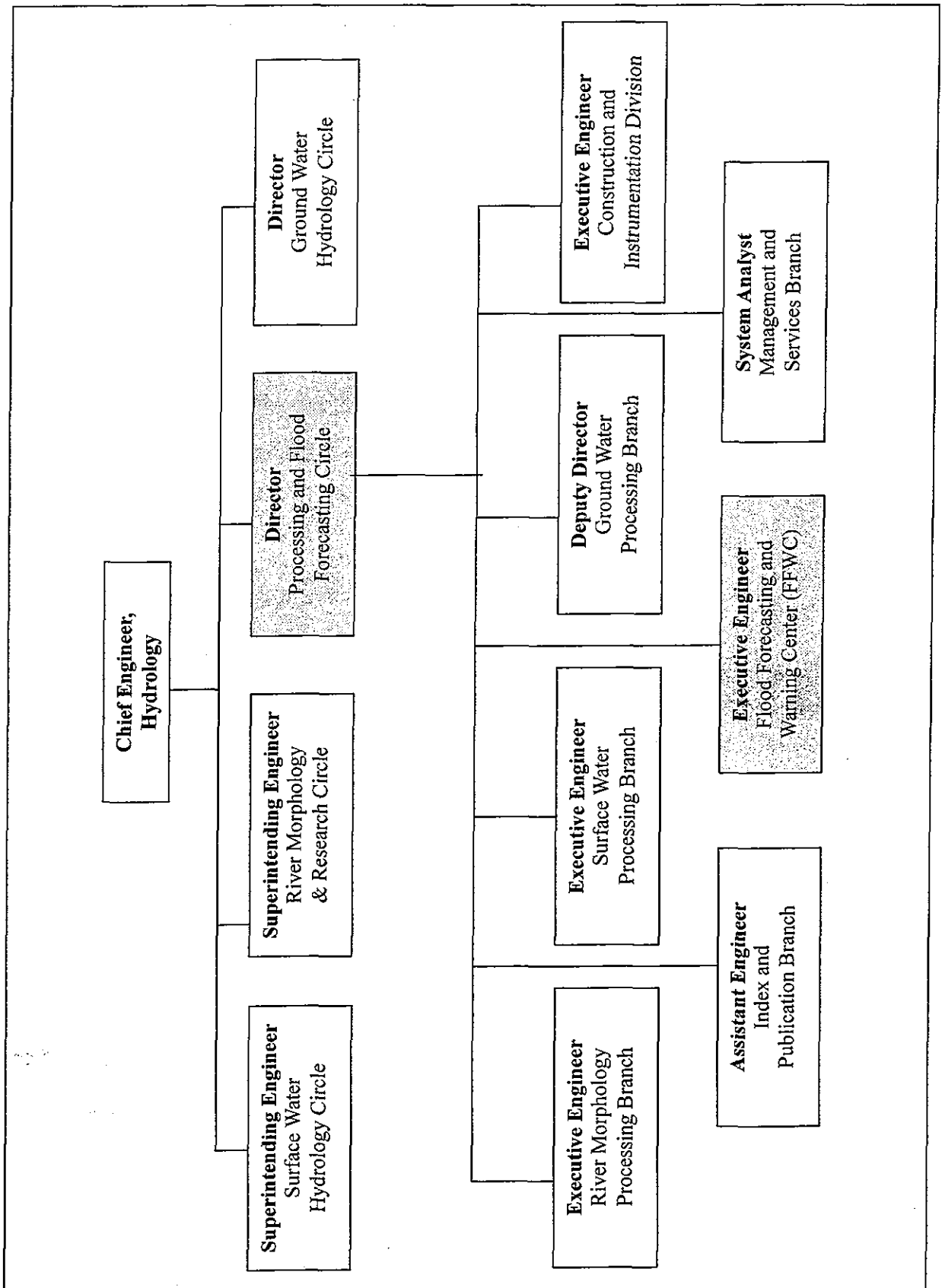


Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.8.2

Organogram of BWDB Head Quaters



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

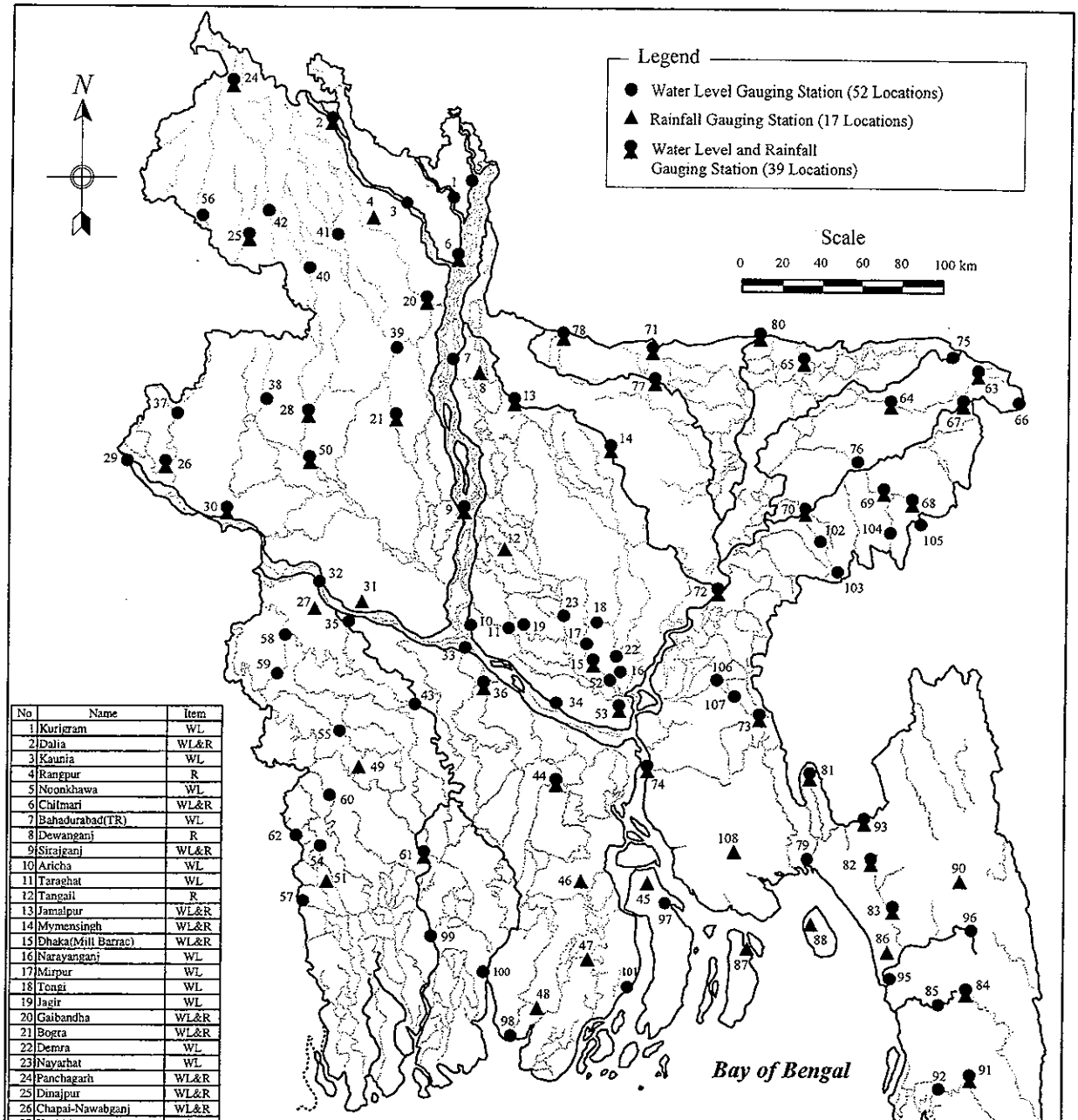
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 2.8.3

Organogram of Chief Engineer, Hydrology

Source: FFWC

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.2.1
JAPAN INTERNATIONAL COOPERATION AGENCY	Daily Activity Flowchart of FFWC



No	Name	Item
1	Kurigram	WL
2	Dalia	WL&R
3	Kaunia	WL
4	Rangpur	R
5	Noonkhawa	WL
6	Chilmari	WL&R
7	Bahadurabad(TR)	WL
8	Dewanganj	R
9	Sirajganj	WL&R
10	Aricha	WL
11	Taraghat	WL
12	Tangail	R
13	Jamalpur	WL&R
14	Mymensingh	WL&R
15	Dhaka(Mill Barrac)	WL&R
16	Narayanganj	WL
17	Mirpur	WL
18	Tongi	WL
19	Jagir	WL
20	Gaibandha	WL&R
21	Bogra	WL&R
22	Demra	WL
23	Nayarhat	WL
24	Panchagarh	WL&R
25	Dinajpur	WL&R
26	Chapai-Nawabganj	WL&R
27	Kushitia	R
28	Naogaon	WL&R
29	Pankha	WL
30	Rajshahi(R-Boalia)	WL&R
31	Pabna	R
32	Hardinge Br.	WL
33	Goalunda Transit	WL
34	Bhagyakul	WL
35	Gorai Rly Br	WL
36	Faridpur	WL&R
37	Rohanpur	WL
38	Mohadevpur	WL
39	Chak Rahimpur	WL
40	Phulbari	WL
41	Badarganj	WL
42	Bhushirbandar	WL
43	Kamarkhali	WL
44	Madaripur	WL&R
45	Bhola	R
46	Barisal	R
47	Patuakhali	R
48	Borguna	R
49	Jessor	R
50	Atrai	WL&R
51	Satkhila	R
52	Hariharpara	WL
53	Rekabi Bazar	WL&R
54	Kalaroa	WL
55	Kaliganj(Jessor)	WL
56	Kodaikatiga/Takuigaon	WL
57	Shakra	WL
58	Hatboalia	WL
59	Chuadanga	WL
60	Jhikargacha	WL
61	Khulna	WL&R
62	Giba	WL
63	Kanaighat	WL&R
64	Sylhet	WL&R
65	Sunamganj	WL&R
66	Amalshid/Zakiganj	WL
67	Sheola	WL&R
68	Monu Rly.	WL&R
69	Moulvi Bazar	WL&R
70	Habiganj	WL&R
71	Durgapur	WL&R
72	Bhairab Bazar	WL&R
73	Comilla	WL&R
74	Chandpur	WL&R
75	Sarighat	WL
76	Sherpur	WL
77	Jaria Jhanjail	WL&R
78	Nakugaon	WL&R
79	Jibonpur/Companiganj	WL
80	Laurergarh Sakt	WL&R
81	Parshuram	WL&R
82	Narayanhat	WL&R
83	Panchapukuria	WL&R
84	Bandarban	WL&R
85	Dohazari	WL
86	Chittagong	R
87	Hatia	R
88	Sandwip	R
89	Cox's Bazar	R
90	Rangamati	R
91	Lama	WL&R
92	Chiringa	WL
93	Ramgarh	WL&R
94	Teknaf	WL&R
95	Sadarghat	WL
96	Kaptai	WL
97	Daulatkhan	WL
98	Patharghata	WL
99	Mongla	WL
100	Rayenda	WL
101	Dasmunia	WL
102	Shaistaganj	WL
103	Baliah	WL
104	Kamalganj	WL
105	Chauraghat	WL
106	Jibanpur(Gumti B)	WL
107	Kangsanagar	WL
108	Noakhali	R

Source : FFWC

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

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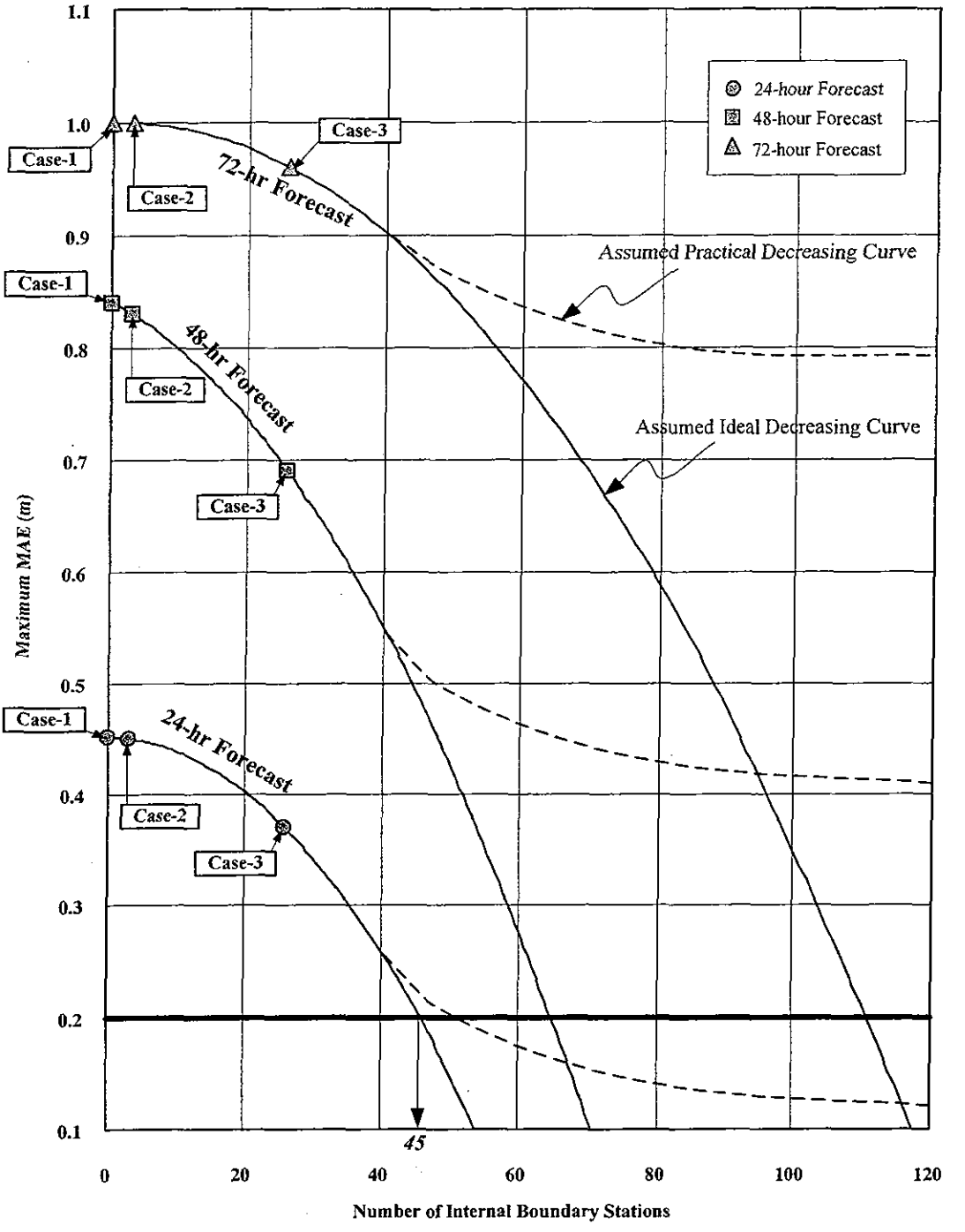
Figure 3.3.1

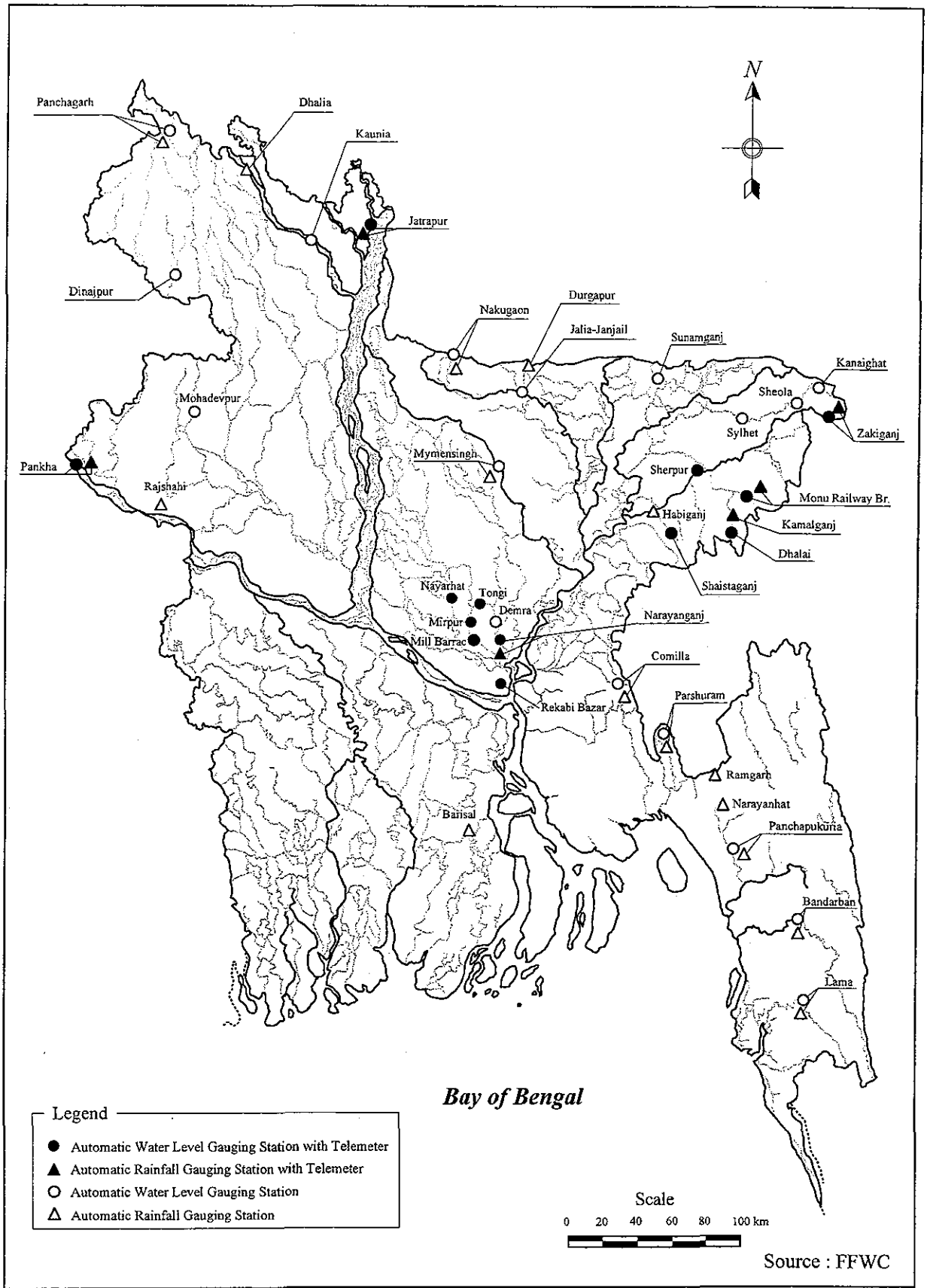
Present Observatories of FFWC



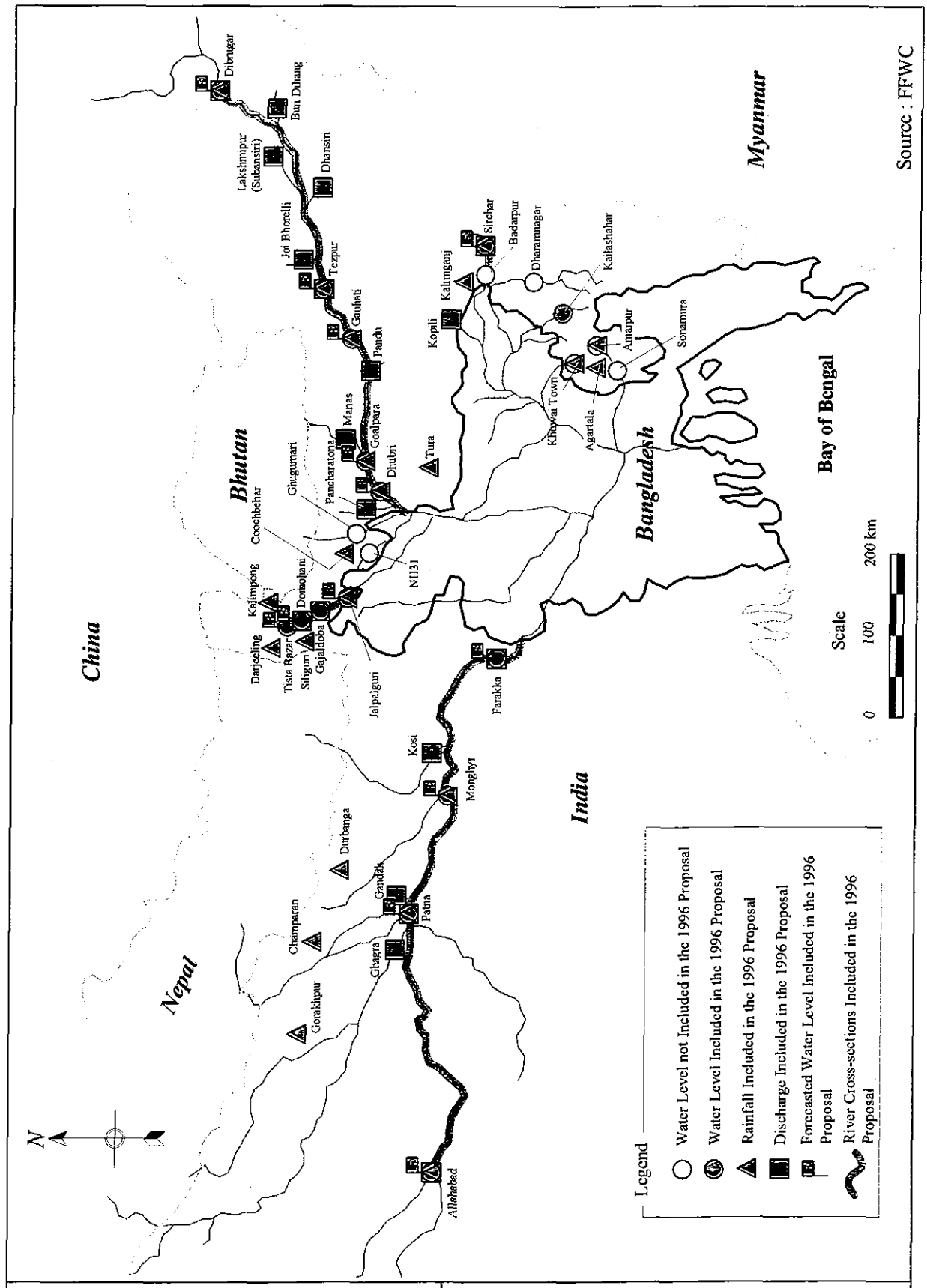
Notes:

1. Case-1: Simulation without internal boundary, Case-2: Simulation with 3 internal boundary, Case-3: Simulation with 27 internal boundary points.
2. There must be some limit of the improvement of the performance (accuracy) of forecasting model by increase of the internal boundary points as drawn as 'practical' decreasing curve. It is due to parameter calibration, the accuracy of topographic information, observation/input errors, and so on. The 'ideal' decreasing curve is derived assuming that the error decreases maintaining the the relationship assumed based on the result of the simulation of case-1, -2 and -3.

Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.3.2 Relationship between the Number of Internal Boundary Stations and Model Performance
JAPAN INTERNATIONAL COOPERATION AGENCY	



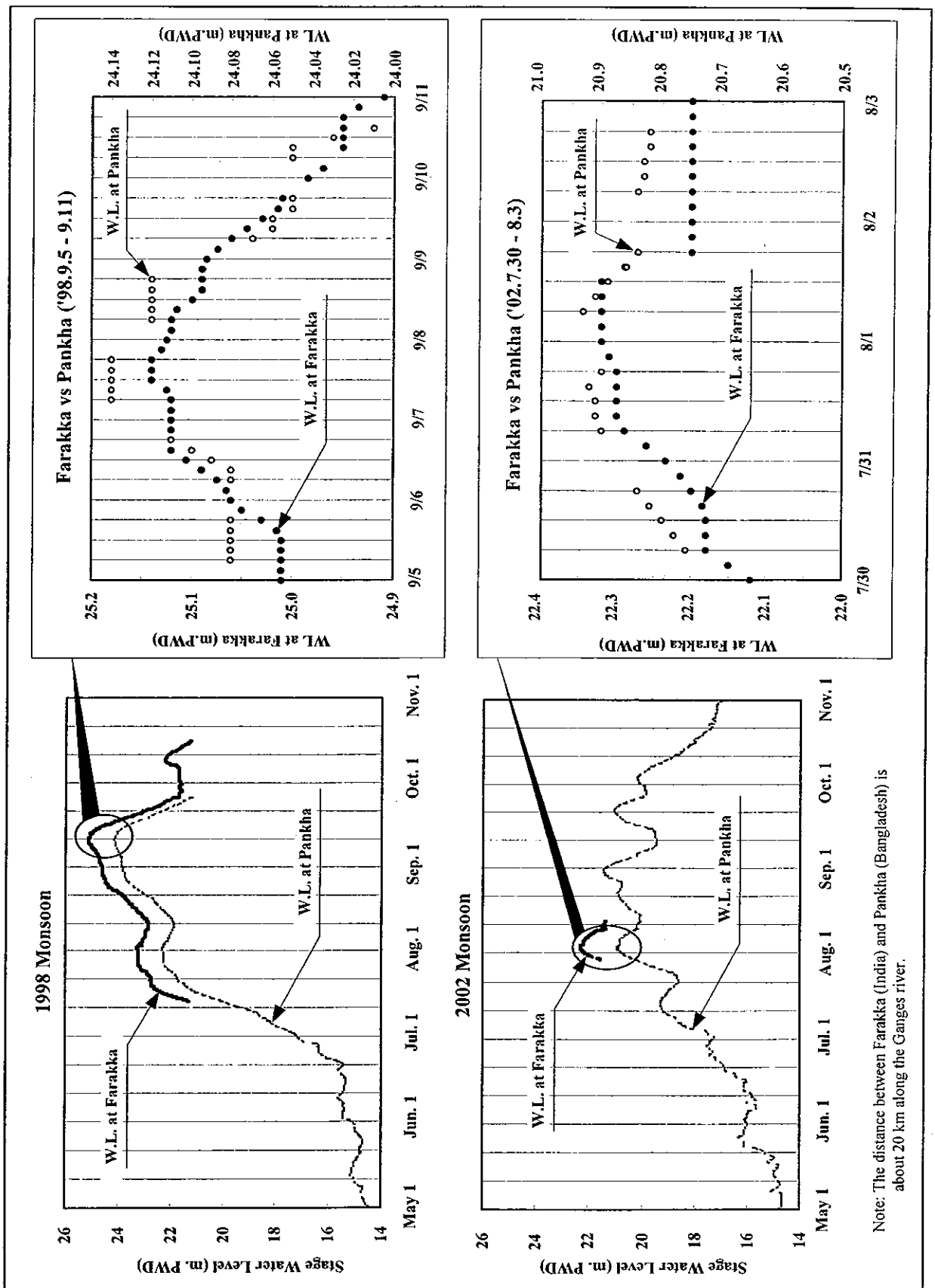
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.3.3 Existing Automatic Water Level / Rainfall Gauges
JAPAN INTERNATIONAL COOPERATION AGENCY	



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 3.3.4
The 1996 Proposal by Bangladesh Side for the Data Exchange Improvement



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

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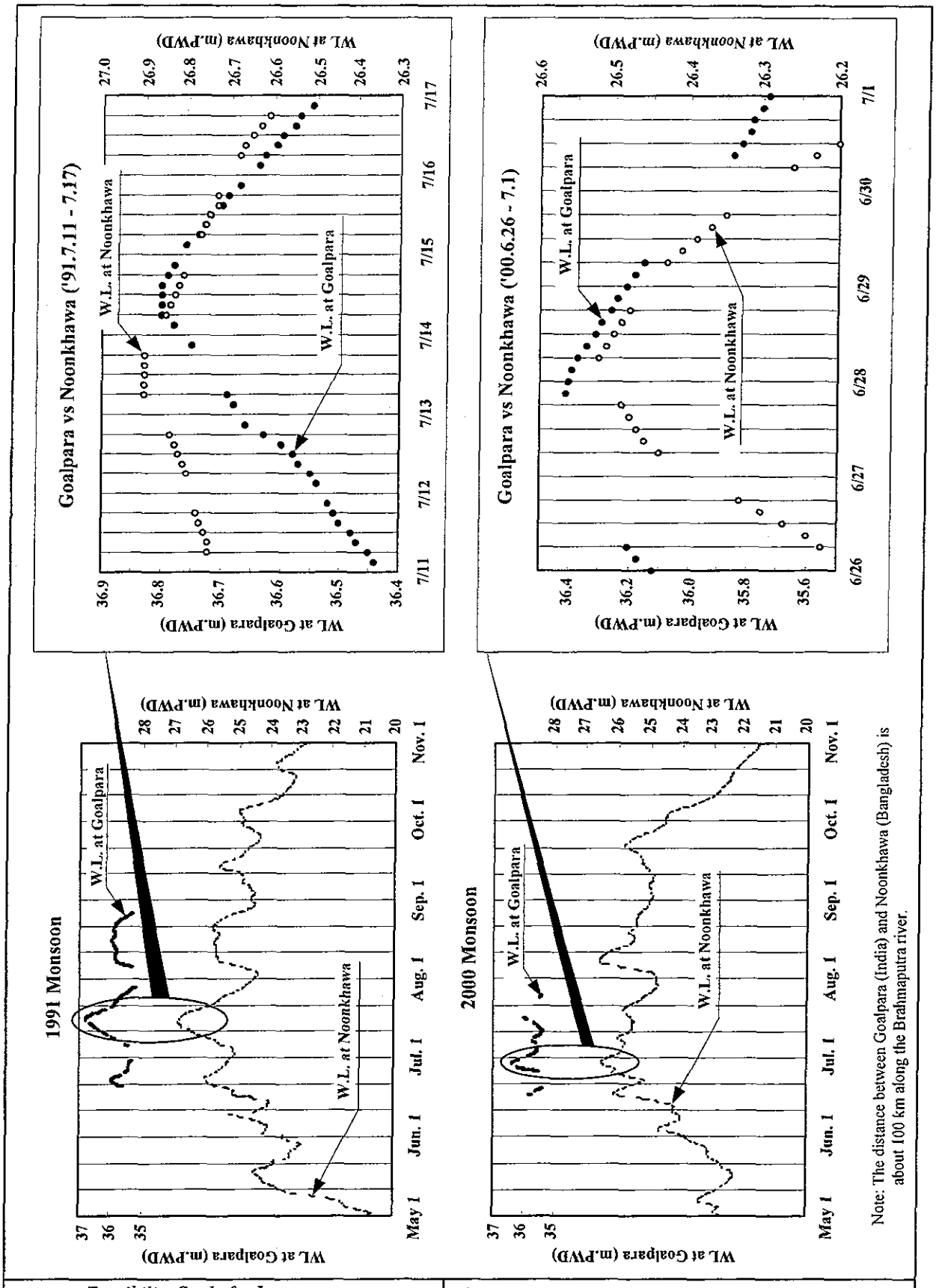
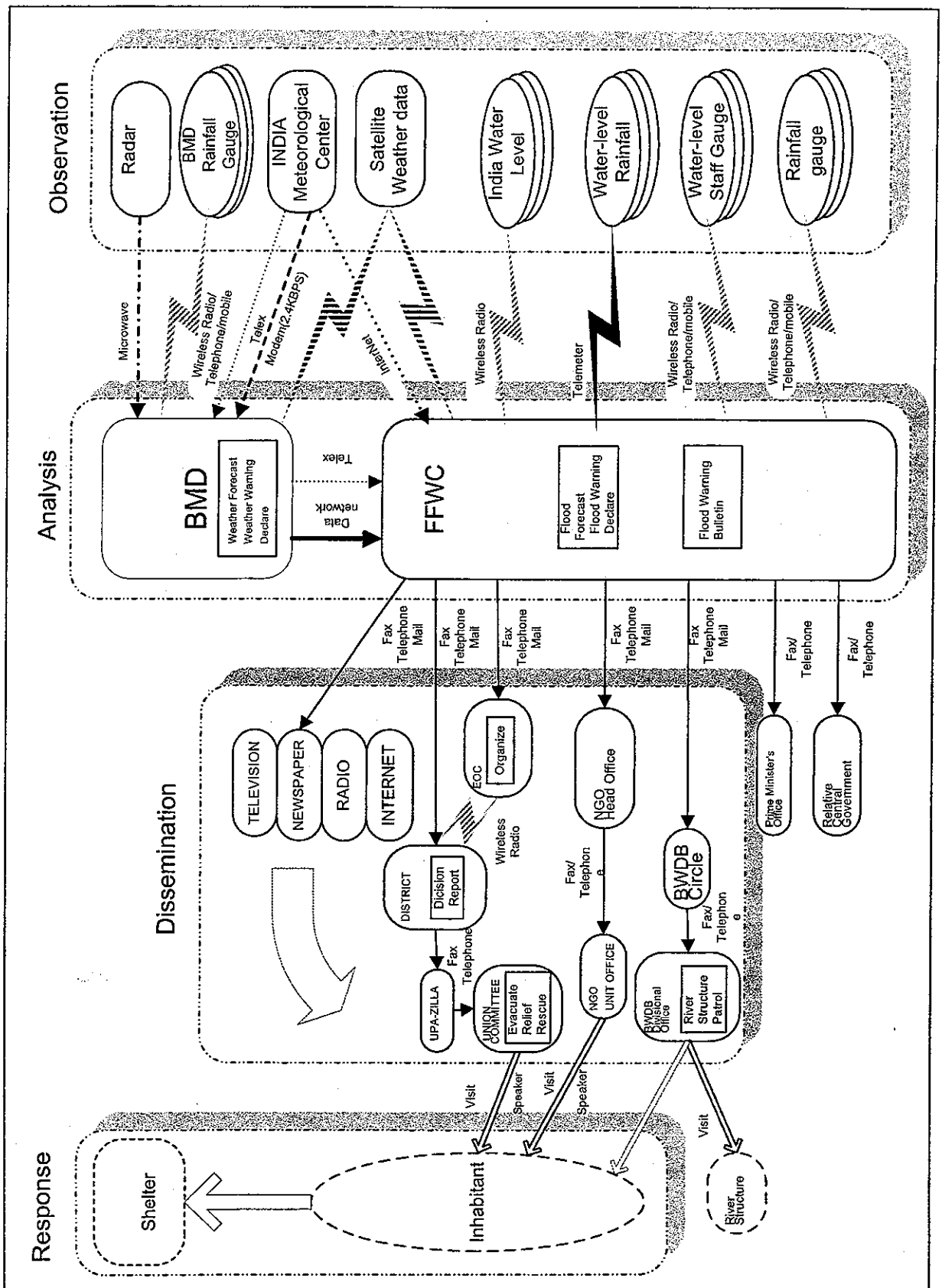
Figure 3.3.5
Water Level Record at Pankha and Farakka, India

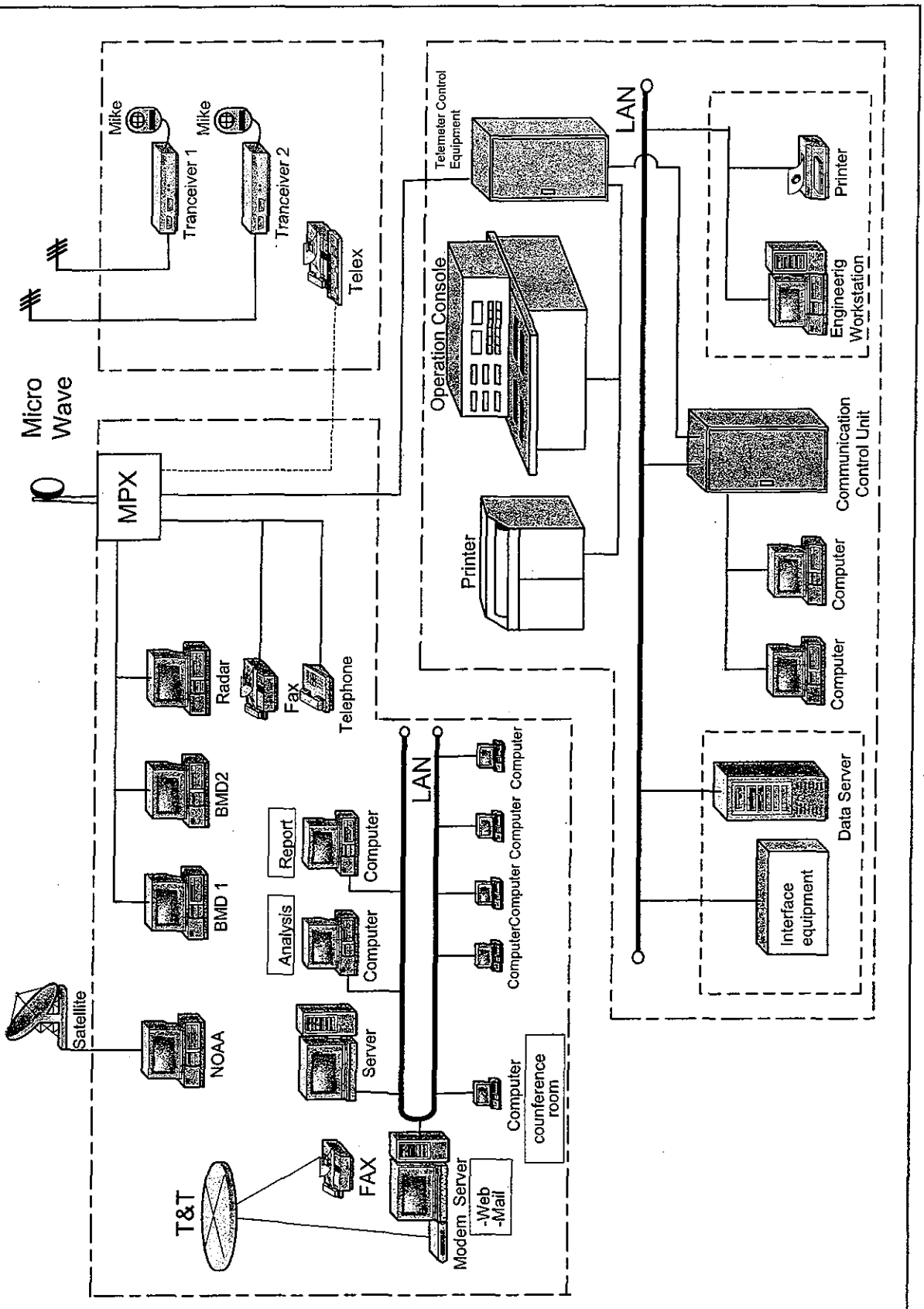


Note: The distance between Goalpara (India) and Noonkhawa (Bangladesh) is about 100 km along the Brahmaputra river.

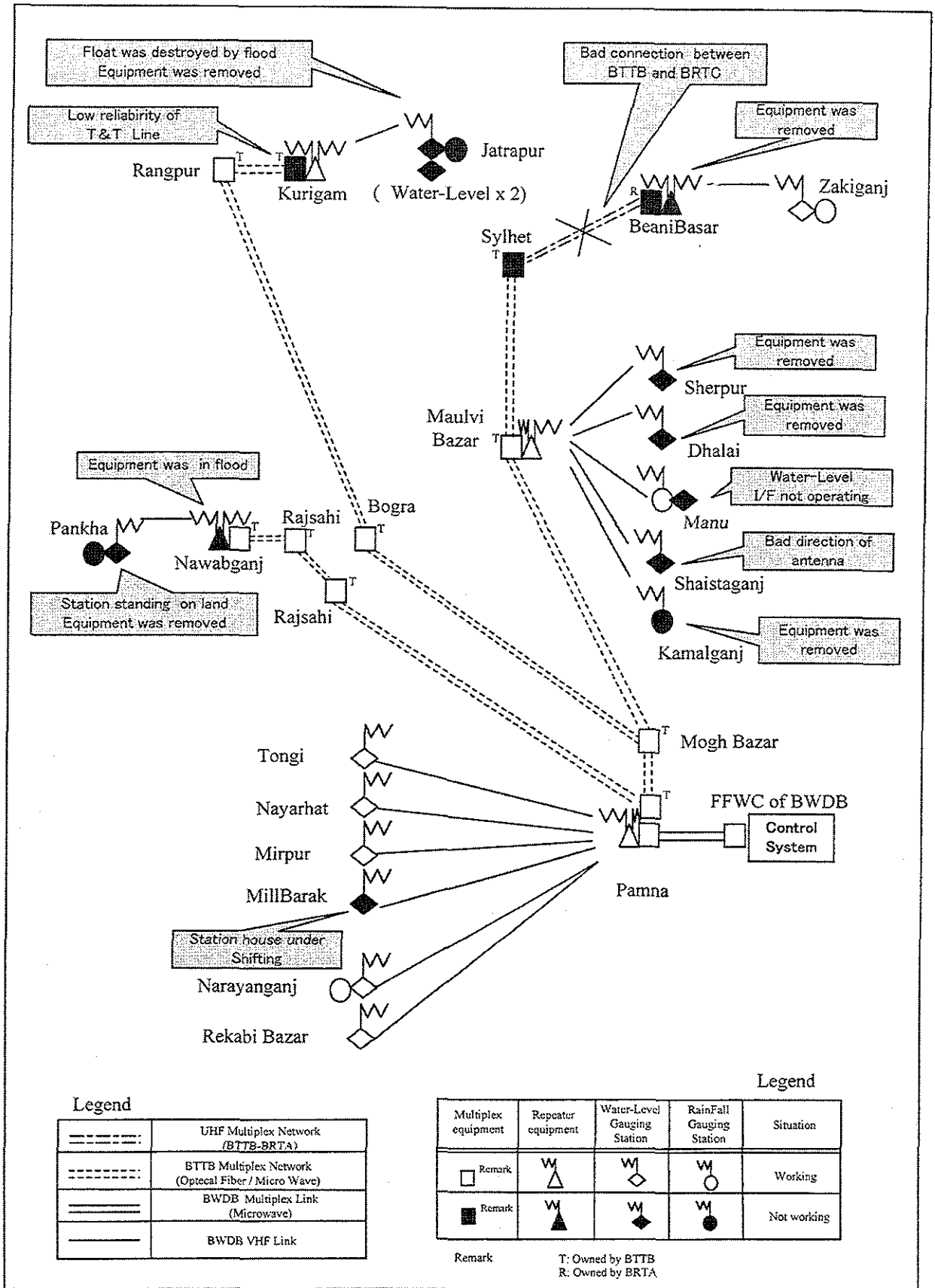
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.3.6 Water Level Record at Noonkhawa and Goalpara, India
JAPAN INTERNATIONAL COOPERATION AGENCY	



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.4.1
JAPAN INTERNATIONAL COOPERATION AGENCY	Communication Network during Flood



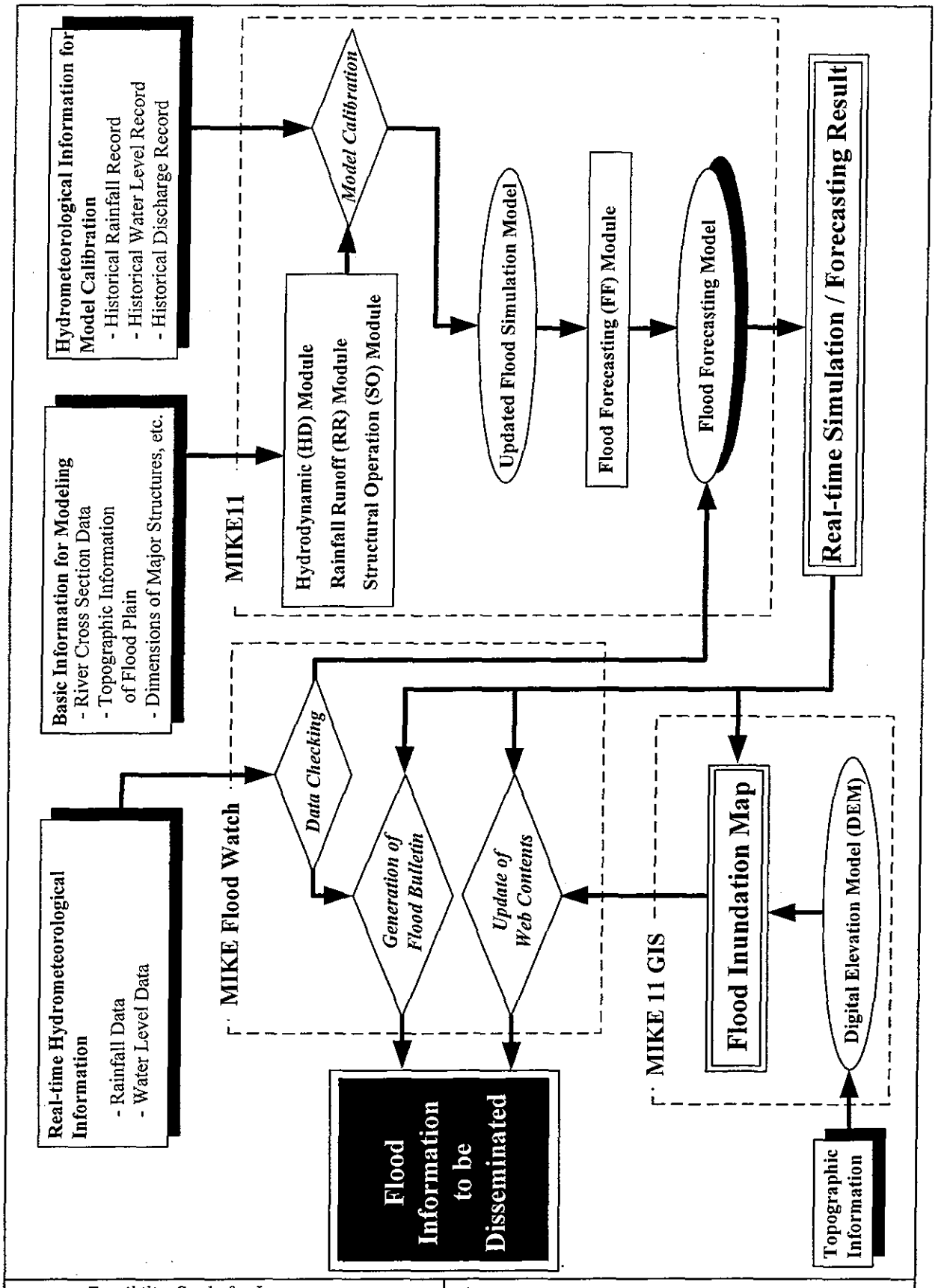
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh JAPAN INTERNATIONAL COOPERATION AGENCY	Figure 3.4.2 FFWC System Configuration



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

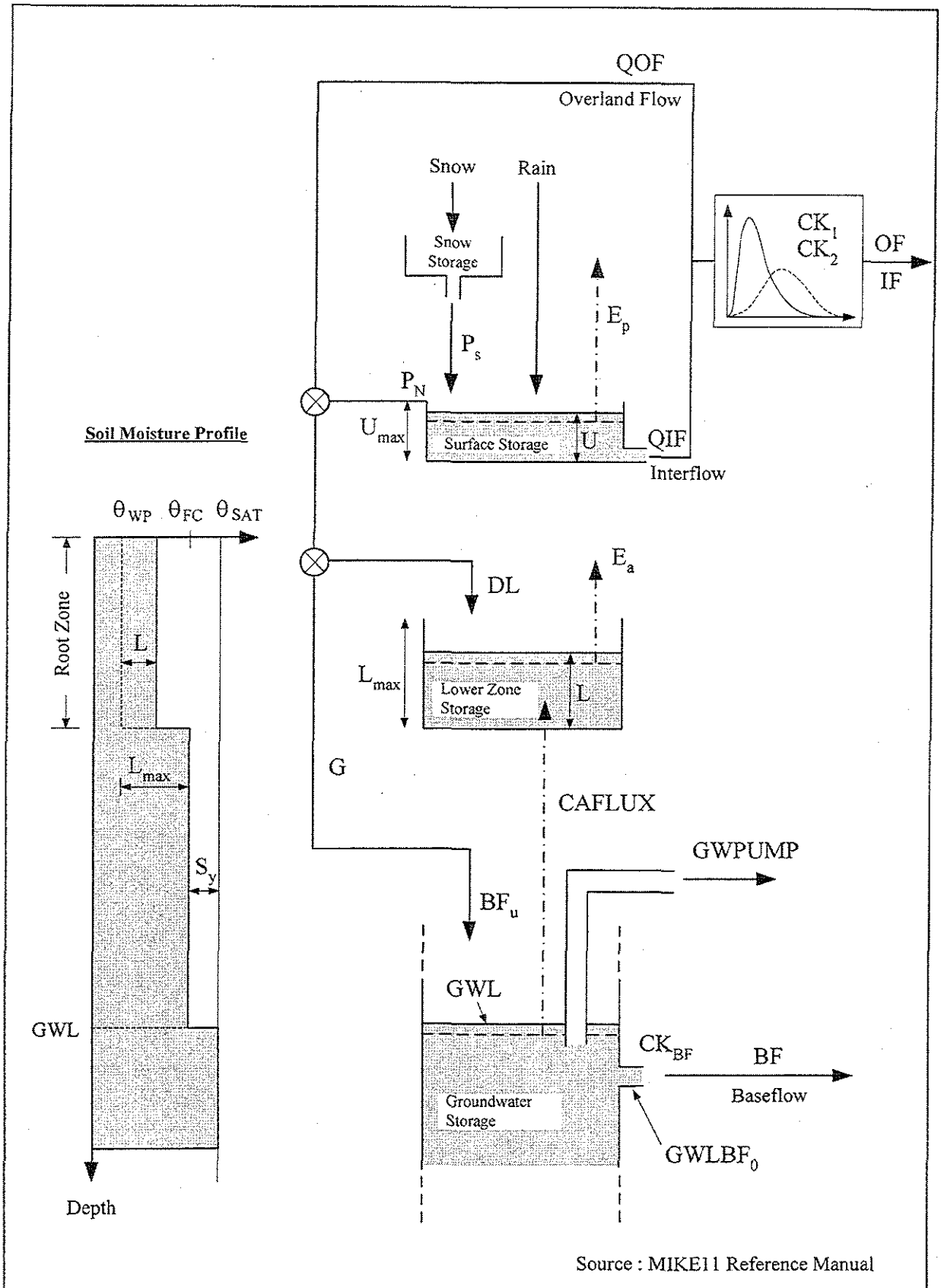
Figure 3.4.3
Telemeter System Network and Existing Problem



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

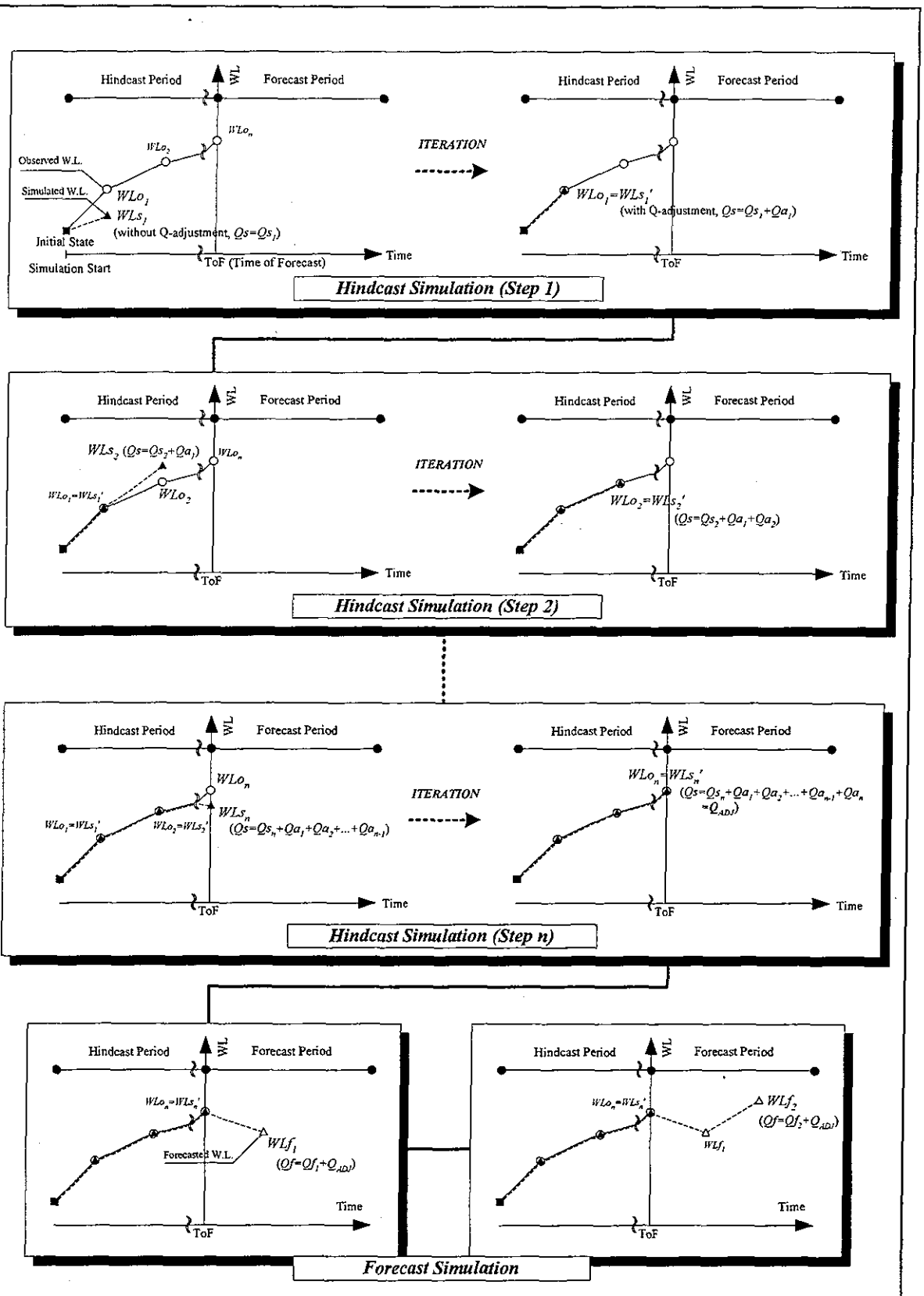
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 3.5.1
Flow of MIKE11 Modeling and Simulation Process



Source : MIKE11 Reference Manual

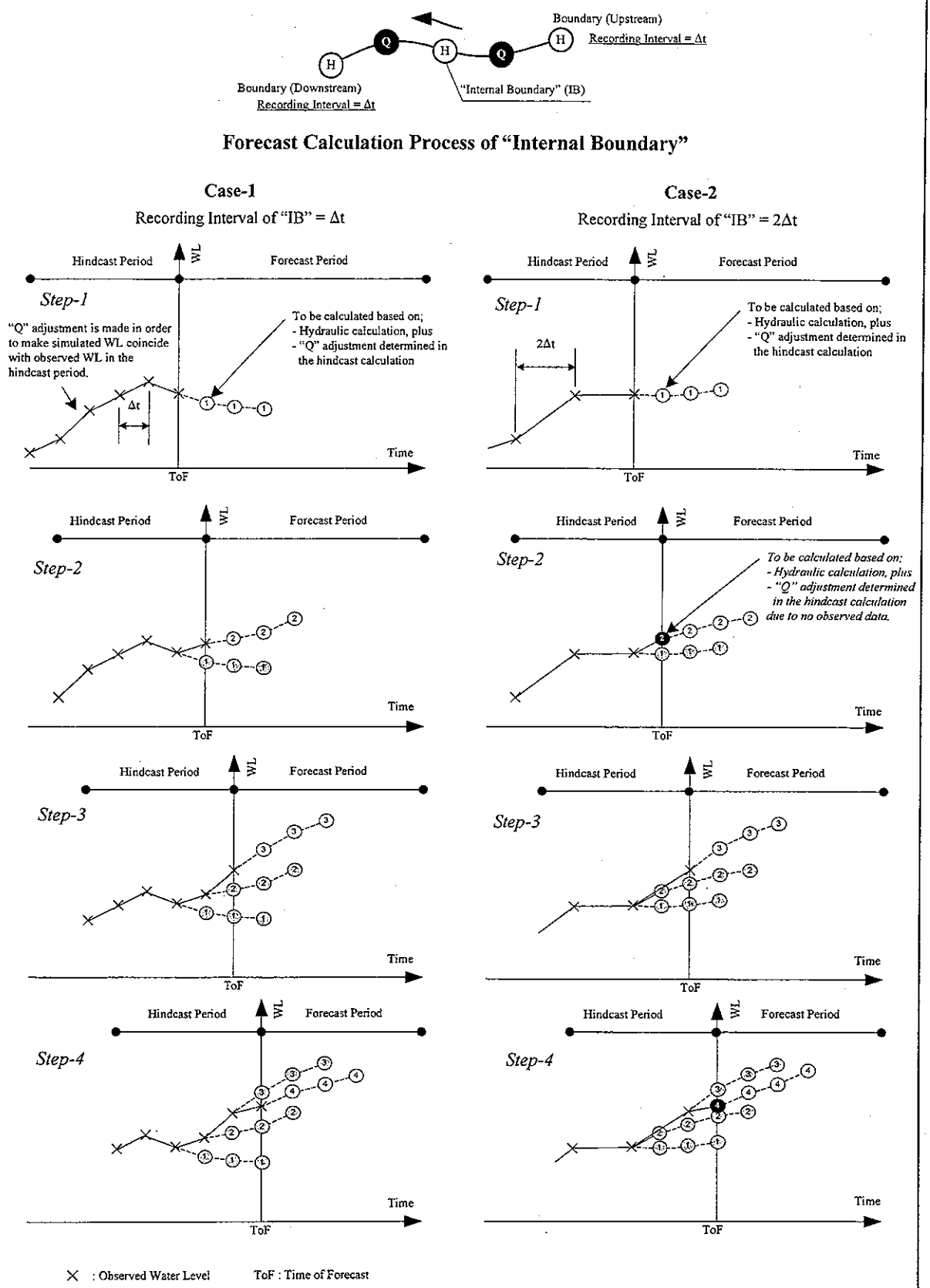
Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.5.2
JAPAN INTERNATIONAL COOPERATION AGENCY	Structure of NAM Rainfall-Runoff Model



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 3.5.3
Concept of Discharge Adjustment in MIKE11 FF Module



Feasibility Study for Improvement of Flood Forecasting and Warning Services in the People's Republic of Bangladesh	Figure 3.5.4 Concept of Internal Boundary in MIKE11 FF Module
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