

TABLES

FOR

APPENDIX IV

Table IV.1-1 Land Use and Buildings in Flood Vulnerable Area

Sub-area	Land Use (ha)				Buildings (nos.)	
	Paddy	Sugar-cane	Fishpond	Others	Residential	Non-residential
Panay River						
P1	4,388	337	1,136	4,801	6,807	430
P2	750	150	0	188	1,083	93
P3	658	267	0	292	702	3
P4	56	31	0	27	32	0
P5	1,782	433	0	630	1,315	4
P6	77	40	0	50	617	94
P7	436	175	0	273	107	17
P8	1,168	331	0	354	998	132
P9	638	401	0	314	882	186
P10	986	454	1	400	961	86
Sub-total	(10,939)	(2,619)	(1,137)	(7,329)	(13,504)	(1,045)
Maayon River						
Y1	28	12	0	14	21	0
Y2	580	256	0	249	643	67
Y3	118	127	0	84	120	2
Y4	996	23	0	137	449	0
Sub-total	(1,722)	(418)	(0)	(484)	(1,233)	(69)
Mambusao River						
M1	127	14	0	31	128	23
M2	710	95	0	200	786	91
M3	640	55	0	344	753	110
M4	274	24	0	148	323	47
M5	700	113	0	204	419	13
M6	291	171	0	85	603	82
M7	2,432	123	0	588	1,733	31
Sub-total	(5,174)	(595)	(0)	(1,600)	(4,745)	(397)
Badbaran River						
B1	103	29	0	56	136	0
B2	796	104	0	285	600	174
Sub-total	(899)	(133)	(0)	(341)	(736)	(174)
Total	(18,734)	(3,765)	(1,137)	(9,754)	(20,218)	(1,685)

Note: The above figures are estimated based on information appeared on 1 : 10,000 map.

TABLE IV.2-1 ACTUAL FLOOD DAMAGE OF 1973 FLOOD
(From "Nation-wide flood control plan")

Date of Occurrence :	November 20, 1973
Name of Typhoon :	Openg
A. Crops	P 32,156,000
B. Building	4,548,000
1) Public	
2) Private	
C. Infrastructure	
1) River structure	14,198,000
2) Roads	
3) Bridges	
D. Livestock	275,000
E. Fishpond	6,223,000
F. Casualties	16
Grand Total	P 57,400,000

Source : Survey through questionnaires by the study team of Nation-wide flood control plan.

Remark : The estimated value is equivalent to P 204.2 million on the economic condition in 1980 applying the following assumptions.

- 1) Crop and livestock damage increase at the same rate with the increase in the palay yield in the Phil. (+ 16.3 %)
- 2) Building and infrastructure damage increase in proportion to the population (+ 16.3 %)
- 3) Indirect damage is estimated at 5% of the direct damage.

TABLE IV.2-2

DIRECT DAMAGE BY UNDANG FLOOD IN THE BASIN

Item	Amount (P1000)	Percentage
1. Crop Damage	115,938	47
Paddy	100,243	40
Corn	1,664	1
Sugar Cane	7,231	3
Others	6,800	3
2. Livestock Damage	5,805	2
3. Fishpond Damage	3,868	2
4. Building Damage	90,149	36
Residential Building	42,373	17
Non-residential Building	47,776	19
5. Infrastructure Damage	31,866	13
Total	247,628	100

Note: 1984 price

TABLE IV. 4-1 INUNDATED AREAS AND BUILDINGS BY RETURN PERIOD

Classification	Return Period (Years)									
	1.1	2	5	10	25	50	100			
Areas (Unit: ha)										
Paddy	5,078	8,513	11,374	13,956	16,073	17,581	18,734			
Sugar cane	813	1,684	2,388	2,922	3,238	3,500	3,756			
Fishpond	228	228	1,034	1,036	1,039	1,055	1,137			
Others	4,847	5,851	6,520	7,391	8,231	9,140	9,754			
Total	10,966	16,276	21,326	25,305	28,581	31,276	33,390			
Buildings (Unit: Nos)										
Residential	4,786	7,122	10,398	13,678	16,205	18,735	20,318			
Non-residential	319	538	872	1,225	1,334	1,534	1,685			
Total	5,105	7,660	11,270	14,903	18,539	20,269	22,003			
Affected Population (1,000 persons)	28.7	42.7	63.5	82.1	97.1	112.3	121.3			

Remarks: Paddy fields are estimated for the first crop season (Wet Season).

Table IV.4-2 Flood Damage by Return Period on Economic Condition in 1984

(Unit: 1,000 Pesos at 1984 price constant)

Categories	Return Period (Year)									
	1	1.1	2	5	10	25	50	100		
1. Crop Damage										
Irrigated Paddy	0	2,460	5,585	9,473	13,457	16,905	19,706	21,798		
Rainfed Paddy	0	2,602	5,446	8,855	11,525	14,161	16,213	17,787		
Vegetable	0	369	805	1,337	1,823	2,267	2,622	2,889		
Sugarcane	0	85	102	184	301	467	616	731		
Sub-total	0	5,516	11,938	19,849	27,106	33,800	39,157	43,205		
2. Live Stock	0	358	775	1,290	1,761	2,197	2,545	2,808		
3. Building Damage										
Residential Building	0	5,001	10,809	20,665	37,181	65,189	89,674	109,874		
Household Effect	0	1,862	4,424	8,618	14,872	23,980	31,157	37,559		
Other Building	0	4,682	17,464	36,473	68,592	100,938	124,088	147,559		
Commercial Stock	0	506	1,892	3,915	7,564	11,405	14,005	16,707		
Sub-total	0	12,052	34,590	69,673	128,211	201,514	257,926	311,701		
4. Infrastructure Damage	0	4,218	12,106	24,385	44,873	70,529	90,274	109,095		
5. Fishpond Damage	0	0	1,622	6,531	12,574	23,980	33,980	46,337		
6. Indirect Damage	0	3,321	9,154	18,259	32,179	49,803	63,582	76,972		
Total Damage	0	25,467	70,187	139,989	246,706	381,825	487,464	590,119		

Note: $\frac{1}{1}$ Average annual flood damage in 1984 is ₱104,521 x 10³.

Table IV.4-3 Flood Damage by Return Period on Economic Condition in 2009

(Unit: 1,000 Pesos at 1984 price constant)

Categories	Return Period (Year)							
	1	1.1	2	5	10	25	50	100
1. Crop Damage								
Irrigated Paddy	0	4,560	10,354	17,562	24,949	31,341	36,534	40,413
Rainfed Paddy	0	4,636	9,704	15,779	20,537	25,234	28,891	31,696
Vegetable	0	504	1,099	1,826	2,489	3,095	3,579	3,944
Sugarcane	0	85	102	184	301	467	616	731
Sub-total	0	9,787	21,260	35,352	48,277	60,139	69,621	76,785
2. Live Stock	0	636	1,381	2,297	3,138	3,909	4,525	4,991
3. Building Damage								
Residential Building	0	17,015	36,773	70,302	126,490	221,775	301,672	373,793
Household Effect	0	6,334	15,050	29,320	50,596	81,580	105,997	127,779
Other Building	0	15,928	59,414	124,083	233,352	343,392	422,148	501,996
Commercial Stock	0	1,722	6,436	13,320	25,734	38,802	47,646	56,837
Sub-total	0	41,000	117,675	237,027	436,173	685,550	877,464	1,060,406
4. Infrastructure Damage	0	14,350	41,186	82,959	152,660	239,942	307,112	371,142
5. Fishpond Damage	0	0	1,793	7,223	13,906	26,521	37,581	51,248
6. Indirect Damage	0	9,866	27,494	54,729	98,123	152,409	194,445	234,686
Total Damage	0	75,640	210,792	419,590	752,280	1,168,473	1,490,751	1,799,260

Note: $\frac{1}{1}$ Average annual flood damage in 2009 is ₱315,842 x 10³.

Table IV.4-4 Flood Damage by Return Period on Economic Condition in 2029

Categories	(Unit: 1,000 Pesos at 1984 price constant)							
	1	1.1	2	5	10	25	50	100
1. Crop Damage								
Irrigated Paddy	0	5,503	12,493	21,191	30,103	37,816	44,082	48,762
Rainfed Paddy	0	5,862	12,269	19,950	25,965	31,904	36,527	40,074
Vegetable	0	614	1,339	2,225	3,032	3,771	4,360	4,805
Sugarcane	0	85	102	184	301	467	616	731
Sub-total	0	12,064	26,204	43,550	59,402	73,959	85,586	94,372
2. Live Stock	0	784	1,703	2,830	3,861	4,807	5,563	6,134
3. Building Damage								
Residential Building	0	58,888	127,269	243,309	437,771	767,544	1,044,058	1,293,663
Household Effect	0	21,923	52,088	101,474	175,108	282,342	366,847	442,231
Other Building	0	55,128	205,626	429,442	807,612	1,188,448	1,461,014	1,737,362
Commercial Stock	0	5,959	22,277	46,102	89,063	134,290	164,899	196,700
Sub-total	0	141,900	407,262	820,329	1,509,556	2,372,625	3,036,820	3,669,967
4. Infrastructure Damage	0	49,665	142,541	287,115	528,344	830,419	1,062,887	1,284,488
5. Fishpond Damage	0	0	1,943	7,824	15,063	28,728	40,708	55,511
6. Indirect Damage	0	30,662	86,948	174,247	317,434	496,580	634,734	766,571
<u>Total Damage</u>	0	235,076	666,604	1,335,898	2,433,663	3,807,120	4,866,300	5,877,046

Note: 1 Average annual flood damage in 2029 is ₱1,011,647 x 10³.

TABLE IV.5-1 FLOOD DAMAGE BY SUB-AREA ON ECONOMIC CONDITION IN 1984

River	Stretch No.	Inundated Properties in Flood Prone Area							Total	Affected Population (1000)	Average Annual Damage (P1000)
		Paddy	Sugar-cane	Fishpond	Others	Total Residential	Non-residential	Buildings (Nos)			
Name		Land Use (ha)									
Panay	P1	4,388	337	1,136	4,801	10,662	6,807	430	7,237	40.8	31,784
	P2	750	150	0	188	1,088	1,083	93	1,176	6.5	3,652
	P3	658	267	0	292	1,217	702	3	705	4.2	2,236
	P4	56	31	0	27	114	32	0	32	0.2	130
	P5	1,782	433	0	630	2,845	1,315	4	1,319	7.9	5,424
	P6	77	40	0	50	167	617	94	711	3.7	4,607
	P7	436	175	0	273	884	107	17	124	0.6	952
	P8	1,168	331	0	354	1,853	998	132	1,130	6.0	16,136
	P9	638	401	0	314	1,353	882	186	1,068	5.3	1,791
	P10	986	454	1	400	1,841	961	86	1,047	5.8	2,027
Maayon	Y1	28	12	0	14	54	21	0	21	0.1	152
	Y2	580	256	0	249	1,085	642	67	710	3.9	4,585
	Y3	118	127	0	84	329	120	2	122	0.7	465
	Y4	996	23	0	137	1,156	449	0	449	2.7	2,626
Mambusao	M1	127	14	0	31	172	128	23	151	0.8	626
	M2	710	95	0	200	1,005	786	91	877	4.7	4,064
	M3	640	55	0	344	1,039	753	110	863	4.5	8,634
	M4	274	24	0	148	446	323	47	370	1.9	1,009
	M5	700	113	0	204	1,017	419	13	432	2.5	1,509
	M6	291	171	0	85	547	603	82	685	3.6	3,567
	M7	2,432	123	0	588	3,143	1,733	31	1,764	10.4	6,217
Badbaran	B1	103	29	0	56	188	136	0	136	0.8	240
	B2	796	104	0	285	1,185	600	174	774	3.6	2,077
Total		18,734	3,765	1,136	9,754	33,390	20,318	1,685	22,003	121.3	104,521.7

Note : /1 Details may not add up to total due to rounding.
At 100-year flood.

Table IV.5-2 Flood Damage Potential by River Stretch and Major Town

Item	River Stretch No.	River Length (km)	Flood Area (km ²)	Annual Average Damage (10 ³ Pesos)			Population in Flood from Area (10 ³)			Damageability Level	Remarks	
				Total	Per km	Per km ²	Total	Per km	Per km ²			
1. Whole Basin:		162.5	338.2	104,521	641	309	121.3	0.74	0.36	-		
2. By River Stretch:												
Panay river												
	P1	13.0	106.6	21,550 (31,784)	1,558 (2,455)	202 (298)	35.4 (60.3)	2.72 (3.14)	0.34 (0.38)	Level-1	(Incl. Pontevedra and Panay)	
	P2	4.0	10.9	1,375 (3,652)	344 (913)	126 (335)	4.1 (6.5)	1.03 (1.53)	0.38 (0.60)	Level-2	To be protected as an integral part of P1. (Incl. Panitan)	
	P3	9.0	12.2	2,237	249	183	4.2	0.47	0.34	Level-3	Right bank area worthy for protection	
	P4	2.2	1.1	130	59	118	0.2	0.09	0.18	Level-3		
	P5	7.0	28.5	5,424	774	190	7.9	1.07	0.29	Level-1		
	P6	1.3	1.5	24 (4,507)	13 (2,559)	16 (3,071)	1.2 (3.7)	0.67 (2.06)	0.30 (2.47)	Level-3	To be protected as an integral part of P5. (Incl. Dao)	
	P7	3.3	13.1	952	108	73	0.6	0.07	0.05	Level-3	Protection of left bank area to be considered.	
	P8	5.4	18.5	5,576 (16,136)	1,032 (2,388)	801 (872)	5.2 (6.0)	0.96 (1.11)	0.25 (0.32)	Level-1	(Incl. Cuarcero)	
	P9	9.5	13.5	1,590 (1,791)	161 (208)	103 (131)	1.4 (5.3)	0.40 (0.52)	0.25 (0.39)	Level-2	(Incl. Dumalag)	
	P10	16.3	18.4	1,972 (2,027)	117 (121)	107 (110)	4.4 (5.3)	0.26 (0.35)	0.24 (0.32)	Level-3	(Incl. Tapaz)	
Maayon river												
	Y1	1.3	0.5	152	34	304	0.1	0.06	0.20	Level-3		
	Y2	5.4	10.9	2,950 (4,585)	320 (716)	188 (421)	2.5 (3.9)	0.41 (0.61)	0.24 (0.36)	Level-2	(Incl. Maayon)	
	Y3	5.0	3.3	465	93	141	0.7	0.14	0.21	Level-3		
	Y4	12.0	11.5	2,526	219	226	2.7	0.23	0.23	Level-2		
Mambusao river												
	M1	2.2	1.7	626	285	368	0.3	0.36	0.47	Level-2		
	M2	9.0	10.1	1,329 (4,064)	148 (452)	132 (402)	3.2 (4.7)	0.26 (0.52)	0.32 (0.46)	Level-2	(Incl. Sigma)	
	M3	10.0	10.4	2,325 (8,534)	283 (863)	272 (830)	2.3 (4.5)	0.23 (0.45)	0.22 (0.43)	Level-2	(Incl. Mambusao)	
	M4	3.2	4.5	1,009	315	224	1.0	0.31	0.22	Level-2		
	M5	11.3	10.2	1,509	134	148	2.5	0.22	0.25	Level-3		
	M6	5.2	5.5	1,948 (3,567)	375 (686)	354 (649)	1.3 (3.6)	0.35 (0.69)	0.33 (0.65)	Level-2	To be improved only after M1-M5 are improved. (Incl. Jamindan)	
	M7	9.6	31.4	6,217	723	198	10.4	1.21	0.33	Level-1	To be improved only after M1 to M6 are improved.	
Babaran river												
	B1	3.4	1.9	240	70	126	0.8	0.24	0.42	Level-3		
	B2	7.8	11.9	1,001 (2,077)	128 (266)	34 (174)	2.1 (3.6)	0.27 (0.46)	0.18 (0.30)	Level-3	(Incl. Dumarao)	
3. By Major Town:												
	Pontevedra	P1	-	1.30	9,359	-	7,581	3.0	-	2.30	Level-1	
	Panay	P1	-	0.51	374	-	733	2.4	-	4.70	Level-3	
	Panitan	P3	-	1.00	2,277	-	2,277	2.4	-	2.40	Level-2	
	Dao	P6	-	1.17	4,582	-	3,916	2.5	-	2.14	Level-2	
	Cuarcero	P8	-	0.49	10,560	-	21,531	0.8	-	1.63	Level-1	
	Dumalag	P9	-	0.66	400	-	606	1.9	-	2.88	Level-3	
	Tapaz	P10	-	0.64	54	-	84	1.4	-	2.19	Level-3	
	Maayon	Y2	-	0.23	2,534	-	11,017	1.1	-	5.65	Level-1	
	Sigma	M2	-	0.47	2,735	-	5,819	1.5	-	3.19	Level-1	
	Mambusao	M3	-	1.03	5,909	-	5,640	3.2	-	3.11	Level-1	
	Jamindan	M6	-	0.18	1,519	-	8,994	1.3	-	10.0	Level-1	
	Dumarao	B2	-	0.48	1,075	-	2,240	1.5	-	3.13	Level-2	

Notes: /1 Length along proposed channel improvement.
/2 Area and annual flood damage at 100-year flood occurrence.

/3 Damage potential level:

Level 1
Level 2
Level 3

River Stretch (10 ³ P/km)	Major Town (10 ³ P/km ²)
500 over	5,000 over
500 - 150	5,000 - 1,000
150 under	1,000 under

() Including major town.

Table IV.5-3 Flood Routing Capacity by Stretch

Location	Stretch No.	Flood ^{/1} Routing Volume (106 m ³)	Damage ^{/2} Potential (106 ₱)	Routing ^{/3} Capacity Index (₱/3)	Damage ^{/4} Potential Level	Proposed Retarding Basin
<u>Panay River:</u>						
1. Upstream of Panitan	P3, P4	60.2	2,366	39	3	**
2. Maayon junction-Mambusao junction	P5	68.6	5,424	79	1	
3. Upstream of Dao	P6, P7	21.0	976	46	3	**
4. Upstream of Cuartero	P8	87.1	5,576	64	1	
5. Upstream of Badbaran junction	P9	28.3	1,390	49	2	*
6. Upstream of Dumalag	P10	44.4	1,972	44	3	**
<u>Maayon River:</u>						
7. Downstream stretches	Y1, Y2, Y4	44.0	4,198	95	2-3	*
<u>Mambusao River:</u>						
8. Upstream of Mambusao town	M4 - M6	24.5	4,166	170	2-3	*
9. Balacuan river	M7	12.1	6,217	513	1	
<u>Badbaran River:</u>						
10. All stretches	B1 - B3	40.2	1,241	31	3	**

- Notes: /1 Routing volume at 100-year flood
 /2 Annual average flood damage
 /3 Damage potential/Routing volume
 /4 See Table
 * Suitable
 ** Most suitable

Table IV.5-4 Protection Area Alternatives - Structural Measures

River Stretch		Damageability Level ^{/1}	Alternative						
			1	2	3	4	5	6	
Panay River									
Stretch	P1	1	o	o	o	o	o	o	o
"	P2	2	o	o	o	o	o	o	o
"	P3	3	x	Δ	Δ	Δ	o	o	o
"	P4	3	x	x	x	x	x	o	o
"	P5	1	x	o	o	o	o	o	o
"	P6	3	x	o	o	o	o	o	o
"	P7	3	x	Δ	Δ	Δ	Δ	o	o
"	P8	1	x	x	o	o	o	o	o
"	P9	2	x	x	x	o	o	o	o
"	P10	3	x	x	x	x	x	o	o
Maayon River									
Stretch	Y1	3	x	x	x	x	x	o	o
"	Y2	2	x	x	x	o	o	o	o
"	Y3	3	x	x	x	x	x	o	o
"	Y4	2	x	x	x	o	o	o	o
Mambusao River									
Stretch	M1	2	x	x	o	o	o	o	o
"	M2	2	x	x	o	o	o	o	o
"	M3	2	x	x	o	o	o	o	o
"	M4	2	x	x	x	x	o	o	o
"	M5	3	x	x	x	x	x	o	o
"	M6	2	x	x	x	x	o	o	o
"	M7	1	x	x	x	o	o	o	o
Badbaran River									
Stretch	B1	3	x	x	x	x	x	o	o
"	B2	3	x	x	x	x	x	o	o

Notes: o Area to be protected by structural measures
 Δ Area partially protected
 x Area to be left unprotected for use as retarding basin
 /1 See Table

Table IV.6-1 Design Discharge of Protection Area Alternatives

Stretch		Alternative					
		1	2	3	4	5	6
<u>Panay River</u>							
<u>Pontevedra</u>	P1	2,700	3,200	4,400	4,600	5,400	6,400
	P2	2,700	3,200	4,400	4,600	5,400	6,400
<u>Jct. Maayon</u>	P3	-	3,200	4,400	4,600	5,400	6,400
	P4	-	2,800	3,900	4,200	4,300	5,100
<u>Jct. Mambusao</u>	P5	-	2,800	3,900	4,200	4,300	5,100
	P6	-	2,100	2,700	2,900	2,900	3,400
	P7	-	2,100	2,700	2,900	2,900	3,400
<u>Jct. Badbaran</u>	P8	-	-	2,700	2,900	2,900	3,400
	P9	-	-	-	1,700	1,700	1,800
	P10	-	-	-	-	-	1,800
<u>Maayon River</u>							
	Y1	-	-	-	1,400	1,400	1,400
	Y2	-	-	-	1,400	1,400	1,400
	Y3	-	-	-	-	-	1,400
<u>Ilas River</u>	Y4	-	-	-	600	600	600
<u>Mambusao River</u>							
	M1	-	-	1,400	1,800	1,900	1,900
	M2	-	-	1,600	1,600	1,700	1,700
	M3	-	-	1,600	1,600	1,600	1,600
	M4	-	-	-	-	1,600	1,600
	M5	-	-	-	-	1,400	1,400
	M6	-	-	-	-	1,400	1,400
<u>Balacuan River</u>	M7	-	-	-	300	300	300
<u>Badbaran River</u>							
	B1	-	-	-	-	-	1,500
	B2	-	-	-	-	-	1,500

Table IV.6-2 Evaluation of Protection Area Alternatives

Item	Protection Area Alternative ^{/1}					
	1	2	3	4	5	6
Flood Discharge ^{/2} (m ³ /sec)	2,670	3,120	4,320	4,520	5,400	6,350
Effect of Protection Work:						
- Annual damage reduction (P x 10 ⁶)	35.4	46.3	76.2	91.4	97.4	104.5
- Population protected (1000)	44.9	59.2	75.2	97.5	107.2	121.3
- Agricultural land protected (km ²)	47.8	68.3	92.9	137.4	144.8	170.7
Cost of Protection Work ^{/3} (P x 10 ⁶)	1,021	2,293	3,917	4,680	5,344	6,987
Comparison Indices:						
- Cost effectiveness ^{/4}	0.70	0.42	0.39	0.39	0.36	0.30
- % Population protected ^{/5}	37	49	62	80	88	100
- % Agricultural land protected ^{/6}	21	30	41	60	64	75
Selected Plan				*		

Notes: /1 See Table 4.2-3 for location of protection areas.

/2 100-year flood at Paritan base station.

/3 Cost of river improvement works

/4 Expressed in terms of benefit cost ration (= Present worth of damage reduction/Present worth of cost).

/5 % of total population in the flood vulnerable area (121,300)

/6 % to total agricultural land in the flood vulnerable area (227.9 km²)

Table IV.6-3 Construction Cost of Protection Area Alternatives

		(Unit: 10 ⁶ P)					
Stretch		1	2	3	4	5	6
<u>Panay River</u>							
Pontevedra	P1	858.0	1,119.8	1,518.0	1,579.0	1,815.0	2,035.0
	P2	163.2	176.0	200.0	204.0	212.0	226.4
Jct. Maayon	P3	-	401.9	454.9	461.0	477.0	509.4
	P4	-	31.4	37.6	39.2	39.2	92.8
Jct. Mambusao	P5	-	279.7	304.0	310.1	310.1	320.7
	P6	-	57.6	62.3	63.7	63.7	67.0
	P7	-	258.7	279.8	285.1	311.5	327.4
Jct. Badbaran	P8	-	-	186.8	191.2	191.2	200.9
	P9	-	-	-	139.3	139.3	144.5
	P10	-	-	-	-	-	275.5
<u>Maayon River</u>							
	Y1	-	-	-	19.1	19.1	38.2
	Y2	-	-	-	202.2	202.2	202.2
	Y3	-	-	-	-	-	158.0
Ilas R.	Y4	-	-	-	192.0	192.0	192.0
<u>Mambusao River</u>							
	M1	-	-	86.7	107.4	111.3	111.3
	M2	-	-	390.6	390.6	406.8	406.8
	M3	-	-	434.0	434.0	452.0	452.0
	M4	-	-	-	-	144.6	144.6
	M5	-	-	-	-	153.7	423.8
	M6	-	-	-	-	195.0	195.0
Balucuan R.	M7	-	-	-	120.0	120.0	120.0
<u>Badbaran River</u>							
	B1	-	-	-	-	-	106.1
	B2	-	-	-	-	-	237.1
	B3	-	-	-	-	-	-
Total		1,021.2	2,325.1	3,954.7	4,738.5	5,555.6	6,987.1

Table IV.6-4 Effectiveness of Flood Control by Structural Measures - Alternative - 1

River Stretch	Protection Area	Population (10 ³)		Agricultural Land (km ²)		100-yr Flood Damage (10 ⁶ Pesos)		Annual Flood Damage (10 ⁶ Pesos)		Cost of Protection Work (10 ⁶ Pesos)
		Present Condition	Protected	Present Condition	Protected	Present Condition	Reduction	Present Condition	Reduction	
Panay River										
P1	0	40.8	40.8	43.9	40.7	150.2	150.2	31.8	31.8	858.0
P2	0	4.1	4.1	7.5	7.1	34.1	34.1	3.7	3.7	163.2
P3	x	6.6	-	6.6	-	-	-	2.2	-	-
P4	x	0.2	-	0.6	-	-	-	0.1	-	-
P5	x	7.9	-	17.8	-	-	-	5.4	-	-
P6	x	3.7	-	0.8	-	-	-	4.6	-	-
P7	x	0.6	-	4.4	-	-	-	1.0	-	-
P8	x	6.0	-	11.7	-	-	-	16.1	-	-
P9	x	5.3	-	6.4	-	-	-	1.8	-	-
P10	x	5.8	-	9.9	-	-	-	2.0	-	-
Maayon River										
Y1	x	0.1	-	0.3	-	-	-	0.2	-	-
Y2	x	3.9	-	5.8	-	-	-	4.6	-	-
Y3	x	0.7	-	1.2	-	-	-	0.5	-	-
Y4	x	2.7	-	10.0	-	-	-	2.6	-	-
Mambusao River										
M1	x	0.8	-	1.3	-	-	-	0.6	-	-
M2	x	4.7	-	7.1	-	-	-	4.1	-	-
M3	x	4.5	-	6.4	-	-	-	8.6	-	-
M4	x	1.9	-	2.7	-	-	-	1.0	-	-
M5	x	2.5	-	7.0	-	-	-	1.5	-	-
M6	x	3.6	-	2.9	-	-	-	3.6	-	-
M7	x	10.4	-	24.3	-	-	-	6.2	-	-
Badbaron River										
B1	x	0.8	-	1.0	-	-	-	0.2	-	-
B2	x	3.6	-	8.0	-	-	-	2.1	-	-
Total	-	121.3	44.9	187.6	47.8	590.1	184.3	104.5	35.5	1,021.2

Table IV.6-5 Effectiveness of Flood Control by Structural Measures - Alternative - 2

River Stretch	Protection Area	Population (10 ³)		Agricultural Land (km ²)		100-yr Flood Damage (10 ⁶ Pesos)		Annual Flood Damage (10 ⁶ Pesos)		Cost of Protection Work (10 ⁶ Pesos)
		Present Condition	Protected	Present Condition	Protected	Present Condition	Reduction	Present Condition	Reduction	
Panay River										
P1	o	40.8	40.8	43.9	40.7	150.2	150.2	31.8	31.8	1,119.8
P2	o	4.1	4.1	7.5	7.1	34.1	34.1	3.7	3.7	176.0
P3	x	6.6	2.4	6.6	0.4	4.7	4.7	2.2	0.8	401.9
P4	x	0.2	-	0.6	-	0.8	-	0.1	-	-
P5	o	7.9	7.9	17.8	17.0	26.9	26.9	5.4	5.4	279.7
P6	o	3.7	3.7	0.8	0.8	29.4	29.4	4.6	4.6	57.6
P7	x	0.6	0.3	4.4	2.3	5.9	3.0	1.0	0.5	258.7
P8	x	6.0	-	11.7	-	47.1	-	16.1	-	-
P9	x	5.3	-	6.4	-	31.4	-	1.8	-	-
P10	x	5.8	-	9.9	-	17.6	-	2.0	-	-
Maayon River										
Y1	x	0.1	-	0.3	-	0.4	-	0.2	-	-
Y2	x	3.9	-	5.8	-	21.2	-	4.6	-	-
Y3	x	0.7	-	1.2	-	1.6	-	0.5	-	-
Y4	x	2.7	-	10.0	-	6.7	-	2.6	-	-
Mambusao River										
M1	x	0.8	-	1.3	-	4.1	-	0.6	-	-
M2	x	4.7	-	7.1	-	31.0	-	4.1	-	-
M3	x	4.5	-	6.4	-	48.6	-	8.6	-	-
M4	x	1.9	-	2.7	-	5.8	-	1.0	-	-
M5	x	2.5	-	7.0	-	7.7	-	1.5	-	-
M6	x	3.6	-	2.9	-	28.7	-	3.6	-	-
M7	x	10.4	-	24.3	-	37.3	-	6.2	-	-
Badbaron River										
B1	x	0.8	-	1.0	-	2.2	-	0.2	-	-
B2	x	3.6	-	8.0	-	38.5	-	2.1	-	-
Total	-	121.2	59.2	187.6	68.3	590.1	248.3	104.5	46.8	2,293.7

Table IV.6-6 Effectiveness of Flood Control by Structural Measures - Alternative - 3

River Stretch	Protection Area	Population (10 ³)		Agricultural Land (km ²)		100-yr Flood Damage (10 ⁶ Pesos)		Annual Flood Damage (10 ⁶ Pesos)		Cost of Protection Work (10 ⁶ Pesos)
		Present Condition	Protected	Present Condition	Protected	Present Condition	Reduction	Present Condition	Reduction	
Panay River										
P1	o	40.8	40.8	43.9	39.8	150.2	150.2	31.8	31.8	1,518.0
P2	o	4.1	4.1	7.5	7.1	34.1	34.1	3.7	3.7	200.0
P3	o	6.6	2.4	6.6	0.4	4.7	4.7	2.2	0.8	454.9
P4	x	0.2	-	0.6	-	-	-	0.1	-	-
P5	o	7.9	7.9	17.8	17.0	26.9	26.9	5.4	5.4	304.0
P6	o	3.7	3.7	0.8	0.8	29.4	29.4	4.6	4.6	62.3
P7	o	0.6	0.3	4.4	2.3	5.9	3.0	1.0	0.5	279.8
P8	o	6.0	6.0	11.7	11.6	47.1	47.1	16.1	16.1	186.8
P9	x	5.3	-	6.4	-	-	-	1.8	-	-
P10	x	5.8	-	9.9	-	17.6	-	2.0	-	-
Maayon River										
Y1	x	0.1	-	0.3	-	0.4	-	0.2	-	-
Y2	x	3.9	-	5.8	-	21.2	-	4.6	-	-
Y3	x	0.7	-	1.2	-	1.6	-	0.5	-	-
Y4	x	2.7	-	10.0	-	6.7	-	2.6	-	-
Mambusao River										
M1	o	0.8	0.8	1.3	1.1	4.1	4.1	0.6	0.6	86.7
M2	o	4.7	4.7	7.1	6.8	31.0	31.0	4.1	4.1	390.6
M3	o	4.5	4.5	6.4	6.0	18.6	48.6	8.6	8.6	434.0
M4	x	1.9	-	2.7	-	5.8	-	1.0	-	-
M5	x	2.5	-	7.0	-	7.7	-	1.5	-	-
M6	x	3.6	-	2.9	-	28.7	-	3.6	-	-
M7	x	10.4	-	24.3	-	37.3	-	6.2	-	-
Badbaron River										
B1	x	0.8	-	1.0	-	2.2	-	0.2	-	-
B2	x	3.6	-	8.0	-	38.5	-	2.1	-	-
Total	-	121.3	75.2	187.6	92.9	570.1	379.1	104.5	76.2	3,917.1

Table IV.6-7 Effectiveness of Flood Control by Structural Measures - Alternative - 4

River Stretch	Protection Area	Population (10 ³)		Agricultural Land (km ²)		100-yr Flood Damage (10 ⁶ Pesos)		Annual Flood Damage (10 ⁶ Pesos)		Cost of Protection Work (10 ⁶ Pesos)
		Present Condition	Protected	Present Condition	Protected	Present Condition	Reduction	Present Condition	Reduction	
Panay River										
P1	o	40.8	40.8	43.9	39.8	150.2	150.2	31.8	31.8	1,579.6
P2	o	4.1	4.1	7.5	7.1	34.1	34.1	3.7	3.7	204.0
P3	o	6.6	2.4	6.6	0.4	12.9	14.7	2.2	0.8	461.0
P4	x	0.2	-	0.6	-	0.8	-	0.1	-	-
P5	o	7.9	7.9	17.8	17.0	26.9	26.9	5.4	5.4	310.1
P6	o	3.7	3.7	0.8	0.8	29.4	29.4	4.6	4.6	63.7
P7	o	0.6	0.3	4.4	2.3	5.9	3.0	1.0	0.5	285.1
P8	o	6.0	6.0	11.7	11.6	47.1	47.1	16.1	16.1	191.2
P9	o	5.3	5.3	6.4	6.1	31.4	31.4	1.8	1.8	139.3
P10	x	5.8	-	9.9	-	17.6	-	2.0	-	-
Maayon River										
Y1	x	0.1	-	0.3	-	0.4	-	0.2	-	-
Y2	o	3.9	3.9	5.8	5.6	21.2	21.2	4.6	4.6	202.2
Y3	x	0.7	-	1.2	-	1.6	-	0.5	-	-
Y4	o	2.7	2.7	10.0	8.7	6.7	6.7	2.6	2.6	192.0
Mambusao River										
M1	o	0.8	0.8	1.3	0.9	4.1	4.1	0.6	0.6	107.4
M2	o	4.7	4.7	7.1	6.8	31.0	31.0	4.1	4.1	390.6
M3	o	4.5	4.5	6.4	6.0	48.6	48.6	8.6	8.6	434.0
M4	x	1.9	-	2.7	-	5.8	-	1.0	-	-
M5	x	2.5	-	7.0	-	7.7	-	1.5	-	-
M6	x	3.6	-	2.9	-	28.7	-	3.6	-	-
M7	o	10.4	10.4	24.3	24.3	37.3	37.3	6.2	6.2	120.0
Badbaron River										
B1	x	0.8	-	1.0	-	2.2	-	0.2	-	-
B2	x	3.6	-	8.0	-	38.5	-	2.1	-	-
Total	-	121.3	97.5	187.6	137.4	590.1	475.7	104.5	91.4	4,680.2

Table IV.6-8 Effectiveness of Flood Control by Structural Measures - Alternative - 5

River Stretch	Protection Area	Population (10 ³)		Agricultural Land (km ²)		100-yr Flood Damage (10 ⁶ Pesos)		Annual Flood Damage (10 ⁶ Pesos)		Cost of Protection Work (10 ⁶ Pesos)
		Present Condition	Protected Condition	Present Condition	Protected Condition	Present Condition	Reduction	Present Condition	Reduction	
Faney River										
P1	o	40.8	40.8	43.9	39.0	150.2	150.2	31.8	31.8	1,815.0
P2	o	4.1	4.1	7.5	4.1	34.1	34.1	3.7	3.7	212.0
P3	o	6.6	6.6	6.6	6.1	12.9	12.9	2.2	2.2	477.0
P4	x	0.2	-	0.6	-	-	-	0.1	-	-
P5	o	7.9	7.9	17.8	17.0	26.9	26.9	5.4	5.4	310.1
P6	o	3.7	3.7	0.8	0.8	29.4	29.4	4.6	4.6	63.7
P7	o	0.6	0.3	4.4	2.3	5.9	3.0	1.0	0.5	311.5
P8	o	6.0	6.0	11.7	11.6	47.1	47.1	16.1	16.1	191.2
P9	o	5.3	5.3	6.4	6.1	31.4	31.4	1.8	1.8	139.3
P10	x	5.8	-	9.9	-	17.6	-	2.0	-	-
Maayon River										
Y1	x	0.1	-	0.3	-	0.4	-	0.2	-	-
Y2	o	3.9	3.9	5.8	5.6	21.2	21.2	4.6	4.6	202.2
Y3	x	0.7	-	1.2	-	1.6	-	0.5	-	-
Y4	o	2.7	2.7	10.0	8.7	6.7	6.7	2.6	2.6	192.0
Mambusso River										
M1	o	0.8	0.8	1.3	0.9	4.1	4.1	0.6	0.6	111.3
M2	o	4.7	4.7	7.1	6.8	31.0	31.0	4.1	4.1	406.8
M3	o	4.5	4.5	6.4	6.0	48.6	48.6	8.6	8.6	452.0
M4	o	1.9	1.9	2.7	2.6	5.8	5.8	1.0	1.0	144.6
M5	x	2.5	-	7.0	-	7.7	-	1.5	-	-
M6	o	3.6	3.6	2.9	2.9	28.7	28.7	3.6	3.6	195.0
M7	o	10.4	10.4	24.3	24.3	37.3	37.3	6.2	6.2	120.0
Badbaron River										
B1	x	0.8	-	1.0	-	2.2	-	0.2	-	-
B2	x	3.6	-	8.0	-	38.5	-	2.1	-	-
Total	-	121.3	107.2	187.6	144.8	590.1	518.4	104.5	97.4	5,343.7

Table IV.6-9 Effectiveness of Flood Control by Structural Measures. - Alternative - 6

River Stretch	Protection Area	Population (10 ³)		Agricultural Land (km ²)		100-yr Flood Damage (10 ⁶ Pesos)		Annual Flood Damage (10 ⁶ Pesos)		Cost of Protection Work (10 ⁶ Pesos)
		Present Condition	Protected	Present Condition	Protected	Present Condition	Reduction	Present Condition	Reduction	
Panay River										
P1	0	40.8	40.8	43.9	38.5	150.2	150.2	31.8	31.8	2,035.0
P2	0	4.1	4.1	7.5	4.1	34.1	34.1	3.7	3.7	226.4
P3	0	6.6	6.6	6.6	6.1	12.9	12.9	2.2	2.2	509.4
P4	0	0.2	0.2	0.6	0.1	0.8	0.8	0.1	0.1	92.8
P5	0	7.9	7.9	17.8	17.0	26.9	26.9	5.4	5.4	320.7
P6	0	3.7	3.7	0.8	0.8	29.4	29.4	4.6	4.6	67.0
P7	0	0.6	0.6	4.4	2.7	5.9	5.9	1.0	1.0	327.4
P8	0	6.0	6.0	11.7	11.6	47.1	47.1	16.1	16.1	200.9
P9	0	5.3	5.3	6.4	6.1	31.4	31.4	1.8	1.8	144.5
P10	0	5.8	5.8	9.9	9.6	17.6	17.6	2.0	2.0	275.5
Maayon River										
Y1	0	0.1	0.1	0.3	0.1	0.4	0.4	0.2	0.2	38.2
Y2	0	3.9	3.9	5.8	5.6	21.2	21.2	4.6	4.6	202.2
Y3	0	0.7	0.7	1.2	1.2	1.6	1.6	0.5	0.5	158.0
Y4	0	2.7	2.7	10.0	8.7	6.7	6.7	2.6	2.6	192.0
Mambusao River										
M1	0	0.8	0.8	1.3	0.9	4.1	4.1	0.6	0.6	111.3
M2	0	4.7	4.7	7.1	6.8	31.0	31.0	4.1	4.1	406.8
M3	0	4.5	4.5	6.4	6.0	48.6	48.6	8.6	8.6	452.0
M4	0	1.9	1.9	2.7	2.6	5.8	5.8	1.0	1.0	144.6
M5	0	2.5	2.5	7.0	6.7	7.7	7.7	1.5	1.5	423.8
M6	0	3.6	3.6	2.9	2.9	28.7	28.7	3.6	3.6	195.0
M7	0	10.4	10.4	24.3	24.3	37.3	37.3	6.2	6.2	120.0
Badbaron River										
B1	0	0.8	0.8	1.0	0.7	2.2	2.2	0.2	0.2	106.1
B2	0	3.6	3.6	8.0	7.6	38.5	38.5	2.1	2.1	237.1
Total	-	121.3	121.3	187.6	170.7	590.1	590.1	104.5	104.5	6,987.1

Table IV.6-10 Economic Evaluation of River Improvement Works (LP) - By River Stretch
(Without Dams)

River	Stretch No.	Length (km)	Construction Cost (P x 10 ⁶)	Present Worth ^{/1} (P x 10 ⁶)		Net Benefit (B - C)	Remarks
				Cost (C)	Benefit (B)		
Panay	P1	13.0	1,580	906	136	-770	
	P2	4.0	204	117	45	-72	
	P3	9.0	461	269	11	-258	
	P4	2.2	-	-	-	-	
	P5	7.0	310	177	63	-114	
	P6	1.8	64	36	66	30	
	P7	8.8	285	166	6	-160	
	P8	5.4	191	109	220	111	
	P9	8.6	139	79	22	-57	
	P10	16.8	-	-	-	-	
Maayon	Y1	1.8	-	-	-	-	
	U2	6.4	202	116	64	-52	
	Y3	5.0	-	-	-	-	
	Y4	12.0	192	109	31	-78	
Mambusao	M1	2.2	107	62	7	-55	
	M2	9.0	390	226	54	-172	
	M3	10.0	434	250	120	-130	
	M4	3.2	-	-	-	-	
	M5	11.3	-	-	-	-	
	M6	5.2	-	-	-	-	
	M7	8.6	120	69	74	5	
Badbaran	B1	3.4	-	-	-	-	
	B2	9.8	-	-	-	-	
Total		162.5	4,680	2,691	919	-1,772	EIRR=2.8%

Notes: /1 Discount rate: 3% p.a.

* Partial improvement of low water channel

- No improvement

Table IV.7-1 Floodway Plans and Corresponding River Improvement Plans

Location of Floodway	Floodway Plan		River Improvement Only	
	Works Involved	Cost/ ¹ (P x 10 ⁶)	Works Involved	Cost (P x 10 ⁶)
FW-1: Mambusao - Balacuan Floodway	- Construction of floodway - Improvement of stretches M1 to M4 for reduced flood discharges	1,113	- Improvement of river stretches M1 to M4	787
FW-2: Mambusao - Sapian Floodway	- Construction of floodway - Improvement of stretches P1 to P6 and M1 to M4 for reduced flood discharges	7,026	- Improvement of stretches P1 to P6 and M1 to M4	3,629
FW-3: Panitan Floodway	- Construction of floodway - Improvement of stretch P2 for reduced flood discharge	332	- Improvement of stretch P2 and a part of P3	236
FW-4: Panitan - Bailan Floodway	- Construction of floodway - Minimum improvement of existing downstream channel ²	1,689	- Improvement of stretches P1 and P4	1,426
FW-5: Cogon Floodway	- Construction of floodway - Minimum improvement of existing downstream channel ²	1,044	- Improvement of stretch P1 (downstream from floodway inlet)	1,383
FW-6: Hamulauon Floodway	- Construction of floodway - Improvement of Pontevedra downstream stretch for reduced flood discharge	954	- Improvement of stretch P1 (downstream from floodway inlet)	946

Notes: ¹ Breakdown of the estimated cost is contained in Appendix IV.

² Minimum required improvement at local places (e.g. erosion protection) in stretch downstream from floodway inlet. Cost to be assumed at 20% of full-scale low-water channel improvement.

Table 7-2 Breakdown of Cost for Floodway Plan

(Units: 10⁶p)

	Mambulan Diversion		Cogan Diversion		Panitah-Pailan Div.		Panitan Floodway		Mambuno-Sapion Div.		Balacuan Floodway	
	Diversion Only	Over Imp. Only	Diversion Only	Over Imp. Only	Diversion Only	Over Imp. Only	Floodway Only	Over Imp. Only	Diversion Only	Over Imp. Only	Floodway Only	Over Imp. Only
Mambulan Diversion	3,100 m ³ /s	-	-	-	-	-	-	-	-	-	-	-
	751.7	-	-	-	-	-	-	-	-	-	-	-
Cogan Diversion	-	4,100 m ³ /s	-	-	-	-	-	-	-	-	-	-
	-	1,035.3	-	-	-	-	-	-	-	-	-	-
Panitah-Pailan Diversion	-	-	4,100 m ³ /s	-	-	-	-	-	-	-	-	-
	-	-	1,669.0	-	-	-	-	-	-	-	-	-
Panitan Floodway	-	-	-	2,800 m ³ /s	-	-	-	-	-	-	-	-
	-	-	-	195.7	-	-	-	-	-	-	-	-
Mambuno-Sapion Diversion	-	-	-	-	-	-	-	-	2,000 m ³ /s	-	-	-
	-	-	-	-	-	-	-	-	4,080.0	-	-	-
Mambuno-Mamburon Floodway	-	-	-	-	-	-	-	-	-	2,000 m ³ /s	-	-
	-	-	-	-	-	-	-	-	-	1,081.4	-	-
P1	1,500 m ³ /s	4,600 m ³ /s	500 m ³ /s	500 m ³ /s & 4,600 m ³ /s	500 m ³ /s	500 m ³ /s	1,800 m ³ /s	4,600 m ³ /s	4,200 m ³ /s	4,600 m ³ /s	4,600 m ³ /s	-
	202.5	946.3	8.4	1,382.5	12.6	186.4	73.0	126.5	1,452.0	1,579.6	4,600 m ³ /s	-
P2	-	-	-	-	500 m ³ /s	500 m ³ /s	1,800 m ³ /s	4,600 m ³ /s	4,200 m ³ /s	4,600 m ³ /s	4,600 m ³ /s	-
	-	-	-	-	7.7	204.0	63.0	109.3	397.6	204.0	4,600 m ³ /s	-
P3	-	-	-	-	-	-	1,800 m ³ /s	4,600 m ³ /s	4,200 m ³ /s	4,600 m ³ /s	4,600 m ³ /s	-
	-	-	-	-	-	-	63.0	109.3	503.9	461.0	4,600 m ³ /s	-
P4	-	-	-	-	-	-	-	-	4,100 m ³ /s	4,500 m ³ /s	4,500 m ³ /s	-
	-	-	-	-	-	-	-	-	74.4	78.3	4,500 m ³ /s	-
P5	-	-	-	-	-	-	-	-	4,100 m ³ /s	4,500 m ³ /s	4,500 m ³ /s	-
	-	-	-	-	-	-	-	-	302.5	310.1	4,500 m ³ /s	-
P6	-	-	-	-	-	-	-	-	4,000 m ³ /s	3,400 m ³ /s	3,400 m ³ /s	-
	-	-	-	-	-	-	-	-	63.7	63.7	3,400 m ³ /s	-
N1	-	-	-	-	-	-	-	-	700 m ³ /s	2,600 m ³ /s	3,700 m ³ /s	2,600 m ³ /s
	-	-	-	-	-	-	-	-	64.7	107.4	5.7	107.4
N2	-	-	-	-	-	-	-	-	500 m ³ /s	2,300 m ³ /s	500 m ³ /s	2,300 m ³ /s
	-	-	-	-	-	-	-	-	261.0	390.6	23.1	390.6
M3	-	-	-	-	-	-	-	-	300 m ³ /s	2,100 m ³ /s	300 m ³ /s	2,300 m ³ /s
	-	-	-	-	-	-	-	-	25.7	434.0	2.6	289.3
Total	954.2	946.3	1,043.7	1,382.5	1,689.3	1,425.4	331.7	235.8	7,025.5	3,628.7	1,112.8	787.3

Table IV.8-1 Preliminary Study Results of Prospective Damsites in Panay River Basin (1)

River System	Dam Site	Type & Scale of Dam	Geological Condition at Damsite	Catch Area Km ²	Design Flood m ³ /sec	Annual num-off 10 m (m ² /sec-km ²)	N.W.L. H.M. m	Total Storage 10 ⁶ m ³	Total Sedim. Storage 10 ⁶ m ³	Total Water Utiliza Storage 10 ⁶ m ³	Flood Conc. 10 ⁶ m ³
Panay	A Site	Concrete gravity H=71.5m, L=110m, V=145,000m ³ Spillway free over-flow type	Conglomerate, Sandstone and siltstone which are not well consolidated. lot of water leakage is recorded in the part drilling	211.9	1,000 (200yr. flood)	560.5 (0.0839)	120	134	21	113	56.5
	B Site	Concrete gravity H=47m, L=130m, V=92,000m ³ Spillway with gates	Andesitic volcanic breccia with many outcrop in river bed	238.8	1,120 (200yr. flood)	632.6 (0.0839)	75	73	24	49	24.5
	C Site	Concrete gravity H=26m, L=153m, V=41,500m ³ Spillway with gates	Andesitic volcanic breccia with same outcrop in riverbed	509.2	2,400	1,151.3	30	229	51	178	89
Badbaran	A Site	Spillway with gates	Andesite and volcanic breccia. Depth to fresh rock is about 10m	256.4	2,130 (1.2x200yr. flood)	354.3 (0.0435)	42.5	115.3	37.5	77.8	35.1
	B Site	Rockfill H=23m, L=335m, V=354,000m ³ Spillway with gate	Karatic limestone much leakage expected	290.0	2,260 (1.2x200yr. flood)	431.5 (0.0472)	35	97	29	68	34
Hambusao	A Site	Concrete gravity H=44m, L=130m, V=77,000m ³ Spillway free over-flow type	Moderately hard consolidated conglomerate, sandstone and siltstone overburden very thick	72.9	250 (200yr. flood)	136.4 (0.0593)	90	38	7	31	15.5
	B Site	Rockfill H=13m, L=280m, V=148,000m ³ Spillway with gate	Sandstone, conglomerate and siltstone. Site is covered with thick overburden.	216.6	910	405.2	32	72	22	50	25
Maayon	Maayon Rockfill	H=30m, L=385m, V=480,000m ³ Spillway with gates		140.1	910	177.5	97	50	14	36	18

Table IV.8-1 Preliminary Study Results of Prospective Damsites in Panay River Basin (2)

River System	Damsite	Firm Disch. m ³ /sec	Max. Disch. m ³ /sec	Intake H.W.L. EL.m	L.W.L. EL.m	T.W.L. EL.m	Total Head m	Inst. Capa. KJ	Depend. Output KJ	Annual Energy 10 ⁶ kWh	Construction Cost Dam P100	Power S. Total P/m ²	Dam Cost Eff. Storage P/m ²	Energy Cost P/kWh	
Panay	A Site	14.46	30.0	104.0	86.0	59.0	44.5 ~27.0	10,700	6,360	45.3	627.5	242.4	869.9	5.55	0.54
	B Site	12.50	25.0	68.0	61.5	39.0	29.0 ~22.5	5,700	4,400	35.5	403.7	166.3	570.0	8.24	0.47
	C Site	24.6	50.0	25.5	21.2	14.0	11.5 ~7.2	4,480	2,760	24.1	523.1	212.4	735.5	2.94	0.88
Badbaram	A Site	8.79	18.0	40.0	36.8	22.0	18.0 ~14.8	2,250	2,120	11.7	275.6	97.5	373.1	3.55	0.83
	B Site	6.5	13.0	31.5	27.5	17.0	14.5 ~10.5	1,400	990	8.7	441.7	106.1	547.8	6.50	1.21
Mambuso	A Site	3.2	6.5	83.0	73.0	35.0	28.0 ~18.0	1,440	920	6.8	297.4	63.7	361.1	9.59	0.94
	B Site	7.8	15.0	30.0	26.0	19.0	11.0 ~7.0	Head is too low. Not planned			358.4		7.17		
Nuayon	Nuayon	3.4	6.8	42.5	38.0	29.0	18.5 ~14.0	900	710	5.8	293.2	74.3	367.5	8.14	1.29

Remarks: 1. Energy cost is tentatively calculated to be $\frac{\text{Construction Cost of Power House}}{\text{Annual energy output}}$ x annual cost factor.

Annual cost factor is taken at 0.1.

Table IV.8-2 General Features of Each Dam Plan

Item	Unit	Panay B	Panay C	Badbaran A	Mambusao B	Panay C (After Panay B)
Reservoir						
Total storage capacity	10 ⁶ m ³	96.0	466.0	75.5	60.2	295.0
Sediment capacity	10 ⁶ m ³	31.7	68.9	37.5	28.7	37.2
Effective storage capacity (for flood control)	10 ⁶ m ³	64.3 (33.8)	397.1 (144.8)	38.0 (38.0)	31.5 (31.5)	257.8 (130.2)
(for power generation)	10 ⁶ m ³	(30.5)	(252.3)	(0)	(0)	(127.6)
Flood water level	El. m	74.9	44.6	43.9	41.7	39.8
Surcharge water level	El. m	71.3	38.3	40.2	36.6	34.3
High water level	El. m	65.0	35.0	-	-	30.0
Low water level	El. m	56.7	25.6	36.8	33.6	23.5
Dam						
Type		Concrete gravity dam	Concrete gravity dam	Rockfill dam	Rockfill dam	Combined dam
Crest elevation	El. m	77.4	47.1	46.9	44.7	42.3
Crest length	m	160.0	190.0	240.0	280.0	175.0
Height	m	52.4	39.1	30.9	34.7	34.3
Power Station						
Maximum discharge	m ³ /sec	27.2	93.0	-	-	80.0
Rated head	m	31.7	14.4	-	-	10.3
Installed capacity	kW	7,100	11,000	-	-	6,800
Annual energy output	GWh	31.4	31.4	-	-	22.6
Tail water level	El. m	30.0	17.0	-	-	17.0

Table IV.8-3 Flood Regulating Capacity of
Preliminarily Selected 4 Dams

(Unit: m³/sec)

Item	Panay B Dam	Panay C Dam ^{/1}	Panay C Dam ^{/2}	Badbaran A Dam	Mambusao B Dam
100-year flood					
- peak inflow	2,420	4,120	3,230	1,900	1,770
- outflow	1,210	824	646	950	885
25-year flood					
- peak inflow	1,250	2,120	1,700	1,080	990
- outflow	625	424	340	540	495
10-year flood					
- peak inflow	750	1,260	1,020	700	620
- outflow	375	252	204	350	310

Notes: ^{/1} Independent scheme.

^{/2} With Panay B dam in upper reach, in which FSL of Panay C dam is planned to be equal to TWL of Panay B dam.

Table IV.8-4 Flood Levels and Discharges Before and After Dam Projects

(At Panitan Base Station)

Dam	Without Dam		With Dam	
	Flood Level (El. m)	Flood Discharge (m ³ /sec)	Flood Level (El. m)	Flood Discharge (m ³ /sec)
Panay B dam	10.30	2,670	10.19	2,610
Panay C dam ^{/1}	10.30	2,670	9.62	2,300
Panay B dam + Panay C dam ^{/2}	10.30	2,670	9.51	2,240
Badbaran A dam	10.30	2,670	10.17	2,600
Mambusao B dam	10.30	2,670	10.25	2,645

Notes: The above represents flood levels and discharges at occurrence of 100-year flood under present river channel condition.

/1 Independent scheme

/2 Scheme with Panay B dam in upper reach

Table IV.9-1 Flood Levels and Discharge under "With-dam"
and "Without-dam" Conditions

(at Panitan Station, 100-year Flood)

Alternative	Dam to be Built	With Dams		Without Dams	
		Flood Level (El. m)	Flood Discharge (m ³ /sec)	Flood Level (El. m)	Flood Discharge (m ³ /sec)
DR-1	Panay B	11.99	4,520	11.82	4,380
DR-2	Panay C ^{/1}	11.99	4,520	11.25	3,960
DR-3	Panay B + Panay C ^{/2}	11.99	4,520	11.14	3,870
DR-4	Panay B + Panay C ^{/2} + Badbaran + Mambusao B	11.99	4,520	10.64	3,520

Notes: The above represents flow conditions in confined channel (after river improvement) for both cases.

/1 Independent scheme.

/2 Scheme with Panay B dam in upper reach.

**Table IV.10-1 Proposed Long-term Flood Control Plan
(LP-Structural Measures) - Evaluation
by River Stretch/Dam**

River Stretch/ Dam	Construc- tion	Annual Benefit (P x 10 ⁶)	Present Worth ^{/1} (P x 10 ⁶)		Net Benefit (B - C)	Remarks
			Cost (P x 10 ⁶)	Benefit (B)		
<u>Panay River</u>						
Stretch P1		1,188	28.0	550	256	-294
" P2		201	3.3	93	33	-60
" P3		455	0.7	210	8	-202
" P4		38	-	18	0	-18 *
" P5		306	4.9	141	46	-95
" P6		62	4.3	28	49	21
" P7		262	0.3	121	3	-118 *
" P8		186	15.2	86	168	82
" P9		134	1.5	62	14	-48
" P10		-	-	-	-	-
<u>Maayon River</u>						
Stretch Y1		19	-	9	0	-9 *
" Y2		202	4.6	94	52	-42
" Y3		-	-	-	-	-
" Y4		192	2.6	89	25	-64
<u>Mambusao River</u>						
Stretch M1		111	0.6	52	5	-47
" M2		407	4.1	188	43	-145
" M3		452	8.6	209	97	-112
" M4		-	-	-	-	-
" M5		-	-	-	-	-
" M6		-	-	-	-	-
" M7		120	6.2	56	59	3
<u>Badbaran River</u>						
Stretch B1		-	-	-	-	-
" B2		-	-	-	-	-
<u>Dams</u>						
Panay B dam		471	56.0	346	499	153
Total		4,766		2,352	1,357	-995 EIRR = 4.5%

Notes: /1 Discount rate: 8% p.a. * Partial improvement of low water channel only
 /2 Incl. hydropower benefit. - No improvement

Table IV.10-2 Breakdown of Construction Cost of LP

Item	Unit	Quantity	Unit Cost (P)	Cost (Px10 ⁶)
1. Channel Improvement Works				
Main Civil Works				
Preparatory Work ¹⁾				218.34
Excavation (Dredger)	cu.m	871,000	47.7	41.55
Excavation (Common)	cu.m	32,766,000	44.3	1,451.54
Embankment	cu.m	9,250,000	15.3	141.53
Revetment (Low water)	sq.m	880,100	600	528.06
Gabion	m	43,100	300	12.93
Slope Foundation	m	43,100	3,000	129.30
Foot Protection	m	29,700	400	11.88
Groin	m	41,300	1,200	49.56
Revetment (High water)	sq.m	416,800	600	250.08
Sod Facing	sq.m	1,023,100	56	57.29
Sluice Gate (1 Gate)	nos.	33	1,620,000	53.46
Sluice Gate (2 Gate)	nos.	3	2,070,000	6.21
Drainage Gate	nos.	2	12,200,000	24.40
Road and Railway (6.5 km)	L.S.			16.85
Bridge (12 nos.)	L.S.			200.63
Fixed Weir (1 no.)	L.S.			31.70
Movable (1 no.)	L.S.			112.20
Sub-total				3,119.17
Miscellaneous ²⁾				116.88
Total				3,504.39
2. Compensation				
Farm Land	sq.m	14,144,000	3.3	46.68
Fishpond Land	sq.m	1,742,000	7	12.19
Residential Land	sq.m	320,000	130	41.60
Residential Building	nos.	732	20,400	14.93
Non-residential Building	nos.	143	204,300	29.21
Sub-total				144.62
3. Engineering and Administration³⁾				
				291.92
4. Contingency⁴⁾				
				394.09
Grand Total				4,335.02

Notes: 1) 7% of main civil works excluding preparatory works and miscellaneous.

2) 5% of main civil works excluding miscellaneous.

3) 8% of (1 + 2)

4) 10% of (1 + 2 + 3)

Table IV.10-3 Comparison of Mid-term Plan (MP)
Alternatives

Alternative	Const. Cost (10 ⁶ P)	Present Worth ^{/1} (10 ⁶ P)			B/C	EIRR (%)
		Cost (C)	Benefit ^{/2} (B)	B-C		
MP-1	2,826	1,702	1,063	-639	0.6	5.8
MP-2	3,200	1,671	1,308	-363	0.8	6.7
MP-3	4,344	1,905	1,483	-422	0.8	6.6

Note: /1 At discount rate of 8% p.a.

/2 Incl. hydropower benefit

<u>Alternative</u>	<u>Proposed Facility</u>	<u>Protection Area (Ref. Section 4.2.3)</u>
MP-1	River improv. (incl. Floodway PW-5)	Alternative-3
MP-2	River improv. + Panay B dam	Alternative-3
MP-3	River improv. + Panay B dam + Panay C dam	Alternative-3

Table IV.10-4 Evaluation of Mid-term Flood Control Plan (MP)- Polder not Considered

River Stretch/ Dam	Construc- tion	Present Value ^{/1} (Ex10 ⁶)			Popula- tion Protected (1,000)	Remarks	
		Cost (C)	Benefit (B)	Net Benefit (B-C)			
<u>Panay River</u>							
Stretch P1		836.0	395	352	-43	40.8	
" P2		163.2	77	39	-38	6.5	
" P3		375.4	183	10	-173	-	*
" P4		30.6	15	0	-15	-	*
" P5		261.4	124	58	-66	7.9	
" P6		54.4	26	61	35	3.7	
" P7		245.5	119	6	-113	-	*
" P8		163.1	77	217	140	6.0	
" P9		-	-	-	-	-	
" P10		-	-	-	-	-	
<u>Maayon River</u>							
Stretch Y1		-	-	-	-	-	
" Y2		-	-	-	-	-	
" Y3		-	-	-	-	-	
" Y4		-	-	-	-	-	
<u>Mambusao River</u>							
Stretch M1		67.3	32	6	-26	0.8	
" M2		271.8	131	48	-83	4.7	
" M3		302.0	145	113	-32	4.5	
" M4		-	-	-	-	-	
" M5		-	-	-	-	-	
" M6		-	-	-	-	-	
" M7		-	-	-	-	-	
<u>Badbaran River</u>							
Stretch B1		-	-	-	-	-	
" B2		-	-	-	-	-	
<u>Dams</u>							
Panay B dam ^{/2}		471.2	346	476	130	-	
Total		3,241.9	1,670	1,386	-284	75.9 (63%)	EIRR = 6.7%

Notes: /1 Discount rate: 8% p.a.

/2 Incl. hydropower benefit.

* Partial improvement of low water channel only.

- No improvement.

Table IV.10-5 Evaluation of Mid-term Flood Control Plan (MP)
- Polder Considered

River Stretch/ Dam	Construc- tion Cost (P x 10 ⁶)	Present Value/ ¹ (P x 10 ⁶)			Popula- tion Protected (1,000)	Remarks
		Cost (C)	Benefit (B)	Net Benefit (B - C)		
<u>River Improvement</u>						
<u>Panay River</u>						
Stretch P1	836.0	395	352	-43	40.8	
" P2	163.2	77	39	-38	6.5	
" P3	375.4	183	10	-173	-	*
" P4	30.6	15	0	-15	-	*
" P5	261.4	124	58	-66	7.9	
" P6	54.4	26	0	-26	1.2	
" P7	245.5	119	3	-116	-	*
" P8	163.1	77	75	-2	5.2	
<u>Mambusao River</u>						
Stretch M1	67.3	32	6	-26	0.8	
" M2	271.8	131	13	-118	3.2	
" M3	302.0	145	37	-108	2.3	
<u>Polder Plan</u> ²						
Dao	55	56	102	46	2.5	Stretch P6
Cuartero	57	59	236	177	0.8	" P8
Sigma	42	43	61	18	1.5	" M2
Mambusao	78	80	130	50	3.2	" M3
<u>Dam</u>						
Panay B dam ³	471.2	346	476	130	-	
Total	3,473.9	1,908	1,598	-310	75.9 (63%)	EIRR = 7.0%

Notes: ¹ Discount rate: 8% p.a.

² Plans to be selected in Short-term Plan (See Subsection 5.4-4).

³ Incl. hydropower benefit.

* Partial improvement of low water channel only.

Table IV.10-6 Breakdown of Construction Cost of MP

Item	Unit	Quantity	Unit Cost (P)	Cost (Px10 ⁶)
1. Channel Improvement Works				
Main Civil Works				
Preparatory Work ¹⁾				138.54
Excavation (Dredger)	cu.m	513,000	47.7	24.47
Excavation (Common)	cu.m	21,454,000	44.3	950.42
Embankment	cu.m	3,518,000	15.3	53.83
Revetment (Low water)	sq.m	556,100	600	333.66
Gabion	m	26,900	300	8.07
Slope Foundation	m	28,700	3,000	86.10
Foot Protection	m	12,500	400	5.00
Groin	m	26,900	1,200	32.28
Revetment (High water)	sq.m	170,900	600	102.54
Sod Facing	sq.m	583,100	56	32.65
Sluice Gate (1 Gate)	nos.	24	1,620,000	38.88
Sluice Gate (2 Gate)	nos.	2	2,070,000	4.14
Drainage Gate	nos.	1	12,200,000	12.20
Road and Railway (4 km)	L.S.			13.55
Bridge (8 nos.)	L.S.			149.32
Fixed Weir (1 no.)	L.S.			19.81
Movable (1 no.)	L.S.			112.20
Sub-total				2,117.66
Miscellaneous ²⁾				105.88
Total				2,223.54
2. Compensation				
Farm Land	sq.m	9,316,000	3.3	30.74
Fishpond Land	sq.m	925,000	7	6.48
Residential Land	sq.m	284,000	130	36.92
Residential Building	nos.	652	20,400	13.30
Non-residential Building	nos.	104	204,300	21.25
Sub-total				108.69
3. Engineering and Administration³⁾				
				186.58
4. Contingency⁴⁾				
				251.88
Grand Total				2,770.70

Notes: 1) 7% of main civil works excluding preparatory works and miscellaneous.

2) 5% of main civil works excluding miscellaneous.

3) 8% of (1 + 2)

4) 10% of (1 + 2 + 3)

Table IV.10-7 Phasing of Piece-mill Works Proposed for Mid-term Implementation

Work	Net Present Value (10 ⁶ Peso)			
	(Year of Completion)			
	2000	2005	2010	2015
<u>River Improvement</u>				
Stretches P1 + P2 ^{/1}	-53	-6	+18	+27
Stretches P3 to P5 ^{/2}	-214	-140	-96	-62
Stretches P6 to P8 ^{/3}	-121	-77	-48	-30
Stretches M1 to M3 ^{/4}	-213	-140	-92	-60
<u>Polder Plan^{/5}</u>				
Dumalag	-20	-12	-8	-5
Tapaz	-33	-22	-15	-10
Maayon	+5	+8	+8	+8
Jamindan	+5	+9	+11	+11
Dumarao	-19	-9	-3	+0

Notes: + Project to be viable at this implementation phasing

^{/1} Downstream from Panitan

^{/2} Panitan - Mambusao confluence

^{/3} Mambusao confluence - Badbaran confluence

^{/4} Mambusao river downstream stretches

^{/5} Polder plans at other towns were not examined, since they are to be included in short-term implementation programs (See Subsection 5.4.4 hereinafter).

Table IV.10-8 Economic Evaluation of Polder Plans

Location	Construction Cost (P x 10 ⁶)	Present worths of; $\frac{1}{1}$ (P x 10 ⁶)			B/C	EIRR (%)
		Cost (C)	Benefit (B)	Net Benefit (B - C)		
<u>Panay River</u>						
Pontevedra	64	66	220	154	3.4	21.4
Panay	28	28	8	-20	0.3	1.6
Panitan	49	51	51	0	1.0	8.0
Dao*	55	56	102	46	1.8	12.7
Cuartero*	57	59	236	177	4.0	25.7
Dumalag	37	38	7	-31	0.2	-
Tapaz	48	50	1	-49	0.0	-
<u>Maayon River</u>						
Maayon	49	50	47	-3	0.9	7.5
<u>Mambusao River</u>						
Sigma*	42	43	61	18	1.4	10.5
Mambusao*	78	80	130	50	1.6	11.6
Jamindan	39	40	36	-4	0.9	7.4
<u>Badbaran River</u>						
Dumarao	58	60	24	-36	0.4	3.1

Notes: * Plans finally selected for inclusion in SP.

- No EIRR value.

Table IV.10-9 Evaluation of Short-term Flood Control Plan SP-1
(Excluding Areas to be separately protected by Polders)

River Stretch/ Dam	Construc- tion Cost (P x 10 ⁶)	Present Value ^{/1} (P x 10 ⁶)			B/C	EIRR (%)
		Cost (C)	Benefit (B)	Net Benefit (B - C)		
<u>SP-1 A : Protection of 4 stretches</u>						
Stretch P1	458	266	385	119	1.4	10.3
" P2	131	78	28	-50	0.4	3.8
" P3	304	187	10	-177	-	-
" P4	22	13	0	-13	-	-
" P5	201	119	58	-61	0.5	4.8
Total	1,116	663	481	-182	0.7	6.4
<u>SP-1 B : Protection of 2 stretches</u>						
Stretch P1	458	220	337	117	1.5	10.6
" P2 ^{/2}	131	65	25	-40	0.4	4.1
Total	589	285	362	77	1.3	9.4
<u>SP-1 C : 25-year Flood Protection (for comparison)</u>						
Stretch P1	836	411	363	-48	0.9	7.4
" P2 ^{/2}	163	81	40	-41	0.5	5.0
Total	999	492	403	-89	0.8	7.0

Note: ^{/1} Discount rate: 8% p.a.

^{/2} To be improved as an integral part of P1.

Table IV.10-10 Evaluation of Short-term Flood Control Plan SP-2
 (Excluding Areas to be separately protected by Polders)

River Stretch/ Dam	Construc- tion Cost (P x 10 ⁶)	Present Value ^{/1} (P x 10 ⁶)			B/C	EIRR (%)
		Cost (C)	Benefit (B)	Net Benefit (C - B)		
<u>SP-2 A : Protection of 4 stretches</u>						
Stretch P1	180	82	78	-4	1.0	7.7
" P2	46	22	2	-20	0.1	<u>/2</u>
" P3	114	60	7	-53	0.1	-
" P4	9	5	1	-4	0.2	-
" P5	64	30	28	0	1.0	7.6
Total	413	199	116	-81	0.6	4.9
<u>SP-2 B : Protection of 2 stretches</u>						
Stretch P1	180	82	78	-4	1.0	7.7
" P2	46	22	2	-20	0.1	-
Total	226	104	78	-26	0.8	6.3

Note: /1 Discount rate: 8% p.a.

/2 - indicates no EIRR.

Table IV.10-11 Breakdown of Costruction Cost of SP

Item	Unit	Quantity	Unit Cost (P)	Cost (Px10 ⁶)
1. Channel Improvement Works				
Main Civil Works				
Preparatory Work ¹⁾				28.92
Excavation (Dredger)	cu.m	336,000	47.7	16.02
Excavation (Common)	cu.m	3,078,000	44.3	136.37
Embankment	cu.m	571,000	15.3	8.74
Revetment (Low water)	sq.m	28,600	600	17.16
Gabion	m	4,400	300	1.32
Slope Foundation	m	3,100	3,000	9.30
Foot Protection	m	700	400	0.26
Groin	m	4,400	1,200	5.28
Revetment (High water)	sq.m	29,600	600	17.76
Sod Facing	sq.m	181,100	56	10.14
Sluice Gate (1 Gate)	nos.	8	1,620,000	12.96
Sluice Gate (2 Gate)	nos.	0	2,070,000	0.00
Drainage Gate	nos.	1	12,200,000	12.20
Road and Rainway (2.8 km)	L.S.			9.83
Bridge (2 nos.)	L.S.			35.65
Fixed Weir (1 no.)	L.S.			7.93
Movable (1 no.)	L.S.			112.20
Sub-total				442.03
Miscellaneous ²⁾				22.10
Total				464.13
2. Compensation				
Farm Land	sq.m	2,000,000	3.3	6.60
Fishpond Land	sq.m	381,000	7	2.67
Residential Land	sq.m	128,000	130	16.64
Residential Building	nos.	132	20,400	2.69
Non-residential Building	nos.	14	204,300	2.86
Sub-total				31.46
3. Engineering and Administration³⁾				
				39.65
4. Contingency⁴⁾				
				53.52
Grand Total				588.80

Notes: 1) 7% of main civil works excluding preparatory works and miscellaneous.

2) 5% of main civil works excluding miscellaneous.

3) 8% of (1 + 2)

4) 10% of (1 + 2 + 3)

Table IV.10-12 Cost-Benefit Comparison of Ad-hoc Improvement Works

Item	Proposed Work	
	Lowering of Existing Mambusao Weir	Enlargement of Channel at Cuartero & Dao
Estimated Construction Cost (P x 10 ⁶)	19.4	44.6
Present Worth (P x 10 ⁶)		
- Cost	10.1	23.3
- Benefit	5.8	19.5
- Net benefit	-4.3	-3.8
Benefit-Cost Ratio (B/C)	0.6	0.8
EIRR (%)	3.9	6.5

Note: Discount rate: 8% p.a.

Table IV.10-13 Comparison of Development Plans
in Panitan - Panay - Pontevedra Areas

Proposed Project	Protection Level (Year)	Construction Cost (P x 10 ⁶)	NPV ^{/1} (P x 10 ⁶)	EIRR (%)	Population Protected (1,000)
<u>Case-A:</u>					
- River improvement SP-1B	10	589	77	9.4	47.3
- Panitan - Panay Irrigation	-	183	88	11.7	-
Total			165	10.1	47.3
<u>Case-B:</u>					
- Polder at Pontevedra	100	64	154	21.4	3.0
- Residual damage due to absence of flood protection works ^{/2}	-	-	-207	8.0	2.4
Total			-53		5.4
<u>Case-C:</u>					
- Residual damages due to absence of flood protection works ^{/2}	-	-	-362	-	0

Notes: Case-A : Whole area will be protected by river improvement work.

Case-B : Only Pontevedra and Panitan towns will be protected by polder dyking, leaving other areas unprotected.

Case-C : No protection by structural measures.

^{/1} : Present worth of net benefit, discounted at 8% p.a.

^{/2} : Corresponds to flood damage reduction attainable by "10-year flood" protection work.

Table IV.10-14 Proposed Short-term Plans - Structural Measures

Type and Location of Work	Construction Cost (P x 10 ⁶)	Net/ ¹ Benefit (P x 10 ⁶)	EIRR (%)	Population Protected (1,000)
River Improvement:				
- Stretches P1 & P2 (SP-1 B plan)	589	77	9.4	47.3
Multipurpose Dam:				
- Panay B dam	471	130	11.0	-
Polder:				
- Dao	55	46	12.7	2.5
- Cuartero	57	177	25.7	0.8
- Sigma	42	18	10.5	1.5
- Mambusao	78	50	11.6	3.2
Total	1,292	498	11.5	55.3 (47%)

Notes: ¹ Discount rate used: 8% p.a.

Table IV.11-1-Non-structural Measure Alternatives

Measure	Appropriateness Applications	Application to Panay River Basin
<p><u>Modify damage susceptibility</u> Flood plain management</p>	<p>Where uses other than agricultural are competing, especially where they involve urban and industrial uses.</p>	<p>This measure is applicable to all areas of the basin, though agricultural land use is prominent.</p>
<p>Structural change</p>	<p>Where building/property damage is remarkable with frequent inundation, especially where the depth of flooding is not large.</p>	<p>This measure is applicable to the Panay river basin, in areas, however, where flooding depth is less than 1 m.</p>
<p>Flood proofing</p>	<p>Where buildings are scattered and frequently flooded, especially where flooding depth is less than 1 m, 3-hr advanced warning is possible.</p>	<p>Such measures as closure of openings and waterproofing interior would be impractical in view of type of local buildings. This plan was, therefore, not examined in this study.</p>
<p>Subsidised relocation</p>	<p>Essentially, this is a part of measures included in flood plain management. This measure is appropriate in areas where building/property's damages are severe with exposure to risk of human life's loss.</p>	<p>This measure is worthy of evaluation for all areas in the basin.</p>
<p>Disaster relief</p>	<p>Eisewhere.</p>	<p>This measure is presently undertaken. Excessive adoption of this measure tends to remove the incentive to avoid future flood losses, and, therefore, this measure would not be an ultimate measure for the basin. No detailed evaluation was attempted in this study.</p>
<p><u>Modify the loss burden</u> Tax write-offs</p>	<p>Eisewhere, if approved by the government.</p>	<p>As in the case of disaster relief, this measure provides little incentive to reduce flood losses. Moreover, this is not supported by present legislation. Therefore no further study was attempted.</p>
<p>Flood insurance</p>	<p>Eisewhere, if insurance system is available.</p>	<p>This type of insurance system is presently not available, and, therefore, not applicable to the basin. Moreover, this measure cannot be studied at a river basin study level, but to be left to a specific nation level study.</p>
<p>Flood forecasting and warning system</p>	<p>Eisewhere, and especially where flood-to-peak interval is longer than 1 day.</p>	<p>Applicable. This system is prerequisite as a supporting measure to any type of structural methods or other non-structural methods.</p>
<p><u>Modify the flood</u> Watershed management</p>	<p>Where enough runoff remains in low-water period, even if this program is undertaken.</p>	<p>No detailed study was attempted in view of lack of data. While, forestation in the watershed area is worthy of encouragement not only for flood control purpose but also other development purposes.</p>

Note: * Specific program as a part of "flood plain management" in a broad meaning.

Table IV.11-2 Unit Cost of Non-structural Measures

(Unit: $\text{Px}10^3$)

Work Item	Estimated Cost
1. <u>Flood Plain Management</u>	
1) <u>Management office expenditures</u> (per 100 km ² of flood area)	
- Personnel cost (per year)	
Project Manager	1 persons x 50 = 50
Engineer	3 " x 40 = 120
Overseer	6 " x 30 = 180
Assistants incl. clerks	6 " x 20 = 120
Others	6 " x 20 = 120
Sub-total	22 persons 590
- Operating expenditures per year (100% of personnel cost)	590
Total cost per year	1,180
2) <u>Initial Cost</u>	
- Initial costs for building, equipment, vehicles, etc. for management office (per 100 km ²)	3,500
- Flood area mapping (per km ²)	50
2. <u>Structural Change of Buildings</u> (per no.)	
- Residential	10
- Non-residential	60
3. <u>Relocation of Housings</u> (per no.)	
1) <u>Resettlement</u>	
- Residential	40
- Non-residential	200
- Public facilities	50% of above
2) <u>Procurement of land</u> (per no.)	
- Residential (300 m ² /no.)	8
- Non-residential (0.1 ha/no.)	25
- Public facilities	100% of above

Table IV.11-3 Evaluation of Non-structural Measures

(Unit: ₱ x 10⁶)

River Stretch/ Major Town	NS-1: Flood Plain Management		NS-2: Structural Change		NS-3: Relocation of Housing		Pro- posed Plan	
	Cost ^{/1}	NPV	Cost	NPV	Cost	NPV		
River Stretch								
Panay	P1	8.9	+5.7 ^{/3}	94.1	-31.9	677	-217	(NS-1)
	P2	0.8	+1.3	16.4	-8.7	115	-42	(NS-1)
	P3	1.0	-0.4	7.2	-3.0	54	-18	NS-1
	P4	0.1	-0.1	0.3	-0.1	3	-7	"
	P5	2.4	-0.5	13.4	-5.1	101	-30	"
	P6	0.1	-0.1	2.4	-1.6	18	-11	"
	P7	1.1	-1.7	2.1	-0.5	14	-2	"
	P8	1.5	+1.9	10.1	-2.0	74	-11	"
	P9	1.1	-0.9	10.5	-11.9	71	-65	"
	P10	1.5	-1.7	10.4	-8.9	74	-47	"
Maayon	Y1	0.1	+0.04	0.2	+0.03	2	+0.08	NS-3
	Y2	1.0	+2.4	10.5	-2.2	72	-7	NS-1
	Y3	0.3	-0.2	1.2	-0.3	10	-3	"
	Y4	1.0	-0.1	4.5	-0.9	34	-8	"
Mambusao	M1	0.6	-0.8	1.3	-0.4	10	-1	"
	M2	0.5	+0.1	5.8	-3.0	43	-17	"
	M3	0.8	+1.0	2.9	+1.8	21	+11	NS-3
	M4	0.4	+0.1	4.3	-1.8	30	-10	NS-1
	M5	0.9	+1.3	5.0	-2.1	36	-11	"
	M6	0.5	+1.0	11.0	-5.7	75	-14	"
	M7	2.7	-0.8	19.2	-17.3	222	-54	"
Badbaran	B1	0.2	-0.2	1.4	-0.7	10	-5	"
	B2	0.9	-1.2	3.6	-1.7	27	-48	"
Total		28.7	+6.2	232.6	-108.0	1,793	-617	
Major Town^{/2}								
Dao		0.1	+4.4 ^{/4}	10.8	-3.3	70	-2	
Cuartero		0.1	+10.6	7.9	+10.5	48	+65 ^{/4}	
Sigma		0.1	+2.7 ^{/4}	7.5	-2.7	48	-5	
Mambusao		0.1	+5.7 ^{/4}	13.0	-3.5	85	-0.1	
Total		0.4	+23.4	39.2	+1.0	251	-57.9	

- Notes: NPV Net present value of benefit, discounted at 8% p.a.
- ^{/1} Initial cost only.
- ^{/2} Selected towns where polder is conceived in Short-term Plan.
- ^{/3} Subject to further evaluation in Section 14 .
- ^{/4} Net benefit is less than that accrued by polder plan (See Table IV.10-3). Therefore polder plan is proposed.

Table IV.12-1 Principal Features of Flood Forecasting Facilities

(1) Supervisory/Control Station: 1 No.

- Graphic display panel
- Tabulating typewriter
- Operating console
- Calling terminal equipment
- Antenna
- Computer
- Generator
- Others

(2) Repeater Station: 2 - 4 Nos.

- Repeater
- Antenna
- Battery pack
- Charger
- Others

(3) Rainfall Measuring Station: 5 Nos.

- Raingage (Tipping bucket type)
- Recorder (Long-term)
- Battery pack (Alkaline)
- Antenna
- Telemetry equipment
- Solar battery
- Solar battery distribution board
- Others

(4) Water Level Measuring Station: 5 Nos.

- Water level meter with recorder (Long-term)
- Antenna
- Telemetry equipment
- Battery pack (Alkaline)
- Charger
- Others

(5) Warning Post: 10 Nos.

- Antenna
- Speaker
- Battery pack
- Charger
- Radio-communication equipment
- Others

(6) Warning Car: 4 Nos.

Note; The numbers of each station are roughly estimated. The civil and structural works are not included in the above list. The criteria of each equipment is to be decided in the further study.

Table IV.12-2 Installation Cost of Flood Forecasting System

Item	Foreign Currency Portion (¥ x 10 ³)	Local Currency Portion (₹ x 10 ³)
I. CIVIL WORK		
1. Station Houses	50,000	1,000
2. Tower/Telepoles	30,000	2,000
3. Installation	75,000	5,000
Sub-total	<u>155,000</u>	<u>8,000</u>
II. TELECOMMUNICATION WORK		
1. Equipment and Materials	400,000	-
2. Installation/Adjustment & Testing	125,000	4,000
3. On-the-job Training/ Factory Training	40,000	500
4. Operation and Maintenance Services	35,000	400
Sub-total	<u>600,000</u>	<u>4,900</u>
III. CONTINGENCY	<u>145,000</u>	<u>2,100</u>
IV. TOTAL	<u>900,000</u>	<u>15,000</u>
	(≒ US\$3,830,000)	(≒ US\$830,000)

Table IV.12-3 Economic Evaluation of Flood Forecasting and Warning System

Item	Amount/Indices
Capital Cost (P x 10 ⁶) :	84
O & M Cost ^{/1} (P x 10 ⁶ /yr) :	4.2
Annual Damage Reduction (P x 10 ⁶) :	2.3
Present Worth (P x 10 ⁶) ^{/2}	
- Cost (C) :	83
- Benefit (B) :	43
B - C :	-40
B/C :	0.5
EIRR (%) :	4.7

Notes: /1 5% of capital cost per year.

/2 Discount rate: 8% p.a.

Table IV.13-1 Summary of Flood Control Projects for Long-, Mid-, and Short-term Plans (1)

Location of Work	Q'ty	Long-term Plan (LP)	Mid-term Plan (MP)	Short-term Plan (SP)
Design Flood				
River Improvement				
Panay River:				
(1) Pontevedra river (P1)	6.1 km	Partial improvement of existing channel between Cogon floodway inlet and Hamulaon bifurcation	- do left -	- do left -
(2) Cogon floodway	9.5 km	Construction of a bypass floodway (Q = 3,900 m ³ /sec)	- do left (Q = 2,200 m ³ /sec) -	- do left (Q = 1,000 m ³ /sec) -
(3) Cogon floodway inlet - Panikan (P1 and P2)	6.5 km	Improvement with levees	- do left -	- do left -
(4) Panican - Maayon confluence (P3)	10.2 km	Improvement of existing channel with a levee for partial protection of right bank area	(No improvement)	(No improvement)
(5) Maayon confluence - Mambusao confluence (P4 and P5)	2.2 km	Partial improvement of existing channel, only at bottleneck sections (P4)	(No improvement)	(No improvement)
(6) Mambusao confluence - Badbaran confluence (P6, P7 and P8)	7.0 km	Improvement with levees (P5)	(No improvement)	(No improvement)
	7.2 km	Improvement with levees (P6 and P8)	(No improvement)	(No improvement)
	8.8 km	Improvement of existing channel with a levee for protection of partial area on left bank	(No improvement)	(No improvement)
(7) Badbaran confluence - Dumalag (P9)	8.6 km	Improvement with levees	(No improvement)	(No improvement)
Maayon River:				
(1) Downstream of Ilas confluence (Y1)	1.8 km	Partial improvement of existing channel, only at bottleneck sections	(No improvement)	(No improvement)
(2) Along Maayon and Ilas river (Y2 and Y4)	18.4 km	Construction of back levees, with improvement of existing channels	(No improvement)	(No improvement)

Table IV.13-1 Summary of Flood Control Projects for Long-, Mid-, and Short-term Plans (2)

Location Work	Q'ty	Long-term Plan (LP)	Mid-term Plan (MP)	Short-term Plan (SP)
<u>Mambusao River:</u>				
(1) Downstream of Mambusao (M1, M2 and M3)	21.2 km	Improvement of existing channel with low levees. Construction of a bypass channel on right bank at Mambusao town.	(No improvement)	(No improvement)
(2) Balacuan river (M7)	8.6 km	Construction of a drainage sluice at Balacuan river mouth, with partial improvement of existing channel, only at bottleneck sections.	(No improvement)	(No improvement)
<u>Polder Plan</u>				
(1) Dao town (P6)	1.17 km ²	(Not applicable. To be protected by river improvement work.)	Construction of polder dyke (100-year flood protection)	Construction of polder dyke (100-year flood protection)
(2) Cuartero town (P8)	0.49 km ²	- do above -	- do above -	- do above -
(3) Sigma town (M2)	0.47 km ²	- do above -	- do above -	- do above -
(4) Mambusao town (M3)	1.03 km ²	- do above -	- do above -	- do above -
(5) Maayon town	0.64 km ²	- do above -	Construction of polder dyke as piece-meal work	(No work)
(6) Jamindán town	0.34 km ²	- do above -	- do above -	(No work)
(7) Dumarao town	0.48 km ²	- do above -	- do above -	(No work)
<u>Multipurpose Dam</u>				
Panay B dam		Construction of a flood control dam, with installation of hydropower facilities.	- do left -	- do left -
<u>Non-structural Measures</u>				
(1) Flood plain management	338 km ²	Application to areas where protection by structural measures is not scheduled	- do left -	Applicable to all areas including P1 and P2 areas (338 km ²)
(2) Relocation of housings	11 km ²	(Not planned)	(Not planned)	To be applied to subdivision areas Y1 and M3 (but excluding Mambusao town), subject to further review in detailed survey.
<u>Flood Forecasting and Warning System</u>				
		To be installed.	To be installed.	To be installed.

Table IV.14-1 General Features of Proposed Projects

Flood Control Project

1. River Improvement - 1st Stage

- a) Design flood : 10-year flood
- b) Improvement section
 - Cogon bypass floodway : 9.5 km
 - Partial improvement of Pontevedra river (Pl partial) : 6.1 km
 - Improvement of Panay lower reach : 6.5 km
(Panitan - Congon floodway inlet)
 - Total : 22.1 km
- c) Major works
 - Excavation : 3,410,000m³
 - Embankment : 570,000m³
 - Revetment works : 58,000m²
 - Groin : 4,400m
 - Drainage sluices/gates : 9 nos.
 - Sluiceway structure at inlet of Pontevedra river : 1 no.
 - Fixed weir at inlet of Cogon floodway : 1 no.
 - Road and railway relocation : 2.8 km
 - Bridge : 2 nos.
- d) Construction cost (1984 base price): P589 x 10⁶

2. River Improvement - 2nd Stage

- a) Design flood : 25-year flood
- b) Improvement section
 - Enlargement of previously improved section (Cogon floodway - Panitan) : 16.0 km

c) Major works

- Excavation	:	4,708,000 m ³
- Embankment	:	743,000 m ³
- Revetment works	:	81,100 m ²
- Groin	:	0 m
- Drainage sluices/gates	:	0 no.
- Road and railway relocation	:	0 km
- Bridge	:	2 nos.

d) Construction cost (1984 base price): Peso 440 x 10⁶

3. River Improvement - 3rd Stage

a) Design flood : 100-year flood

b) Improvement section

- Enlargement of previously improved sections (Cogon floodway - Panitan)	:	16.0 km
- Improvement of Panay Middle reach (Panitan - Badbalan confluence)	:	35.4 km
. Improvement with levees (P5, P6 & P8)	:	(14.2 km)
. Partial improvement with Levee on one bank (P3 & P7)	:	(19.0 km)
. Partial improvement of low water channel (P4)	:	(2.2 km)
- Improvement of Mambusao lower reaches (M1, M2 & M3)	:	21.2 km
- Improvement of Panay upper reach (P9)	:	8.6 km
- Improvement of Maayon river	:	20.2 km
. Improvement with levees (Y2 & Y4)	:	(18.4 km)
. Partial improvement of low water channel (Y1)	:	(1.8 km)
- Construction of a sluice gate structure at Balacuan river mouth, with partial improvement of existing Balacuan river channel	:	8.0 km

Total : 109.4 km

c) Major works

- Excavation	:	25,515,000 m ³
- Embankment	:	7,936,000 m ³
- Revetment works	:	1,157,600 m ²
- Groin	:	36,900 m
- Drainage sluices/gates	:	28 nos.
- Sluice gate structure at Balacuan: river mouth	:	1 no.
- Road and railway relocation	:	3.8 km

d) Construction cost (1984 base price): P3,486 x 10⁶

4. Polder Plan - First Stage Project

<u>Location</u>	<u>Protection Area</u>	<u>Length of Dyke</u>	<u>Construction Cost</u>
- Dao	1.17 km ²	3.0 km	P54.7 x 10 ⁶
- Cuartero	0.49 km ²	2.0 km	P56.7 x 10 ⁶
- Sigma	0.47 km ²	2.8 km	P41.8 x 10 ⁶
- Mambusao	1.03 km ²	4.9 km	P77.6 x 10 ⁶

5. Polder Plan - 2nd Stage Project

<u>Location</u>	<u>Protection Area</u>	<u>Length of Dyke</u>	<u>Construction Cost</u>
- Maayon	0.64 km ²	2.5 km	P49.3 x 10 ⁶
- Jamindan	0.34 km ²	2.3 km	P38.7 x 10 ⁶
- Dumarao	0.48 km ²	2.3 km	P58.4 x 10 ⁶

Multipurpose Dam Project

Panay B Dam:

a) Hydrology

- Catchment area	:	239 km ²
- Average runoff	:	14.3 m ³ /sec
- Flood discharges	:	

<u>Return Period</u>	<u>Inflow</u>	<u>Outflow</u>
100-year	2,420 m ³ /sec	1,210 m ³ /sec
25-year	1,250 m ³ /sec	625 m ³ /sec

b) Reservoir

- Gross storage : $96.0 \times 10^6 \text{ m}^3$
- Effective storage : $64.3 \times 10^6 \text{ m}^3$
 - Flood control : $(33.8 \times 10^6 \text{ m}^3)$
 - Hydropower : $(30.5 \times 10^6 \text{ m}^3)$
- Normal high water level : El. 65.0 m
- Surcharge water level : El. 71.3 m
(100-year flood control)

c) Dam

- Type : Concrete gravity dam
- Crest El. : El. 77.4 m
- Crest length : 160 m
- Dam Height : 52.4 m
- Dam volume : $93 \times 10^3 \text{ m}^3$

d) Generating facilities

- Max. plant discharge : $27.2 \text{ m}^3/\text{sec}$
- Head, max. static : 35.0 m
 - , rated : 31.7 m
- Installed capacity : 7.1 MW
- Annual energy output : 31.4 GWh

e) Power transmission facilities

- Voltage : 69 kV
- Transmission line length : 45 km
- Receiving substation : Panitan substation
(Existing)

f) Construction cost (1988 base price) : $\text{P}471.2 \times 10^6$

Table IV.14-2 Summary of Construction Cost of
River Improvement Works
(1984 Base Price)

(Unit: ₱ x 10⁶)

Work Item	First Stage	Second Stage	Third Stage
1. Construction Works			
(1) Preparatory Works ^{/1}	28.9	20.2	167.5
(2) Excavations	152.4	209.2	1,131.5
(3) Embankment	8.7	11.4	121.4
(4) Revetment and Slope Protection	55.9	61.5	872.1
(5) Groins	5.3	0.0	44.3
(6) Drainage Gates	25.2	0.0	58.9
(7) Diversion Weirs	120.1	0.0	0.0
(8) Road and Bridge Relocations	45.5	6.8	165.3
(9) Miscellaneous Works	22.1	53.5	267.6
Sub-total	<u>464.1</u>	<u>362.5</u>	<u>2,828.6</u>
2. Land Acquisition and Resettlement	<u>31.5</u>	<u>7.7</u>	<u>105.4</u>
3. Engineering and Administration ^{/2}	<u>39.7</u>	<u>29.6</u>	<u>234.7</u>
4. Physical Contingency ^{/3}	<u>53.5</u>	<u>40.0</u>	<u>317.0</u>
Grand Total	<u>588.8</u>	<u>439.8</u>	<u>3,485.7</u>

Notes: ^{/1} 7% of main civil works cost

^{/2} 8% of (1 + 2)

^{/3} 10% of (1 + 2 + 3)

Table IV.14-3 Breakdown of Cost of River Improvement Works for Second Stage

Item	Unit	Quantity	Unit Cost (P)	Cost (Ex10 ⁶)
1. Channel Improvement Works				
Main Civil Works				
Preparatory Work ¹⁾				109.62
Excavation (Dredger)	cu.m	177,000	47.7	8.44
Excavation (Common)	cu.m	18,376,000	44.3	814.07
Embankment	cu.m	2,947,000	15.3	45.09
Revetment (Low water)	sq.m	527,500	600	316.50
Gabion	m	22,500	300	6.75
Slope Foundation	m	25,600	3,000	76.80
Foot Protection	m	11,800	400	4.72
Groin	m	22,500	1,200	27.00
Revetment (High water)	sq.m	141,300	600	84.78
Sod Pacing	sq.m	402,000	56	22.51
Sluice Gate (1 Gate)	nos.	16	1,620,000	25.92
Sluice Gate (2 Gate)	nos.	2	2,070,000	4.14
Drainage Gate	nos.	0	12,200,000	0
Road and Railway (1.2 km)	L.S.			3.72
Bridge (6 nos.)	L.S.			113.67
Fixed Weir (1 no.)	L.S.			11.88
Movable (1 no.)	L.S.			0.00
Sub-total				1,675.62
Miscellaneous				158.09
Total				1,833.71
2. Compensation				
Farm Land	sq.m	7,316,000	3.3	24.14
Fishpond Land	sq.m	544,000	7	3.81
Residential Land	sq.m	156,000	130	20.28
Residential Building	nos.	520	20,400	10.61
Non-residential Building	nos.	90	204,300	18.39
Sub-total				77.23
3. Engineering and Administration ²⁾				
				152.88
4. Contingency ³⁾				
				206.38
Grand Total				2,270.20

Notes: 1) 7% of main civil works excluding preparatory works and miscellaneous.

2) 8% of (1 + 2)

3) 10% of (1 + 2 + 3)

Table IV.14-4 Breakdown of Cost of River Improvement Works for Third Stage

Item	Unit	Quantity	Unit Cost (P)	Cost (Px10 ⁶)
1. Channel Improvement Works				
Main Civil Works				
Preparatory Work ¹⁾				79.80
Excavation (Dredger)	cu.m	358,000	47.7	17.08
Excavation (Common)	cu.m	11,314,000	44.3	501.10
Embankment	cu.m	5,732,000	15.3	87.70
Revetment (Low water)	sq.m	324,000	600	194.40
Gabion	m	16,200	300	4.86
Slope Foundation	m	14,400	3,000	43.20
Foot Protection	m	17,200	400	6.88
Groin	m	14,400	1,200	17.28
Revetment (High water)	sq.m	245,900	600	147.54
Sod Pacing	sq.m	440,000	56	24.64
Sluice Gate (1 Gate)	nos.	9	1,620,000	14.58
Sluice Gate (2 Gate)	nos.	1	2,070,000	2.07
Drainage Gate	nos.	1	12,200,000	12.20
Road and Railway (2.5 km)	L.S.			3.30
Bridge (4 nos.)	L.S.			51.31
Fixed Weir (1 no.)	L.S.			11.89
Movable (0 no.)	L.S.			0.00
Sub-total				1,219.84
Miscellaneous				410.81
Total				1,630.65
2. Compensation				
Farm Land	sq.m	4,828,000	3.3	15.93
Fishpond Land	sq.m	817,000	7	5.72
Residential Land	sq.m	36,000	130	4.68
Residential Building	nos.	80	20,400	1.63
Non-residential Building	nos.	39	204,300	7.97
Sub-total				35.93
3. Engineering and Administration²⁾				
				133.33
4. Contingency³⁾				
				180.00
Grand Total				1,979.90

Notes: 1) 7% of main civil works excluding preparatory works and miscellaneous.

2) 8% of (1 + 2)

3) 10% of (1 + 2 + 3)

Table IV.14-5 Construction Cost of Pandy B Dam

(Unit: ₹x10⁶)

Work Item	Foreign Portion	Local Portion	Total
A. Preparatory Works			
(1) Road construction	0	17.01	17.01
(2) Work shops, offices and etc. ^{1/}	8.86	6.92	15.78
Sub-total of A.	8.86	23.93	32.79
B. Civil Works			
(1) River diversion works	11.56	8.78	20.34
(2) Dam and spillway	88.04	68.89	156.93
(3) Power station	11.12	8.82	19.94
Sub-total of B.	110.72	86.49	197.21
C. Metal Works	29.63	2.96	32.59
D. Electrical Works	87.76	25.61	113.37
E. Land Acquisition and Compensation	0	14.72	14.72
F. Government Administration ^{2/}	0	18.80	18.80
G. Engineering Service ^{3/}	15.04	3.76	18.80
H. Physical Contingency ^{4/}	25.23	17.69	42.92
Grand Total	277.24	193.96	471.20

Note: ^{1/}; (2) = 8% of item B
^{2/}; F = 5% of item (A+B+C+D)
^{3/}; G = 5% of item (A+B+C+D)
^{4/}; H = 10% of item A to G

Table IV.14-6 Construction Cost of Each Polder Plan- 1st Stage Project

Item	Unit	Unit Price (P)	Dao		Sigma		Mambusao		Cuartero	
			Q'ty	Amount (P x 10 ⁶)	Q'ty	Amount (P x 10 ⁶)	Q'ty	Amount (P x 10 ⁶)	Q'ty	Amount (P x 10 ⁶)
1. Construction Works										
Preparatory works ^{1/}				2.92	2.16		4.10			3.07
Dike embankment	m ³	51.8	233,850	12.11	188,000	243,050	12.59	294,000	15.23	
Concrete Revetment	m ²	600.0	18,360	11.02	11,300	34,680	20.81	24,600	14.76	
Sod facing	m ²	50.0	62,280	3.49	63,300	51,840	2.90	56,700	3.18	
Gravel pavement for road	m	750.0	0	0	0	0	0	0	0	0
Asphalt pavement for road	m	3,600.0	0	0	500	1.80	2.88	0	0	0
Drainage facilities in town	ha	54,000.0	27	1.46	11	0.59	39	2.11	21	1.13
Drainage facilities in paddy	ha	18,000.0	90	1.62	36	0.65	64	1.15	28	0.50
Pumping station	L.S			10.00	6.30	13.40		6.90		
Others ^{2/}				1.99	1.47	2.79		2.09		
Total of 1				44.61	33.03	62.73		46.86		
2. Compensation										
Residential buildings	nos.	20,400.0	33	0.67	40	0.82	55	1.12	0	0
Non-residential buildings	nos.	204,300.0	0	0	4	0.82	2	0.41	0	0
Total of 2				0.67	1.64	1.53		0		
3. Government Administration^{3/}										
Government Administration ^{3/}				2.23	1.65	3.14		2.34		
4. Engineering Service^{4/}										
Engineering Service ^{4/}				2.23	1.65	3.14		2.34		
5. Physical Contingency^{5/}										
Physical Contingency ^{5/}				4.97	3.80	7.05		5.15		
Grand Total				54.71	41.77	77.59		56.69		

Notes: 1/; 7% of construction works excluding preparatory works.

2/; 5% of construction works excluding preparatory works and others.

3/; 5% of construction works

4/; 5% of construction works

5/; 10% of (1 + 2 + 3 + 4)

Table IV.14-7 Construction Cost of Ench Forder Plan (2nd Stage)

Item	Unit	Unit Price (P)	Maeyon		Jamindan		Dumarao	
			Q'ty	Amount (P x 10 ⁶)	Q'ty	Amount (P x 10 ⁶)	Q'ty	Amount (P x 10 ⁶)
1. Construction Works								
Preparatory works ^{1/}				2.63		2.05		3.03
Dike embankment	m ³	51.8	227,850	11.80	211,050	10.93	221,950	11.50
Concrete Revetment	m ²	600.0	19,800	11.88	9,720	5.83	24,750	14.85
Sod facing	m ²	56.0	59,340	3.32	61,320	3.43	51,150	2.86
Asphalt pavement for road	m	3,600.0	0	0	0	0	1,100	3.96
Drainage facilities in town	ha	54,000.0	8	0.43	18	0.97	21	1.13
Drainage facilities in paddy	ha	18,000.0	56	1.01	16	0.29	27	0.49
Pumping station	L.S			7.30		6.40		6.50
Others ^{2/}				1.79		1.39		2.06
Total of 1				40.16		31.29		46.38
2. Compensation								
Residential buildings	nos.	20,400.0	30	0.61	35	0.72	50	1.02
Non-residential buildings	nos.	204,300.0	0	0	0	0	5	1.02
Total of 2				0.61		0.72		2.04
3. Government Administration ^{3/}								
Government Administration ^{4/}				2.01		1.57		2.32
Engineering Service ^{4/}				2.01		1.57		2.32
5. Physical Contingency ^{5/}				4.48		3.52		5.31
Grand Total				49.27		38.67		58.37

Notes: ^{1/} 7% of construction works excluding preparatory works.

^{2/} 5% of construction works excluding preparatory works and others.

^{3/} 5% of construction works

^{4/} 5% of construction works

^{5/} 10% of (1 + 2 + 3 + 4)

Table IV.14-8 Results of Sensitivity Analysis

Project	Standard Value	Sensitivity Analysis	
		Cost 20% up	Benefit 20% down
Flood Control Project			
(a) River improvement			
- 1st stage work	9.4	8.3	8.1
- 2nd stage work	9.8	9.1	9.0
- 3rd stage work	15.2	13.8	13.5
(b) Polder			
- 1st stage work			
. Dao	12.7	11.0	10.6
. Cuartero	25.7	21.5	20.7
. Sigma	10.5	9.1	8.8
. Mambusao	11.6	10.0	9.7
- 2nd stage work			
. Maayon	9.3	7.4	7.0
. Jamindan	9.2	7.9	7.7
. Dumarao	8.1	6.4	6.1
(c) Multipurpose dam			
- Panay B dam (1st Stage)	11.2	9.4	9.0
(d) Overall^{/1}			
- 1st stage projects	11.4	9.9	9.5
- 2nd stage projects	9.8	8.7	8.5
Irrigation Development Project			
- Panitan-Panay Project	11.7	9.8	9.4
- Mambusao Project	12.3	10.6	10.2
Roxas City Water Supply Project	16.9	12.4	11.5
(Reference)			
1st stage river impr.			
+ Panitan-Panay irrigation	10.1	8.9	8.7

Note: ^{/1} Incl. non-structural measures and flood forecasting/warning system.

Table IV.15-1 Tentative Plan of Future Land Uses and Developments in Flood Prone Area (1)

	AREA - 1	AREA - 2	AREA - 3
Item	where flood protection work (structural measure) is provided or scheduled to be provided under short-term programs.	where no protection work is proposed or the work will be implemented only in distant future.	Area to be protected for river improvement work in future, i.e. area confined by levees to form a future river channel.
Land Use	<p><u>Policy</u></p> <p>No specific regulation of land uses. However, inhabitants should be informed of remaining flood risks which are not removed by the protection works provided in the area.</p> <p><u>Guideline</u></p> <p><u>Agriculture:</u></p> <ul style="list-style-type: none"> - uses for labour intensive and value-added agricultural productions - uses for value-added aquacultural productions such as fishponds <p><u>Town proper:</u></p> <ul style="list-style-type: none"> - promotion of intensive commercial and industrial uses - positive uses for public facilities such as public buildings, schools, hospitals, etc. - uses for residential buildings - promotion of orderly urbanization development 	<p><u>Policy</u></p> <p>Present land uses can be continued with some intensification within a limit of people's own acceptance of loss burden.</p> <p><u>Guideline</u></p> <p><u>Agriculture:</u></p> <ul style="list-style-type: none"> - uses for labour-saving agricultural productions - change of cropping schedule¹ in heavily damaged areas - no extensive land development (such as new irrigation), unless it is clarified not to receive excessive flood damage - reinforcement of fishpond dykes <p><u>Town proper:</u></p> <ul style="list-style-type: none"> - restrictive expansion of existing towns - encouragement of land uses in high level areas <p><u>Other uses:</u></p> <ul style="list-style-type: none"> - uses of lands for temporarily used facilities such as recreation, sports and fiesta facilities - positive uses for water storage and that they will have flood retaining function - positive provision of evacuation area on highlands 	<p><u>Policy</u></p> <p>In principle, present land uses will be allowed until the lands are protected for river improvement work. People should be informed that the area is defined as essential floodway of design flood.</p> <p><u>Guideline</u></p> <p><u>Agriculture:</u></p> <ul style="list-style-type: none"> - restrictive uses as is used presently - No new reclamation <p><u>Town proper:</u></p> <ul style="list-style-type: none"> - restriction of further expanding uses <p><u>Other uses:</u></p> <ul style="list-style-type: none"> - only open land uses to be allowed - prohibition of excessive land fill/deposits and permanent obstructions

Notes: The above shows preliminary guidelines for future land uses and development activities. Details of the implementation methods. (incl. legislation, planning and enforcing organizations, public information, etc.) should be examined in a separated study.

¹ For example, plantation of Mung beans instead of cropping of the 2nd paddy (See Appendix IV for details).

Table IV.15-1 Tentative Plan of Future Land Uses and Developments in Flood Prone Area (2)

	AREA-1	AREA-2	AREA-3
Item	where flood protection work (structural measure) is provided or scheduled to be provided under short-term programs.	where no protection work is proposed or the work will be implemented only in distant future.	Area to be procured for river improvement work in future, i.e. area confined by levees to form a future river channel.
Building	<p><u>Policy</u></p> <p>No specific restriction of building development.</p> <p><u>Guideline</u></p> <ul style="list-style-type: none"> - encouragement of non-combustible and durable buildings - construction of residential areas according to land use zoning - construction of buildings on land fill or elevated floor buildings in areas where only low-level protection work is provided. 	<p><u>Policy</u></p> <p>No positive enforcement of restriction. However, people should be educated to make them incentive to reduce flood damages on their buildings and properties.</p> <p><u>Guideline</u></p> <ul style="list-style-type: none"> - guidance to people to have their new buildings in flood-free area or on elevated lands, or otherwise to construct elevated floor buildings - relocation of housings in areas which are exposed to danger to life - preparedness for emergency (stock of foodstuffs, rescue boat, etc.) 	<p><u>Policy</u></p> <p>Any new settlement/building development should be discouraged through dissemination of flood risks to people.</p>
Public Facilities/ Government Projects	<p><u>Policy</u></p> <p>No specific constraints in implementing facilities and/or projects. However, the plan and design should take into account the remaining risks of occurrence of larger floods than the design one.</p> <p><u>Guideline</u></p> <ul style="list-style-type: none"> - promotion of irrigation, fishpond and other productive facilities - positive provision of infra-structures for amplification of social capitals 	<p><u>Policy</u></p> <p>Restricted development in this area. All facilities should be built in due consideration of present/future flood conditions in the area.</p> <p><u>Guideline</u></p> <ul style="list-style-type: none"> - no implementation of large scale projects, unless they are proven to be free from flood damage - construction of flood-tive structures (e.g. construction of levees above flood water level with proper drainage facilities) 	<p><u>Policy</u></p> <p>In principle, no new public facilities will be newly added and no government project proposed in this area. Bridges and other river facilities are planned in consideration of future river improvement works.</p>

Notes: The above shows preliminary guidelines for future land uses and development activities. Details of the implementation methods. (incl. legislation, planning and enforcing organizations, public information, etc.) should be examined in a separated study.

FIGURES
FOR
APPENDIX IV

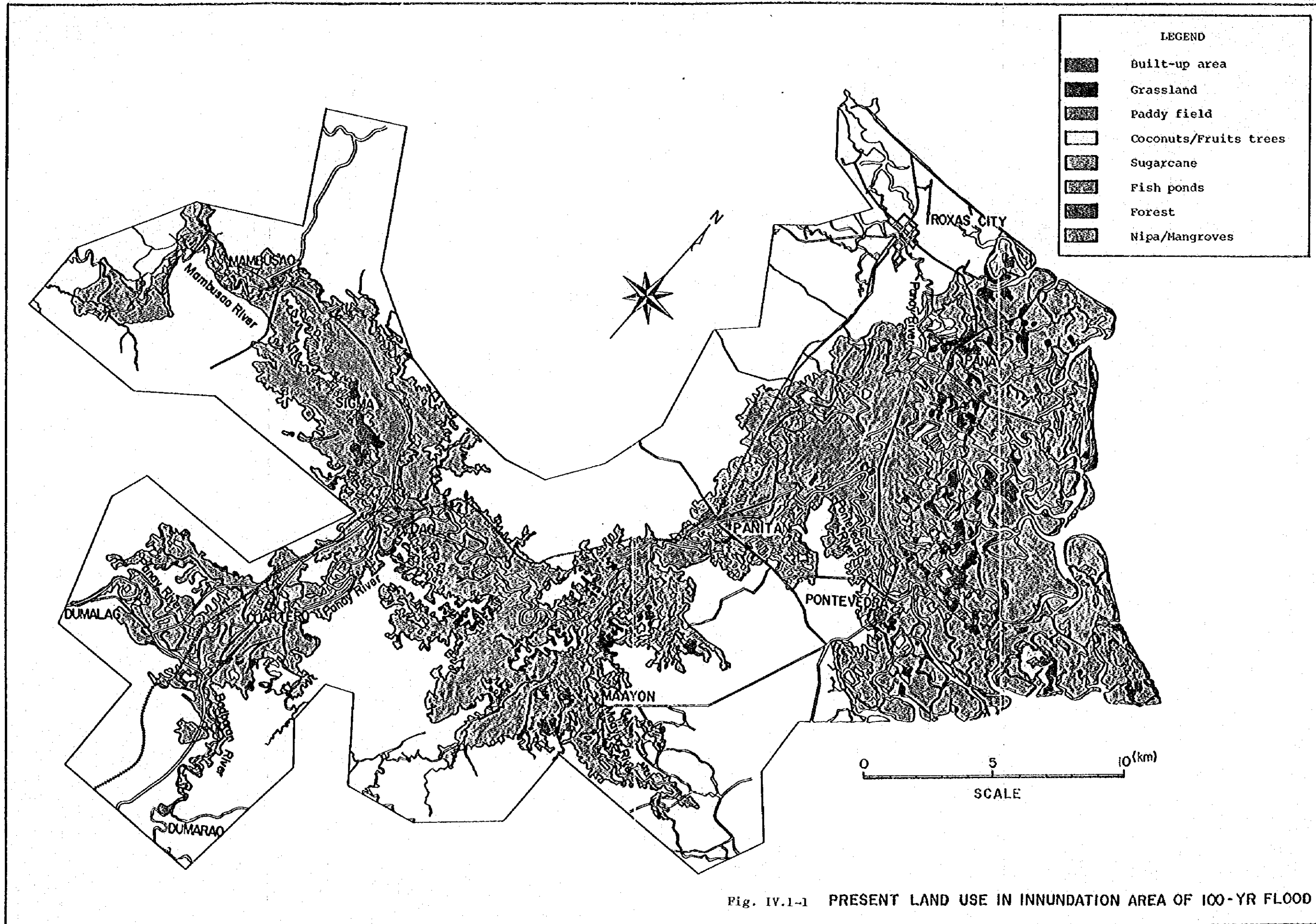
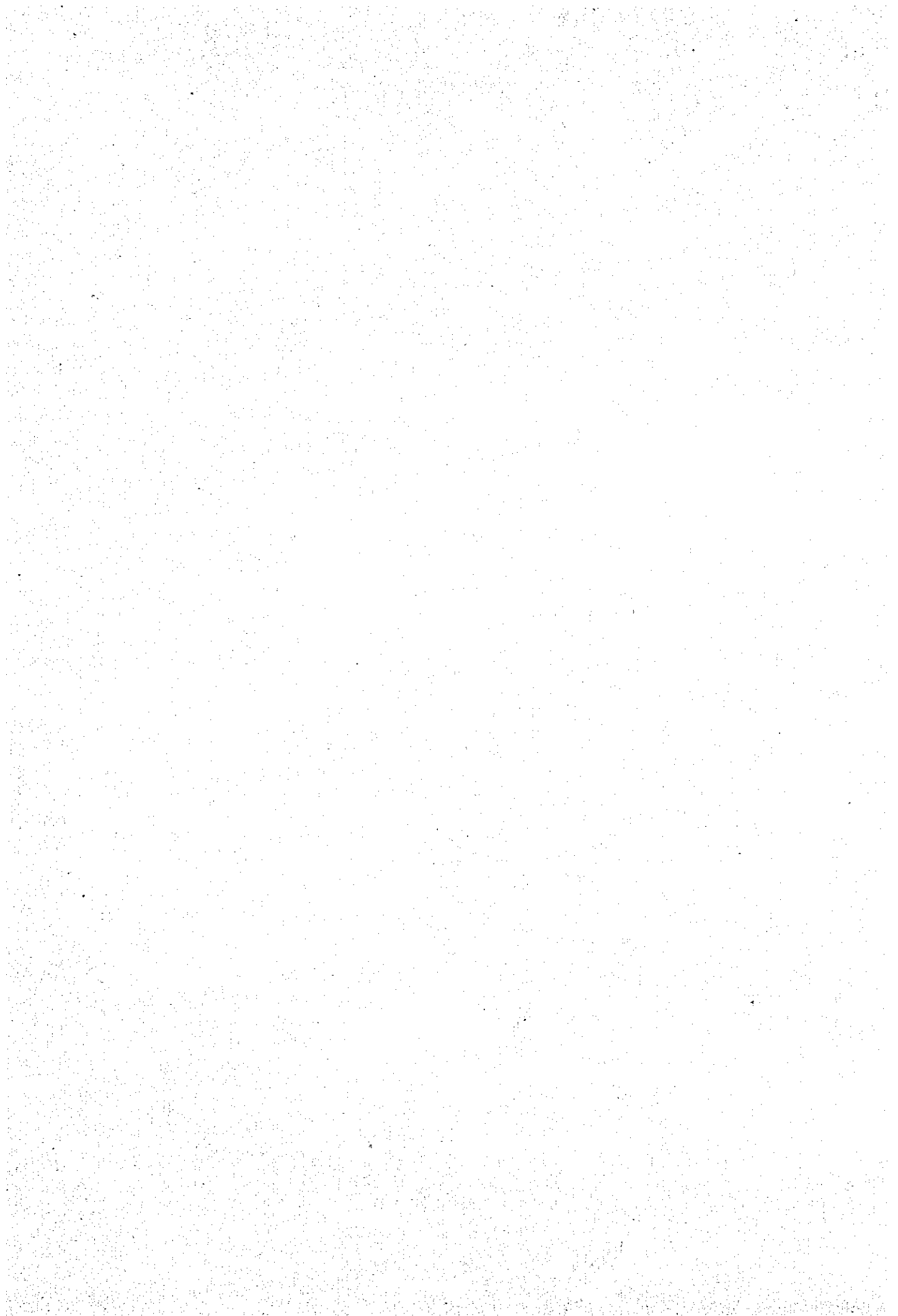


Fig. IV.1-1 PRESENT LAND USE IN INNUNDATION AREA OF 100-YR FLOOD



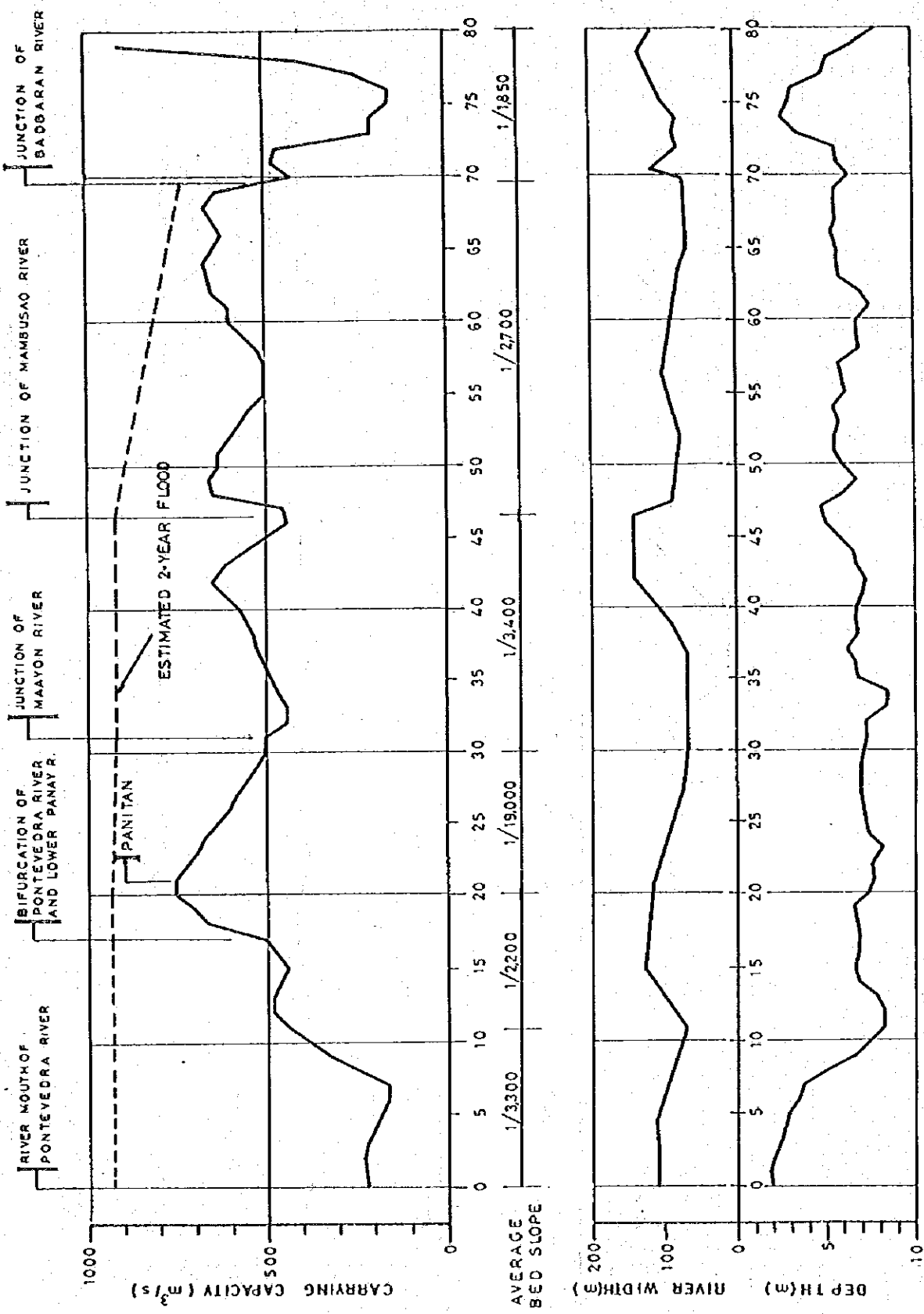


FIG. N.2-1 CHARACTER OF PRESENT PANAY RIVER

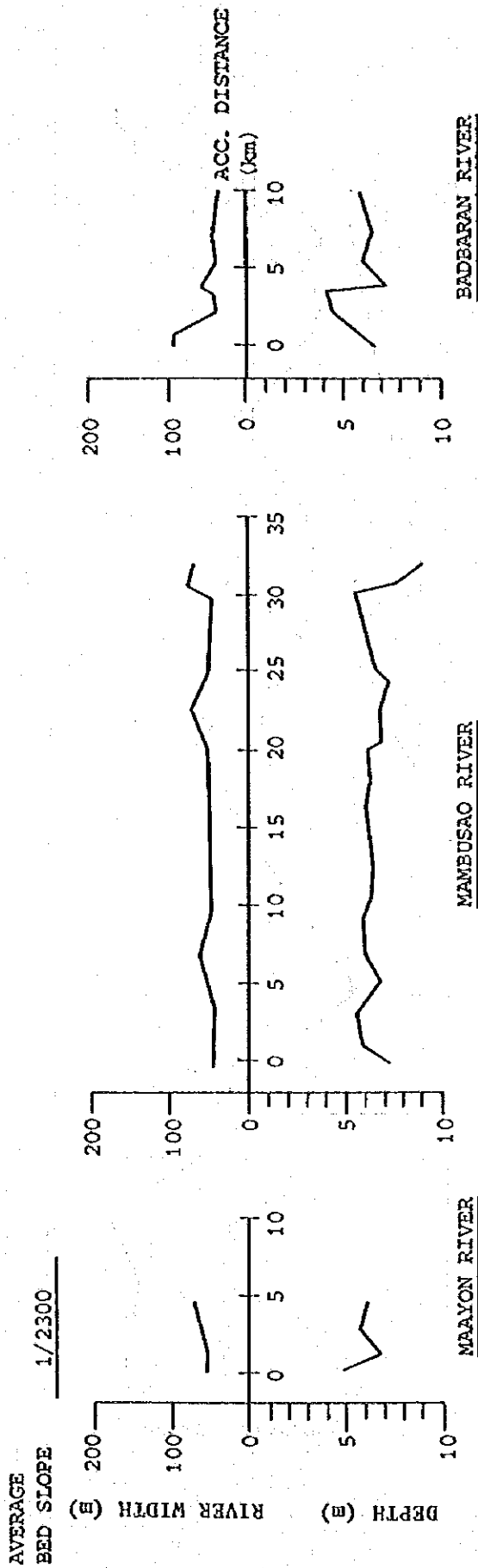
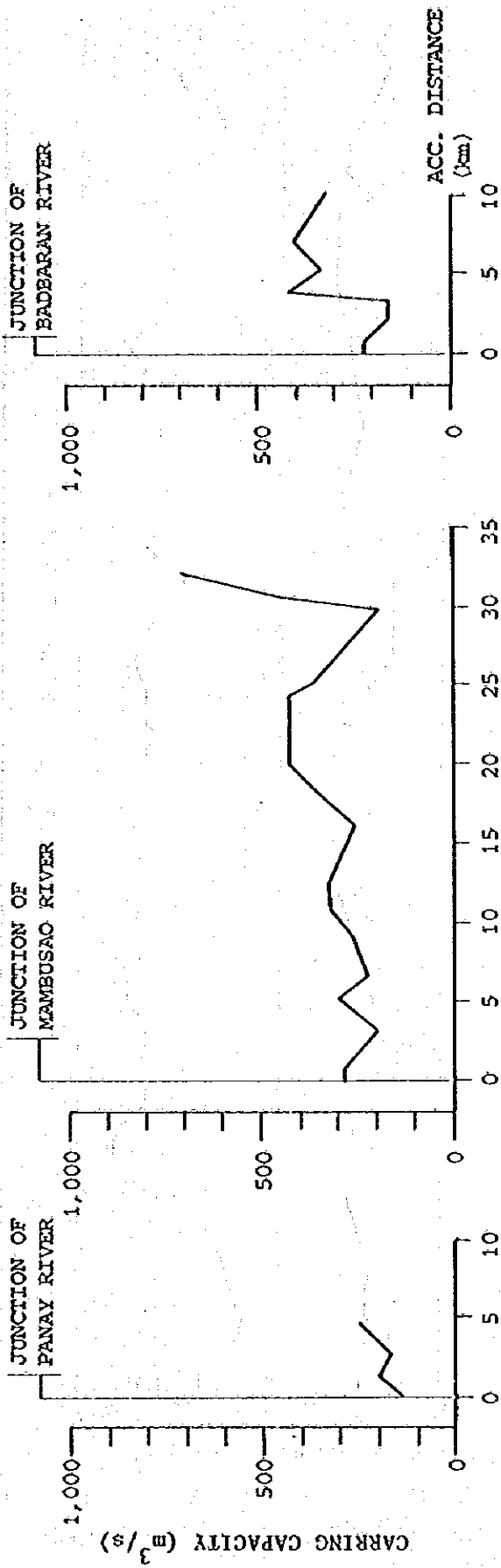
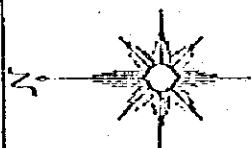


Fig. IV.2-2 CHARACTER OF PRESENT PANAY RIVER (TRIBUTARIES)



NOTES:

- AREAL PHOTOGRAPHY
MARCH 1983 - FEBRUARY 1984
- - - - - AREAL PHOTOGRAPHY 1947

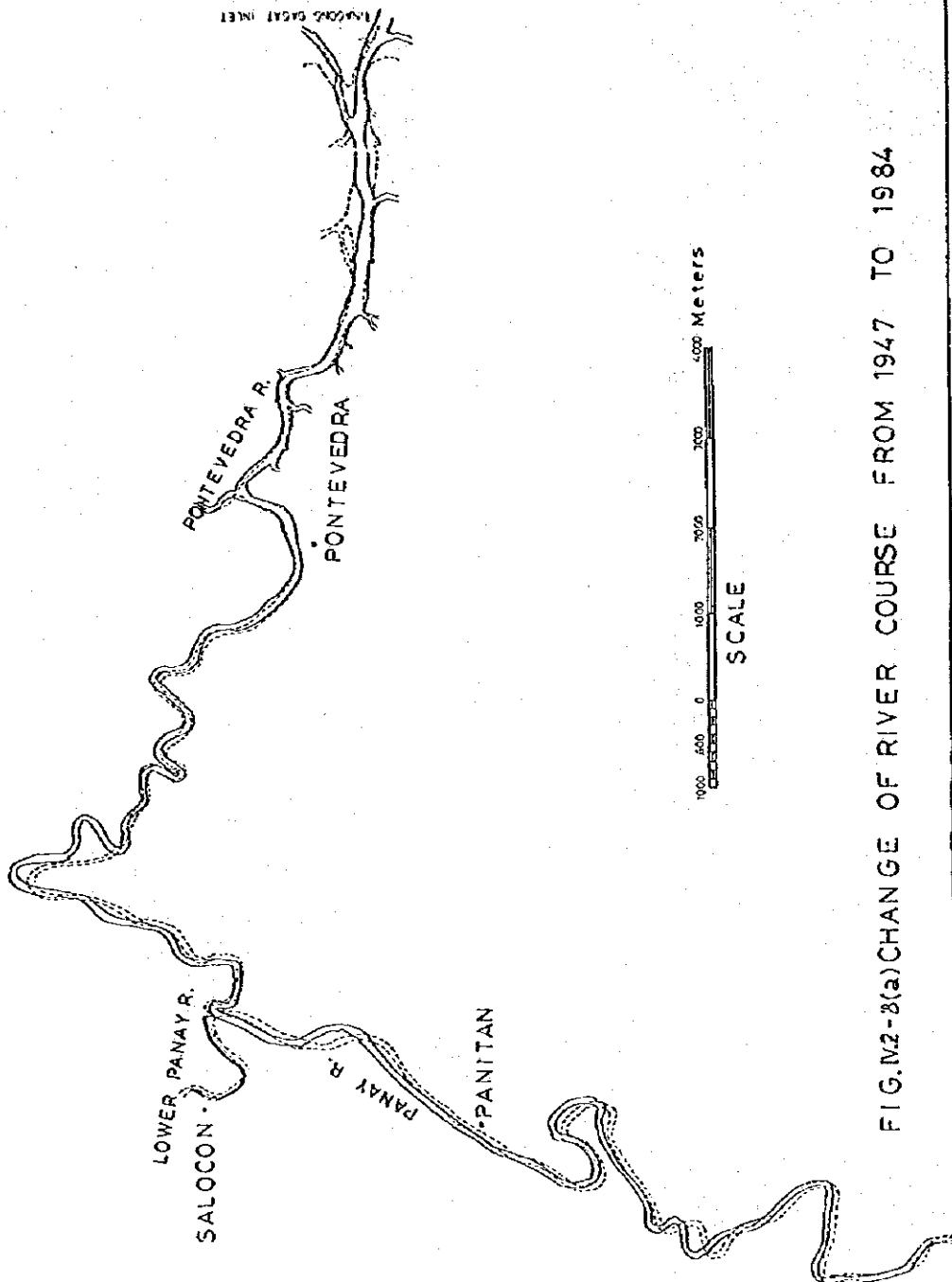


FIG. M2-8(a) CHANGE OF RIVER COURSE FROM 1947 TO 1984

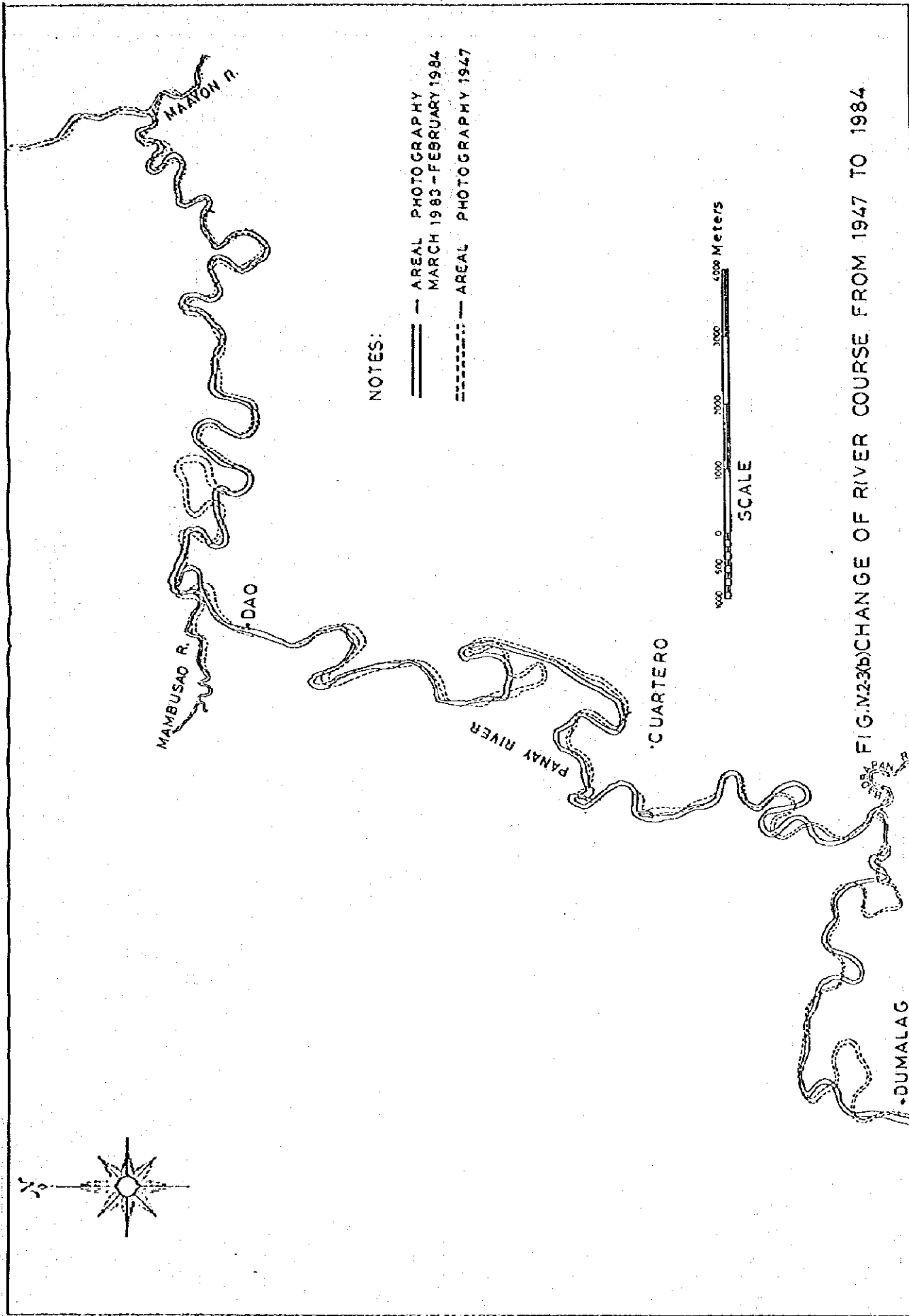


FIG. M23(b) CHANGE OF RIVER COURSE FROM 1947 TO 1984

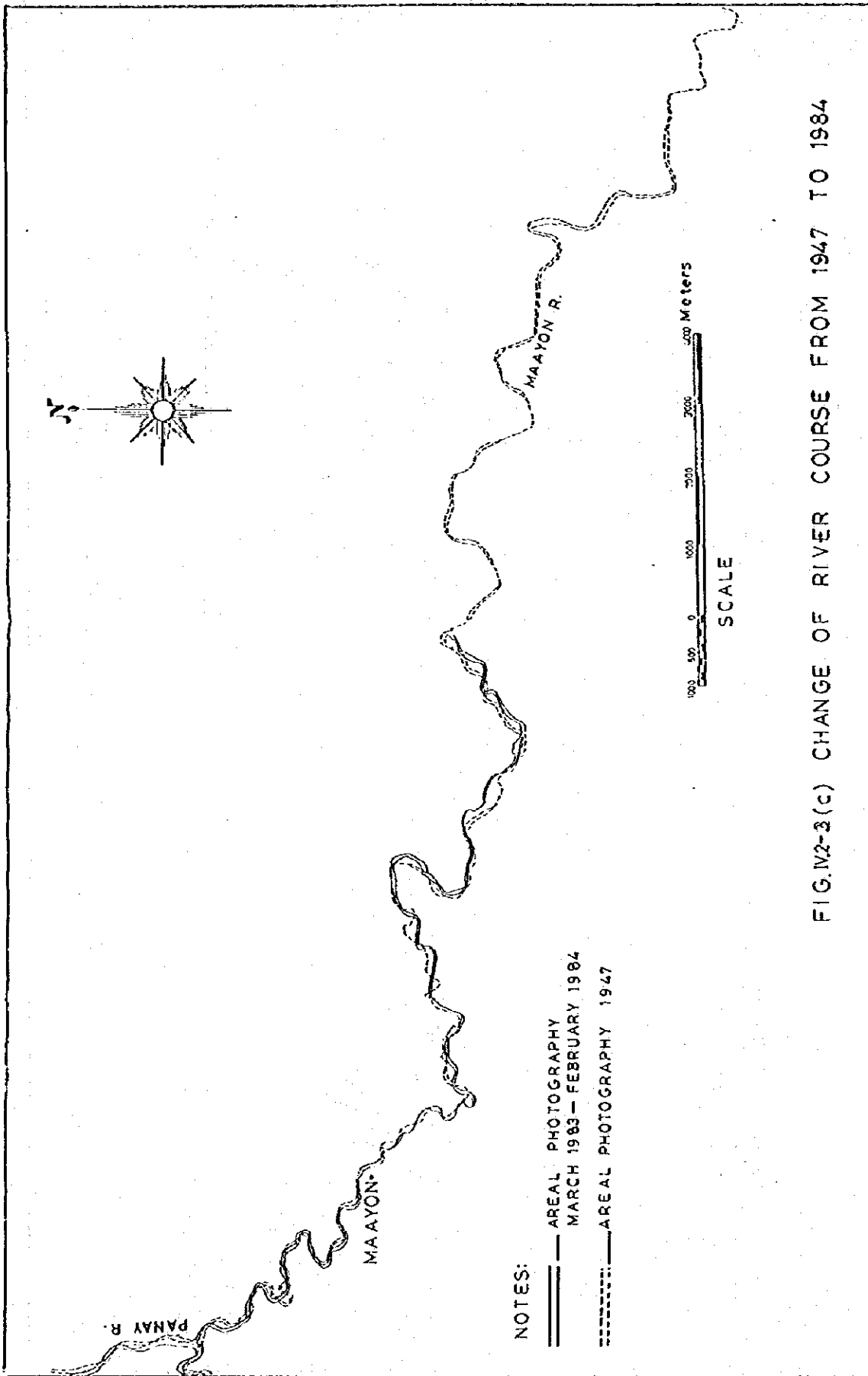


FIG.M2-3(c) CHANGE OF RIVER COURSE FROM 1947 TO 1984

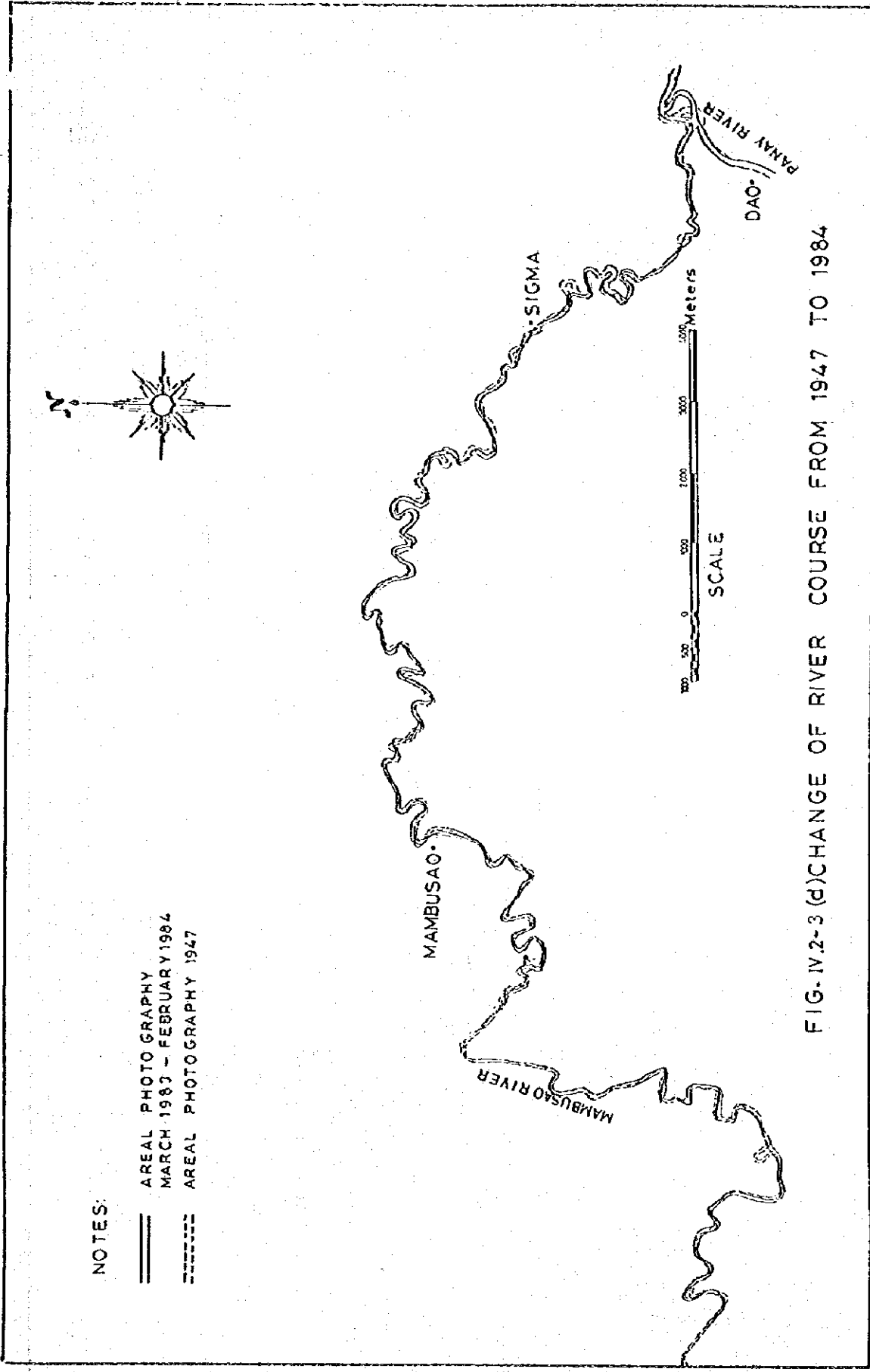


FIG. IV.2-3 (d) CHANGE OF RIVER COURSE FROM 1947 TO 1984

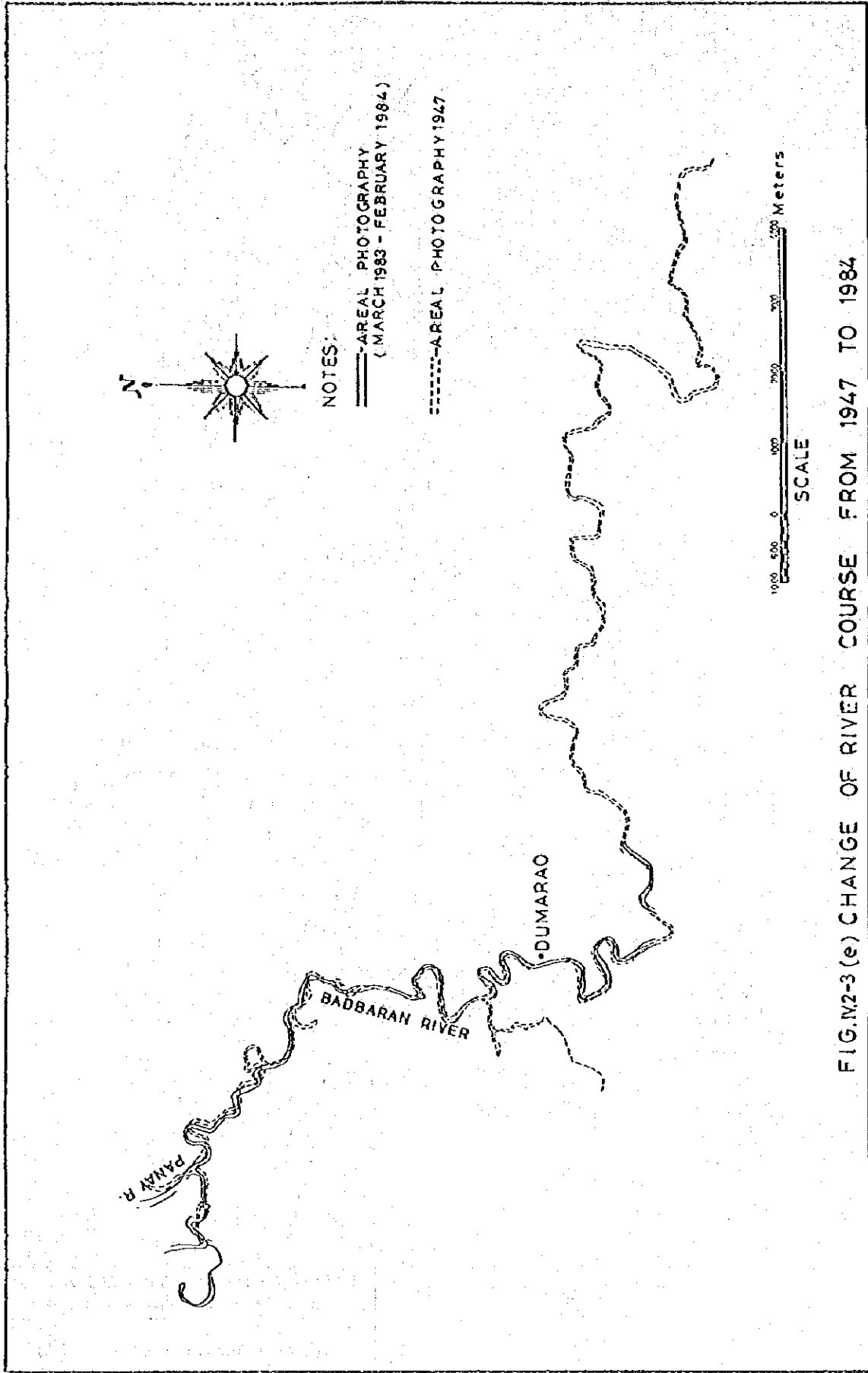
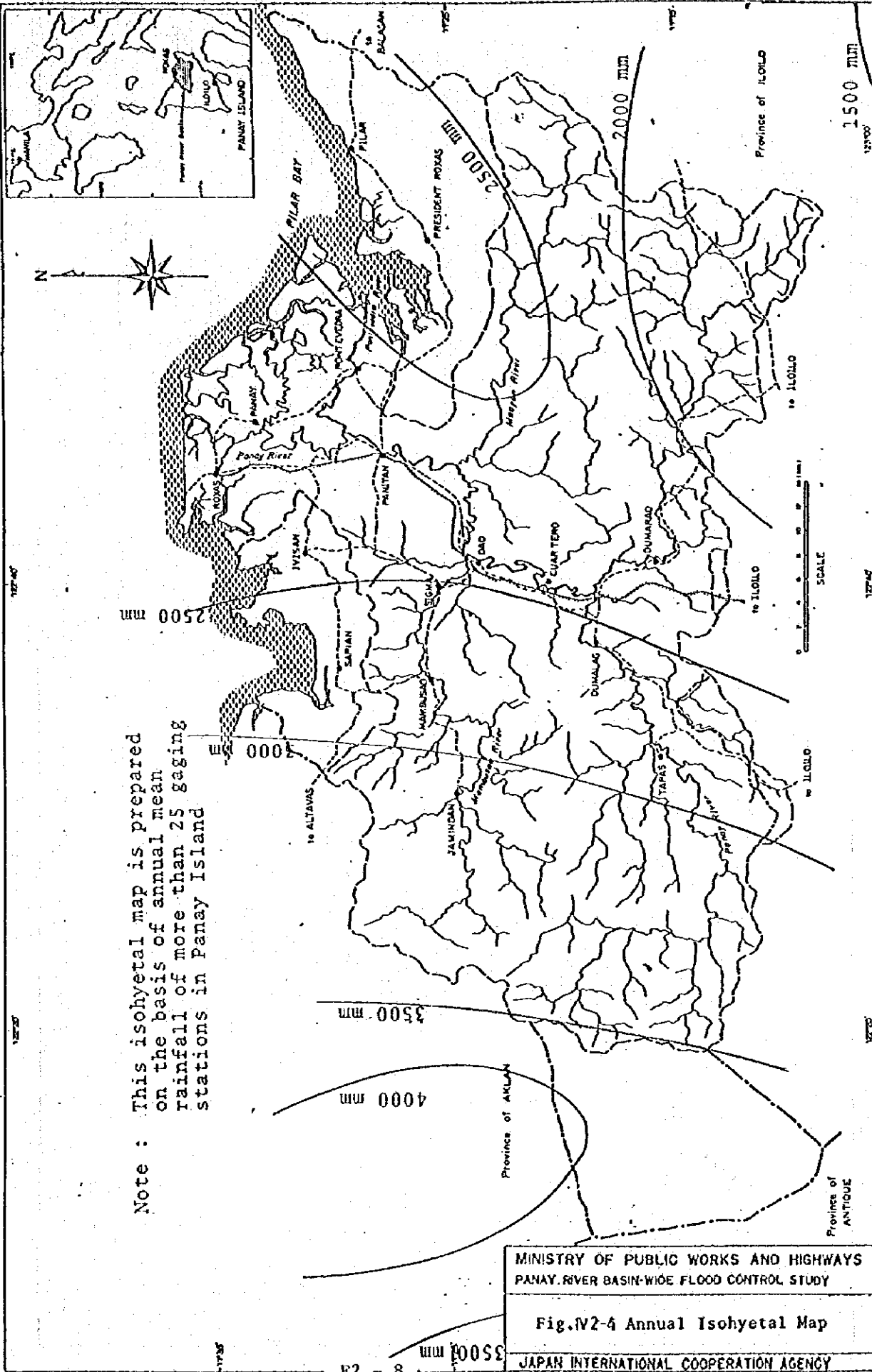


FIG.M2-3 (e) CHANGE OF RIVER COURSE FROM 1947 TO 1984



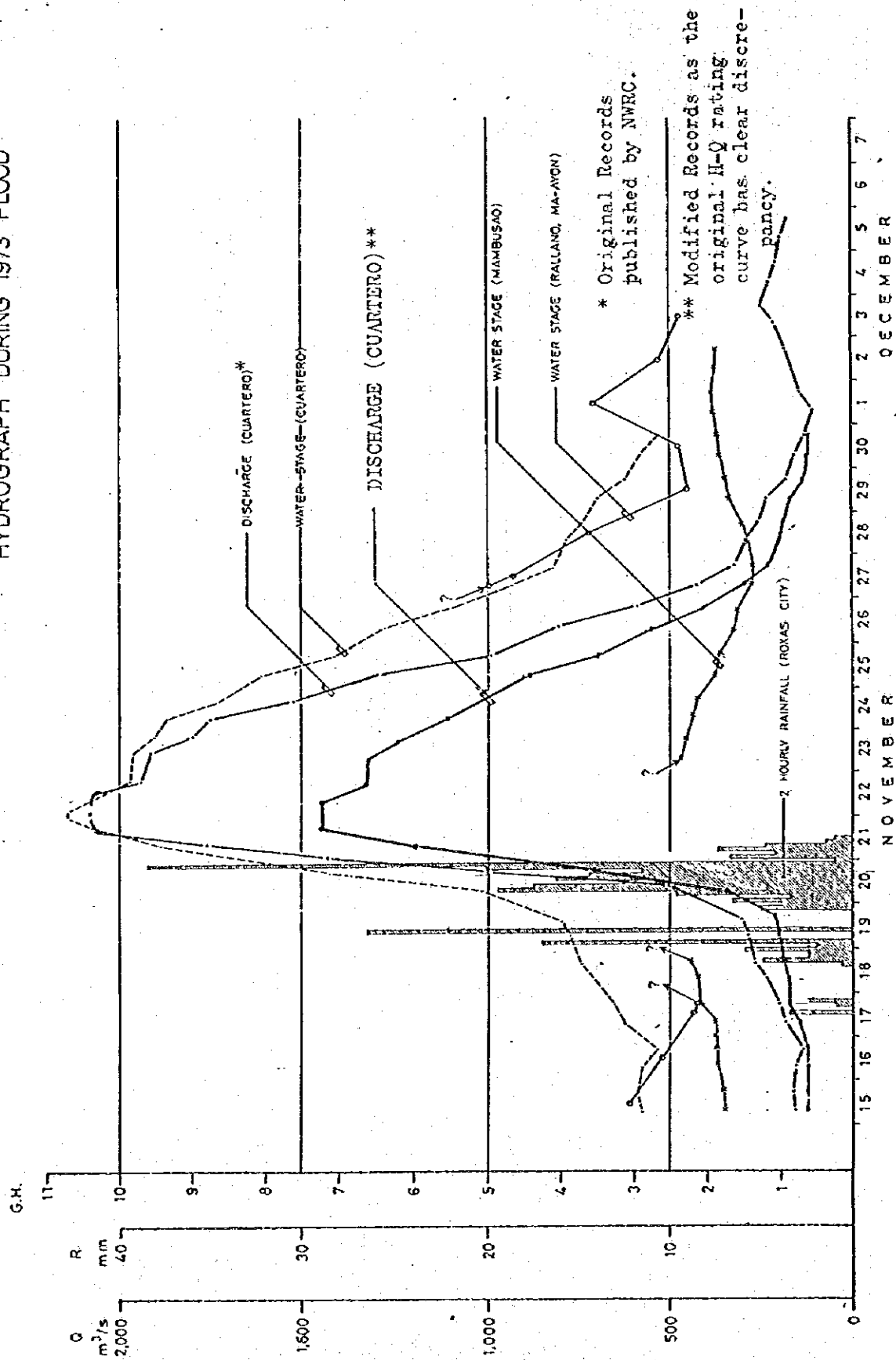
Note : This isohyetal map is prepared on the basis of annual mean rainfall of more than 25 gaging stations in Panay Island

MINISTRY OF PUBLIC WORKS AND HIGHWAYS
PANAY RIVER BASIN-WIDE FLOOD CONTROL STUDY

Fig. IV2-4 Annual Isohyetal Map

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. I.2-5
HYDROGRAPH DURING 1973 FLOOD



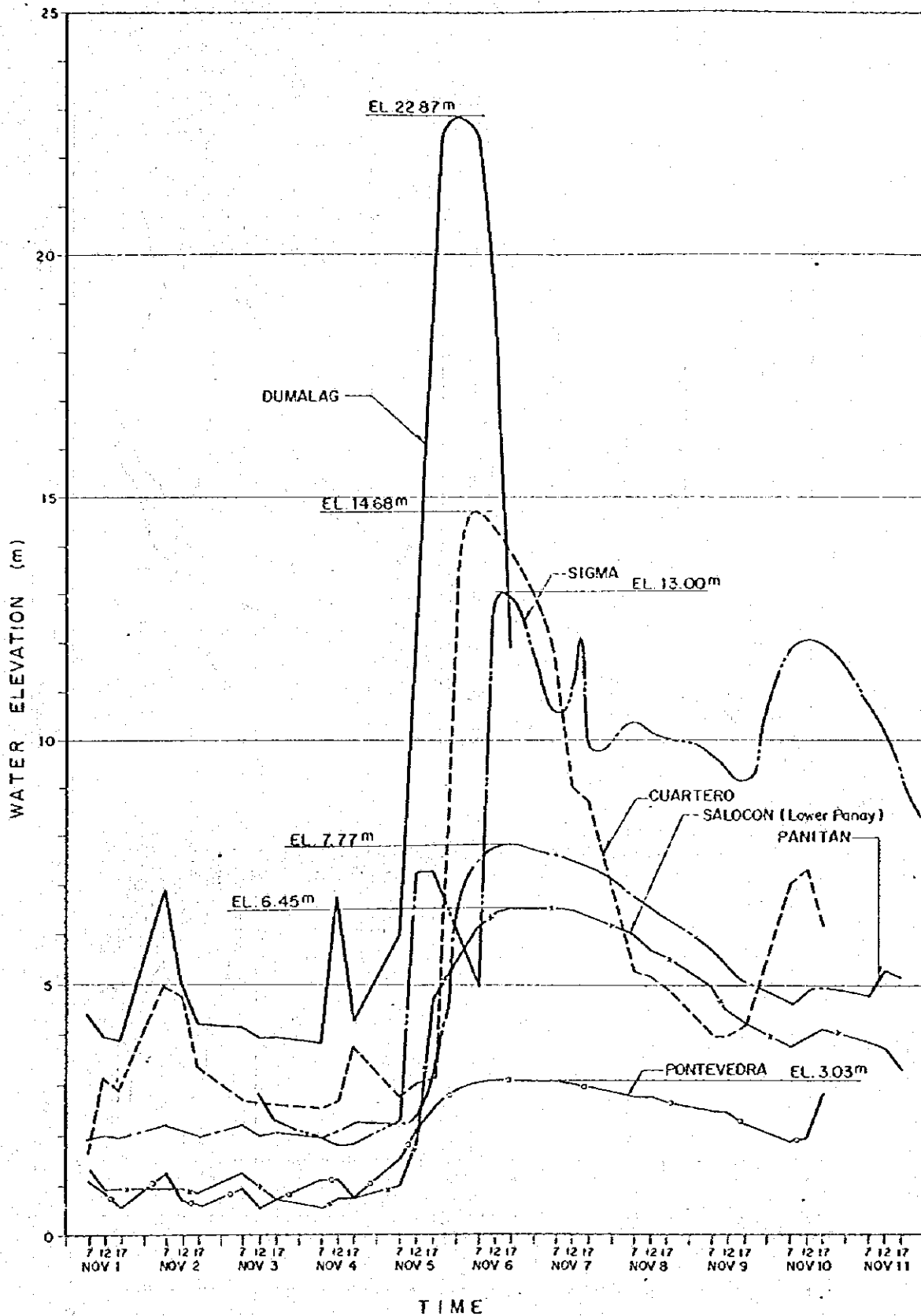


Fig. IV.2-6. WATER STAGE HYDROGRAPH AT GAGING STATION AT THE TIME OF NOV. 1984 FLOOD

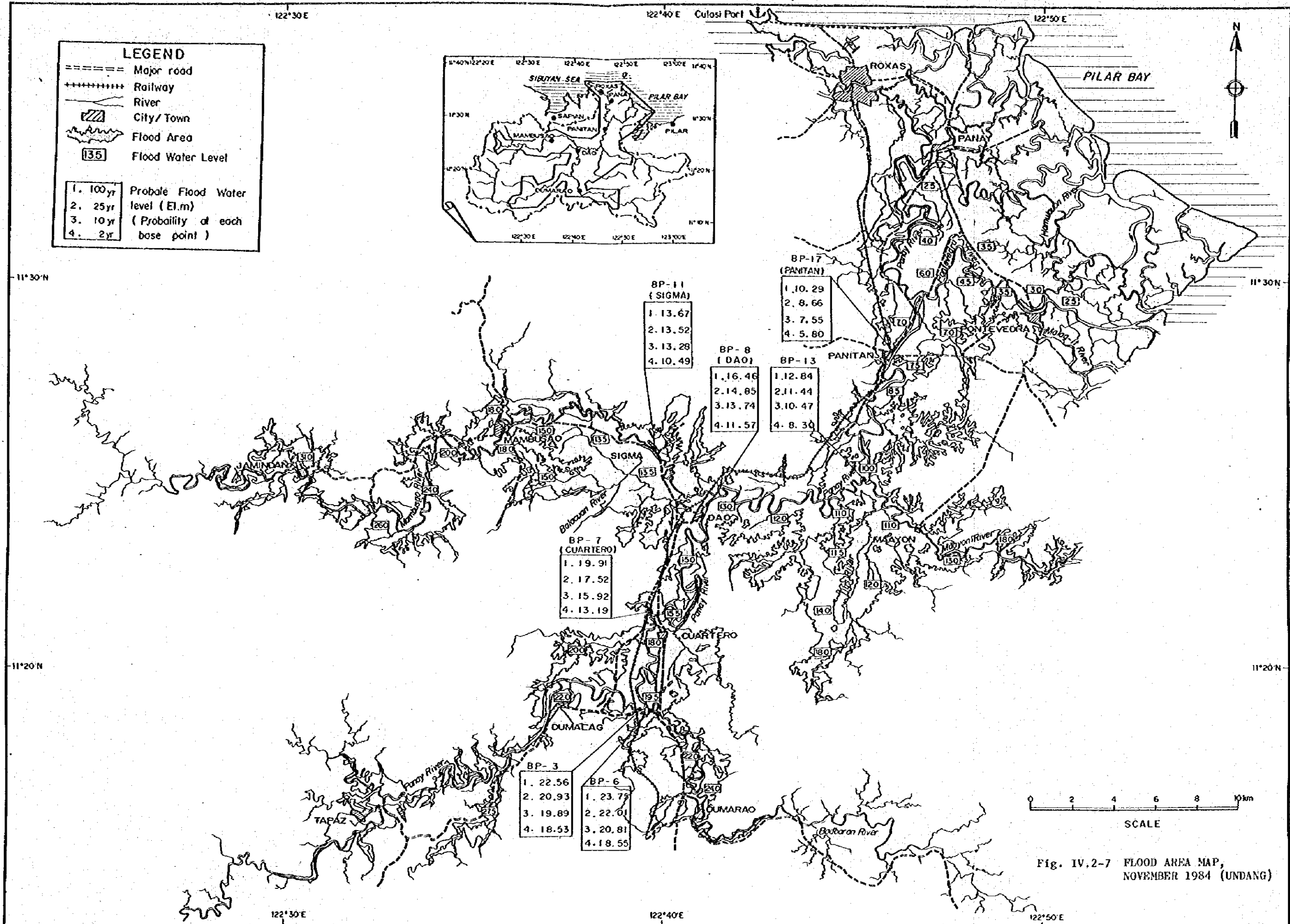


Fig. IV.2-7 FLOOD AREA MAP, NOVEMBER 1984 (UNDANG)



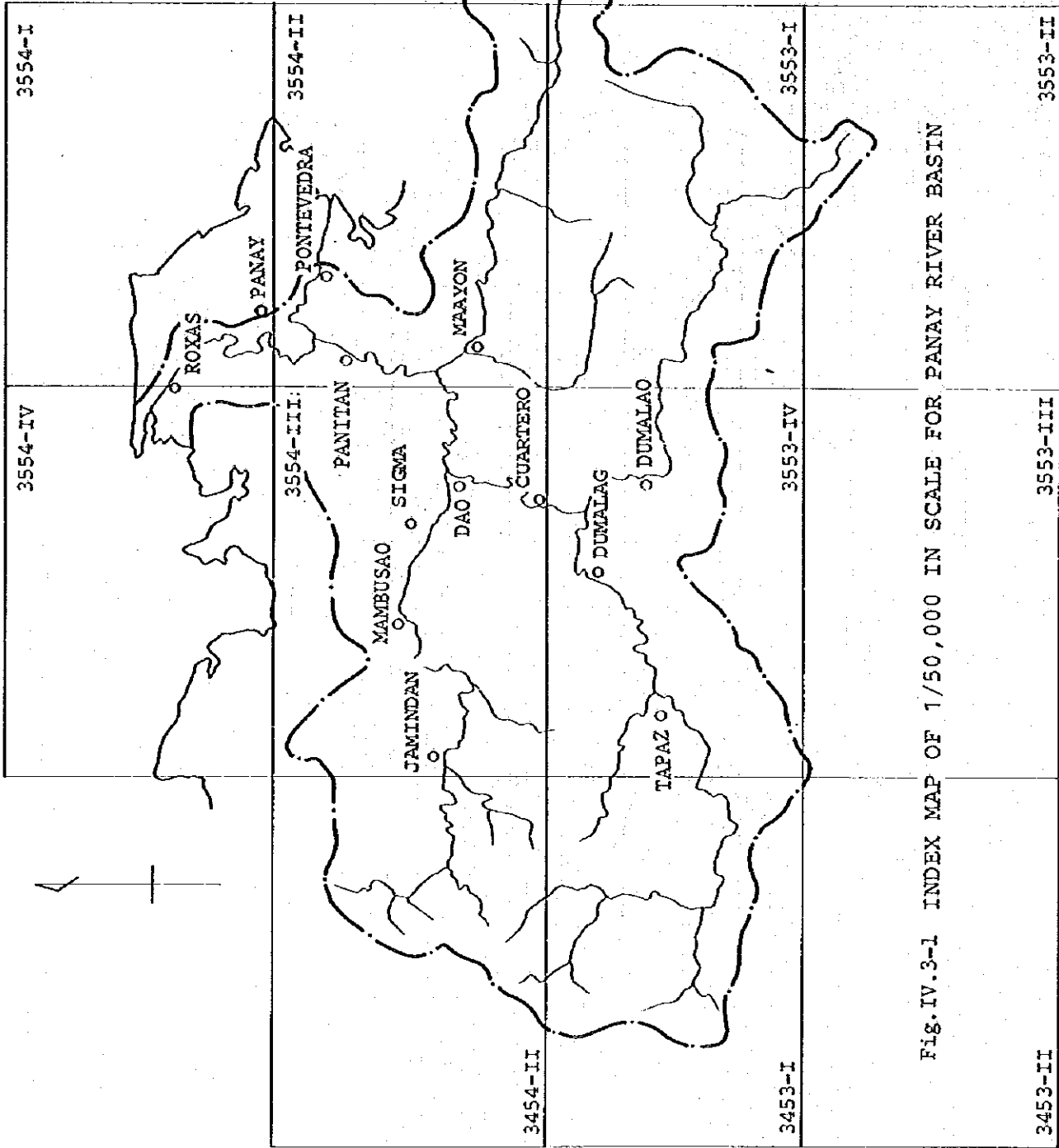


Fig. IV.3-1 INDEX MAP OF 1/50,000 IN SCALE FOR PANAY RIVER BASIN

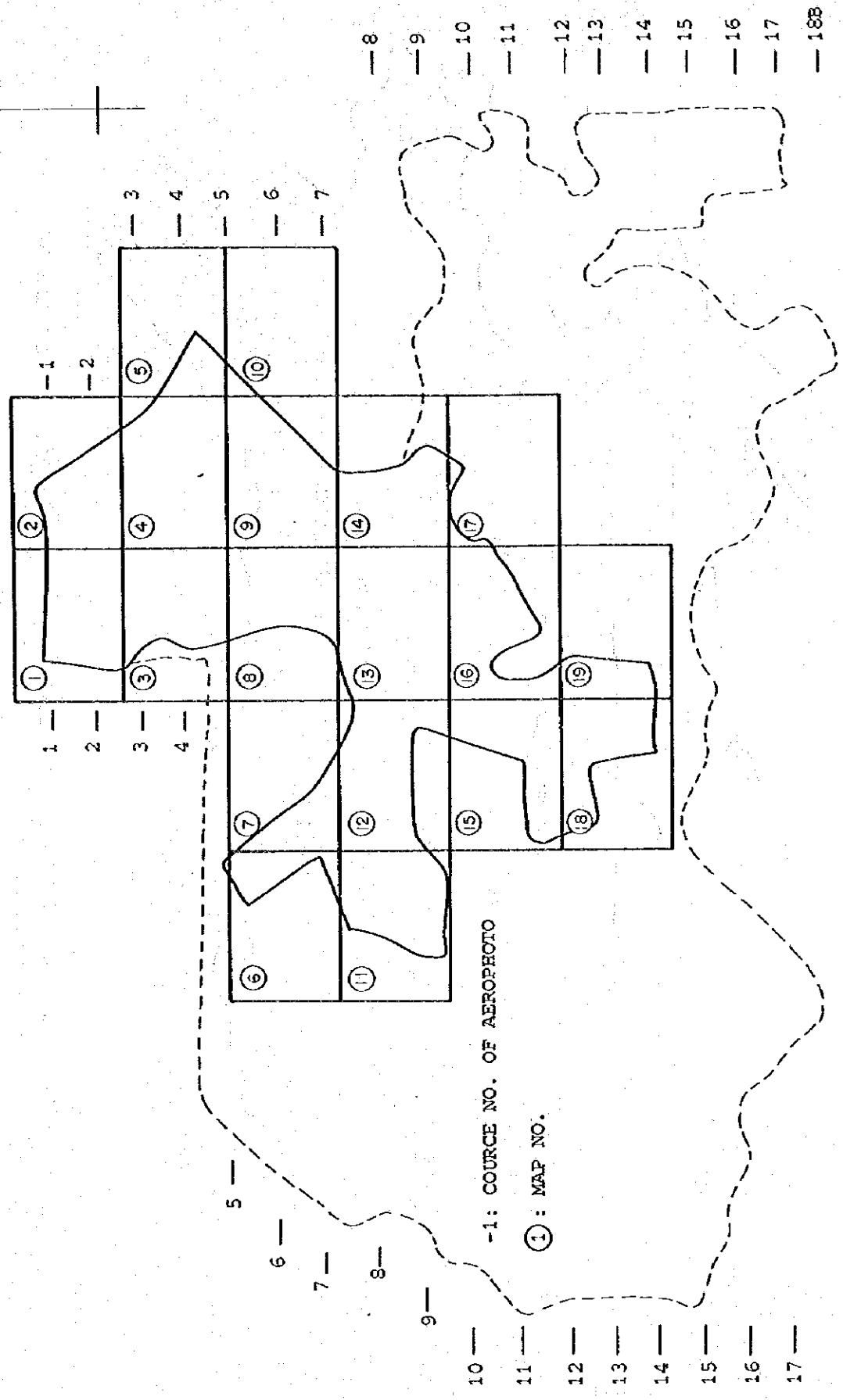
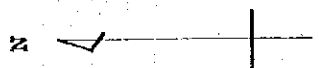
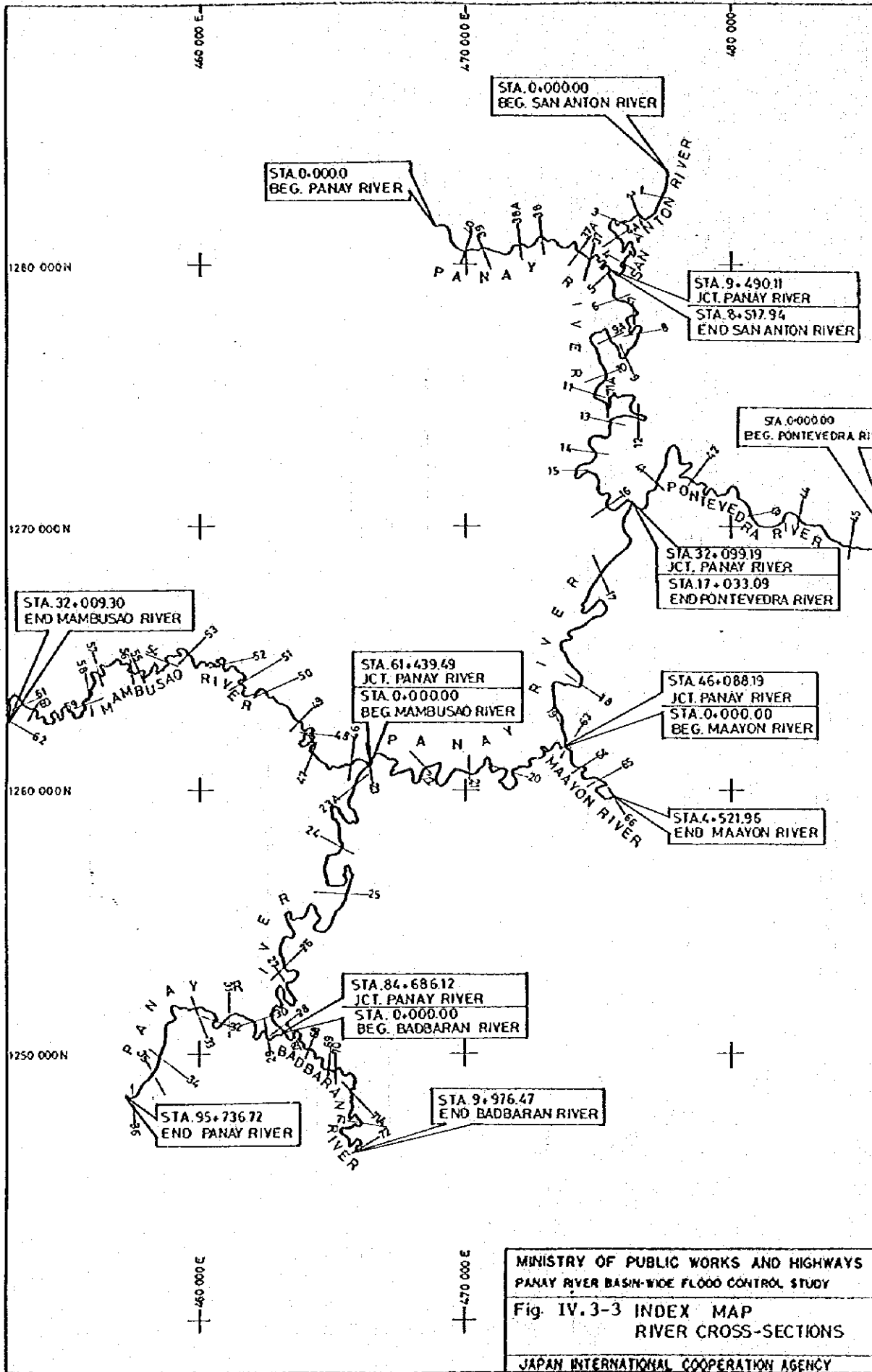


Fig. IV.3-2 INDEX MAP OF 1/10,000 IN SCALE FOR PANAY RIVER BASIN



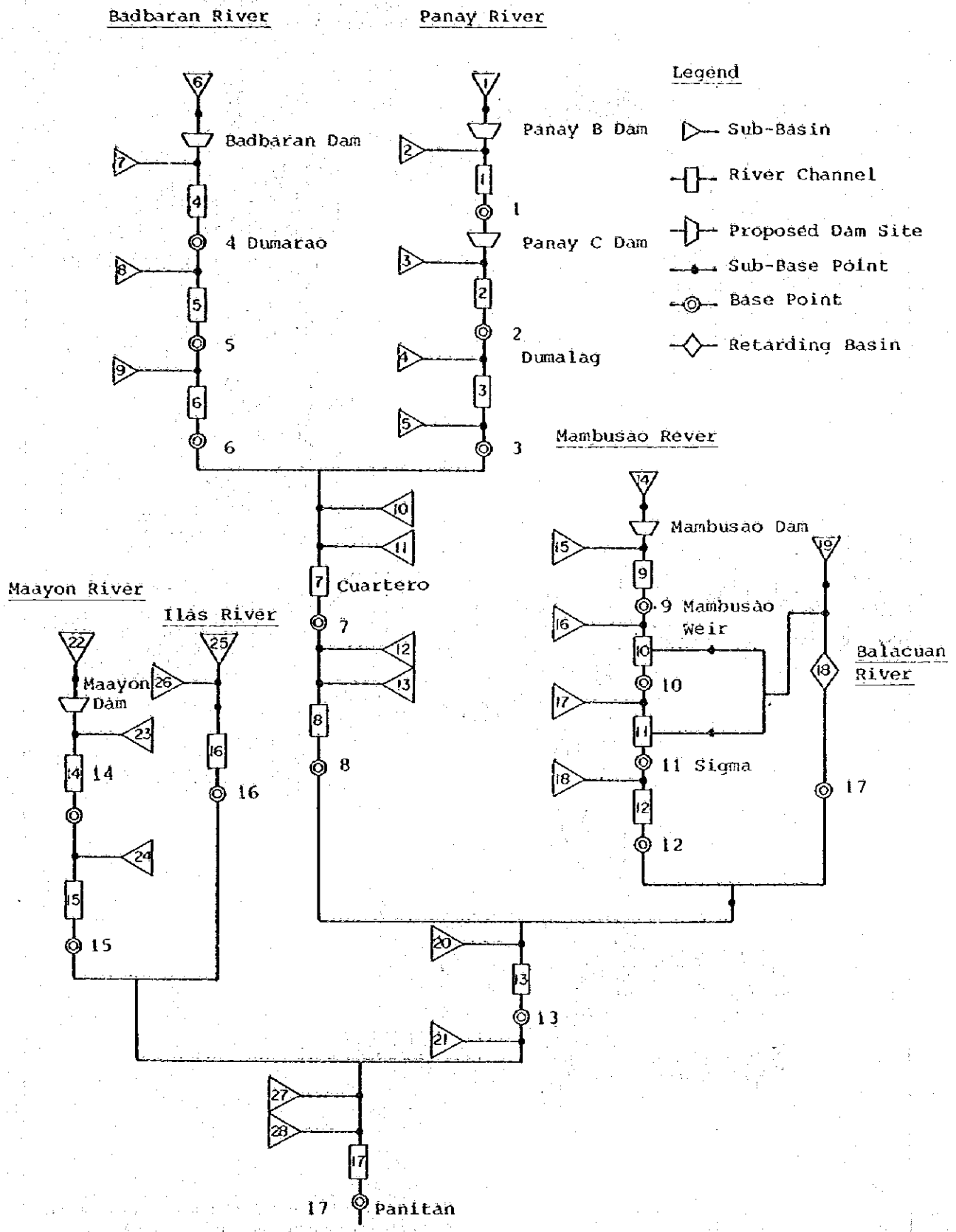


Fig. IV. 4-1 River System Model

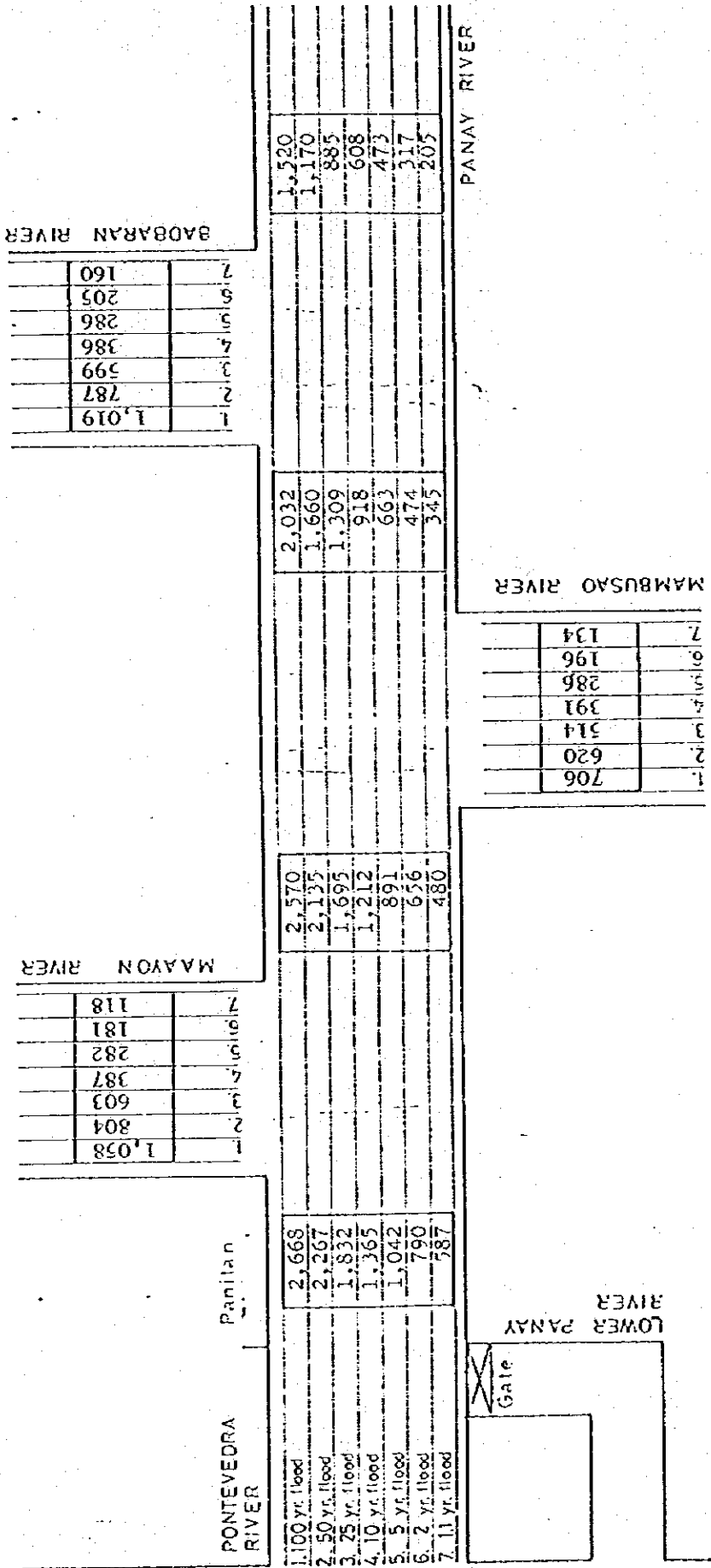
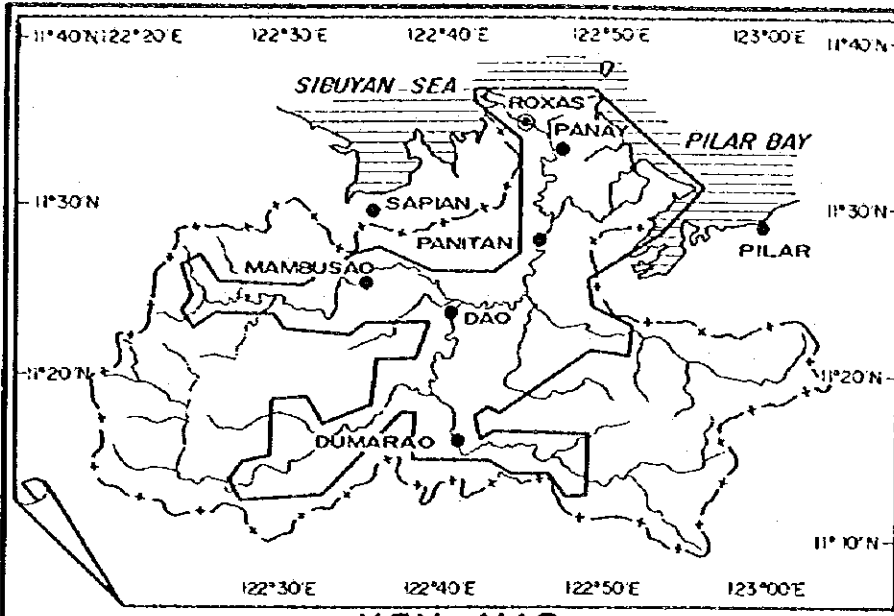
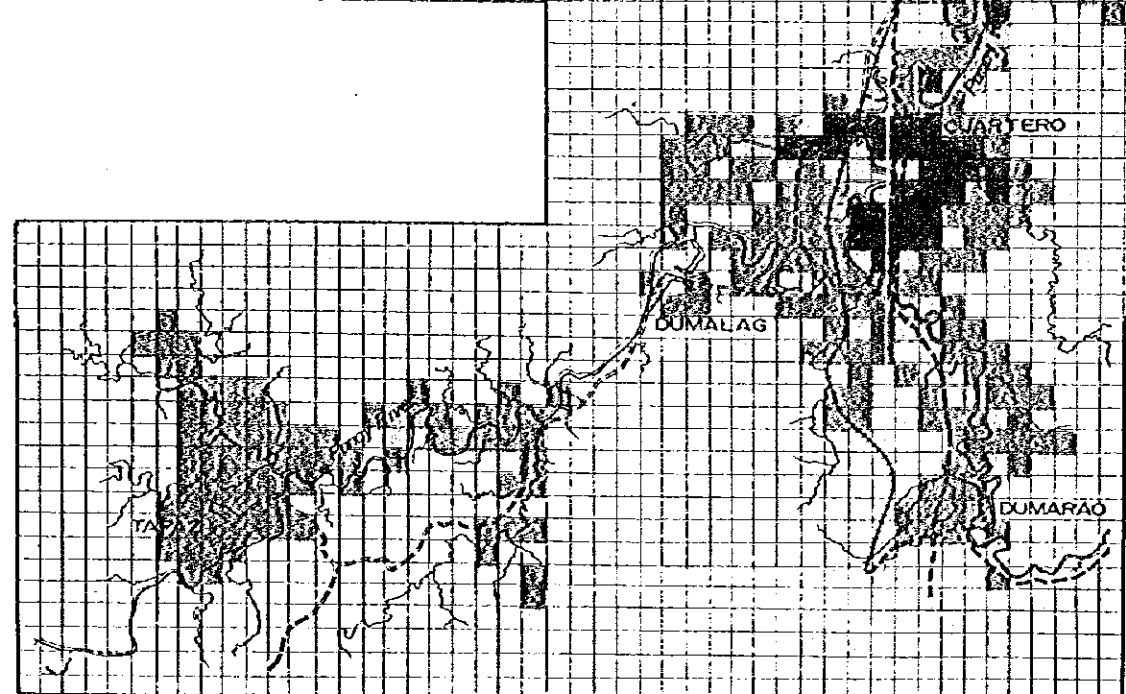
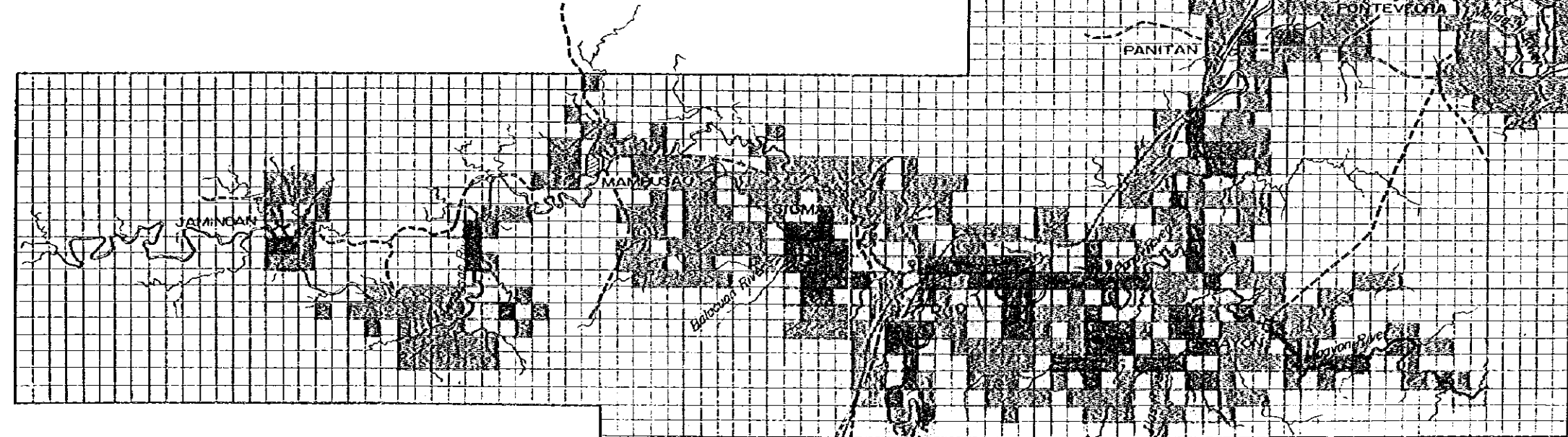
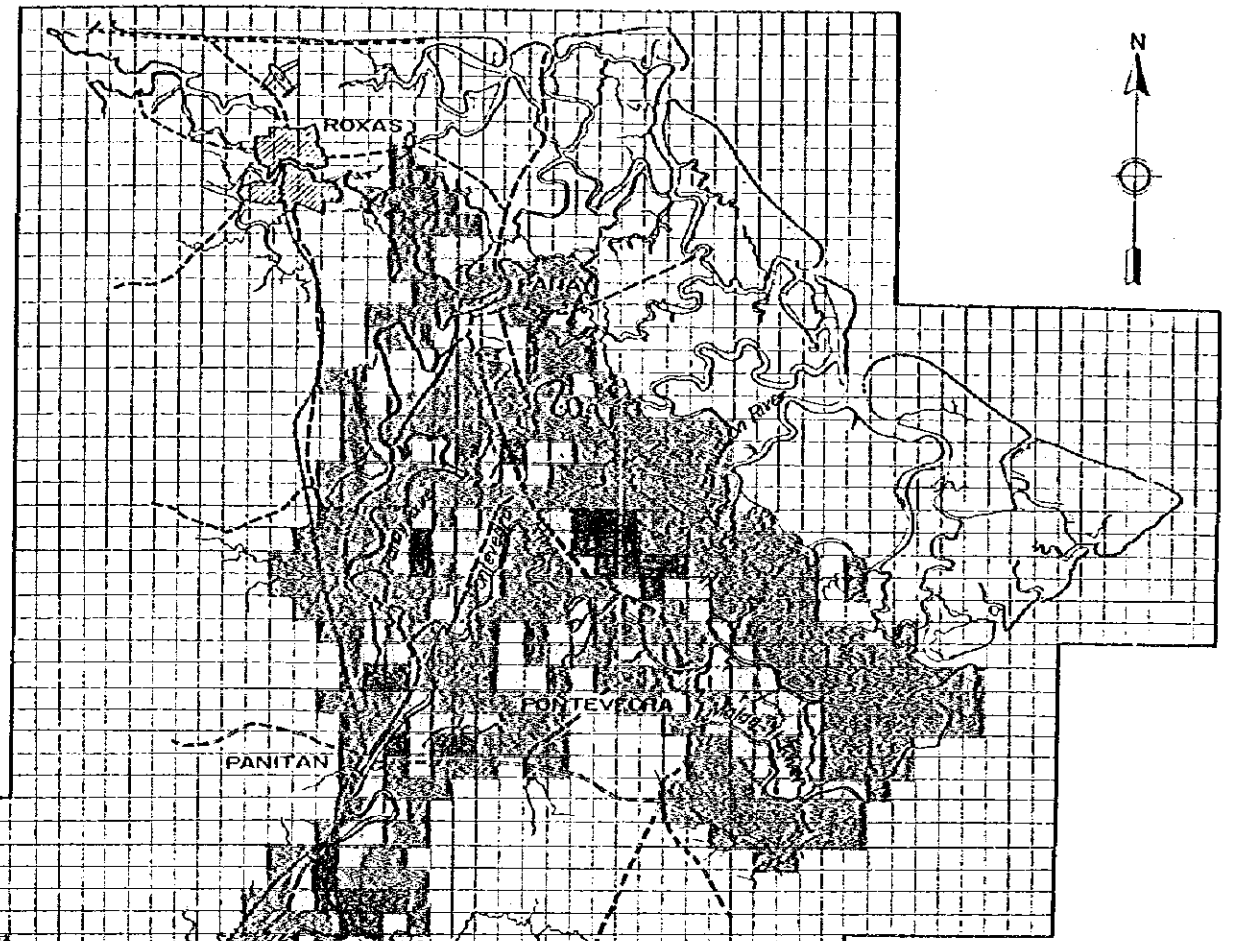






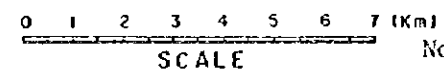
Fig. IV.4-2 Flood Flow Distribution for Present River Condition
(Probability of Basin Rainfall at Panitan)



KEY MAP



- LEGEND
-  : More than 2.0 m
 -  : 1.0 to 2.0 m
 -  : Less than 1.0 m
 -  : No inundation



Note: Each mesh is square of 500 m x 500 m.

Fig. IV. 4-3 INUNDATION DEPTH BY 5-YEAR FLOOD

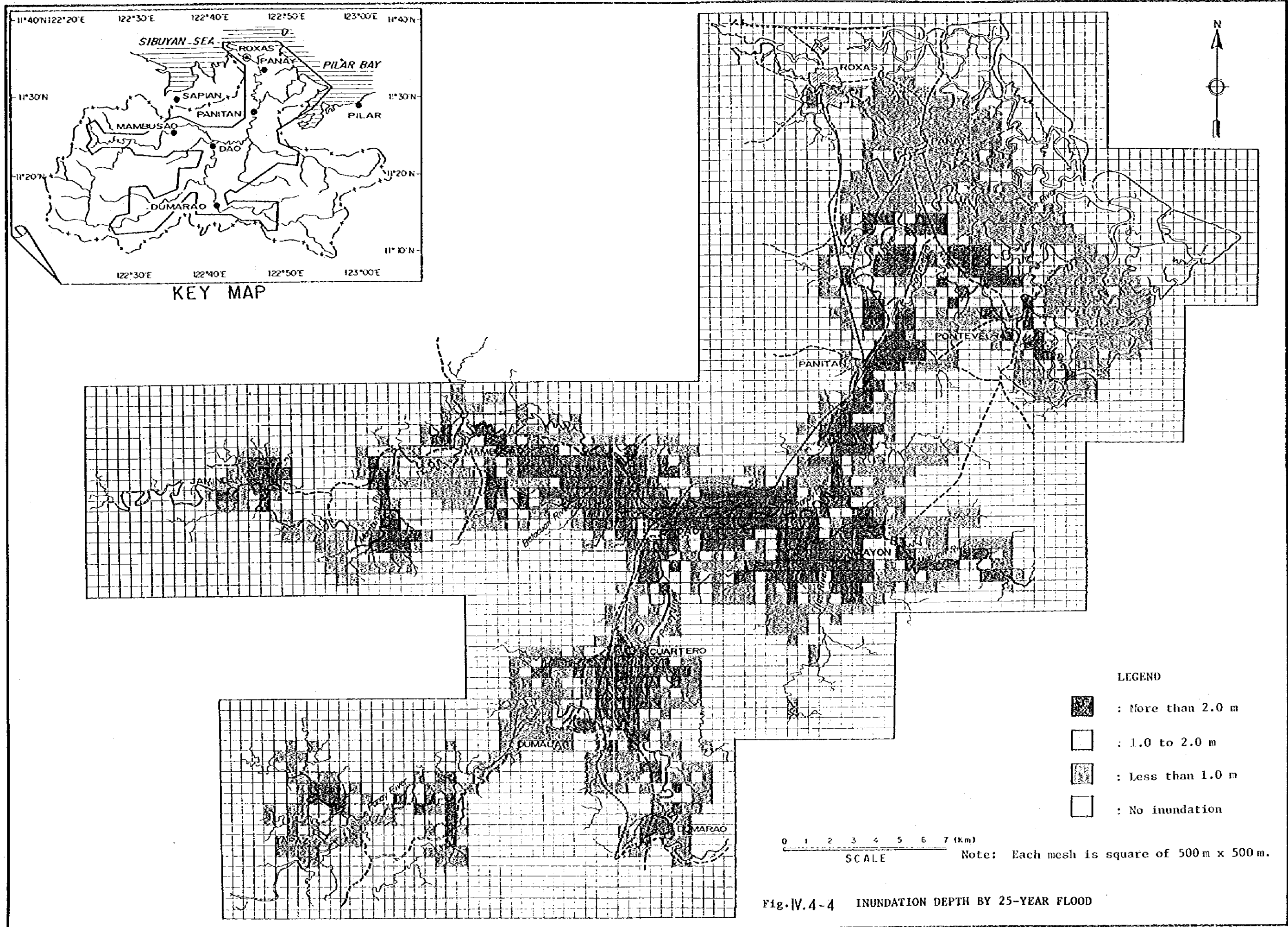


Fig. IV.4-4 INUNDATION DEPTH BY 25-YEAR FLOOD

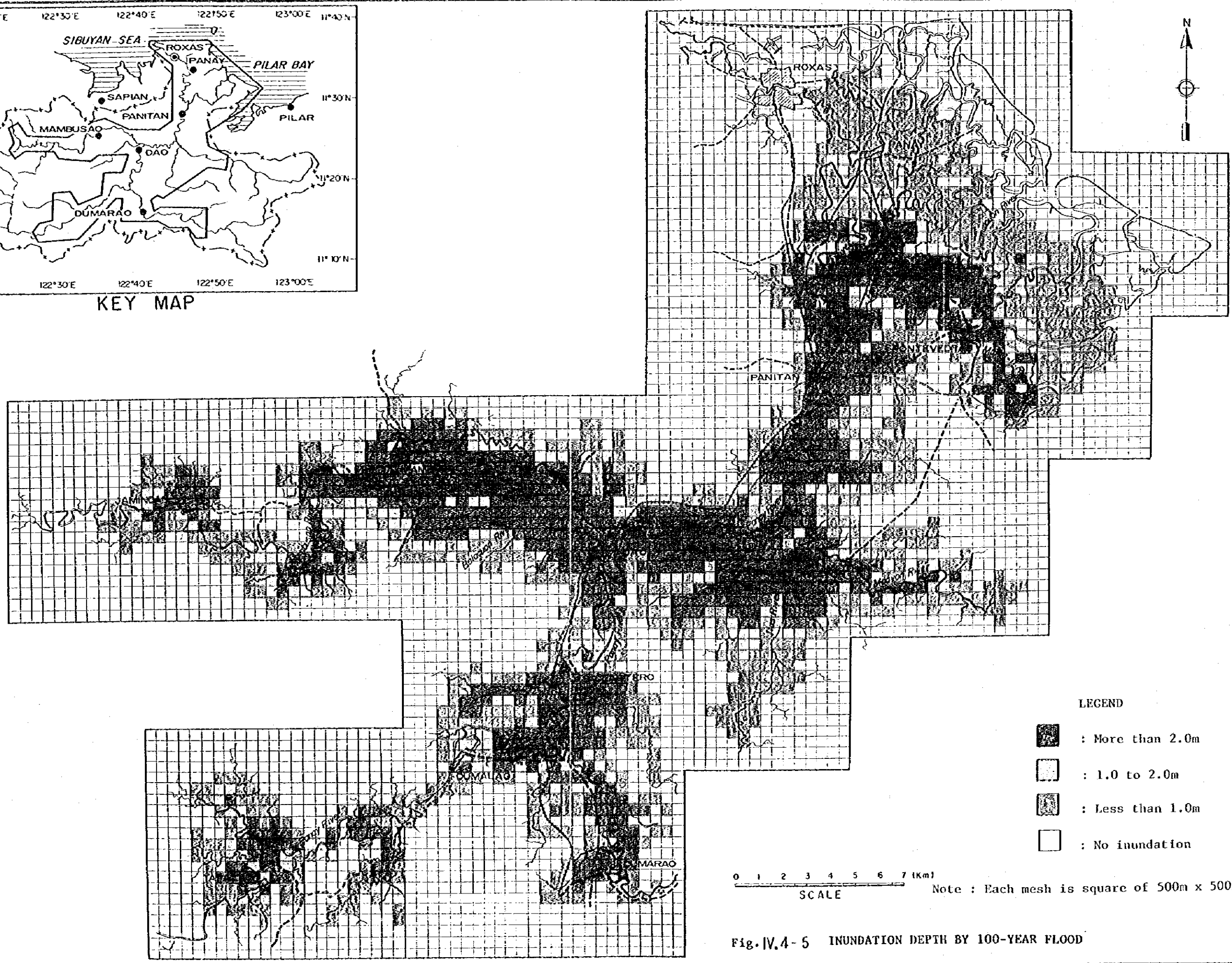
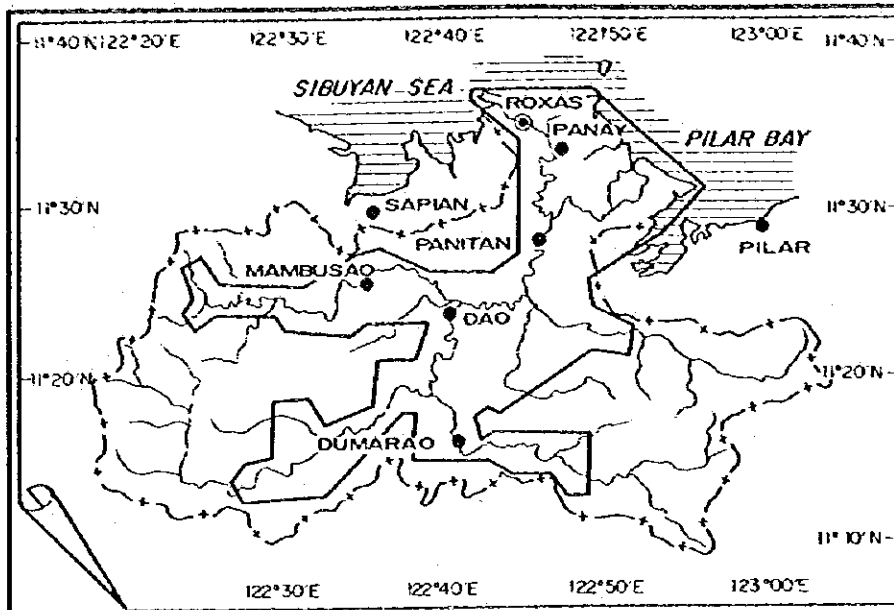
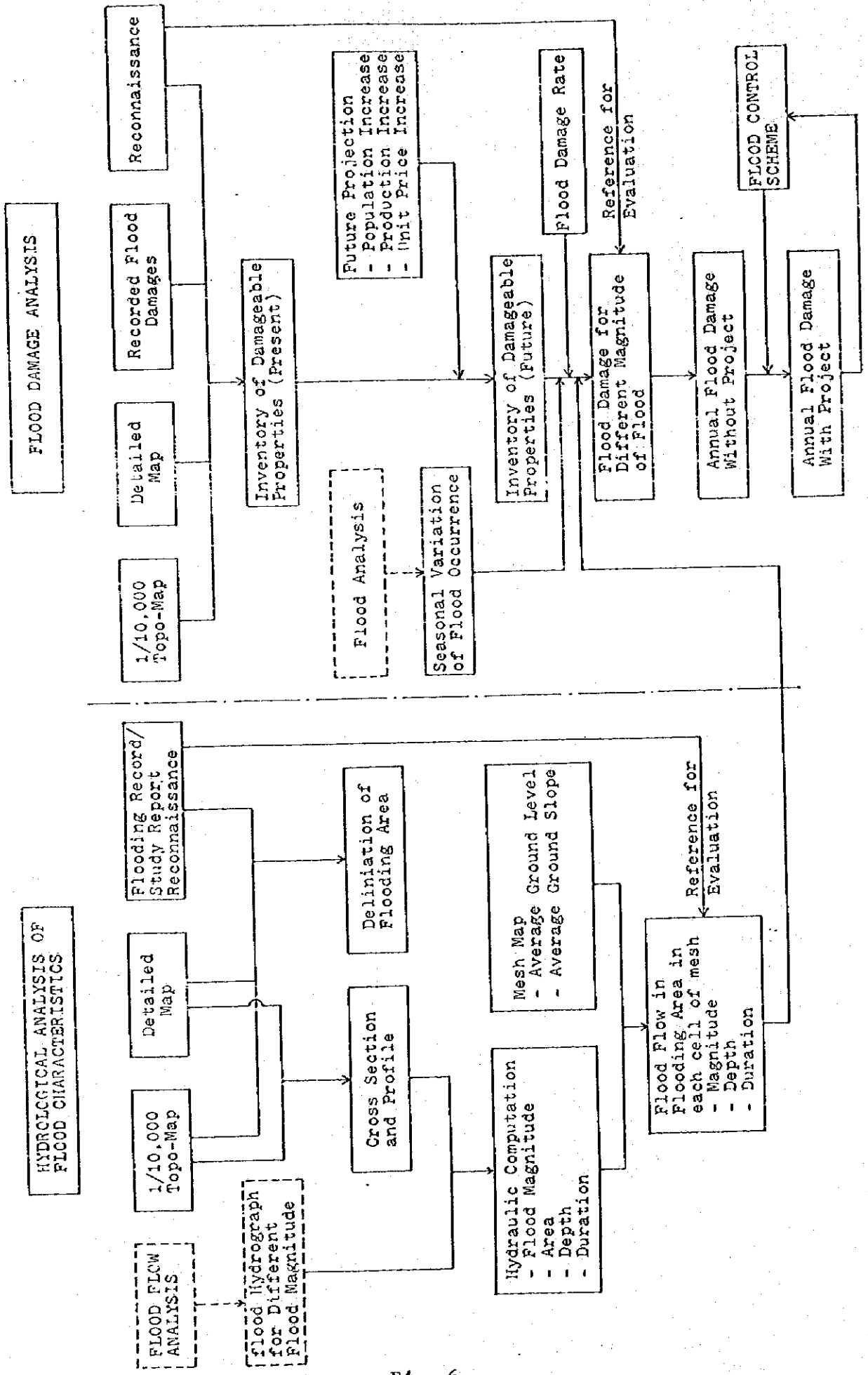


Fig. IV.4-5 INUNDATION DEPTH BY 100-YEAR FLOOD

FIGURE IV.4-6 FLOW CHART OF FLOOD DAMAGE ANALYSIS





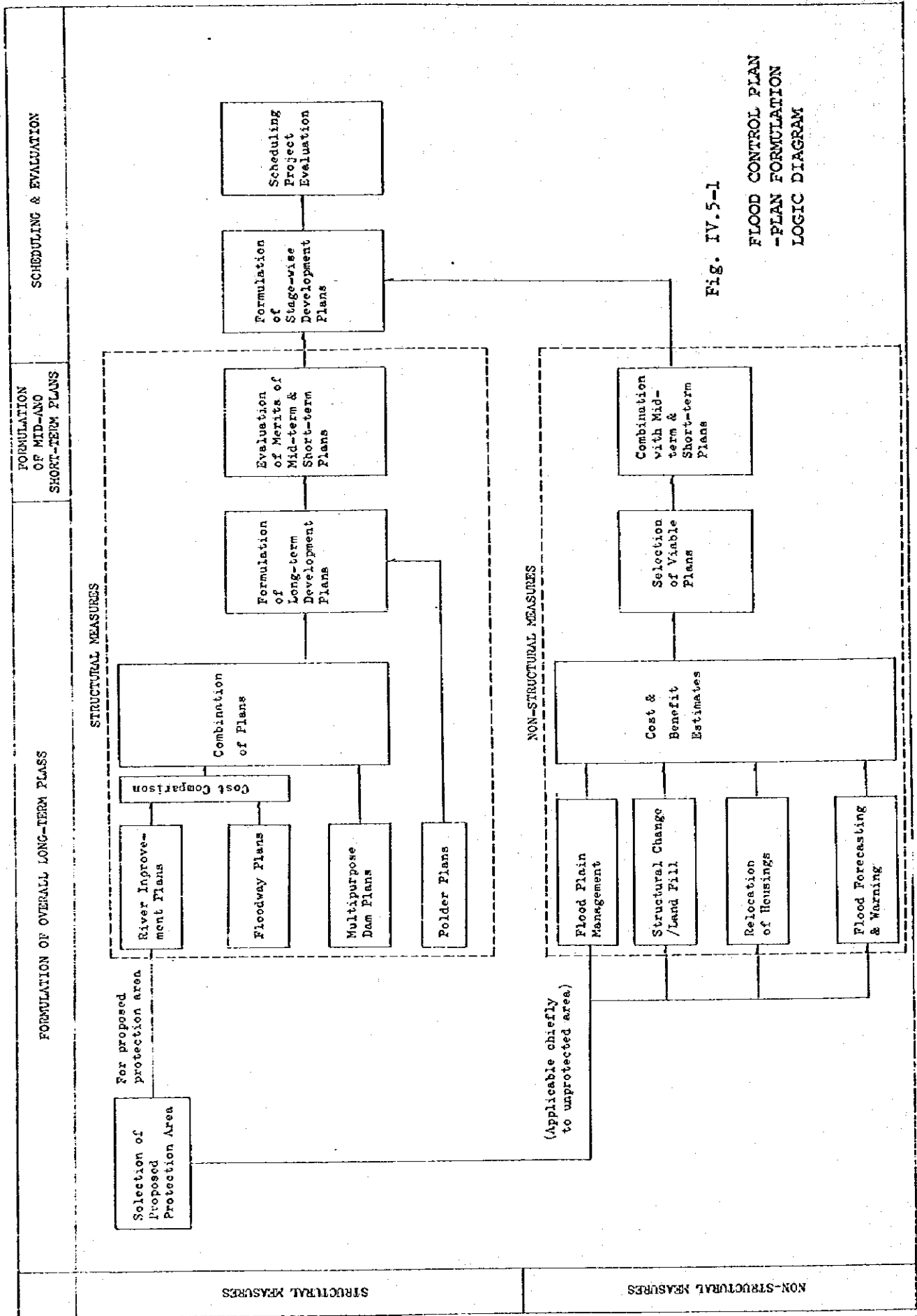


Fig. IV.5-1

FLOOD CONTROL PLAN
-PLAN FORMULATION
LOGIC DIAGRAM

LEGEND

- ==== Major road
- +++++ Railway
- River
- ▨ City/Town
- Inundation area by 100-yr flood
- Inundation area by 5-yr flood

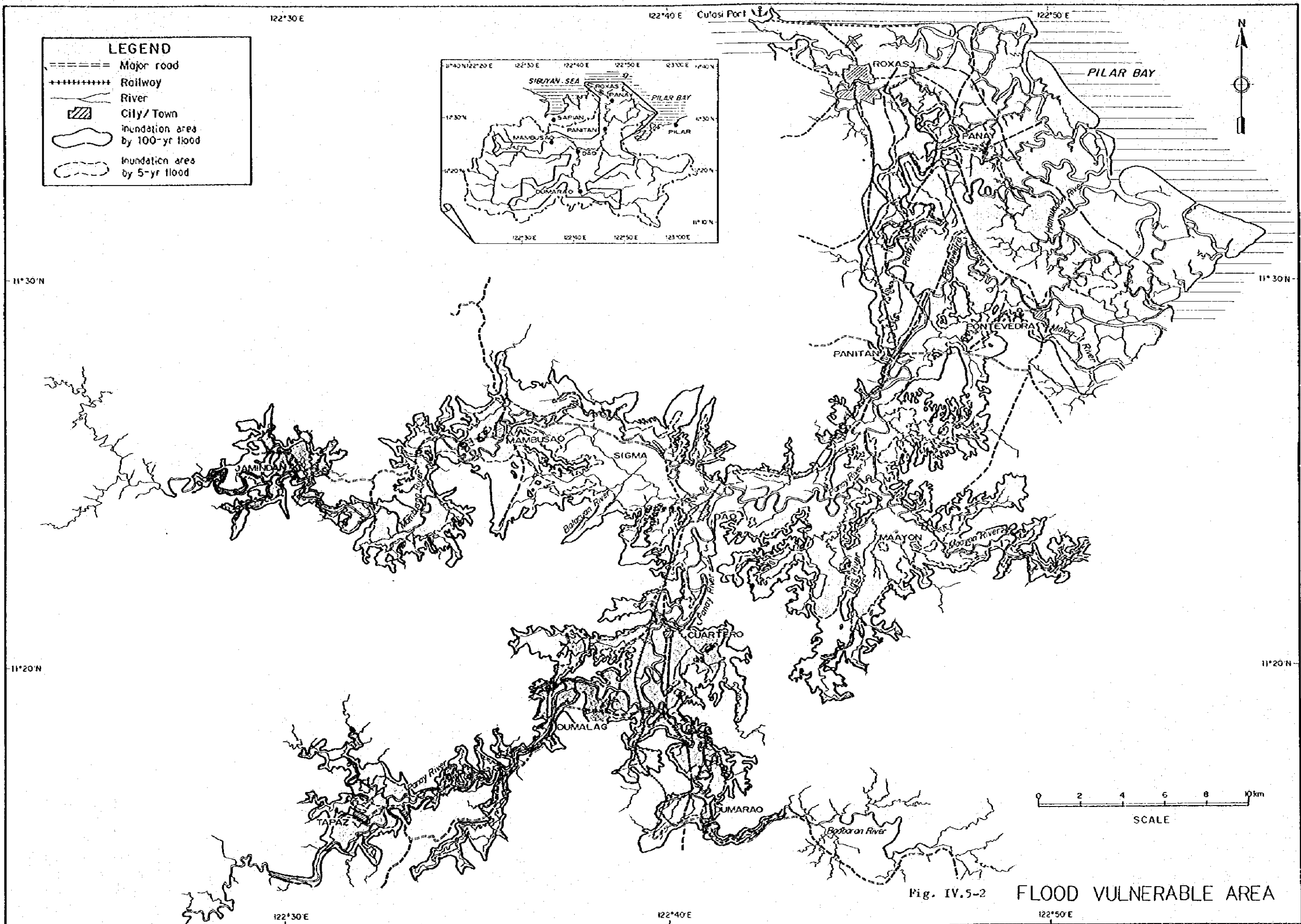
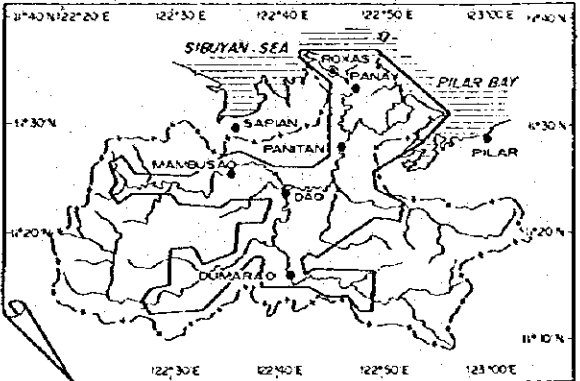


Fig. IV.5-2 FLOOD VULNERABLE AREA

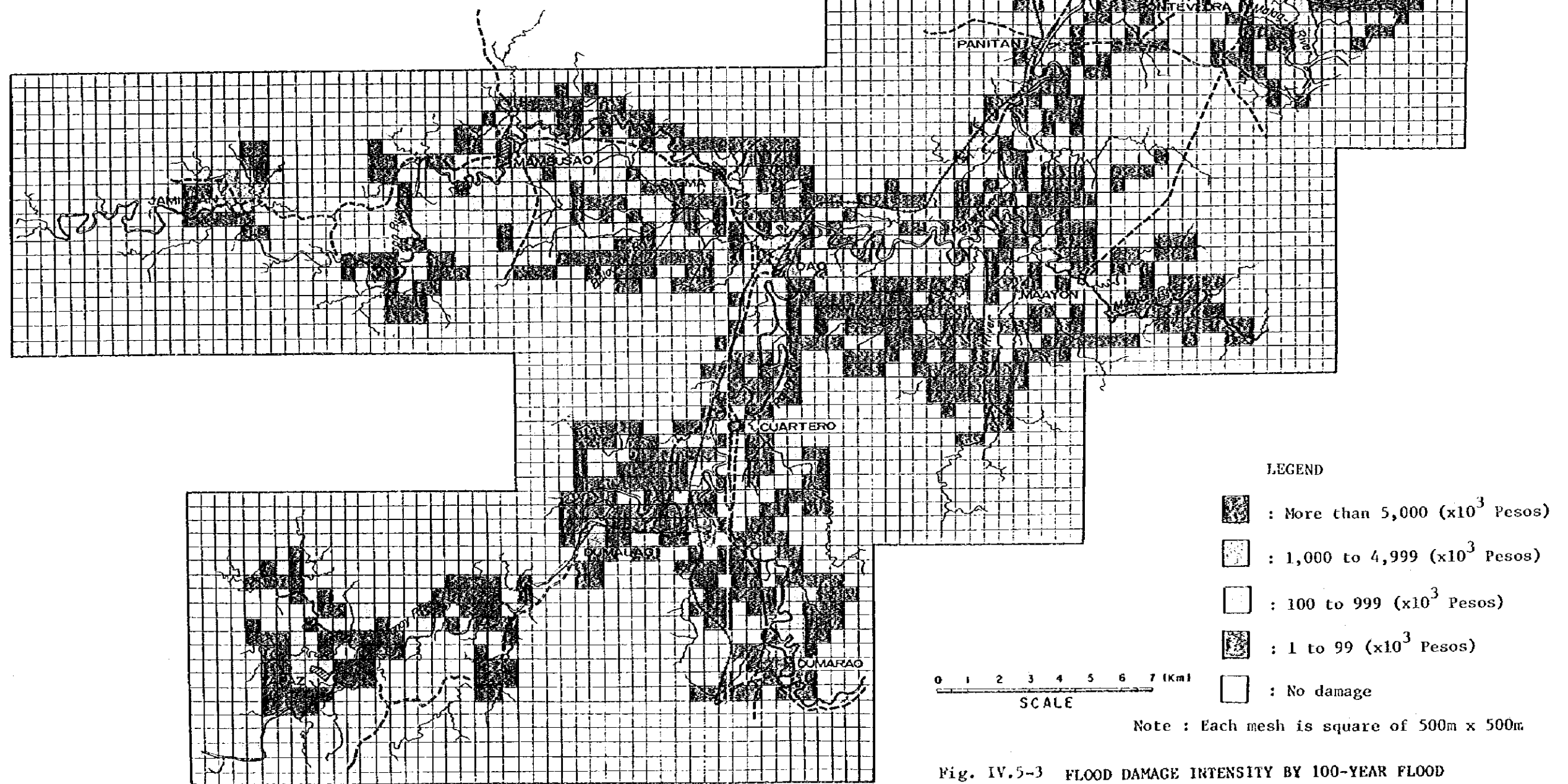
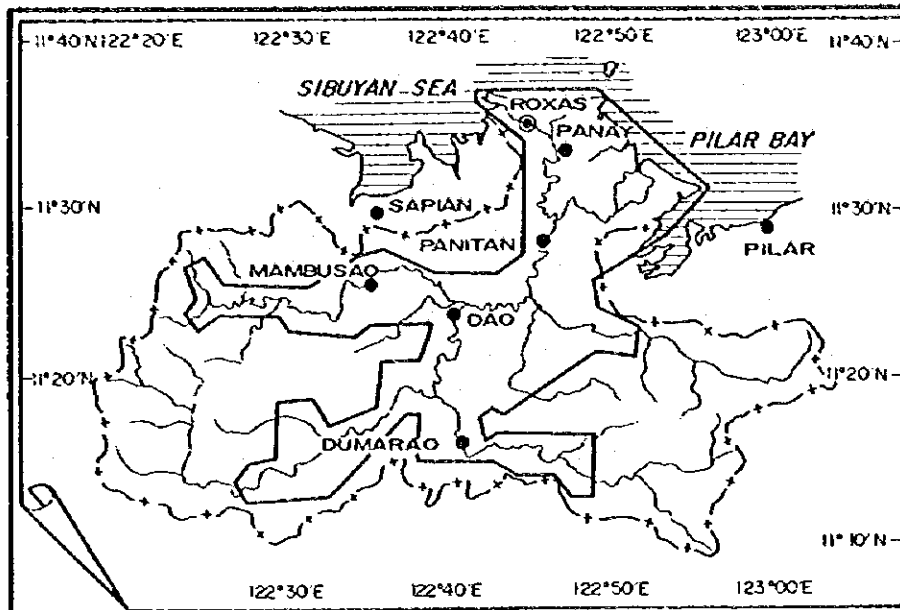


Fig. IV.5-3 FLOOD DAMAGE INTENSITY BY 100-YEAR FLOOD

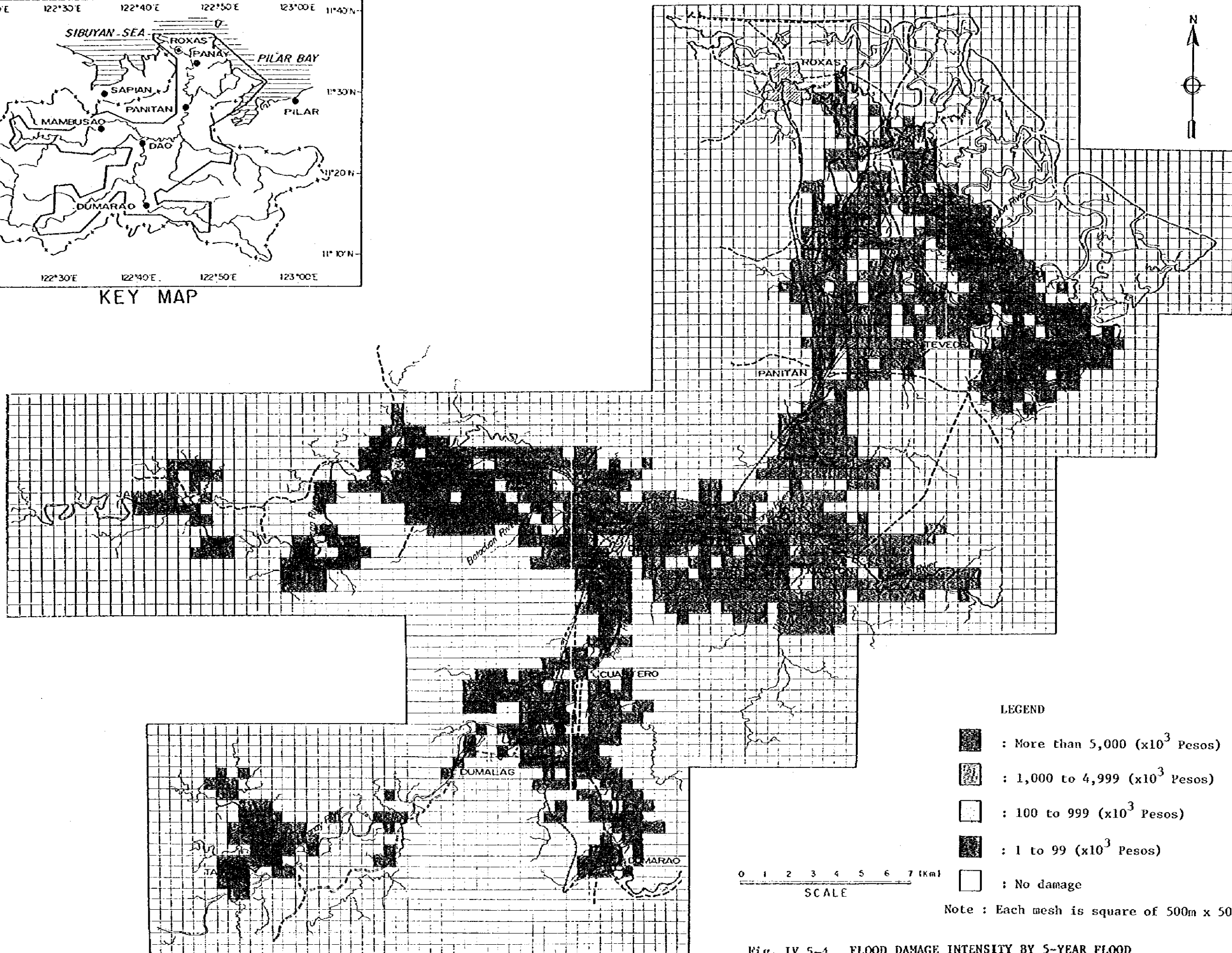
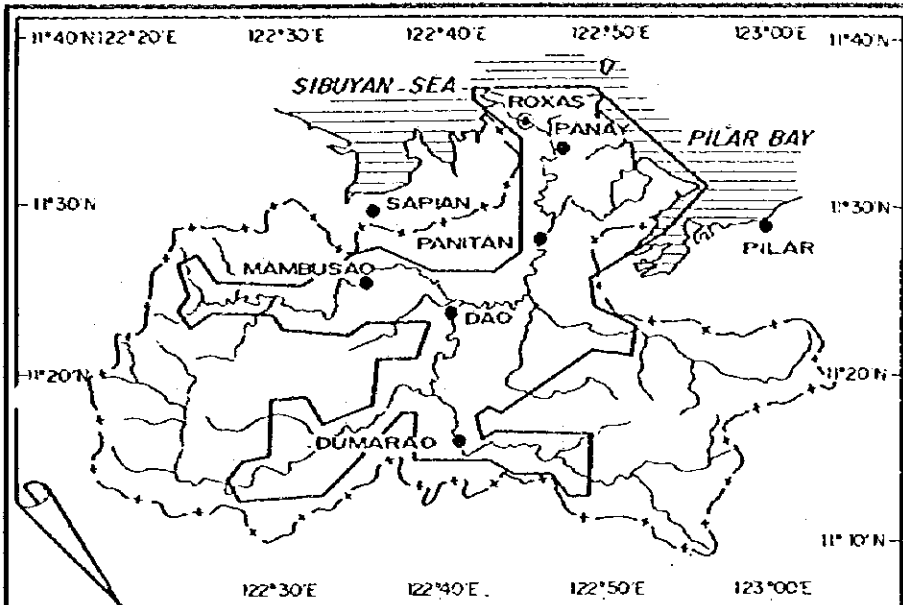


Fig. IV.5-4 FLOOD DAMAGE INTENSITY BY 5-YEAR FLOOD