11. COST ESTIMATES

11.1 Cost Estimation Criteria

The cost estimation criteria presented herein are prepared for comparative study of alternative and proposed flood control plans.

11.1.1 Constitution of Project Cost

Basic Conditions

In estimating the project cost, the following basic conditions are assumed.

(1) The construction works are to be procured by bidding.

(2) Unit cost of each construction work item is estimated on a unit price basis, except for some work items to be estimated on a lump sum/percentage basis.

(3) Unit prices are based on the price level of June 1989.

(4) Exchange rates of the foreign and local currencies are US$1.00 = ₱21.30 = ¥132.00.

Constitution of Project Cost

The project cost is composed of main construction cost, compensation cost, administration and engineering services, and contingencies. The detailed constitution of the project cost is shown in Figure 11.1.1. The project cost is classified into two categories: financial cost and economic cost. The financial cost is the budgetary cost required for implementation of the project, and the economic cost is used for economic evaluation of the project.

11.1.2 Main Construction Cost

The main construction cost consists of the cost of preparatory works, main works and miscellaneous works.

Preparatory Works

The cost of preparatory works is usually in the range of 5 to 10% of the cost of main construction works for flood control and river improvement depending on the project study status. Therefore, in this estimation, 10% which is onin the higher side of the range is applied.

Main Works

The cost of main works is computed as the unit cost multiplied by the work quantity. The unit cost of each work item consists of a direct cost and indirect cost. The direct cost in the unit cost consists of materials cost, equipment expenses, and labor cost. These costs and expenses are estimated on unit prices based on the "Agno Flood Control System CY-1989 Regular Infrastructure Program" of DPWH-PMO AFCS and similar projects in the Study area.

The indirect cost consists of (1) overhead, contingencies and miscellaneous (OCM), (2) profit, (3) mobilization and demobilization for contractor, and (4) Value Added Tax (VAT). Each item of the indirect cost is computed in percentage according to the guideline of DPWH.

The percentages of indirect cost are as follows.

(1)	Overhead, Contingencies and Miscellaneous	:	9% of sum of estimated direct cost
(2)	Profit	:	7% of sum of estimated direct cost
(3)	Mobilization and Demobilization	:	5% of sum of estimated direct cost
(4)	Value Added Tax	:	10% of equipment expenses and labor cost in direct cost

Miscellaneous Works

This study is made at the master plan level. Therefore, 15% of the sum of prepatory works and main works is adopted as the rate of miscellaneous works.

11.1.3 Compensation

The cost of compensation is estimated on a unit basis divided into land acquisition and house evacuation, which are classified as follows.

Land Acquisition	:	Land 1 (farmland)
		Land 2 (non-farmland)
House Evacuation	:	Building 1 (light)
		Building 2 (strong-framed)

The following unit costs, which represent average values in the project area obtained from the provincial assessors, are adopted in the estimate of cost of compensation.

Commercial area	:	₱400,000/ha
Residential area	:	₱150,000/ha
Farmland (Irrigated) area	:	₱10,000/ha
Non-farmland area	:	₱7,000/ha
Building 1	:	₱40,000/unit
Building 2	:	₱80,000/unit

11.1.4 Administration and Engineering Services

The administration cost of the government is computed at 5% of the sum of the main construction and compensation costs according to the standard criteria of DPWH.

The cost of engineering services herein estimated covers the detailed design and construction supervision. Therefore, 16% of the cost of main construction works is adopted as the rate of the engineering cost.

11.1.5 Project Contingency

The project contingency consists of physical contingency and price escalation contingency.

The physical contingency is usually estimated at 10 to 20% depending on the project study status. In this study, 15% which is the average value of the above percentage is applied.

The price escalation rates adopted are 6% for local currency and 3% for foreign currency which are currently used in the projects financed by OECF loan.

11.1.6 Currency Proportion

The financial project cost is estimated assuming that the majority of it will be financed by international financing agencies. The assumed currency components of unit costs are as follows:

Particulars	Portion of Unit Cost	
	Foreign Currency (%)	Local Currency (%)
(1) Labor Cost	0	100
(2) Equipment Cost	100	0
(3) Material Cost		
(a) Fuel	50	50
(b) Cement	65	35
(c) Re-bar	65	35
(d) Structural Steel	100	0
(e) Others	0	100
(4) Overhead (Excl. VAT)	(2+3) x 21	(1+3) x 21
(5) Value Added Tax (VAT)	0	(1+3) x 10
(6) Compensation (land acquisition and resettlement)	0	100
(7) Administration	0	100
(8) Engineering Services	90	10

11.2 Unit Costs

11.2.1 Financial Unit Costs

The financial unit costs of respective construction work items of river and dam works are preliminary prepared based on the foregoing criteria and are listed in Tables 11.2.1 for river works and 11.2.2 for dam works.

11.2.2 Economic Unit Costs

The economic cost is the financial cost less government tax and profit of the contractor, and price escalation contingency.

The economic unit costs of respective construction work items are shown in Table 11.2.3 for river works and Table 11.2.4 for dam works.

11.2.3 Lump Sum Unit Costs

The cost of revetments, groins, sluice ways, water gates, bridges and fixed weirs are estimated by lump sum unit costs listed in Table 11.2.5. These lump sum unit costs are prepared based on the standard design.

11.3 Cost Estimates

11.3.1 Project Cost

The economic project cost and the financial project cost of the Framework Plan and the Long Term Plan were estimated at 1989 constant price level based on the cost estimation criteria and the unit prices specified in Sections 11.1 and 11.2.

Those project costs and work quantities presented in Chapters 9 and 10 were estimated by river stretches and/or river systems constituted in Figure 11.1.2. Corresponding location map is presented in Figure 11.1.3.

Further details of the project cost and the work quantities of the alternative Framework Plans and the Long Term Plan are presented in the Supporting Report, CP: Construction Plan and Cost Estimates.

11.3.2 Financial Project Cost for Long Term Plan

The financial project cost of the proposed Long Term Plan is summarized as follows:

(Unit Mill. Pesos)

River	Foreign Currency Portion	Local Currency Portion	Total
I. Agno River (25-year design flood)			
1. Lower Agno River	4,048	2,248	6,296
2. Poponto Stretch	761	366	1,127
3. Upper Agno River	1,393	811	2,204
Sub-Total	6,203	3,424	9,627
4. Tarlac River	903	518	1,421
5. Tributaries	937	703	1,640
Total of Agno River	8,043	4,645	12,688
II. Allied Rivers (10-year design flood)			
1. Panto-Sinocalan River	1,311	849	2,160
2. Cayanga-Patalan River	615	511	1,126
Total for Allied Rivers	1,926	1,360	3,286
Grand Total	9,969	6,005	15,974

The cost and work quantities are listed in Tables 11.2.6 (1/2) - (2/2) by stretches or tributaries.

Further details of the financial project cost are compiled in Table 2.19 (1-22) of the Supporting Report, CP: Construction Plan and Cost Estimates. The quantity and the cost of compensation for the proposed Long Term Plan is presented in Table 11.2.7.

Table 11.2.1 UNIT COSTS OF RIVER CONSTRUCTION WORKS (FINANCIAL COST)

(Unit : Pesos)

Item No.	Item of Work	Unit	Direct Cost				Indirect Cost					Unit Cost	Remarks
			Material	Equipment	Labor	Total	Overhead Cont'cy & Misc.	Profit	Mob. & Demob.	Value Added Tax	Total		
1.	Excavation 1	cu.m	7.49	35.04	3.57	46.10	4.15	3.23	2.30	3.87	13.55	60	Common Soil
2.	Excavation 2	cu.m	9.36	40.59	4.17	54.12	4.78	3.72	2.65	4.48	15.63	69	Stony with Boulder
3.	Dredging	cu.m	8.10	17.88	1.48	27.46	2.47	1.92	1.37	1.94	7.70	36	Fine Sand
4.	Embankment 1	cu.m	12.53	49.31	5.74	67.58	6.08	4.73	3.38	5.52	19.71	88	Excavated Materials
5.	Embankment 2	cu.m	20.76	76.27	8.16	105.19	9.46	7.37	5.27	8.44	30.54	136	Borrow Materials
6.	Stone Masonry	cu.m	531.53	79.11	138.04	748.68	67.38	52.41	37.43	21.72	178.94	929	Rubble Concrete Class B
7.	Backfilling Gravel	cu.m	15.87	31.00	87.13	134.00	12.06	9.38	6.70	11.81	39.95	174	Hauling Distance : 20km
8.	Sodding	sq.m	1.00	0.00	6.88	7.88	0.71	0.55	0.39	0.67	2.32	10	Native Grass
9.	Concrete (210 kg/cu.cm)	cu.m	1,467.19	62.98	199.12	1,729.29	132.05	121.05	86.46	26.21	365.77	2,095	Class A
10.	Concrete (140 kg/cu.cm)	cu.m	1,274.53	62.98	199.12	1,536.63	138.30	107.56	76.83	26.21	348.90	1,896	Class C
11.	Reinforcing Steel Bar	kg	18.80	1.50	2.47	22.77	2.05	1.59	1.14	0.40	5.18	29	Including Fabrication
12.	Stone Spurdike	cu.m	26.31	38.75	68.67	133.73	12.04	9.36	6.69	10.74	38.83	173	Boulder, 20-40 cm in diameter
13.	Gabion Cylinder	m	95.18	0.00	29.71	124.89	11.24	8.74	6.24	2.97	29.19	154	0.45 m in diameter, L=5.00 m
14.	Gabion Cylinder	m	136.89	0.00	44.21	181.10	16.30	12.68	9.06	4.42	42.46	224	0.60 m in diameter, L=5.00 m
15.	Gabion Mattress	sq.m	229.13	0.00	35.31	264.44	23.80	18.51	13.22	3.53	59.06	324	0.50 x 1.20 x 3.00 m
16.	RC Pile	m	656.02	195.73	267.05	1,118.80	100.69	78.32	55.94	46.28	281.23	1,400	0.40 x 0.40 m
17.	Wooden Pile 1	m	47.46	6.16	22.16	75.78	6.82	5.30	3.79	2.83	18.74	95	0.15 m in diameter
18.	Wooden Pile 2	m	84.00	8.62	31.03	123.65	11.13	8.66	6.18	3.97	29.94	154	0.20 m in diameter
19.	Steel Pipe Pile	m	3,027.45	284.57	116.57	3,428.59	308.57	240.00	171.43	40.11	760.11	4,189	0.60 m in diameter
20.	RC Sheet Pile	sq.m	831.12	445.16	310.03	1,586.31	142.77	111.04	79.32	75.52	408.65	1,995	0.45 x 0.20 m in diameter
21.	Steel Sheet Pile	sq.m	3,917.43	53.04	11.64	3,982.11	358.39	278.75	199.11	6.47	842.72	4,825	Type III
22.	Sluice Gate-1	set	194,000.00	39,000.00	30,000.00	263,000.00	24,000.00	18,000.00	13,000.00	7,000.00	62,000.00	325,000	1.5 x 1.5 m Steel Gate
23.	Sluice Gate-2	set	580,000.00	120,000.00	93,000.00	793,000.00	73,000.00	54,000.00	40,000.00	21,000.00	188,000.00	981,000	2.0 x 2.0 m Steel Gate
24.	Steel Roller Gate	ton	140,000.00	13,000.00	30,000.00	183,000.00	17,000.00	13,000.00	9,000.00	5,000.00	44,000.00	227,000	0.8 t/sq.m w/Guide & Hoist
25.	Bridge	sq.m	7,844.00	1,159.00	1,074.00	10,077.00	907.00	705.00	504.00	223.00	2,339.00	12,420	RC Type
26.	Demolishment, Concrete	cu.m	132.86	334.42	726.72	1,194.00	107.46	83.58	59.70	106.11	356.85	1,550	Reinforced Structure
27.	Demolishment, Metal	ton	56.09	1,600.29	96.40	1,752.78	157.75	122.69	87.64	169.67	537.75	2,290	Metal Structure

Table 11.2.2 UNIT COSTS OF DAM CONSTRUCTION WORKS (FINANCIAL COST)

(Unit : Pesos)

Item No.	Item of Work	Unit	Direct Cost				Indirect Cost					Unit Cost	Remarks
			Material	Equipment	Labor	Total	Overhead Cont'cy & Misc.	Profit	Mob. & Demob.	Value Added Tax	Total		
1.	RIVER DIVERSION WORKS												
1.1	Excavation (Common)	cu.m	8	42	6	56	5	4	3	5	17	73	Soil & Riverbed Materials.
1.2	Excavation (Rock)	cu.m	48	144	8	200	18	14	10	15	57	257	Sound Rock
1.3	Excavation (Tunnel)	cu.m	245	650	13	908	82	64	45	66	257	1,165	
1.4	Concrete (Inlet & Outlet)	cu.m	1,470	400	197	2,067	186	144	103	60	493	2,560	
1.5	Concrete (Tunnel Lining)	cu.m	1,470	455	300	2,225	200	156	111	76	543	2,768	
1.6	Concrete (Plug)	cu.m	1,270	400	130	1,800	162	126	90	53	431	2,231	
1.7	Consolidation Grout	m	1,350	90	60	1,500	135	105	75	15	330	1,830	
1.8	Reinforcing Steel Bar	kg	19	1	3	23	2	2	1	1	6	29	
1.9	Cofferdam	cu.m	12	99	6	117	10	8	6	11	35	152	
2.	DAM												
2.1	Excavation (Common)	cu.m	8	42	6	56	5	4	3	5	17	73	Soil & Riverbed Materials.
2.2	Excavation (Rock)	cu.m	48	144	8	200	18	14	10	15	57	257	Sound Rock
2.3	Excavation (Core)	cu.m	12	99	6	117	10	8	6	11	35	152	
2.4	Embankment (Filter)	cu.m	21	156	6	183	17	13	9	16	55	238	
2.5	Embankment (Rock)	cu.m	38	157	4	199	18	14	10	16	58	257	
2.6	Embankment (Riprap)	cu.m	52	232	8	292	26	20	15	24	85	377	
2.7	Curtain Grout	m	1,800	120	80	2,000	180	140	100	200	620	2,620	
2.8	Blanket/Consolidation Grout	m	1,350	90	60	1,500	135	105	75	15	330	1,830	
2.9	Mass Concrete (Concrete Dam)												
	(1) Volume : 100,000 cu.m	cu.m	576	436	256	1,268	151	89	84	69	393	1,661	
	(2) Volume : 250,000 cu.m	cu.m	561	425	249	1,235	147	86	82	67	382	1,617	
	(3) Volume : 500,000 cu.m	cu.m	540	409	240	1,189	142	83	79	65	369	1,558	
	(4) Volume : 1,000,000 cu.m	cu.m	510	386	227	1,123	134	79	74	61	348	1,471	
	(5) Volume : 2,000,000 cu.m	cu.m	488	370	217	1,075	128	75	71	59	333	1,408	
3.	SPILLWAY												
3.1	Excavation (Common)	cu.m	8	42	6	56	5	4	3	5	17	73	Soil & Riverbed Materials.
3.2	Excavation (Rock)	cu.m	48	144	8	200	18	14	10	15	57	257	Sound Rock
3.3	Concrete	cu.m	1,315	350	175	1,840	162	126	92	53	433	2,273	
3.4	Reinforcing Steel Bar	kg	19	1	3	23	2	2	1	1	6	29	
3.5	Bridge	sq.m	6,500	960	890	8,350	743	578	418	185	1,924	10,274	RC T-beam Type
4.	OUTLET FACILITIES												
4.1	Excavation (Common)	cu.m	8	42	6	56	5	4	3	5	17	73	Soil & Riverbed Materials.
4.2	Excavation (Rock)	cu.m	48	114	8	170	18	14	10	15	57	227	Sound Rock
4.3	Concrete	cu.m	1,470	400	197	2,067	186	144	103	60	493	2,560	
4.4	Reinforcing Steel Bar	kg	19	1	3	23	2	2	1	1	6	29	
5.	METAL WORKS												
5.1	Diversion Closure Gate	ton	98	9	21	128	12	9	6	3	30	158	0.9 t/sq.m, w/steel log
5.2	Spillway Gate	ton	140	13	30	183	17	13	9	5	44	227	0.8 t/sq.m, w/guide and hoist
5.3	Intake Gate	ton	140	13	30	183	17	13	9	5	44	227	2.4 t/sq.m, w/guide and hoist
5.4	Valve	ton	210	18	42	270	24	19	14	6	63	333	40 kg/mm, w/guard gate and hoist
5.5	Other Steel Materials	ton	60	5	13	78	7	5	4	2	18	96	Screen, pipe, etc.

Table 11.2.3 UNIT COSTS OF RIVER CONSTRUCTION WORKS (ECONOMIC COST)

(Unit : Pesos)

Item No.	Item of Work	Unit	Direct Cost				Indirect Cost					Unit Cost	Remarks
			Material	Equipment	Labor	Total	Overhead Cont'cy & Misc.	Profit	Mob. & Demob.	Value Added Tax	Total		
1.	Excavation 1	cu.m	6.74	35.04	3.57	45.35	4.08	0.00	2.27	0.00	6.35	52	Common Soil
2.	Excavation 2	cu.m	7.52	40.59	4.17	52.28	4.71	0.00	2.61	0.00	7.32	60	Stony with Boulder
3.	Dredging	cu.m	7.29	17.88	1.48	26.65	2.39	0.00	1.33	0.00	3.72	30	Fine Sand
4.	Embankment 1	cu.m	11.28	49.31	5.74	66.33	5.97	0.00	3.32	0.00	9.29	76	Excavated Materials
5.	Embankment 2	cu.m	18.68	76.27	8.16	103.11	9.28	0.00	5.16	0.00	14.44	118	Borrow Materials
6.	Stone Masonry	cu.m	478.38	79.11	138.04	695.53	62.60	0.00	34.78	0.00	97.38	793	Rubble Concrete Class B
7.	Backfilling Gravel	cu.m	14.28	31.00	87.13	132.41	11.92	0.00	6.62	0.00	18.54	151	Hauling Distance : 20km
8.	Sodding	sq.m	0.90	0.00	6.88	7.78	0.70	0.00	0.39	0.00	1.09	9	Native Grass
9.	Concrete (210 kg/cu.cm)	cu.m	1,320.47	62.98	199.12	1,582.57	142.43	0.00	79.13	0.00	221.56	1,804	Class A
10.	Concrete (140 kg/cu.cm)	cu.m	1,147.08	62.98	199.12	1,409.18	126.83	0.00	70.46	0.00	197.29	1,606	Class C
11.	Reinforcing Steel Bar	kg	16.92	1.50	2.47	20.89	1.88	0.00	1.04	0.00	2.92	24	Including Fabrication
12.	Stone Spurdike	cu.m	23.68	38.75	68.67	131.10	11.80	0.00	6.56	0.00	18.36	149	Boulder, 20-40 cm in diameter
13.	Gabion Cylinder	m	85.66	0.00	29.71	115.37	10.38	0.00	5.77	0.00	16.15	132	0.45 m in diameter, L=5.00 m
14.	Gabion Cylinder	m	123.20	0.00	44.21	167.41	15.07	0.00	8.37	0.00	23.44	191	0.60 m in diameter, L=5.00 m
15.	Gabion Mattress	sq.m	206.22	0.00	35.31	241.53	21.74	0.00	12.08	0.00	33.82	275	0.50 x 1.20 x 3.00 m
16.	RC Pile	m	590.42	195.73	267.05	1,053.20	94.79	0.00	52.66	0.00	147.45	1,201	0.40 x 0.40 m
17.	Wooden Pile 1	m	42.71	6.16	22.16	71.03	6.39	0.00	3.55	0.00	9.94	81	0.15 m in diameter
18.	Wooden Pile 2	m	75.60	8.62	31.03	115.25	10.37	0.00	5.76	0.00	16.13	131	0.20 m in diameter
19.	Steel Pipe Pile	m	2,724.71	284.57	116.57	3,125.85	281.33	0.00	156.29	0.00	437.62	3,563	0.60 m in diameter
20.	RC Sheet Pile	sq.m	748.01	445.16	310.03	1,503.20	135.29	0.00	75.16	0.00	210.45	1,714	0.45 x 0.20 m in diameter
21.	Steel Sheet Pile	sq.m	3,525.69	53.04	11.64	3,590.37	323.13	0.00	179.52	0.00	502.65	4,093	Type III
22.	Sluice Gate-1	set	175,000.00	39,000.00	30,000.00	244,000.00	22,000.00	0.00	12,000.00	0.00	34,000.00	278,000	1.5 x 1.5 m Steel Gate
23.	Sluice Gate-2	set	522,000.00	120,000.00	93,000.00	735,000.00	66,000.00	0.00	37,000.00	0.00	103,000.00	838,000	2.0 x 2.0 m Steel Gate
24.	Steel Roller Gate	ton	126,000.00	13,000.00	30,000.00	169,000.00	15,000.00	0.00	8,000.00	0.00	23,000.00	192,000	0.8 t/sq.m w/Guide & Hoist
25.	Bridge	sq.m	7,060.00	1,159.00	1,074.00	9,293.00	836.00	0.00	465.00	0.00	1,301.00	10,594	RC Type
26.	Demolishment, Concrete	cu.m	119.57	334.42	726.72	1,180.71	106.26	0.00	59.04	0.00	165.30	1,346	Reinforced Structure
27.	Demolishment, Metal	ton	50.48	1,600.29	96.40	1,747.17	157.25	0.00	87.35	0.00	244.60	1,992	Metal Structure

Table 11.2.4 UNIT COSTS OF DAM CONSTRUCTION WORKS (ECONOMIC COST)

(Unit : Pesos)

Item No.	Item of Work	Unit	Direct Cost				Indirect Cost					Unit Cost	Remarks
			Material	Equipment	Labor	Total	Overhead Cont'cy & Misc.	Profit	Mob. & Demob.	Value Added Tax	Total		
1.	RIVER DIVERSION WORKS												
1.1	Excavation (Common)	cu.m	7	42	6	55	5	0	3	0	8	63	Soil & Riverbed Materials.
1.2	Excavation (Rock)	cu.m	43	144	8	195	18	0	10	0	28	223	Sound Rock
1.3	Excavation (Tunnel)	cu.m	221	650	13	884	80	0	44	0	124	1,008	
1.4	Concrete (Inlet & Outlet)	cu.m	1,323	400	197	1,920	173	0	96	0	269	2,189	
1.5	Concrete (Tunnel Lining)	cu.m	1,323	455	300	2,078	187	0	104	0	291	2,369	
1.6	Concrete (Plug)	cu.m	1,143	400	130	1,673	151	0	84	0	235	1,908	
1.7	Consolidation Grout	m	1,215	90	60	1,365	123	0	68	0	191	1,556	
1.8	Reinforcing Steel Bar	kg	17	1	3	21	2	0	1	0	3	24	
1.9	Cofferdam	cu.m	11	99	6	116	10	0	6	0	16	132	
2.	DAM												
2.1	Excavation (Common)	cu.m	7	42	6	55	5	0	3	0	8	63	Soil & Riverbed Materials.
2.2	Excavation (Rock)	cu.m	43	144	8	195	18	0	10	0	28	223	Sound Rock
2.3	Excavation (Core)	cu.m	11	99	6	116	10	0	6	0	16	132	
2.4	Embankment (Filter)	cu.m	19	156	6	181	16	0	9	0	25	206	
2.5	Embankment (Rock)	cu.m	34	157	4	195	18	0	10	0	28	223	
2.6	Embankment (Riprap)	cu.m	47	232	8	287	26	0	14	0	40	327	
2.7	Curtain Grout	m	1,620	120	80	1,820	164	0	91	0	255	2,075	
2.8	Blanket/Consolidation Grout	m	1,215	90	60	1,365	123	0	68	0	191	1,556	
2.9	Mass Concrete (Concrete Dam)												
	(1) Volume : 100,000 cu.m	cu.m	518	436	256	1,210	151	0	84	0	235	1,445	
	(2) Volume : 250,000 cu.m	cu.m	505	425	249	1,179	147	0	82	0	229	1,408	
	(3) Volume : 500,000 cu.m	cu.m	486	409	240	1,135	142	0	79	0	221	1,356	
	(4) Volume : 1,000,000 cu.m	cu.m	459	386	227	1,072	134	0	74	0	208	1,280	
	(5) Volume : 2,000,000 cu.m	cu.m	439	370	217	1,026	128	0	71	0	199	1,225	
3.	SPILLWAY												
3.1	Excavation (Common)	cu.m	7	42	6	55	5	0	3	0	8	63	Soil & Riverbed Materials.
3.2	Excavation (Rock)	cu.m	43	144	8	195	18	0	10	0	28	223	Sound Rock
3.3	Concrete	cu.m	1,184	350	175	1,709	154	0	85	0	239	1,948	
3.4	Reinforcing Steel Bar	kg	17	1	3	21	2	0	1	0	3	24	
3.5	Bridge	sq.m	5,850	960	890	7,700	693	0	385	0	1,078	8,778	RC T-beam Type
4.	OUTLET FACILITIES												
4.1	Excavation (Common)	cu.m	7	42	6	55	5	0	3	0	8	63	Soil & Riverbed Materials.
4.2	Excavation (Rock)	cu.m	43	144	8	195	18	0	10	0	28	223	Sound Rock
4.3	Concrete	cu.m	1,323	400	197	1,920	173	0	96	0	269	2,189	
4.4	Reinforcing Steel Bar	kg	17	1	3	21	2	0	1	0	3	24	
5.	METAL WORKS												
5.1	Diversion Closure Gate	ton	88	9	21	118	11	0	6	0	17	135	0.9 t/sq.m, w/steel log
5.2	Spillway Gate	ton	126	13	30	169	15	0	8	0	23	192	0.8 t/sq.m, w/guide and hoist
5.3	Intake Gate	ton	126	13	30	169	15	0	8	0	23	192	2.4 t/sq.m, w/guide and hoist
5.4	Valve	ton	189	18	42	249	22	0	12	0	34	283	40 kg/mm, w/guard gate and hoist
5.5	Other Steel Materials	ton	54	5	13	72	6	0	4	0	10	82	Screen, pipe, etc.

Table 11.2.5 STANDARD UNIT CONSTRUCTION COSTS OF FLOOD CONTROL WORKS AND FACILITIES

(Unit : Pesos)

Item No.	Work Items	Unit	Financial Cost			Economic Cost	Remarks
			Foreign Cost	Local Cost	Total		
1.	Excavation 1	cu.m	47	13	60	52	Common soil
2.	Excavation 2	cu.m	54	15	69	60	Stony with boulder
3.	Dredging	cu.m	27	9	36	30	Fine sand
4.	Embankment 1	cu.m	67	21	88	76	Excavated materials
5.	Embankment 2	cu.m	104	32	136	118	Borrow materials
6.	Sodding	sq.m	0	10	10	9	Native grass
7.	Revetment (L.W.C.)						Gabion type
	Type-A	sq.m	284	346	630	539	
	Type-B	sq.m	191	233	424	363	
8.	Revetment (H.W.C.)						Wet masonry type
	Type-A	sq.m	302	370	672	575	
	Type-B	sq.m	239	291	530	453	
9.	Groin (L.W.C.)						
	Type-A	pc.	33,860	97,140	131,000	112,000	Wooden pile type
	Type-B	pc.	287,000	390,000	677,000	575,000	Concrete frame type
10.	Groin (H.W.C.)						
	Type-A	pc.	33,500	61,500	95,000	80,000	Wooden pile type
	Type-B	pc.	232,000	317,000	549,000	465,000	Concrete frame type
11.	Sluice Way						
	Type-A	pc.	1,161,000	549,000	1,710,000	1,450,000	Culvert, 1.5x1.5 m
	Type-B	pc.	1,736,000	775,000	2,511,000	2,128,000	Culverts, 1.5x1.5 m x 2
12.	Water Gate						
	Type-A	pc.	14,730,000	5,881,000	20,611,000	17,459,000	Slide gate, 10.0x7.0 m
	Type-B	pc.	31,174,000	11,172,000	42,346,000	36,161,000	Slide gate, 20.0x8.0 m
13.	Demolishment						
	Concrete	cu.m	485	1,065	1,550	1,346	
	Metal	ton	1,970	320	2,290	1,992	
14.	Bridge	sq.m	6,620	5,800	12,420	10,594	Concrete type
15.	Fixed Weir	pc.	44,490,000	36,403,000	80,893,000	69,300,000	

Table 11.2.6 FINANCIAL PROJECT COST OF LONG TERM PLAN (1/2)

(Unit:1,000 Pesos)

River	Length (km)	F.C.	L.C.	Total
I. Agno River				
1. Lower Agno River				
(1) RM-AG045	6.9	955,609	679,183	1,634,792
(2) AG045-AG122	25.1	1,958,053	963,113	2,921,166
(3) AG122-AG282	11.9	979,063	519,039	1,498,102
Sub-total of 1	43.9	3,892,725	2,161,335	6,054,060
2. Poponto Stretch				
(1) Bayambang Stretch	10.5	76,139	53,450	129,589
(2) Poponto Floodway	10.7	685,298	312,500	997,798
Sub-total of 2	21.2	761,437	365,950	1,127,387
3. Upper Agno River				
(1) AG309-AG351	14.3	299,418	225,551	524,969
(2) AG351-AG405	10.6	222,559	155,322	377,881
(3) AG405-AG473	19.5	871,344	429,655	1,300,999
Sub-total of 3	44.4	1,393,321	810,528	2,203,849
Total of I	109.5	6,047,483	3,337,813	9,385,296
II. Tarlac River				
(1) AG180-TA200	8.1	456,111	184,589	640,700
(2) TA200-TA265	29.0	446,532	333,839	780,371
Total of II	37.1	902,643	518,428	1,421,071
III. Agno River Tributary				
(1) Camiling River	20.0	225,737	161,015	386,752
(2) Banila River	30.9	459,202	314,534	773,736
(3) Viray-Dipalo River	20.1	150,801	149,433	300,234
(4) Ambayoan River	8.7	101,274	78,013	179,287
Total of III	79.7	937,014	702,995	1,640,009
GRAND TOTAL (I+II+III)	226.3	7,887,140	4,559,236	12,446,376

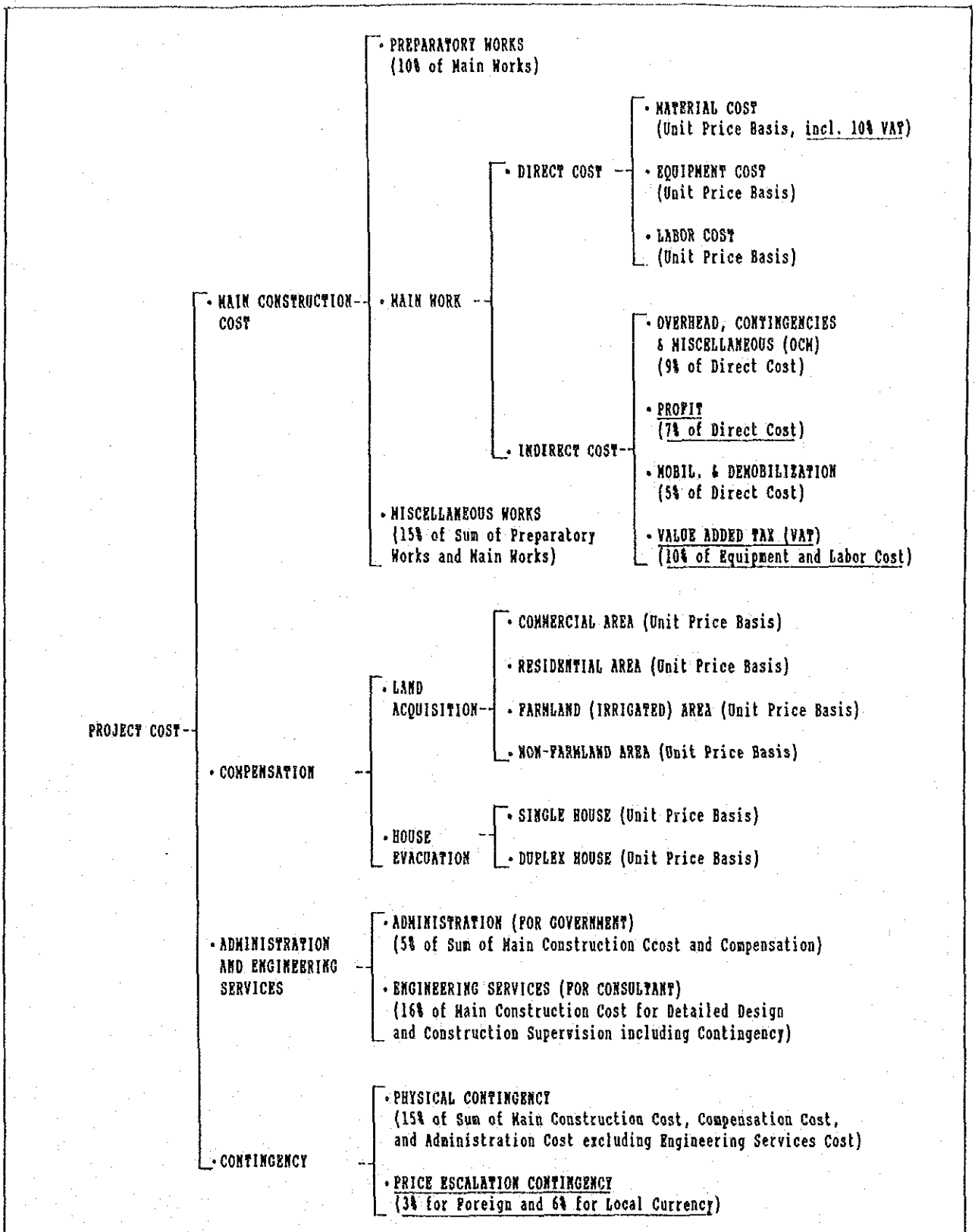
Table 11.2.6 FINANCIAL PROJECT COST OF LONG TERM PLAN (2/2)

(Unit:1,000 Pesos)

River	Length (km)	F.C.	L.C.	Total
I. Pantal-Sinocalan River				
(1) Pantal-Sinocalan River	49.8	539,589	376,417	916,006
(2) Dagupan River	27.6	379,441	207,483	586,924
(3) Ingalera River	37.5	334,582	219,499	554,081
(4) Macalong River	22.0	57,757	45,235	102,992
(5) Binalonan Floodway	-	-	-	-
Sub-total of I	136.9	1,311,369	848,634	2,160,003
II. Cayanga-Patalan River				
(1) Cayanga-Pantalan River	37.5	338,684	262,748	601,432
(2) Bued River	19.0	214,179	161,985	376,164
(3) Aloragat River	21.3	61,882	86,802	148,684
Sub-total of II	77.8	614,745	511,535	1,126,280
Total of I and II	214.7	1,926,114	1,360,169	3,286,283

Table 11.2.7 QUANTITY AND COST OF COMPENSATION

River/River Stretch	Land (ha)	House (Nos)	Lost (Mill. Pesos)
I. Agno River			
RM-AG045	1,290	1,370	158
AG045-AG122	7,489	750	120
AG122-AG282	2,232	900	76
AG282-AG307	941	190	21
AG307-AG309	1,010	100	16
AG309-AG351	1,860	190	30
AG351-AG405	2,438	250	39
AG405-AG473	2,940	150	30
Total	20,200	3,900	490
II. Tarlac River			
AG180-TA200	885	90	14
TA200-TA265	2,768	90	30
Total	3,653	180	44
III. Tributaries of Agno River			
Ambayoan River	334	0	3
Viray-Dipalo River	651	0	7
Banila River	555	0	6
Camiling River	408	0	4
Total	1,948	0	20
IV. Allied River			
Cayanga-Patalan River	850	0	9
Bued River	910	0	9
Aloragat River	206	0	2
Total	1,966	0	20
V. Pantal-Sinocalan River			
Pantal-Sinocalan River	880	0	9
Binalonan Floodway	68	60	4
Ingalera River	402	0	4
Dagupan River	445	0	4
Macalong River	495	0	5
Total	2,290	60	26
Grand Total	30,057	4,140	600



Note: For Financial Project Cost, all items are included.
For Economic Project Cost, underlined items are excluded.

Fig. 11.1.1 CONSTITUTION OF PROJECT COST (CONTRACT SYSTEM)

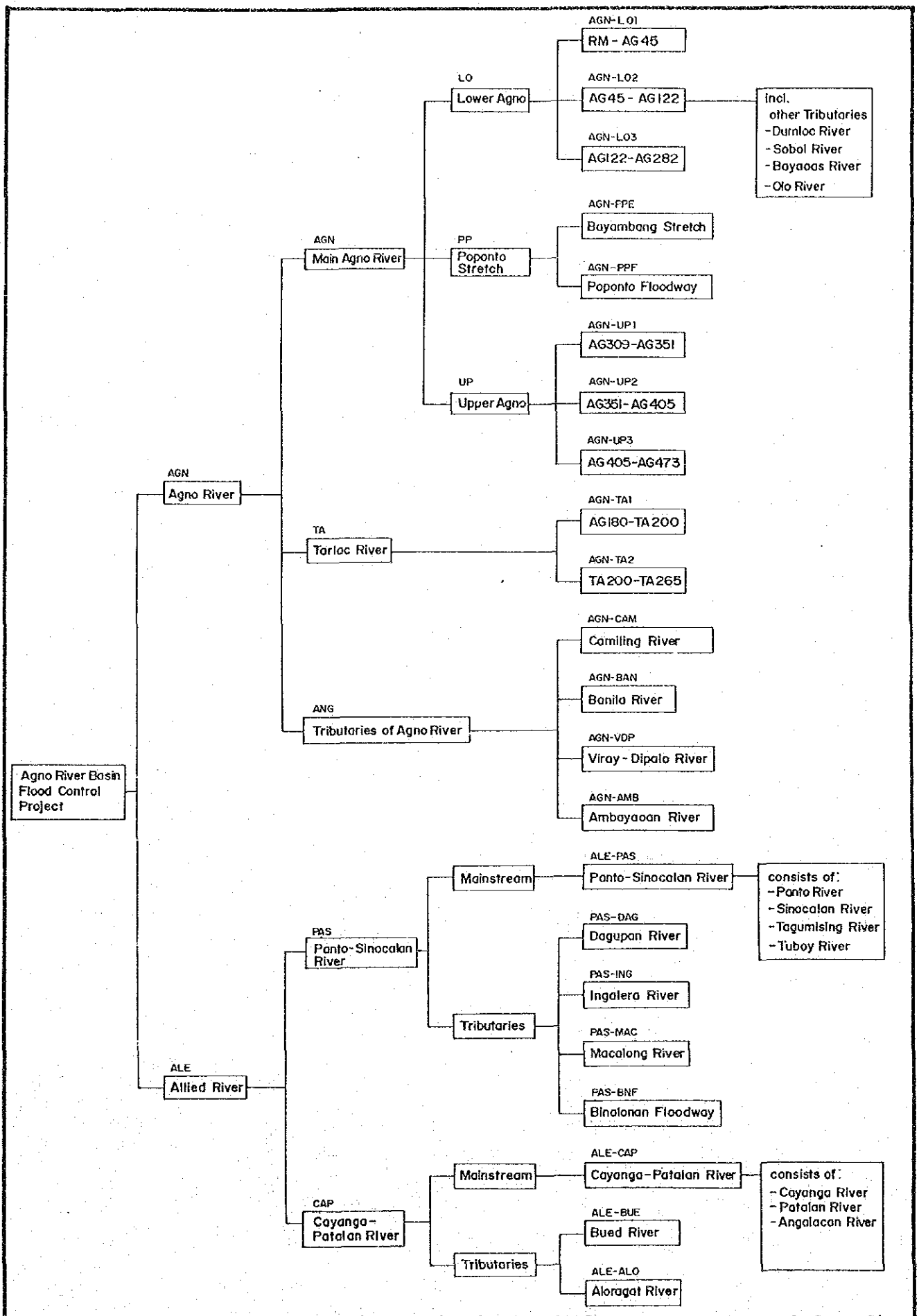


Fig. 11.1.2 CONSTITUTION OF COST ESTIMATE BY RIVER SYSTEMS/ RIVER STRETCHES

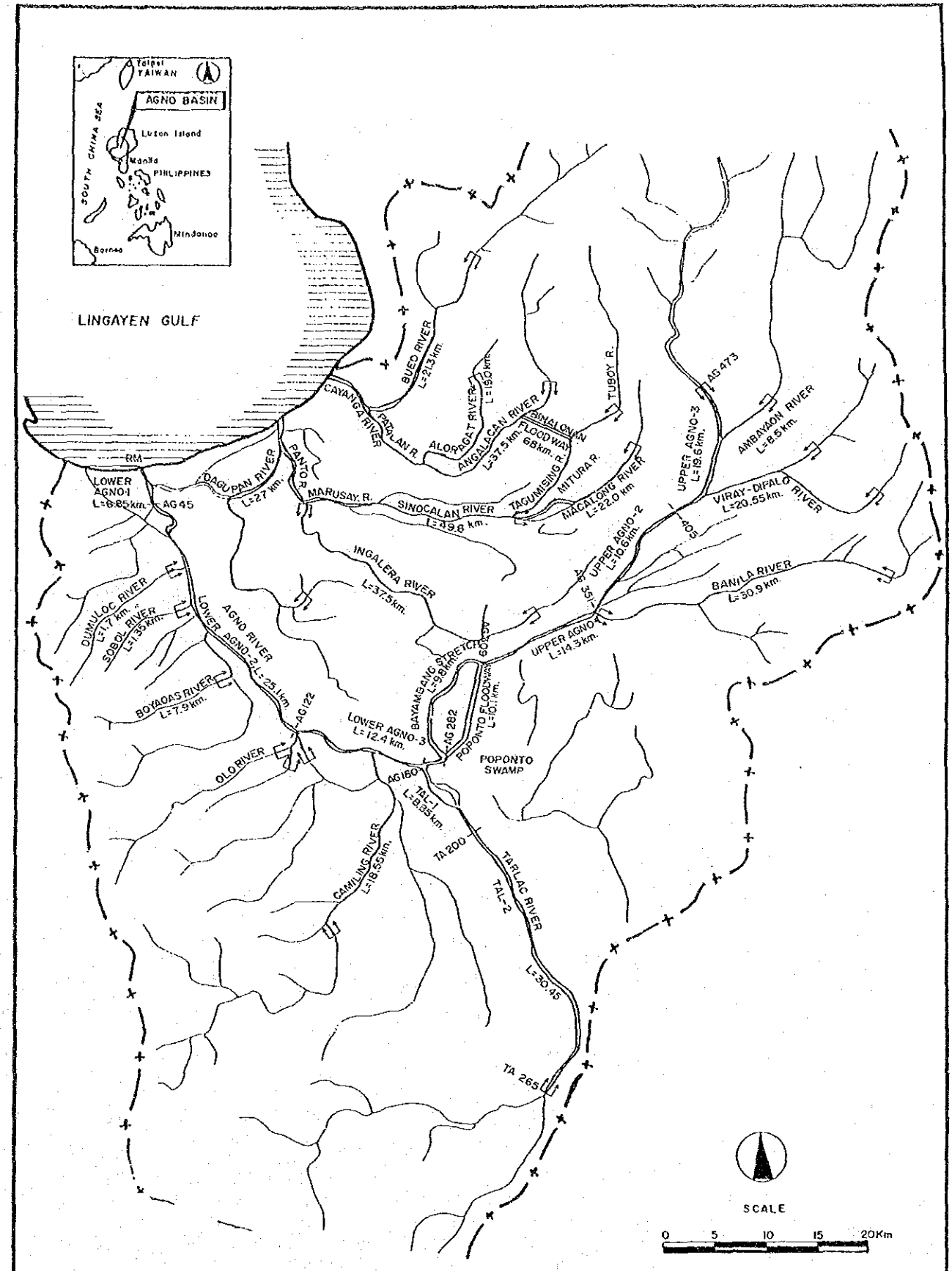


Fig. 11.1.3 LOCATION OF RIVER SYSTEMS/RIVER STRETCHES OF RIVER IMPROVEMENT WORKS

12. ECONOMIC EVALUATION

12. ECONOMIC EVALUATION

12.1 Benefit

The cumulative annual average probable flood damages under the 1989 condition without the project are estimated for the flood frequencies of 1.05, 2, 5, 10, 25, 50 and 100 years as discussed in Section 5.4.

The amount of these annual average probable flood damages which can be reduced by the flood control structural measures (river improvement, dams, retarding basins, floodways) is accounted for by the flood control benefit at 1989 constant price level. The annual average flood control benefit is compiled in Table 12.1.1 for respective river stretches and basins by different flood frequencies.

The study employs the following two benefit flows during the project life of 50 years:

a) Current Development Level (Constant Benefit Flow)

In this case it is assumed that the damageable assets and indirect damages in the Study Area are kept as they are now throughout the project life, computed at 1989 constant price.

b) Future Development Level (Future Growth of Benefit Flow)

In this case the region's damageable assets and indirect damages in the Study Area will increase at the same rate as the region's likely GRDP growth rate (hereinafter called low growth case).

Since the benefit flow of the current development level does not reflect the actual condition of the future damages in the Study Area correctly, the benefit flow of the future development level is adopted for assessing viability of the project, while that of current development level is used as supplemental information.

For projecting the future damageable assets and indirect damages, cases of high growth and low growth are reviewed. The high growth case assumes

that the region's damageable assets and indirect damages will increase at the same rate as the region's targeted GRDP growth rate (projected by NEDA) while the low growth case assumes that those of the region will increase at the same rate taken from the actual performance of the region's economy during the period 1975-1982. The projected growth factors are as follows:

	1989	1990	1991	2000	2001	2010	2044
High Growth Case							
.GRDP Growth Rate(%/yr)	5.9	5.9	5.2	5.2	5.6	5.6	5.6
.Growth Factor	1.000	1.059	1.114	1.850	1.953	3.368	22.68
Low Growth Case							
.GRDP Growth Rate(%/yr)	5.2	5.2	5.2	5.2	5.2	5.2	5.2
.Growth Factor	1.0	1.052	1.107	1.837	1.933	3.209	18.92

In this study the of low GRDP growth case is adopted because it will reflect more realistic future damages in the Study Area.

12.2 Economic Benefit Cost Analysis

Optimization of Long Term Plan

This study employs the normative economic evaluation of benefit cost analysis. The economic internal rate of return (EIRR) is calculated as the optimization criteria. The Long Term Plan is considered as an independent flood control and protection project for the flood prone areas in the Study Area.

For the optimization of the development scale (flood control scale) of the Long Term Plan the following evaluation criteria are adopted for the benefit cost analysis:

(1)	Base Year for B/C Analysis	Beginning of 1990
(2)	Project Life	50 year (from 1995-2044)
(3)	Start of Construction	Beginning of 1995
(4)	Construction Period	15 years (from 1995-2009)

(5)	Disbursement Schedule	Uniform distribution of total project cost during the construction period
(6)	Annual Operation and Maintenance Cost	0.5% of main construction cost and physical contingency of completed works
(7)	Price Escalation Rate	No escalation
(8)	Timing of Benefits	(a) River improvement and floodway: in proportion to the completion rate of the main construction works. (b) Dam: the year the whole dam is completed.
(9)	Growth Factor (GF) of Future Benefits	(a) Current development level: constant (GF=1.0) (b) Future development level: low growth of GRDP (see Section 12.1)

The results of the benefit cost analysis are summarized in Table 12.2.1 and the optimization result is illustrated in Figure 12.2.1. The optimum development scale is assessed for the case of future development level in terms of EIRR as set out below:

	Optimum Flood Control Scale	EIRR(%)
Agno River with Tarlac	25 year flood	16.6 (3.9)
Agno River Tributaries	25 year flood	15.5 (3.1)
Allied Rivers	10 year flood	33.8 (15.2)
STUDY AREA	25 year flood	20.5 (6.5)

The EIRR in the parentheses is the case of current development level.

The cash flows of the optimum Long Term Plan are shown in Table 12.2.2 for the Agno River, Table 2.2.3 for the Agno River Tributaries and Table 2.2.4 for the Allied Rivers.

Priority Project Areas

The priority flood control areas identified in Section 13.1.2 are assessed for the 10-year flood in terms of EIRR assuming the same evaluation criteria. The calculation results of the benefit cost analysis are summarized in Table 13.1.1.

12.3 Project Evaluation

The result of the economic benefit cost analysis presented in Section 12.2 justifies that the Long Term Plan is economically viable with the economic internal rate of return of 20% in the whole Study Area.

If all the river improvement works of the Long Term Plan are implemented by the end of year 2009, the monetary and non-monetary benefits will be attained as summarized below.

Flood Protection

- Agno River and its tributaries; 25-year flood
- Pantal-Sinocalan River and Cayanga-Patalan River ; 10-year flood

Benefited Area (protected area)

- 1,400 km^2 ; 57% of the potential inundation area

Benefited Resident (protected people)

- 2.1 million at 2010 ; 65% of the residents in the Study Area or 90% in the potential inundation area

Annual Average Economic Benefit

- 1.03 billion pesos/year at 1989
- 3.31 billion pesos/year at 2010 (1989 price level)

Other Non Monetary Benefits

- Reduction in water-borne parasitic diseases including malaria which usually break out after large floods
- Reduction in loss of lives
- Enhancement of socio-economic stability in the Study Area
- Creation of job opportunities to the local people

Table 12.1.1 ECONOMIC FLOOD CONTROL BENEFIT BY FLOOD FREQUENCIES

Unit:million pesos/yr

River	100-year Flood	50-year Flood	25-year Flood	10-year Flood
AGNO RIVER				
- Agno Main Stream	532	503	456	346
- Tarlac River	45	42	37	26
Total	577	545	493	372
AGNO TRIBUTARIES	-	76	70	58
ALLIED RIVERS				
- Cayanga-Patalan River	-	100	97	90
- Pantol-Sinocalan River	-	406	400	381
Total	-	506	497	471
Study Area	-	1,127	1,060	901

Table 12.2.1 ECONOMIC COST, BENEFIT AND INTERNAL RATE OF RETURN OF THE ALTERNATIVE LONG TERM PLANS

	100 Year Flood (Million Pesos)	50 Year Flood (Million Pesos)	25 Year Flood (Million Pesos)	10 Year Flood (Million Pesos)
AGNO RIVER MAINSTREAM				
(1) Main Construction Cost	6,952	6,254	5,528	4,811
(2) Total Project Cost	10,340	9,400	8,394	7,413
(3) Benefit (Annual)	532	503	456	346
TARLAC RIVER				
(1) Main Construction Cost	897	792	713	612
(2) Total Project Cost	1,288	1,170	1,061	923
(3) Benefit (Annual)	45	42	37	26
AGNO TRIBUTARIES				
(1) Main Construction Cost		1,293	1,012	893
(2) Total Project Cost		1,925	1,506	1,330
(3) Benefit (Annual)		76	70	58
(4) EIRR		(2.1%) 14.0%	(3.1%) 15.5%	(2.7%) 14.9%
AGNO MAIN AND TARLAC RIVERS				
(1) Main Construction Cost	7,831	7,056	6,241	5,423
(2) Total Project Cost	11,628	10,570	9,455	8,336
(3) Benefit (Annual)	577	545	493	372
(4) EIRR		(3.8%) 16.5%	(3.9%) 16.6%	(2.8%) 15.1%
AGNO MAIN, TRIBUTARIES AND TARLAC RIVERS				
(1) Main Construction Cost		8,349	7,253	6,316
(2) Total Project Cost		12,495	10,961	9,666
(3) Benefit (Annual)		621	563	430
CAYANGA-PATALAN RIVER		with floodway	with floodway	with floodway
(1) Main Construction Cost		837	777	715
(2) Total Project Cost		1,246	1,159	1,066
(3) Benefit (Annual)		100	97	90
PANTAL-SINOCALAN RIVER		with floodway	with floodway	with floodway
(1) Main Construction Cost		1,715	1,546	1,319
(2) Total Project Cost		2,553	2,303	1,965
(3) Benefit (Annual)		406	400	381
ALLIED RIVERS		with floodway	with floodway	with floodway
(1) Main Construction Cost		2,552	2,323	2,027
(2) Total Project Cost		3,799	3,462	3,020
(3) Benefit (Annual)		506	497	471
(4) EIRR		(12.9%) 30.2%	(13.9%) 31.8%	(15.2%) 33.8%
AGNO MAIN, TARLAC, AND ALLIED RIVERS				
(1) Main Construction Cost		9,608	8,564	7,450
(2) Total Project Cost		14,369	12,917	11,356
(3) Benefit (Annual)		1,051	990	843
(4) EIRR		(6.4%) 20.4%	(6.9%) 21.0%	(6.6%) 20.6%
AGNO MAIN, TARLAC, TRIBUTARIES AND ALLIED RIVERS (STUDY AREA)				
(1) Main Construction Cost		10,901	9,576	8,343
(2) Total Project Cost		16,294	14,423	12,686
(3) Benefit (Annual)		1,127	1,060	901
(4) EIIR		(6.0%) 19.7%	(6.5%) 20.5%	(6.2%) 20.0%

Remarks

a) Cost and benefit at constant 1989 prices.

b) Economic Internal Rate of Return (EIRR) in parentheses are for the case of current development level, i.e. constant benefit.

c) EIRR values without parentheses are for the case of future development level, i.e. increasing at the growth rate of the GDP of the inundated area under the "low growth" scenario.

Table 12.2.2 CASH FLOW AND ECONOMIC BENEFIT COST ANALYSIS FOR AGNO RIVER : LONG TERM PLAN (CURRENT LEVEL) (1/2)

AGNO RIVER BASIN FLOOD CONTROL STUDY — ECONOMIC EVALUATION PROGRAM (at 1989 Constant Prices)

		Main Const.	Other Costs	Total Cost
CASE NO. LAG-A2-25 Constant Benefit				Unit : Million Pesos
RIVER IMPROVEMENT WORK		6241	3214	9455
DAM CONSTRUCTION WORK		0	0	0
ANNUAL BENEFIT		493 mil. Pesos		
GROWTH FACTORS	2000	1.000		
	2010	1.000		
	2044	1.000		

CALCULATED EIRR 3.86%

No.	Year	Cost Stream: River	Dam	OM River	OM Dam	Total	Benefit	B-C	GROWTH FACTOR
0	1989					0.00	0.00	0.00	1.000
1	1990					0.00	0.00	0.00	1.000
2	1991					0.00	0.00	0.00	1.000
3	1992					0.00	0.00	0.00	1.000
4	1993					0.00	0.00	0.00	1.000
5	1994					0.00	0.00	0.00	1.000
6	1995	630.33	0.00	0.00		630.33	0.00	-630.33	1.000
7	1996	630.33	0.00	2.39		632.73	32.87	-599.86	1.000
8	1997	630.33	0.00	4.78		635.12	65.73	-569.38	1.000
9	1998	630.33	0.00	7.18		637.51	98.60	-538.91	1.000
10	1999	630.33	0.00	9.57		639.90	131.47	-508.44	1.000
11	2000	630.33		11.96	0.00	642.30	164.33	-477.96	1.000
12	2001	630.33		14.35	0.00	644.69	197.20	-447.49	1.000
13	2002	630.33		16.75	0.00	647.08	230.07	-417.01	1.000
14	2003	630.33		19.14	0.00	649.47	262.93	-386.54	1.000
15	2004	630.33		21.53	0.00	651.86	295.80	-356.06	1.000
16	2005	630.33		23.92	0.00	654.26	328.67	-325.59	1.000
17	2006	630.33		26.32	0.00	656.65	361.53	-295.12	1.000
18	2007	630.33		28.71	0.00	659.04	394.40	-264.64	1.000
19	2008	630.33		31.10	0.00	661.43	427.27	-234.17	1.000
20	2009	630.33		33.49	0.00	663.83	460.13	-203.69	1.000
21	2010			35.89	0.00	35.89	493.00	457.11	1.000
22	2011			35.89	0.00	35.89	493.00	457.11	1.000
23	2012			35.89	0.00	35.89	493.00	457.11	1.000
24	2013			35.89	0.00	35.89	493.00	457.11	1.000
25	2014			35.89	0.00	35.89	493.00	457.11	1.000
26	2015			35.89	0.00	35.89	493.00	457.11	1.000
27	2016			35.89	0.00	35.89	493.00	457.11	1.000
28	2017			35.89	0.00	35.89	493.00	457.11	1.000
29	2018			35.89	0.00	35.89	493.00	457.11	1.000
30	2019			35.89	0.00	35.89	493.00	457.11	1.000
31	2020			35.89	0.00	35.89	493.00	457.11	1.000
32	2021			35.89	0.00	35.89	493.00	457.11	1.000
33	2022			35.89	0.00	35.89	493.00	457.11	1.000
34	2023			35.89	0.00	35.89	493.00	457.11	1.000
35	2024			35.89	0.00	35.89	493.00	457.11	1.000
36	2025			35.89	0.00	35.89	493.00	457.11	1.000
37	2026			35.89	0.00	35.89	493.00	457.11	1.000
38	2027			35.89	0.00	35.89	493.00	457.11	1.000
39	2028			35.89	0.00	35.89	493.00	457.11	1.000
40	2029			35.89	0.00	35.89	493.00	457.11	1.000
41	2030			35.89	0.00	35.89	493.00	457.11	1.000
42	2031			35.89	0.00	35.89	493.00	457.11	1.000
43	2032			35.89	0.00	35.89	493.00	457.11	1.000
44	2033			35.89	0.00	35.89	493.00	457.11	1.000
45	2034			35.89	0.00	35.89	493.00	457.11	1.000
46	2035			35.89	0.00	35.89	493.00	457.11	1.000
47	2036			35.89	0.00	35.89	493.00	457.11	1.000
48	2037			35.89	0.00	35.89	493.00	457.11	1.000
49	2038			35.89	0.00	35.89	493.00	457.11	1.000
50	2039			35.89	0.00	35.89	493.00	457.11	1.000
51	2040			35.89	0.00	35.89	493.00	457.11	1.000
52	2041			35.89	0.00	35.89	493.00	457.11	1.000
53	2042			35.89	0.00	35.89	493.00	457.11	1.000
54	2043			35.89	0.00	35.89	493.00	457.11	1.000
55	2044			35.89	0.00	35.89	493.00	457.11	1.000

Table 12.2.2 CASH FLOW AND ECONOMIC BENEFIT COST ANALYSIS FOR AGNO RIVER : LONG TERM PLAN (CURRENT LEVEL) (2/2)

AGNO RIVER BASIN FLOOD CONTROL STUDY — ECONOMIC EVALUATION PROGRAM (at 1989 Constant Prices)

	Main Const.	Other Costs	Total Cost	Unit : Million Pesos
CASE NO. LAG-A2-25 Low Growth				
RIVER IMPROVEMENT WORK	6241	3214	9455	
DAM CONSTRUCTION WORK	0	0	0	
ANNUAL BENEFIT	493 mil. Pesos			
GROWTH FACTORS 2000	1.837			
2010	3.209			
2044	18.920			
CALCULATED EIRR	16.57%			

No.	Year	Cost Stream: River	Dam	OM River	OM Dam	Total	Benefit	B-C	GROWTH FACTOR
0	1989					0.00	0.00	0.00	1.000
1	1990					0.00	0.00	0.00	1.076
2	1991					0.00	0.00	0.00	1.152
3	1992					0.00	0.00	0.00	1.228
4	1993					0.00	0.00	0.00	1.304
5	1994					0.00	0.00	0.00	1.380
6	1995	630.33	0.00	0.00		630.33	0.00	-630.33	1.457
7	1996	630.33	0.00	2.39		632.73	50.37	-582.35	1.533
8	1997	630.33	0.00	4.78		635.12	105.75	-529.37	1.609
9	1998	630.33	0.00	7.18		637.51	166.12	-471.39	1.685
10	1999	630.33	0.00	9.57		639.90	231.50	-408.40	1.761
11	2000	630.33		11.96	0.00	642.30	301.88	-340.41	1.837
12	2001	630.33		14.35	0.00	644.69	389.31	-255.38	1.974
13	2002	630.33		16.75	0.00	647.08	485.76	-161.32	2.111
14	2003	630.33		19.14	0.00	649.47	591.23	-58.24	2.249
15	2004	630.33		21.53	0.00	651.86	705.72	53.85	2.386
16	2005	630.33		23.92	0.00	654.26	829.23	174.97	2.523
17	2006	630.33		26.32	0.00	656.65	961.75	305.10	2.660
18	2007	630.33		28.71	0.00	659.04	1103.29	444.25	2.797
19	2008	630.33		31.10	0.00	661.43	1253.86	592.42	2.935
20	2009	630.33		33.49	0.00	663.83	1413.44	749.61	3.072
21	2010			35.89	0.00	35.89	1582.04	1546.15	3.209
22	2011			35.89	0.00	35.89	1809.85	1773.96	3.671
23	2012			35.89	0.00	35.89	2037.66	2001.77	4.133
24	2013			35.89	0.00	35.89	2265.47	2229.58	4.595
25	2014			35.89	0.00	35.89	2493.28	2457.39	5.057
26	2015			35.89	0.00	35.89	2721.08	2685.20	5.519
27	2016			35.89	0.00	35.89	2948.89	2913.01	5.982
28	2017			35.89	0.00	35.89	3176.70	3140.82	6.444
29	2018			35.89	0.00	35.89	3404.51	3368.63	6.906
30	2019			35.89	0.00	35.89	3632.32	3596.44	7.368
31	2020			35.89	0.00	35.89	3860.13	3824.25	7.830
32	2021			35.89	0.00	35.89	4087.94	4052.06	8.292
33	2022			35.89	0.00	35.89	4315.75	4279.87	8.754
34	2023			35.89	0.00	35.89	4543.56	4507.67	9.216
35	2024			35.89	0.00	35.89	4771.37	4735.48	9.678
36	2025			35.89	0.00	35.89	4999.18	4963.29	10.140
37	2026			35.89	0.00	35.89	5226.99	5191.10	10.602
38	2027			35.89	0.00	35.89	5454.80	5418.91	11.065
39	2028			35.89	0.00	35.89	5682.61	5646.72	11.527
40	2029			35.89	0.00	35.89	5910.42	5874.53	11.989
41	2030			35.89	0.00	35.89	6138.23	6102.34	12.451
42	2031			35.89	0.00	35.89	6366.04	6330.15	12.913
43	2032			35.89	0.00	35.89	6593.85	6557.96	13.375
44	2033			35.89	0.00	35.89	6821.66	6785.77	13.837
45	2034			35.89	0.00	35.89	7049.47	7013.58	14.299
46	2035			35.89	0.00	35.89	7277.27	7241.39	14.761
47	2036			35.89	0.00	35.89	7505.08	7469.20	15.223
48	2037			35.89	0.00	35.89	7732.89	7697.01	15.685
49	2038			35.89	0.00	35.89	7960.70	7924.82	16.147
50	2039			35.89	0.00	35.89	8188.51	8152.63	16.610
51	2040			35.89	0.00	35.89	8416.32	8380.44	17.072
52	2041			35.89	0.00	35.89	8644.13	8608.25	17.534
53	2042			35.89	0.00	35.89	8871.94	8836.06	17.996
54	2043			35.89	0.00	35.89	9099.75	9063.86	18.458
55	2044			35.89	0.00	35.89	9327.56	9291.67	18.920

Table 12.2.3 CASH FLOW AND ECONOMIC BENEFIT COST ANALYSIS FOR AGNO RIVER TRIBUTARIES : LONG TERM PLAN (CURRENT LEVEL) (1/2)

AGNO RIVER BASIN FLOOD CONTROL STUDY — ECONOMIC EVALUATION PROGRAM (at 1989 Constant Prices)

CASE NO. LAT-AT-25 Constant Benefit	Main Const.	Other Costs	Total Cost	Unit : Million Pesos
RIVER IMPROVEMENT WORK	1012	494	1506	
DAM CONSTRUCTION WORK	0	0	0	
ANNUAL BENEFIT	70 mil. Pesos			
GROWTH FACTORS 2000	1.000			
2010	1.000			
2044	1.000			
CALCULATED EIRR	3.08%			

No.	Year	Cost Stream: River	Dam	OM River	OM Dam	Total	Benefit	B-C	GROWTH FACTOR
0	1989					0.00	0.00	0.00	1.000
1	1990					0.00	0.00	0.00	1.000
2	1991					0.00	0.00	0.00	1.000
3	1992					0.00	0.00	0.00	1.000
4	1993					0.00	0.00	0.00	1.000
5	1994					0.00	0.00	0.00	1.000
6	1995	100.40	0.00	0.00		100.40	0.00	-100.40	1.000
7	1996	100.40	0.00	0.39		100.79	4.67	-96.12	1.000
8	1997	100.40	0.00	0.78		101.18	9.33	-91.84	1.000
9	1998	100.40	0.00	1.16		101.56	14.00	-87.56	1.000
10	1999	100.40	0.00	1.55		101.95	18.67	-83.29	1.000
11	2000	100.40		1.94	0.00	102.34	23.33	-79.01	1.000
12	2001	100.40		2.33	0.00	102.73	28.00	-74.73	1.000
13	2002	100.40		2.72	0.00	103.12	32.67	-70.45	1.000
14	2003	100.40		3.10	0.00	103.50	37.33	-66.17	1.000
15	2004	100.40		3.49	0.00	103.89	42.00	-61.89	1.000
16	2005	100.40		3.88	0.00	104.28	46.67	-57.61	1.000
17	2006	100.40		4.27	0.00	104.67	51.33	-53.33	1.000
18	2007	100.40		4.66	0.00	105.06	56.00	-49.06	1.000
19	2008	100.40		5.04	0.00	105.44	60.67	-44.78	1.000
20	2009	100.40		5.43	0.00	105.83	65.33	-40.50	1.000
21	2010			5.82	0.00	5.82	70.00	64.18	1.000
22	2011			5.82	0.00	5.82	70.00	64.18	1.000
23	2012			5.82	0.00	5.82	70.00	64.18	1.000
24	2013			5.82	0.00	5.82	70.00	64.18	1.000
25	2014			5.82	0.00	5.82	70.00	64.18	1.000
26	2015			5.82	0.00	5.82	70.00	64.18	1.000
27	2016			5.82	0.00	5.82	70.00	64.18	1.000
28	2017			5.82	0.00	5.82	70.00	64.18	1.000
29	2018			5.82	0.00	5.82	70.00	64.18	1.000
30	2019			5.82	0.00	5.82	70.00	64.18	1.000
31	2020			5.82	0.00	5.82	70.00	64.18	1.000
32	2021			5.82	0.00	5.82	70.00	64.18	1.000
33	2022			5.82	0.00	5.82	70.00	64.18	1.000
34	2023			5.82	0.00	5.82	70.00	64.18	1.000
35	2024			5.82	0.00	5.82	70.00	64.18	1.000
36	2025			5.82	0.00	5.82	70.00	64.18	1.000
37	2026			5.82	0.00	5.82	70.00	64.18	1.000
38	2027			5.82	0.00	5.82	70.00	64.18	1.000
39	2028			5.82	0.00	5.82	70.00	64.18	1.000
40	2029			5.82	0.00	5.82	70.00	64.18	1.000
41	2030			5.82	0.00	5.82	70.00	64.18	1.000
42	2031			5.82	0.00	5.82	70.00	64.18	1.000
43	2032			5.82	0.00	5.82	70.00	64.18	1.000
44	2033			5.82	0.00	5.82	70.00	64.18	1.000
45	2034			5.82	0.00	5.82	70.00	64.18	1.000
46	2035			5.82	0.00	5.82	70.00	64.18	1.000
47	2036			5.82	0.00	5.82	70.00	64.18	1.000
48	2037			5.82	0.00	5.82	70.00	64.18	1.000
49	2038			5.82	0.00	5.82	70.00	64.18	1.000
50	2039			5.82	0.00	5.82	70.00	64.18	1.000
51	2040			5.82	0.00	5.82	70.00	64.18	1.000
52	2041			5.82	0.00	5.82	70.00	64.18	1.000
53	2042			5.82	0.00	5.82	70.00	64.18	1.000
54	2043			5.82	0.00	5.82	70.00	64.18	1.000
55	2044			5.82	0.00	5.82	70.00	64.18	1.000

Table 12.2.3 CASH FLOW AND ECONOMIC BENEFIT COST ANALYSIS FOR AGNO RIVER TRIBUTARIES : LONG TERM PLAN (CURRENT LEVEL) (2/2)

AGNO RIVER BASIN FLOOD CONTROL STUDY — ECONOMIC EVALUATION PROGRAM (at 1989 Constant Prices)

		Main Const.	Other Costs	Total Cost	Unit : Million Pesos
CASE NO. LAT-AT-25 Low Growth					
RIVER IMPROVEMENT WORK		1012	494	1506	
DAM CONSTRUCTION WORK		0	0	0	
ANNUAL BENEFIT		70	mil. Pesos		
GROWTH FACTORS	2000	1.837			
	2010	3.209			
	2044	18.920			
CALCULATED EIRR		15.46%			

No.	Year	Cost Stream: River	Dam	OM River	OM Dam	Total	Benefit	B-C	GROWTH FACTOR
0	1989					0.00	0.00	0.00	1.000
1	1990					0.00	0.00	0.00	1.076
2	1991					0.00	0.00	0.00	1.152
3	1992					0.00	0.00	0.00	1.228
4	1993					0.00	0.00	0.00	1.304
5	1994					0.00	0.00	0.00	1.380
6	1995	100.40	0.00	0.00		100.40	0.00	-100.40	1.457
7	1996	100.40	0.00	0.39		100.79	7.15	-93.64	1.533
8	1997	100.40	0.00	0.78		101.18	15.01	-86.16	1.609
9	1998	100.40	0.00	1.16		101.56	23.59	-77.98	1.685
10	1999	100.40	0.00	1.55		101.95	32.87	-69.08	1.761
11	2000	100.40		1.94	0.00	102.34	42.86	-59.48	1.837
12	2001	100.40		2.33	0.00	102.73	55.28	-47.45	1.974
13	2002	100.40		2.72	0.00	103.12	68.97	-34.14	2.111
14	2003	100.40		3.10	0.00	103.50	83.95	-19.56	2.249
15	2004	100.40		3.49	0.00	103.89	100.20	-3.69	2.386
16	2005	100.40		3.88	0.00	104.28	117.74	13.46	2.523
17	2006	100.40		4.27	0.00	104.67	136.56	31.89	2.660
18	2007	100.40		4.66	0.00	105.06	156.65	51.60	2.797
19	2008	100.40		5.04	0.00	105.44	178.03	72.59	2.935
20	2009	100.40		5.43	0.00	105.83	200.69	94.86	3.072
21	2010			5.82	0.00	5.82	224.63	218.81	3.209
22	2011			5.82	0.00	5.82	256.98	251.16	3.671
23	2012			5.82	0.00	5.82	289.32	283.50	4.133
24	2013			5.82	0.00	5.82	321.67	315.85	4.595
25	2014			5.82	0.00	5.82	354.01	348.20	5.057
26	2015			5.82	0.00	5.82	386.36	380.54	5.519
27	2016			5.82	0.00	5.82	418.71	412.89	5.982
28	2017			5.82	0.00	5.82	451.05	445.23	6.444
29	2018			5.82	0.00	5.82	483.40	477.58	6.906
30	2019			5.82	0.00	5.82	515.75	509.93	7.368
31	2020			5.82	0.00	5.82	548.09	542.27	7.830
32	2021			5.82	0.00	5.82	580.44	574.62	8.292
33	2022			5.82	0.00	5.82	612.78	606.97	8.754
34	2023			5.82	0.00	5.82	645.13	639.31	9.216
35	2024			5.82	0.00	5.82	677.48	671.66	9.678
36	2025			5.82	0.00	5.82	709.82	704.00	10.140
37	2026			5.82	0.00	5.82	742.17	736.35	10.602
38	2027			5.82	0.00	5.82	774.52	768.70	11.065
39	2028			5.82	0.00	5.82	806.86	801.04	11.527
40	2029			5.82	0.00	5.82	839.21	833.39	11.989
41	2030			5.82	0.00	5.82	871.55	865.73	12.451
42	2031			5.82	0.00	5.82	903.90	898.08	12.913
43	2032			5.82	0.00	5.82	936.25	930.43	13.375
44	2033			5.82	0.00	5.82	968.59	962.77	13.837
45	2034			5.82	0.00	5.82	1000.94	995.12	14.299
46	2035			5.82	0.00	5.82	1033.28	1027.47	14.761
47	2036			5.82	0.00	5.82	1065.63	1059.81	15.223
48	2037			5.82	0.00	5.82	1097.98	1092.16	15.685
49	2038			5.82	0.00	5.82	1130.32	1124.50	16.147
50	2039			5.82	0.00	5.82	1162.67	1156.85	16.610
51	2040			5.82	0.00	5.82	1195.02	1189.20	17.072
52	2041			5.82	0.00	5.82	1227.36	1221.54	17.534
53	2042			5.82	0.00	5.82	1259.71	1253.89	17.996
54	2043			5.82	0.00	5.82	1292.05	1286.23	18.458
55	2044			5.82	0.00	5.82	1324.40	1318.58	18.920

Table 12.2.4 CASH FLOW AND ECONOMIC BENEFIT COST ANALYSIS FOR ALLIED RIVERS : LONG TERM PLAN (CURRENT LEVEL) (1/2)

AGNO RIVER BASIN FLOOD CONTROL STUDY — ECONOMIC EVALUATION PROGRAM (at 1989 Constant Prices)

	Main Const.	Other Costs	Total Cost
CASE NO. LAL-AT-10 Constant Benefit			Unit : Million Pesos
RIVER IMPROVEMENT WORK	2027	993	3020
DAM CONSTRUCTION WORK	0	0	0
ANNUAL BENEFIT	471 mil. Pesos		
GROWTH FACTORS 2000	1.000		
2010	1.000		
2044	1.000		
CALCULATED EIRR	15.18%		

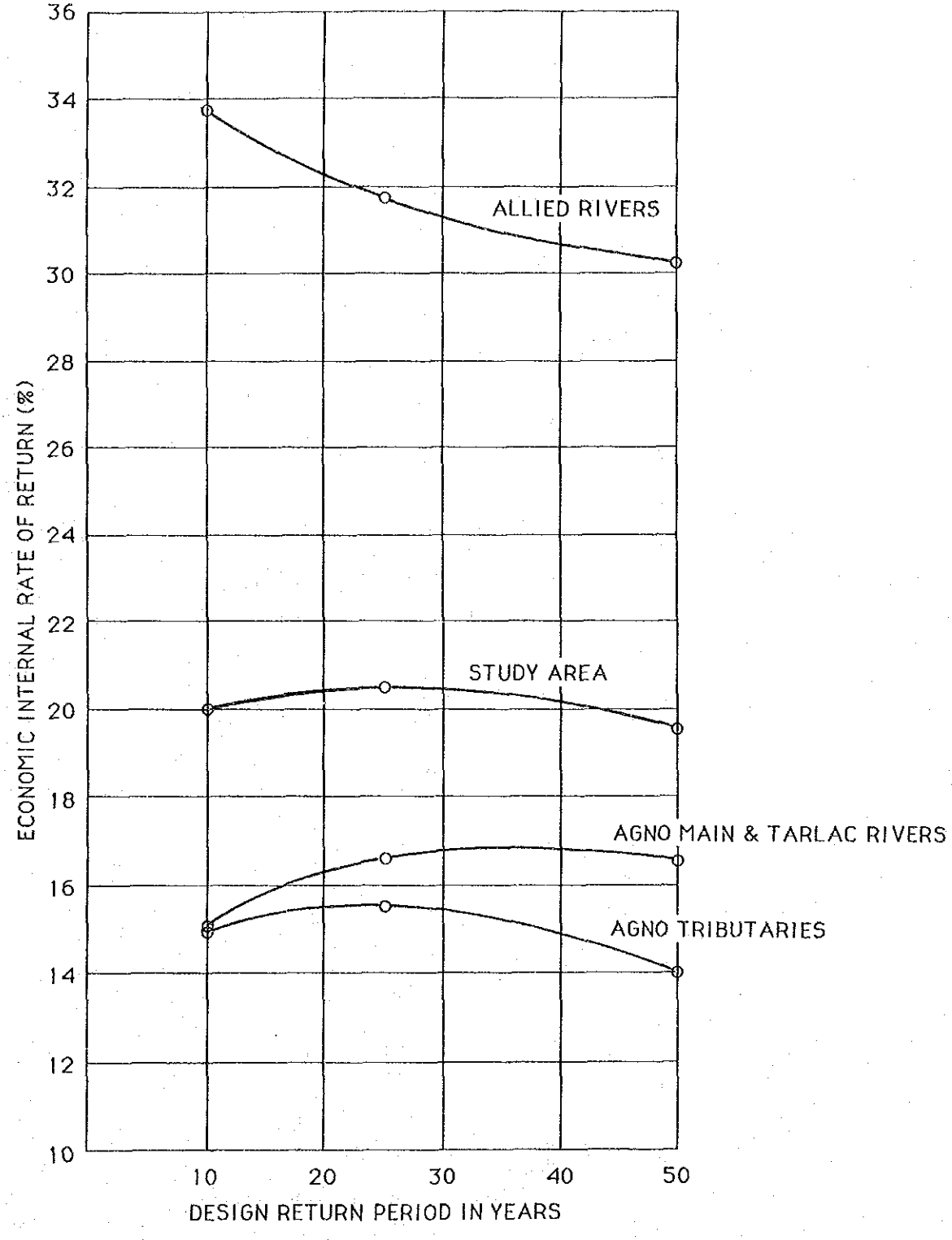
No.	Year	Cost Stream: River	Dam	OM River	OM Dam	Total	Benefit	B-C	GROWTH FACTOR
0	1989					0.00	0.00	0.00	1.000
1	1990					0.00	0.00	0.00	1.000
2	1991					0.00	0.00	0.00	1.000
3	1992					0.00	0.00	0.00	1.000
4	1993					0.00	0.00	0.00	1.000
5	1994					0.00	0.00	0.00	1.000
6	1995	201.33	0.00	0.00		201.33	0.00	-201.33	1.000
7	1996	201.33	0.00	0.78		202.11	31.40	-170.71	1.000
8	1997	201.33	0.00	1.55		202.89	62.80	-140.09	1.000
9	1998	201.33	0.00	2.33		203.66	94.20	-109.46	1.000
10	1999	201.33	0.00	3.11		204.44	125.60	-78.84	1.000
11	2000	201.33		3.89	0.00	205.22	157.00	-48.22	1.000
12	2001	201.33		4.66	0.00	206.00	188.40	-17.60	1.000
13	2002	201.33		5.44	0.00	206.77	219.80	13.03	1.000
14	2003	201.33		6.22	0.00	207.55	251.20	43.65	1.000
15	2004	201.33		6.99	0.00	208.33	282.60	74.27	1.000
16	2005	201.33		7.77	0.00	209.10	314.00	104.90	1.000
17	2006	201.33		8.55	0.00	209.88	345.40	135.52	1.000
18	2007	201.33		9.32	0.00	210.66	376.80	166.14	1.000
19	2008	201.33		10.10	0.00	211.43	408.20	196.77	1.000
20	2009	201.33		10.88	0.00	212.21	439.60	227.39	1.000
21	2010			11.66	0.00	11.66	471.00	459.34	1.000
22	2011			11.66	0.00	11.66	471.00	459.34	1.000
23	2012			11.66	0.00	11.66	471.00	459.34	1.000
24	2013			11.66	0.00	11.66	471.00	459.34	1.000
25	2014			11.66	0.00	11.66	471.00	459.34	1.000
26	2015			11.66	0.00	11.66	471.00	459.34	1.000
27	2016			11.66	0.00	11.66	471.00	459.34	1.000
28	2017			11.66	0.00	11.66	471.00	459.34	1.000
29	2018			11.66	0.00	11.66	471.00	459.34	1.000
30	2019			11.66	0.00	11.66	471.00	459.34	1.000
31	2020			11.66	0.00	11.66	471.00	459.34	1.000
32	2021			11.66	0.00	11.66	471.00	459.34	1.000
33	2022			11.66	0.00	11.66	471.00	459.34	1.000
34	2023			11.66	0.00	11.66	471.00	459.34	1.000
35	2024			11.66	0.00	11.66	471.00	459.34	1.000
36	2025			11.66	0.00	11.66	471.00	459.34	1.000
37	2026			11.66	0.00	11.66	471.00	459.34	1.000
38	2027			11.66	0.00	11.66	471.00	459.34	1.000
39	2028			11.66	0.00	11.66	471.00	459.34	1.000
40	2029			11.66	0.00	11.66	471.00	459.34	1.000
41	2030			11.66	0.00	11.66	471.00	459.34	1.000
42	2031			11.66	0.00	11.66	471.00	459.34	1.000
43	2032			11.66	0.00	11.66	471.00	459.34	1.000
44	2033			11.66	0.00	11.66	471.00	459.34	1.000
45	2034			11.66	0.00	11.66	471.00	459.34	1.000
46	2035			11.66	0.00	11.66	471.00	459.34	1.000
47	2036			11.66	0.00	11.66	471.00	459.34	1.000
48	2037			11.66	0.00	11.66	471.00	459.34	1.000
49	2038			11.66	0.00	11.66	471.00	459.34	1.000
50	2039			11.66	0.00	11.66	471.00	459.34	1.000
51	2040			11.66	0.00	11.66	471.00	459.34	1.000
52	2041			11.66	0.00	11.66	471.00	459.34	1.000
53	2042			11.66	0.00	11.66	471.00	459.34	1.000
54	2043			11.66	0.00	11.66	471.00	459.34	1.000
55	2044			11.66	0.00	11.66	471.00	459.34	1.000

Table 12.2.4 CASH FLOW AND ECONOMIC BENEFIT COST ANALYSIS FOR ALLIED RIVERS : LONG TERM PLAN (CURRENT LEVEL) (2/2)

AGNO RIVER BASIN FLOOD CONTROL STUDY — ECONOMIC EVALUATION PROGRAM (at 1989 Constant Prices)

CASE NO. LAL-AT-10 Low Growth		Main Const.	Other Costs	Total Cost	Unit : Million Pesos
RIVER IMPROVEMENT WORK		2027	993	3020	
DAM CONSTRUCTION WORK		0	0	0	
ANNUAL BENEFIT		471 mil. Pesos			
GROWTH FACTORS	2000	1.837			
	2010	3.209			
	2044	18.920			
CALCULATED EIRR		33.77%			

No.	Year	Cost Stream: River	Dam	OM River	OM Dam	Total	Benefit	B-C	GROWTH FACTOR
0	1989					0.00	0.00	0.00	1.000
1	1990					0.00	0.00	0.00	1.076
2	1991					0.00	0.00	0.00	1.152
3	1992					0.00	0.00	0.00	1.228
4	1993					0.00	0.00	0.00	1.304
5	1994					0.00	0.00	0.00	1.380
6	1995	201.33	0.00	0.00		201.33	0.00	-201.33	1.457
7	1996	201.33	0.00	0.78		202.11	48.12	-153.99	1.533
8	1997	201.33	0.00	1.55		202.89	101.03	-101.86	1.609
9	1998	201.33	0.00	2.33		203.66	158.71	-44.95	1.685
10	1999	201.33	0.00	3.11		204.44	221.17	16.73	1.761
11	2000	201.33		3.89	0.00	205.22	288.41	83.19	1.837
12	2001	201.33		4.66	0.00	206.00	371.94	165.94	1.974
13	2002	201.33		5.44	0.00	206.77	464.09	257.31	2.111
14	2003	201.33		6.22	0.00	207.55	564.85	357.30	2.249
15	2004	201.33		6.99	0.00	208.33	674.23	465.90	2.386
16	2005	201.33		7.77	0.00	209.10	792.22	583.12	2.523
17	2006	201.33		8.55	0.00	209.88	918.83	708.95	2.660
18	2007	201.33		9.32	0.00	210.66	1054.06	843.40	2.797
19	2008	201.33		10.10	0.00	211.43	1197.90	986.47	2.935
20	2009	201.33		10.88	0.00	212.21	1350.36	1138.15	3.072
21	2010			11.66	0.00	11.66	1511.44	1499.78	3.209
22	2011			11.66	0.00	11.66	1729.08	1717.43	3.671
23	2012			11.66	0.00	11.66	1946.73	1935.07	4.133
24	2013			11.66	0.00	11.66	2164.37	2152.71	4.595
25	2014			11.66	0.00	11.66	2382.01	2370.36	5.057
26	2015			11.66	0.00	11.66	2599.66	2588.00	5.519
27	2016			11.66	0.00	11.66	2817.30	2805.65	5.982
28	2017			11.66	0.00	11.66	3034.94	3023.29	6.444
29	2018			11.66	0.00	11.66	3252.59	3240.93	6.906
30	2019			11.66	0.00	11.66	3470.23	3458.58	7.368
31	2020			11.66	0.00	11.66	3687.87	3676.22	7.830
32	2021			11.66	0.00	11.66	3905.52	3893.86	8.292
33	2022			11.66	0.00	11.66	4123.16	4111.51	8.754
34	2023			11.66	0.00	11.66	4340.81	4329.15	9.216
35	2024			11.66	0.00	11.66	4558.45	4546.79	9.678
36	2025			11.66	0.00	11.66	4776.09	4764.44	10.140
37	2026			11.66	0.00	11.66	4993.74	4982.08	10.602
38	2027			11.66	0.00	11.66	5211.38	5199.72	11.065
39	2028			11.66	0.00	11.66	5429.02	5417.37	11.527
40	2029			11.66	0.00	11.66	5646.67	5635.01	11.989
41	2030			11.66	0.00	11.66	5864.31	5852.65	12.451
42	2031			11.66	0.00	11.66	6081.95	6070.30	12.913
43	2032			11.66	0.00	11.66	6299.60	6287.94	13.375
44	2033			11.66	0.00	11.66	6517.24	6505.59	13.837
45	2034			11.66	0.00	11.66	6734.88	6723.23	14.299
46	2035			11.66	0.00	11.66	6952.53	6940.87	14.761
47	2036			11.66	0.00	11.66	7170.17	7158.52	15.223
48	2037			11.66	0.00	11.66	7387.82	7376.16	15.685
49	2038			11.66	0.00	11.66	7605.46	7593.80	16.147
50	2039			11.66	0.00	11.66	7823.10	7811.45	16.610
51	2040			11.66	0.00	11.66	8040.75	8029.09	17.072
52	2041			11.66	0.00	11.66	8258.39	8246.73	17.534
53	2042			11.66	0.00	11.66	8476.03	8464.38	17.996
54	2043			11.66	0.00	11.66	8693.68	8682.02	18.458
55	2044			11.66	0.00	11.66	8911.32	8899.66	18.920



Remarks : The minimum requirement of the flood control scale is set at 10-year flood.

Fig. 12.2.1 OPTIMIZATION OF DEVELOPMENT SCALE FOR LONG TERM PLAN

13. IMPLEMENTATION PROGRAM

13. IMPLEMENTATION PROGRAM

13.1 Priority Project Areas Subject to Feasibility Study

13.1.1 Alternative Priority Flood Control Areas

Among the areas under the Long Term Plan formulated in Section 10.3.2, the priority flood control areas are to be identified for pursuing the Feasibility Study. The priority flood control areas are defined as:

a) The areas where existing and potential flood damages are high, and flood protection measures are required to be implemented with the highest priority.

b) The areas where flood control performance is high in terms of economic efficiency and social and regional impact.

c) The areas whose discharge carrying capacity is less than the 10-year design flood.

The Long Term Plan areas, therefore, are assessed for the 10-year design flood in terms of flood control efficiency (EIRR; economic internal rate of return). The main stream of the Agno River is divided into four stretches for assessment; the downstream stretch (river mouth-AG180), Bayambang-Poponto swamp area (AG180-AG309), the upstream stretch (AG309-AG473) and the Tarlac River (AG180-TA265). The four Agno River tributaries (Camiling, Banila, Viray-Dipalo, Ambayoan) are assessed independently. The Pantal-Sinocalan and Cayanga-Patalan Rivers are also assessed independently.

Since construction of a new diking system in the upstream stretch (AG309-AG473) of the Agno River will confine flood runoff inside the new river area and induce significant increase of flood discharge in the downstream stretches (river mouth to AG309) as illustrated in Figure 13.1.1 and Figure 13.1.2, improvement of the upstream stretch can only be implemented together with the improvement of the Bayambang stretch including the new Poponto floodway or the whole river improvement. Under this precondition, three alternatives, Case 1 to 3 are formulated for the Agno River main stream (river mouth to AG473).

The river stretches which have discharge carrying capacity less than 10-year design flood, in particular in the significantly affected region are identified as the stretches subject to first priority flood control measures. Such river stretches of the Agno River are illustrated in the longitudinal profile in Figure 13.1.4. The location and the corresponding length of the stretches and their carrying capacities are assessed as summarized in Table 13.1.2 for the Agno River and Table 13.1.3 for the Allied Rivers.

13.1.2 Selection of Priority Project Areas

The result of economic assessment tabulated in Table 13.1.1 indicates that the combined river improvement from the Bayambang stretch with the Poponto retarding basin (AG180) to the upstream end (AG473) is the most significant in the Agno River, while the Pantal-Sinocalan River gains the highest EIRR in the Study Area. The following three significant flood control areas are identified:

No.1 Upper Agno River: Case 2, Bayambang stretch with Poponto retarding basin to upstream end

No.2 Pantal-Sinocalan River

No.3 Cayanga-Patalan River with Bued River

The location of these areas is shown in Figure 13.1.3.

Among the foregoing three projects, Project-A, Upper Agno River and Project-B, Pantal-Sinocalan River are chosen as the Priority Project Areas to be retained for Feasibility Study taking account of the economic efficiency and regional significance of flood control.

A. Upper Agno River; Bayambang stretch with Poponto retarding basin (AG180) to the San Manuel stretch (AG473)
   - Improvement of Bayambang stretch of the main Agno River
   - Improvement of Poponto floodway
   - Improvement of Upper Agno stretch

B. Pantal-Sinocalan River; River mouth to the upstream to protect Dagupan city, Calasiao and Santa Barbara towns
   . Improvement of the main Pantal-Sinocalan River
   . Improvement of Dagupan River
   . Improvement of Ingalera River

The economic internal rate of return is preliminarily estimated to be about 24% for Project-A and 40% for the Project-B under future development level.

13.2 Implementation Schedule

Alternative implementation programs for the Long Term Plan are formulated for the target year 2010 and 2020 as shown in Figure 13.2.1 and Figure 13.2.2 respectively. The total project cost of the Long Term Plan, which is estimated to be 15,974 million pesos at 1989 constant price level, corresponds to about 2.5% of the projected cumulative GRDP of the Study Area in the period 1995-2009 (16.9 billion pesos).

Since this amount of public fund required for the flood control works is very high if it is compared with the present level (some 0.5% of GRDP), the study recommends implementing the Long Term Plan by the end of the year 2019 as shown in Figure 13.2.2.

Table 13.1.1 ASSESSMENT OF PRIORITY FLOOD CONTROL AREAS

	10-year Flood Protection					
	Project Cost (million pesos)	Annual Benefit (million pesos)	EIRR (%)	Order of Flood Control Efficiency	Selected Priority Project Area	Weight of River Importance
AGNO MAIN STREAM						1
Case 1: Lower Agno (RM-AG282)	5,069 (4,685)	95.5	9.3	7		
Case 2: Poponto Stretch (AG180-AG309) and Upper Agno (AG309-AG473)	3,102 (2,728)	250.4	23.6	2	No.1	
Case 3: The Whole River (RM-AG473)	8,170 (7,413)	345.9	15.5	4		
TARLAC RIVER (AG180-TA265)	1,221 (923)	25.8	11.3	6		2
AGNO TRIBUTARIES	1,455 (1,330)	58.1	14.9	5		5
. Camiling River	303 (278)	9.3	12.7			
. Banila River	694 (636)	31.3	16.0			
. Viray-Dipalo River	291 (264)	12.1	15.3			
. Ambayoan River	167 (152)	5.4	13.1			
PANTAL-SINOCALAN RIVER	2,160 (2,000)	391.0	39.9	1	No.2	3
CAYANGA-PATALAN RIVER	1,126 (1,020)	79.7	21.3	3	No.3	4

Remarks :
(1) The project cost is the financial cost at 1989 constant price level.
The project cost in the parentheses is the economic cost.
(2) Annual benefit is the economic price at 1989 constant level.
(3) EIRR is the economic internal rate of return for the case of future increase of benefit under lower economic growth.

Table 13.1.2 ASSESSMENT OF CARRYING CAPACITY OF PRIORITY AREAS OF AGNO RIVER AND TARLAC RIVER

River/Stretch	Length of stretch (km)	Design Discharge (m3/s)	Existing Carrying Capacity				
			Discharge (m3/s) Max.	Min.	Q<10yr	10yr<Q<25yr	Q>25yr	Length (km)
					Length of stretch (km)			
I. Agno River		10-year						
1. Lower Agno River								
(1) R.M-AG45	6.85	6500	R 6000	2500	6.85	0.00	0.00	6.85
			L 6000	2500	6.85	0.00	0.00	6.85
(2.1) AG45-AG65	9.05	6500	R 8200	3300	2.50	6.05	0.50	2.50
			L 4800	1200	6.10	1.50	1.45	4.20
(2.2) AG65-AG122	16.05	6500	R 13800	6400	1.20	6.45	8.40	1.20
			L 4000	1000	16.05	0.00	0.00	0.00
(3) AG122-AG282	12.40	5900-5500	R 8400	4400	8.30	4.10	0.00	8.30
			L 3400	1600	12.40	0.00	0.00	0.00
Sub-total of 1	44.35	-	R -	-	18.85	16.60	8.90	18.85
			L -	-	41.40	1.50	1.45	11.05
2. Poponto Stretch								
(1.1) D/S of Bayamban	5.50	1600	2000	1100	4.50	1.00	0.00	3.40
(1.2) U/S of Bayamban	4.95	1600	3000	1500	1.00	2.95	1.00	0.00
(2.1) Retarding Basin	5.50	-	-	-	5.50	0.00	0.00	5.50
(2.2) Floodway	4.60	2400	3200	700	3.60	0.50	0.50	3.60
Sub-total of 2	20.55	-	-	-	14.60	4.45	1.50	12.50
3. Upper Agno River								
(1) AG309-AG351	14.30	4000	R 8400	1500	4.00	7.90	2.40	4.00
			L 14000	1300	6.00	3.00	5.30	6.00
(2) AG351-AG405	10.60	3500	R 12900	1600	2.00	4.10	4.50	2.00
			L 8200	2600	1.50	4.10	5.00	1.50
(3.1) AG405-AG453	10.05	3500	R 5800	1100	2.50	0.75	6.80	2.50
			L 6400	900	7.55	2.00	0.50	2.00
(3.2) AG453-AG473	9.45	2400	R 11200	1000	3.50	1.45	4.50	3.50
			L 12000	1000	3.65	3.00	2.80	0.00
Sub-total of 3	44.40	-	R -	-	12.00	14.20	18.20	12.00
			L -	-	18.70	12.10	13.60	9.50
Total of I	109.30	-	R -	-	45.45	35.25	28.60	43.35
			L -	-	74.70	18.05	16.55	33.05
II. Tarlac River		10-year						
(1) AG180-TA200 Ratarding Basin	8.10	-	-	-	8.10	0.00	0.00	0.00
(2.1) TA200-TA251	24.80	1700	7500	1300	7.50	6.30	11.00	7.50
(2.2) 251-TA265	4.15	1350	5800	1900	0.00	0.00	4.15	0.00
Total of II	37.05				15.60	6.30	15.15	7.50

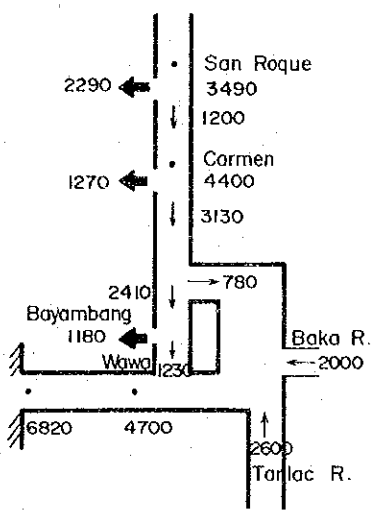
Remarks: R= Right bank; L=Left bank; Q=Discharge

Table 13.1.3 ASSESSMENT OF CARRYING CAPACITY OF PRIORITY AREAS OF ALLIED RIVERS

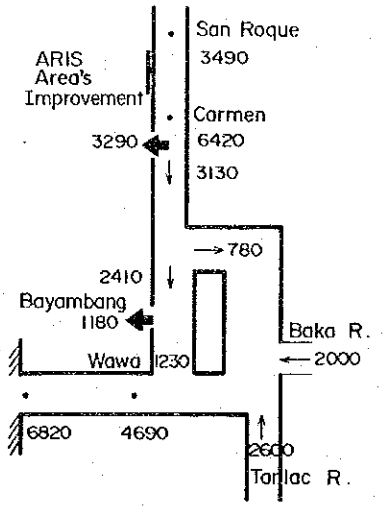
River/Stretch	Length of Stretch (km)	Design Discharge (m3/s)	Existing carrying Capacity (Minimum) Discharge (m3/s)	Probability (yr)	Requirement of Improvement Length (km)
I. Panto-Sinocalan River		10-year			
1. Panto-Sinocalan River					
(1) 0k-2.5k	2.50	1900	500(2)	1.5-2yr	2.50
(2) 2.5k-8.3k	5.80	1250			5.80
(3) 8.3k-18.0k	9.70	900	120(4)	1.00yr	9.70
(4) 18.0k-31.0k	13.00	650			0.00
(5) Tagumising River	18.40	160	180(3)	1.5yr	0.00
Sub-total of 1	49.40				18.00
2. Dagupan River	27.60	700-190	-	-	22.00 (Dike for backwater stretch of Panto river)
3. Ingalera River	37.50	360-80	75(3)	1.00yr	12.00 (Dike for backwater stretch of Panto river)
4. Macalong River	21.00	130-70	-	-	0.00
5. Binalonan Flood	0	-	-	-	0.00
Total of I	135.50				52.00
II. Cayonga-Patalan River		10-year			
1. Cayanga-Patalan River					
(1) 0k-6.5k	6.50	1500	830(2)	3-yr	6.50
(2) 6.5k-14.8k	8.30	800	260(2)	1.5-2yr	0.00
(3) Angalacan River	22.70	400-50	180(3)	1.5-2yr	0.00
Sub-total of 1	37.50				6.50
2. Bued River	19.80	750-500	380(2)	3-yr	15.10
3. Aloragat River	19.70	300-100	-	-	0.00
Total of II	77.00				21.60
Total of I and II	212.50				73.60

Note: The value in parenthesis is available number of river cross-section for estimation of carrying capavity.
Remarks: Q=Discharge

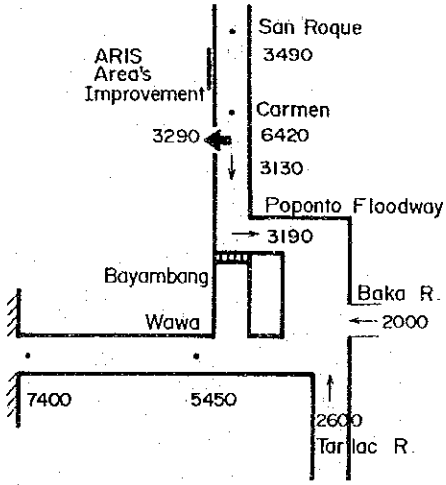
Present Condition
(Without any measures)



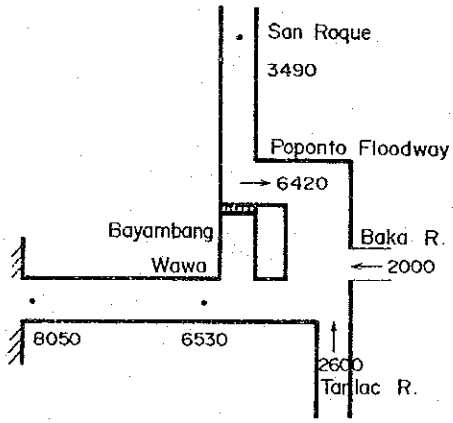
With Improvement of Breaches
in the Upstream Only



With Improvement of Upstream
Breaches and Poponto Floodway
Only



With Improvement of Breaches,
Other Upstream Dikes and Poponto
Floodway



Conditions: (1) 25-year probable flood
(2) without San Roque dam
(3) start dike breaching with the water level over 50% of the freeboad

Unit : m^3/sec

Fig. 13.1.1 PROBABLE FLOOD DISCHARGE DISTRIBUTION OF AGNO RIVER WITH/WITHOUT RIVER IMPROVEMENT WORKS

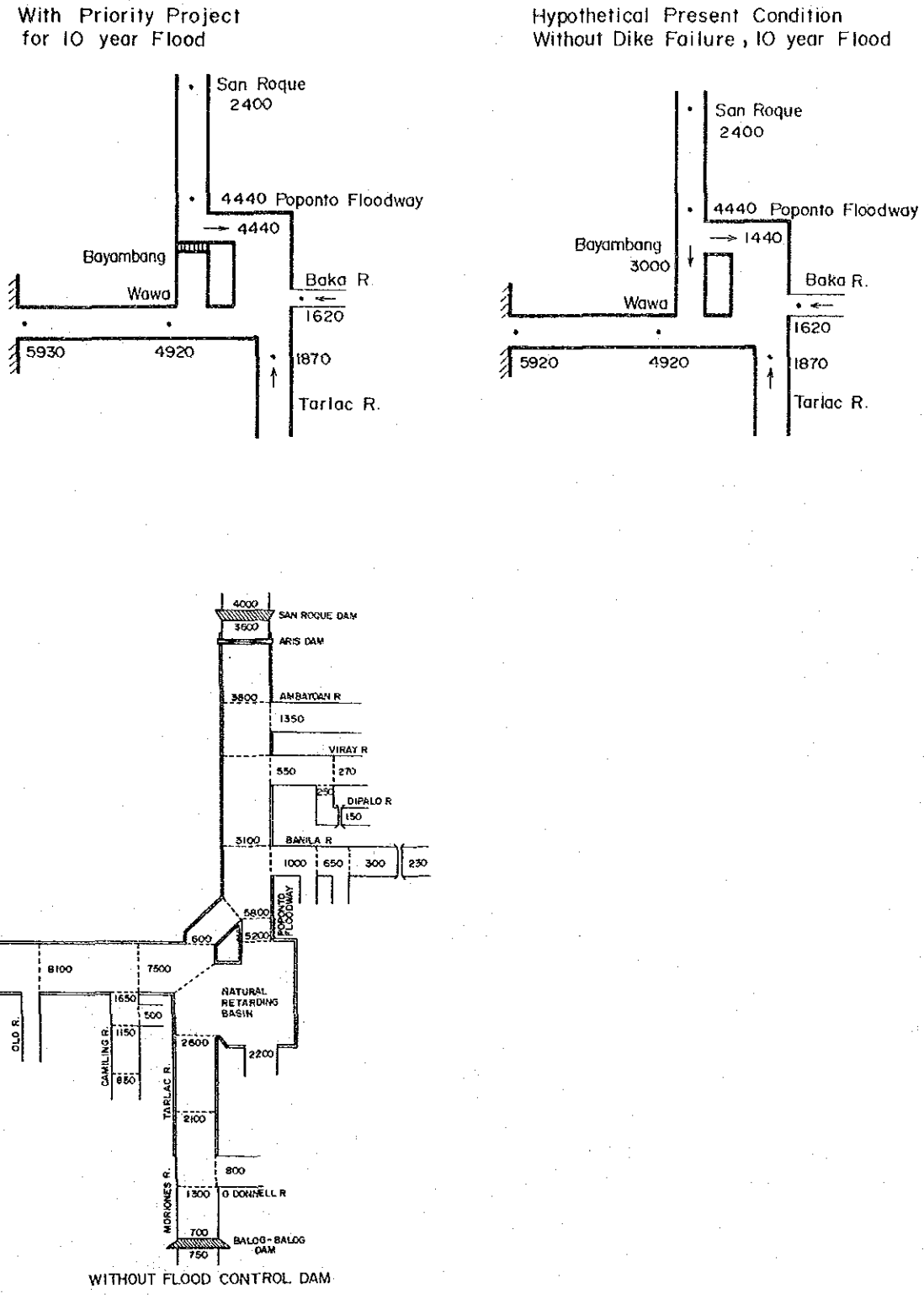


Fig. 13.1.2 PROBABLE FLOOD DISCHARGE DISTRIBUTION OF AGNO RIVER WITH/WITHOUT LONG TERM PLAN AND PRIORITY PROJECT

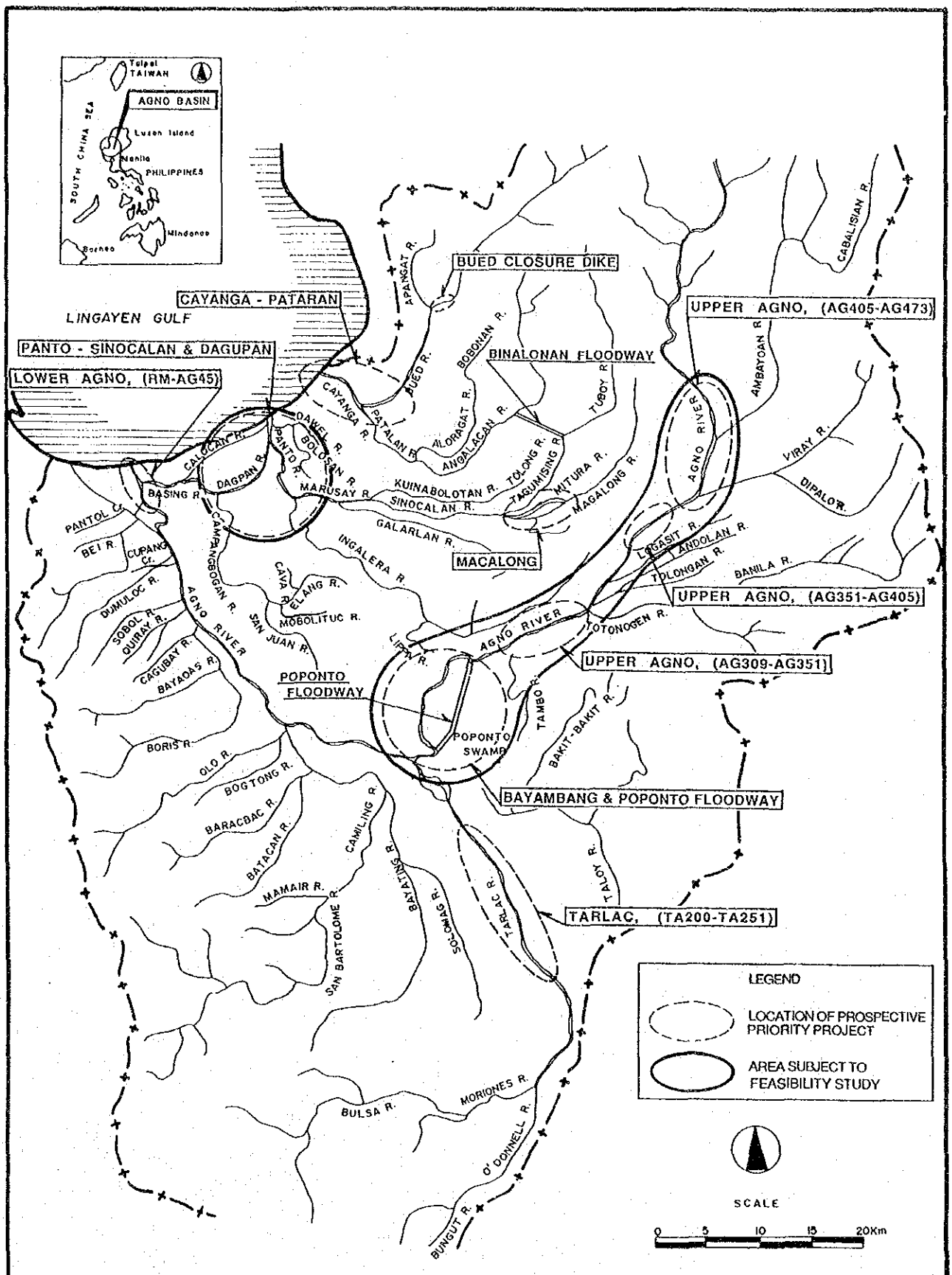


Fig. 13.1.3 LOCATION OF PROSPECTIVE PRIORITY AREAS FOR RIVER IMPROVEMENT WORKS

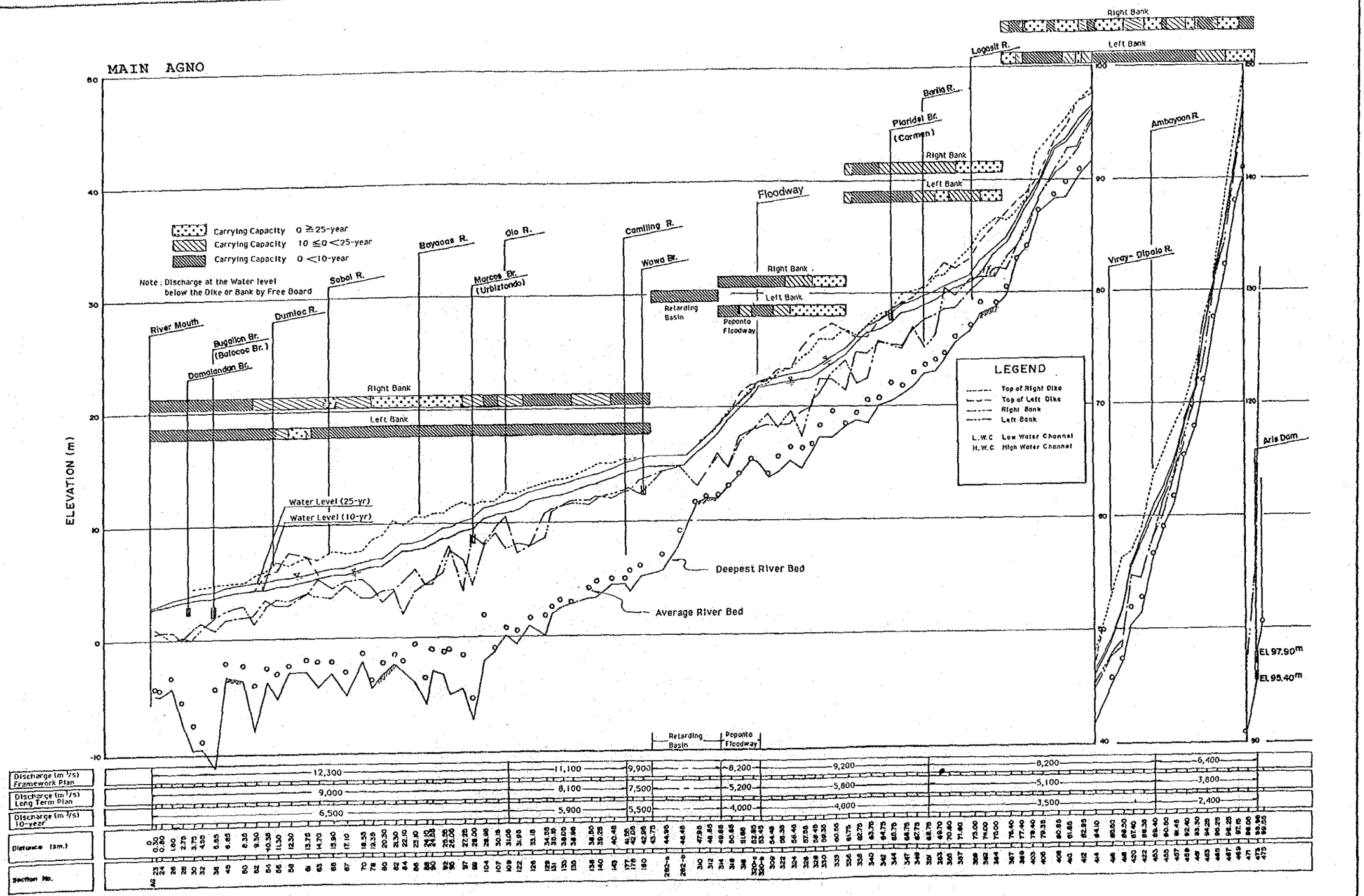


Fig. 13.1.4 EXISTING CARRYING CAPACITY OF AGNO RIVER (1/2)

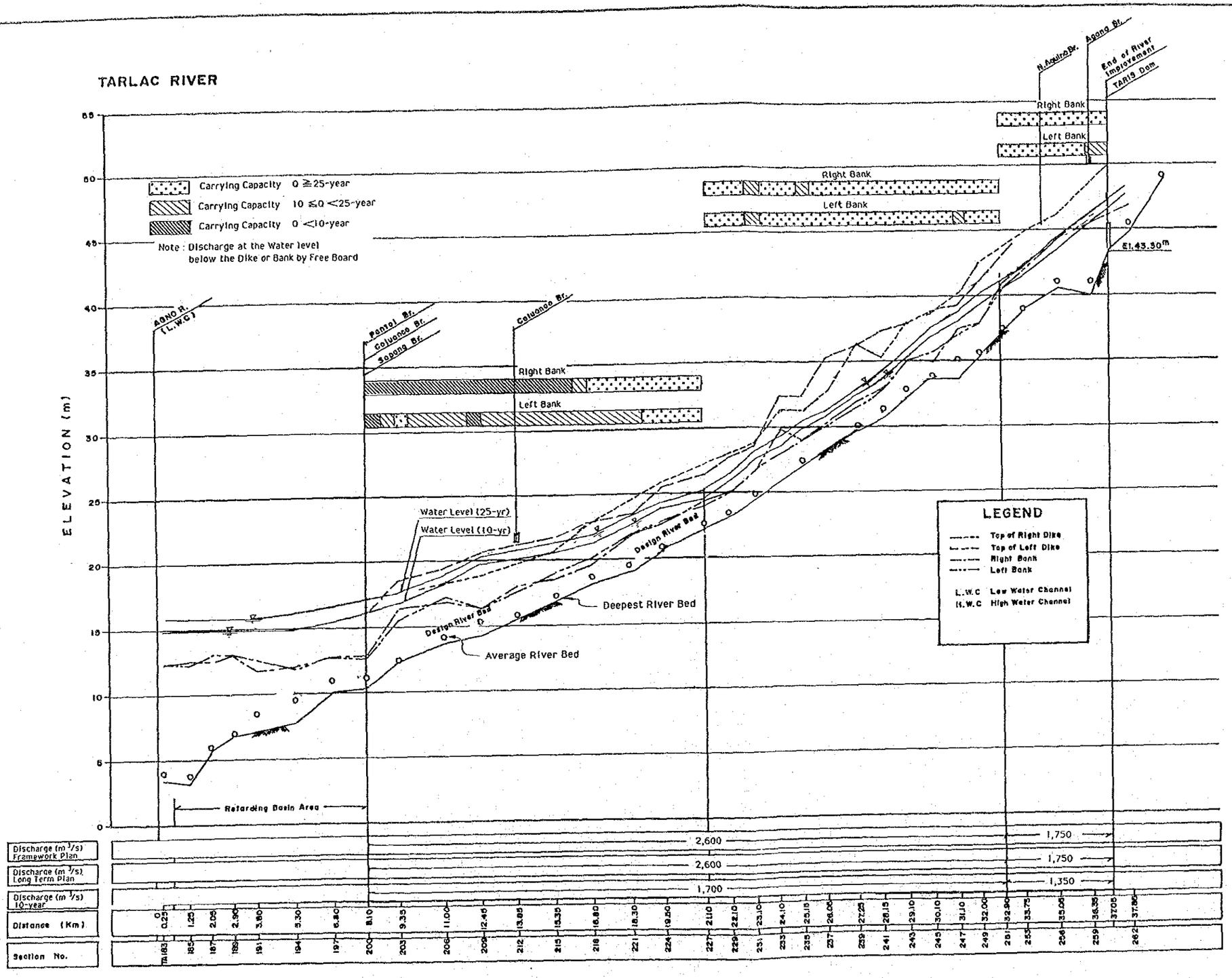


Fig. 13.1.4 EXISTING CARRYING CAPACITY OF AGNO RIVER (2/2)

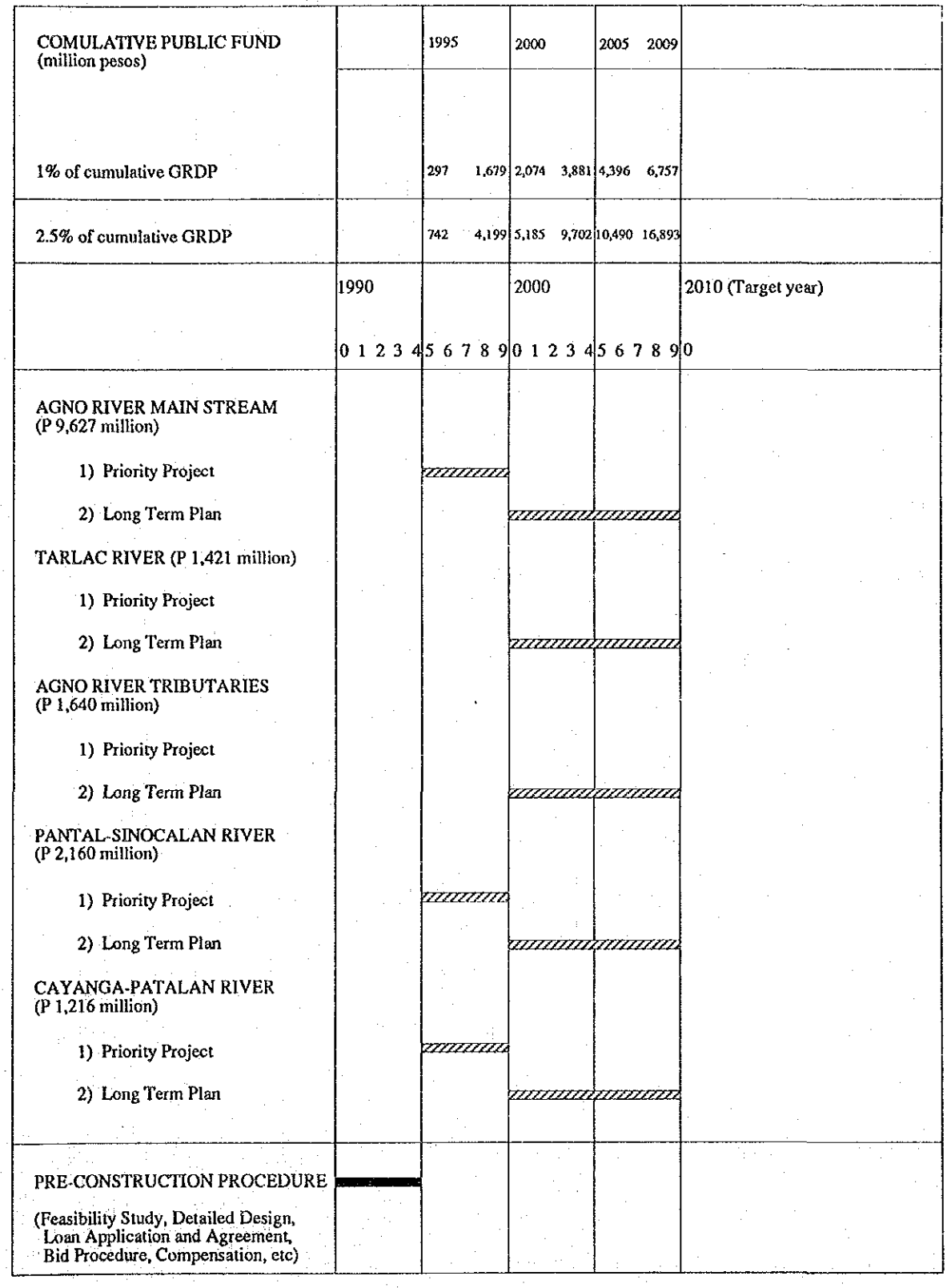


Fig. 13.2.1 ALTERNATIVE IMPLEMENTATION PROGRAM OF LONG TERM PLAN FOR TARGET YEAR 2010

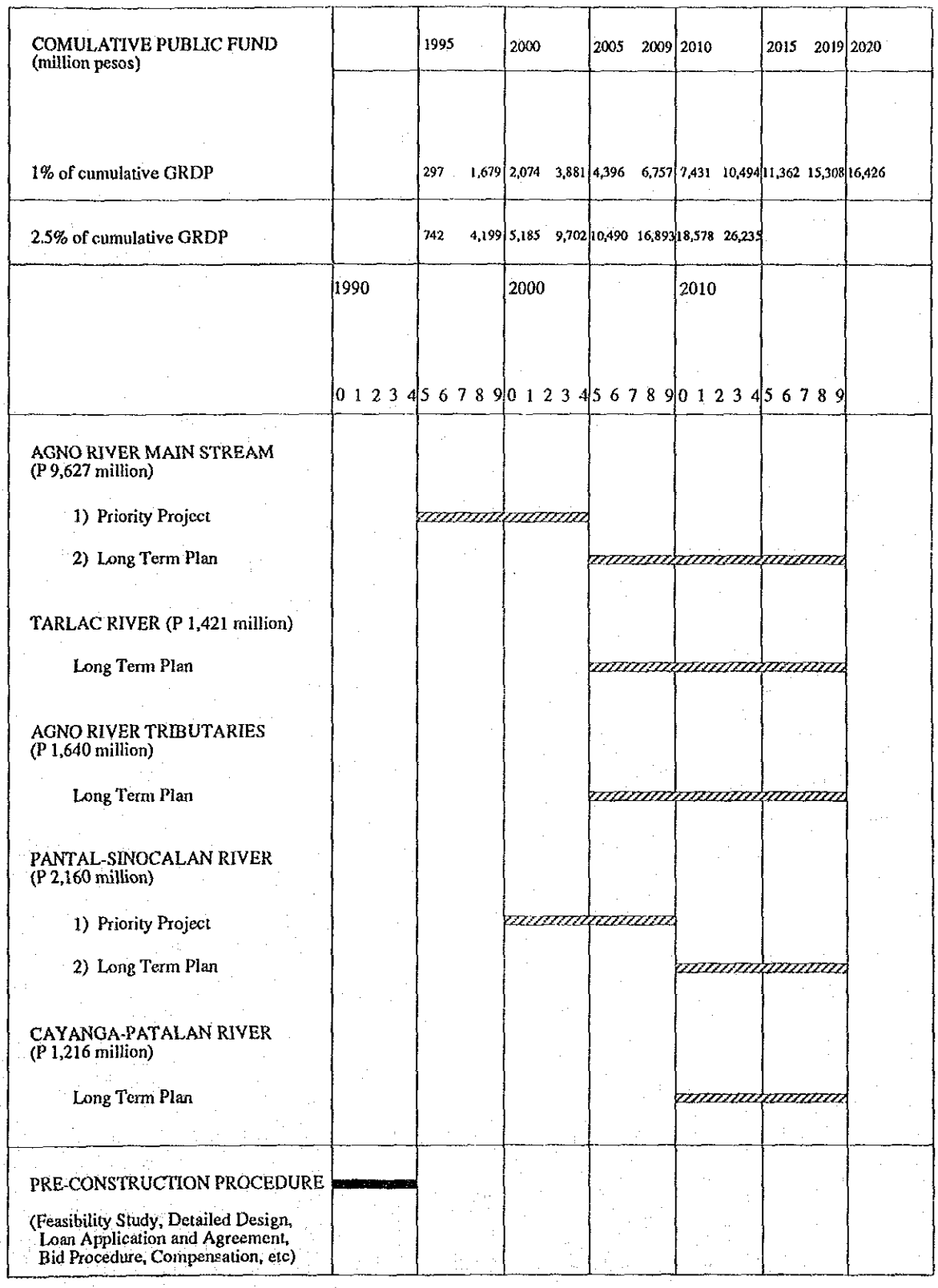


Fig. 13.2.2 PROPOSED IMPLEMENTATION PROGRAM OF LONG TERM PLAN

14. ENVIRONMENTAL ASSESSMENT

14. ENVIRONMENTAL ASSESSMENT

14.1 Objectives of the Environmental Study

The objectives of the Environmental Study on the Agno River Basin Flood Control in the Master Plan stage are as follows;

(1) To identify impacts on the environment concerned by the Project,

(2) To evaluate the magnitude/significance of the impacts,

(3) To judge whether the proposed projects need further environmental study, and if so, to point out the effects to be studied in the Feasibility Study Stage.

14.2 Environmental Impact Assessment in the Master Plan Stage

14.2.1 Methodology of EIA for the Project

To attain the objectives of this environmental study in the Master Plan stage, an Initial Environmental Examination (IEE) is conducted. IEE is essentially an initial examination of the potential environmental effects of the proposed projects based mostly on the preliminary information readily obtainable. IEE is thus a first approach to EIA by scooping, to be carried out at a depth only to determine whether EIA will be required in the next Feasibility Study stage.

A checklist method is applied as a basic tool for IEE in this environmental study, because it is one of the useful initial tools for identification of impacts and evaluation of their significance. The checklist is prepared by placing major items of environmental effects in rows and major project components in columns. The expected effects are evaluated by significance ranging from A to C for each project component with classification as positive or negative. The checklist items are selected by the Study Team taking into consideration the features of the Project and the guidelines prepared by the Government of Philippines (GOP) and the Asian Development Bank (ADB). (Refer to Table 14.2.1)

14.2.2 Result of IEE for the Project

The results of the Initial Environmental Examination for the Framework Plan and the Long Term Plan are presented in Table 14.2.1.

Agno River

The major project components of flood control in the Agno River are the San Roque dam, the Moriones-O'Donnell dam, the river improvement works along the Agno River and the Poponto retarding basin. All of these components could be expected to cause relatively significant effects on the environment, in particular, social impact due to resettlement and evacuation.

First of all, issues of resettlement of the local people are expected especially in the inundation areas of the San Roque dam and Moriones-O'Donnell dam. Agricultural lands in the prospective reservoir areas are also affected by inundation. Secondly, erosion problems in the upstream and downstream areas are expected because San Roque dam and Moriones-O'Donnel dam are located in the erosion-prone area with a slope of 8° - 15°. Water quality deterioration may not be caused by these dams, but eutrophication and saline water intrusion might be expected.

As for the river improvement works in the Agno River and the Poponto retarding basin, these might have significant social impacts due to the acquisition of a right-of-way for new dike construction and the inundation by the basin.

Pantal-Sinocalan River

The major components of the Pantal-Sinocalan River flood control are the river improvement works and Binalonan floodway.

The river improvement works might have significant social impacts due to the acquisition of a right-of-way for new dike construction.

Although no crucial natural environmental issues are expected by the project, water quality deterioration in the downstream area of the Sinocalan

River might be caused by the diversion of flood water from the Tuboy River to the Angalacan River through the Binalonan floodway.

Cayanga-Patalan River

The major components of the Cayanga-Patalan River flood control are the river improvement works and the Bued closing dike. The river improvement works might have significant social impacts due to the acquisition of a right-of-way for new dike construction. The Bued closing dike is not planned to be constructed inside the river channel. It can, therefore, be considered that the natural and social environmental impacts caused by the closing dike are similar to those of the river improvement works except flood flow increases downstream of the dike.

Several environmental impacts are identified in the three project areas. The degree of social impacts due to the location might be significant. The natural environmental impacts could be reduced by taking proper countermeasures.

14.2.3 Conclusion of IEE for the Project

(1) According to the EIA guidelines of DPWH, preparation of an EIA report is required for the project because it includes two large scale dams in the Framework Plan and the project area is considered prime agricultural land.

(2) Among the proposed schemes of the Framework Plan, the construction of San Roque, and Moriones-O'Donnell dams, provision of new dikes and extension of Poponto retarding basin may have significant environmental impacts, such as resettlement problems and encroachment of agricultural lands. Thus, most careful attention shall be paid to those prospective socio-economic impacts.

(3) As for the other schemes, no significant environmental effects would be expected under both the Framework Plan and Long Term Plan. However, some natural environmental impacts of low or medium significance may be expected. Further environmental study is, therefore required to visualize the expected impacts, and to find proper and possible countermeasures.

Table 14.2.1 RESULT OF IEE FOR THE PROJECT

Checklist Item	Agno River				Pantal-Sinocalan River		Cayanga-Patalan River	
	San Roque Dam	Moriones-O'Donnell Dam	River Improvement	Poponto Reter-ding Basin	River Improvement	Binalonan Floodway	River Improvement	Bued Closing Dike
A) Problems due to the Location								
1. Resettlement/evacuation	-/B	-/A	-/A	-/A	-/A	-/A	-/A	-/B
2. Encroachment of cultural tribes	o	o	o	o	o	o	o	o
3. Land value changes	+/A	+/A	+/A	+/A	+/A	+/A	+/A	+/A
4. Encroachment of agricultural lands	-/B	-/A	-/A	-/B	-/A	-/B	-/A	-/C
5. Depreciation of forestry	o	o	o	o	o	o	o	o
6. Inundation of mineral resources	-/C	o	o	o	o	o	o	o
7. Encroachment of historical/cultural values	o	o	-/C	o	o	o	o	o
8. Watershed erosion/silt runoff	-/C	-/C	o	o	o	o	o	o
9. Effects on groundwater hydrology	=	=	o	o	o	-/C	o	o
10. Impairment of navigation	o	o	-/C	o	-/C	o	-/C	o
11. Encroachment of precious ecology	o	o	o	o	o	o	o	o
12. Migrating valuable fish species	o	o	o	o	o	o	o	o
B) Problems related to the Design								
1. Road erosion	-/B	-/B	o	o	o	o	o	o
2. Water right conflicts	-/C	o	o	o	o	o	o	o
3. Loss of community and recreation areas	o	-/B	-/C	-/B	-/C	-/C	-/C	-/C
4. Intensification of traffic congestion	o	o	o	o	o	o	o	o
5. Aesthetic and landscape	o	o	o	o	o	o	o	o
6. Prevention of accessibility	-/C	-/C	o	o	o	o	o	o
C) Problems in Construction Stage								
1. Soil erosion and silt runoff	-/C	-/C	o	o	o	o	o	o
2. Hazards to workers and nearby residents	-/C	-/C	-/C	o	-/C	-/C	-/C	o
3. Spread of communicable diseases	o	o	o	o	o	o	o	o
4. Deterioration of water quality	o	o	o	o	o	o	o	o
D) Problems in Operation Stage								
1. Downstream erosion/aggradation	-/C	-/C	o	o	o	o	o	o
2. Deterioration of water quality	o	o	o	o	o	-/B	o	o
3. Intrusion of saline water	=	o	o	o	o	o	o	o
4. Eutrophication	-/B	-/C	o	o	o	o	o	o
5. Encroachment of precious ecology	o	o	o	o	o	o	o	o
6. Deperciation of fisheries	+/C	o	o	o	o	o	o	o
7. Vector disease hazards	o	o	+/C	-/C	+/C	o	+/C	+/C
8. Aesthetic and landscape	o	o	o	o	o	o	o	o

Note : (1) / : Upper side is the expected effect, and lower side is its significance.
(2) o : Noeffect expected,
+ : Positive effect expected,
- : Negative effect expected,
= : Neutral effect expected, i.e. there may be a change but such change will be neither benefical nor harmful,
(3) A : Effect which has relatively high level of significance,
B : Effect which has relatively medium level of significance,
C : Effect which has relatively low level of significance,

15. REVIEW OF MASTER PLAN AFTER RESUMPTION OF STUDY

15. REVIEW OF MASTER PLAN AFTER RESUMPTION OF STUDY

15.1 Suspension and Resumption of the Study

The Master Plan Study was executed in the period of May 25, 1989 - February 15, 1990. The Feasibility Study commenced on May 1, 1990 and was scheduled to be completed by the end of January, 1991. However, the basic study which was scheduled to start from August 1990 was suspended due to the occurrence of an earthquake on July 16, 1990 which inflicted heavy damages to the Study Area. After review of the results of the earthquake damage inspection conducted from September 9 to October 23, 1990, the homework of the Feasibility Study was resumed on November 26, 1990 while work in the Philippines re-started on December 4, 1990.

The Steering Committee and the Study Team confirmed the following basic principles for resumption of the study in the Joint Meeting held on December 12, 1990:

a. The Master Plan of the Agno River Basin Flood Control established in the Interim Report is unchanged.

b. The Feasibility Study areas selected in the Interim Report and accepted in the Sixth Joint Meeting held on March 1, 1990, are unchanged; the Upper Agno River and the Lower Pantal-Sinocalan Rivers.

15.2 Review of Framework Plan for Agno River

15.2.1 Existing Condition After the Earthquake

Among the river facilities damaged by the earthquake, the most serious damages have been identified over the diking system in the middle and upper reaches of the Agno River. In pursuing the feasibility studies, DPWH and the Study Team recognized in the Fifth Technical Meeting held on January 14, 1991 that the present condition of the flood control facilities shall be the condition immediately after the earthquake because the restoration works may not be realized due to the current economic condition. In the middle of February, however, DPWH issued the department order to restore all the

damaged flood control facilities, especially dikes to the their original condition before the 1991 flood season. Under this circumstance both DPWH and the Study Team agreed to set the condition after the programmed restoration works as the basic present condition for plan formulation.

15.2.2 Revision of Storage Capacity of Poponto Swamp

The storage area and capacity curves of the Poponto retarding basin were established anew using the new topographic maps with a scale of 1 to 25,000 and were compared with those made in the Master Plan stage using the old topographic maps with a scale of 1 to 50,000. The new topographic maps were made available in December, 1990.

Figure 15.2.1 indicates that the new storage area and storage capacity decrease by about 35% and 40% respectively at elevation 16.0 m. It is assessed that this decrease is brought about by the difference in accuracy of two different maps. Difference of contour lines of these maps is illustrated in Figure 15.2.2. The contour interval of the 1:50,000 maps is 20 m while that of the 1:25,000 maps is 2.5 m. The supplemental contour lines (2.5 m interval) of the 1:50,000 maps are interpolated by use of the point elevations on the maps. The study adopts the new area and capacity curves based on the following standpoints:

(a) The ground elevation of the 1:50,000 maps was surveyed around 1950 - 1960 and there is no way to verify its accuracy at present, while that of the 1:25,000 maps was surveyed in 1989.

(b) The elevation difference cannot be explained by historical ground transformation, such as sedimentation in the swamp area in the past 20 - 30 years.

15.2.3 Review of Framework Plan

The general layout of the Framework Plan for the Agno River shown in Figure 10.2.3. was reassessed by using the new high water level of the Poponto natural retarding basin which is made higher due to reduction of the new storage capacity curve. The design flood distribution of the Framework Plan shown in Case 3 of Figure 10.2.1 was modified as shown in Figure 15.2.3. The previous and revised discharges are summarized below.

Location	Adopted Framework Plan		The Case of Sole River Improvement
	Previous discharge	Revised discharge	
River mouth	12,300 m^3/s	13,800 m^3/s	17,310 m^3/s
Wawa	9,900 m^3/s	11,200 m^3/s	14,820 m^3/s
High Water Level of Swamp	El. 16.60m	El. 16.67m	

The project economic cost of the Alternative Framework Plans estimated in Table 10.2.1 was reviewed taking into account the cost increase of the lower reaches of the Agno River due to the increase is design flood discharge. The results summarized in Table 15.2.1 indicate that the least cost case is unchanged, and thus the adopted Framework Plan, combination of river improvement and Poponto natural retarding basin, is unchanged.

The general layout of the Framework Plan for the Allied Rivers shown in Figure 10.2.4 was reassessed by using the new river cross-sections, topographic maps and data. The Framework Plan, which provides the basin transfer of the upstream Tuboy River into the Angalacan River through the Binalonan floodway is unchanged. The design flood discharge distributions of the Framework Plan and the Long Term Plan are adopted unchanged as shown in Figure 10.2.2. and Figure 10.3.1 respectively.

15.2.4 Modification

For pursuing the Feasibility Study the following items were modified based on the foregoing revision:

1) Design Flood Distribution of the Agno River
   - Framework Plan (100-year flood) Figure 15.2.3
   - Long Term Plan (25-year flood) Figure 15.2.4

2) Storage Area and Capacity Curves of Poponto Swamp Figure 15.2.1

3) Project Economic Cost of Alternative Framework Plans Table 15.2.1

4) Project Financial Cost of the Long Term Plan

Table 15.2.2 (1/2)-(2/2)

5) Features of Design Channel of Agno River for Framework Plan

Table 15.2.3 (1/2)-(2/2)

6) Features of Design Channel of Agno River for Long Term Plan

Table 15.2.4 (1/2)-(2/2)

7) Design Plan of Upper Agno River — Figure 15.2.5 (1/5)-(5/5)

8) Longitudinal Profile of Framework Plan — Figure 15.2.6

Table 15.2.1 PROJECT ECONOMIC COST ALTERNATIVE FRAMEWORK PLANS

A. AGNO MAIN AND TARLAC RIVER — Unit: Million Pesos

	Case 1 Solo River Improvement	Case 2 River Improvment & Natural Ratarding Basin	Case 3 River Improvement Natural Retarding Basin & Dam	Case 4 River Improvement & Dam
Agno Main Stream	11.472	11,050 (10,700)	10,810 (10,485)	11,202
Tarlac River	1,587	1,288	1,061	1,265
Moriones-O. Dam	-	-	1,811	1,811
Sub-Total	13.059	*12,338 (11,988)	13,682 (13,357)	14,278
Production Foregone	-	-	340	340
Increase in Dredging	2,166	-	-	2 ,166
Reduction in Dredging	-	-	-1,979	-1,979
Sub-Total	2,166	-	-1,639	14,805
Grand-Total	15,225	12,338 (11,988)	*12,043 (11,718)	14,805

Remarks

* The case of the least cost

The values in the parentheses are the previous cost.

Table 15.2.2 PROJECT FINANCIAL COST OF LONG TERM PLAN FOR AGNO RIVER

(Unit:1,000 Pesos)

River	Length (km)	F.C.	L.C.	Total
I. Agno River				
1. Lower Agno River				
(1) RM-AG045	6.9	993,833	706,350	1,700,184
(2) AG045-AG122	25.1	2,036,375	1,001,638	3,038,013
(3) AG122-AG282	11.9	1,018,226	539,801	1,558,026
Sub-total of 1	43.9	4,048,434	2,247,788	6,296,222
2. Poponto Stretch				
(1) Bayambang Stretch	10.5	76,139	53,450	129,589
(2) Poponto Floodway	10.7	685,298	312,500	997,798
Sub-total of 2	21.2	761,437	365,950	1,127,387
3. Upper Agno River				
(1) AG309-AG351	14.3	299,418	225,551	524,969
(2) AG351-AG405	10.6	222,559	155,322	377,881
(3) AG405-AG473	19.5	871,344	429,655	1,300,999
Sub-total of 3	44.4	1,393,321	810,528	2,203,849
Total of I	109.5	6,203,192	3,424,266	9,627,458
II. Tarlac River				
(1) AG180-TA200	8.1	456,111	184,589	640,700
(2) TA200-TA265	29.0	446,532	333,839	780,371
Total of II	37.1	902,643	518,428	1,421,071
III. Agno River Tributary				
(1) Camiling River	20.0	225,737	161,015	386,752
(2) Banila River	30.9	459,202	314,534	773,736
(3) Viray-Dipalo River	20.1	150,801	149,433	300,234
(4) Ambayoan River	8.7	101,274	78,013	179,287
Total of III	79.7	937,014	702,995	1,640,009
GRAND TOTAL (I+II+III)	226.3	8,042,849	4,645,689	12,688,538

Table 15.2.3 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR FRAMEWORK PLAN (1/2)

River:Agno River
Design Flood: 100-yr

Item	Unit	Agno R.			
		RM - AG45	AG45 - AG65	AG65 - AG109	AG109 - AG177
Design Discharge	m3/s	13800	13800	13800	12700
Distance	m	6850	9050	15150	10500
Gradient of Channel Bed	-	1/6500	1/6500	1/3500	1/2000
River width	m	400-300	1500	1500	1500
Width of Channel Bed	m	100	300	240	200
Dike Height (Ave.)	m	4.9	5.5	6.6	6.0
Water Depth	m	8.73-9.75	9.75-11.1	11.1	11.1-9.74
Low Channel Depth (Ave.)	m	6.5	6.5	6.5	6.5

Item	Unit	Agno R	Retarding 1>	Floodway	Bayanbang 2>
		AG177 - AG181	AG181 - AG314	AG314 - AG320(b)	AG282(b)- AG307
Design Discharge	m3/s	11200	-	8200	1000
Distance	m	2200	7100	3800	9640
Gradient of Channel Bed	-	1/2000	1/1600	1/1600	1/1850
River width	m	1500	-	1200	250-1300
Width of Channel Bed	m	200	180	180	80-100
Dike Height (Ave.)	m	5.6	6.7	5.3	3.3
Water Depth	m	9.74-9.56	9.56-7.80	7.8	8.5-4.1
Low Channel Depth (Ave.)	m	6.0	4.0	4.0	5.0

1>:Retarding Basin stretch 2>:Bayanbang Stretche of Agno R.

Item	Unit	Agno R.			
		AG320(b)- AG351	AG351 - AG367	AG367 - AG414	AG414 - AG453
Design Discharge	m3/s	9200	8200	8200	8200
Distance	m	15930	8170	8150	5330
Gradient of Channel Bed	-	1/1600	1/1300	1/665	1/440
River width	m	900-1900	1250-3000	3000-2000	2000-1200
Width of Channel Bed	m	180	180	180	150
Dike Height (Ave.)	m	5.3	4.6	3.9	3.4
Water Depth	m	7.8	7.8-5.4	5.4	4.9
Low Channel Depth (Ave.)	m	4.0	3.5	3.0	3.0

Table 15.2.3 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR FRAMEWORK PLAN (2/2)

River:Agno River
Design Flood: 100-yr

Item	Unit	Agno R.			
		AG367 - AG460	AG460 - AG464	AG464 - AG469	AG469 - AG474
Design Discharge	m3/s	6400	6400	6400	6400
Distance	m	3120	1990	2420	2800
Gradient of Channel Bed	-	1/280	1/230	1/230	1/230
River width	m	1500-3000	3000-2200	2200-1100	1100-300
Width of Channel Bed	m	150	150	150	150
Dike Height (Ave.)	m	2.5	2.5	3.1	3.4
Water Depth	m	4.0	4.0	4.0-6.3	6.3-7.5
Low Channel Depth (Ave.)	m	3.0	3.0	3.5	5.0

Table 15.2.4 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR LONG TERM PLAN (1/2)

River:Agno River
Design Flood: 25-yr

Item	Unit	Agno R.			
		RM - AG45	AG45 - AG65	AG65 - AG109	AG109 - AG177
Design Discharge	m3/s	10100	10100	10100	9300
Distance	m	6850	9050	15150	10500
Gradient of Channel Bed	-	1/6500	1/6500	1/3500	1/2000
River width	m	1500	(1500)	(1500)	(1500)
Width of Channel Bed	m	360-250	240	200	200
Dike Height (Ave.)	m	4.2	4.8	5.4	4.8
Water Depth	m	8.2-9.2	9.2-10.4	10.4	10.4-9.1
Low Channel Depth (Ave.)	m	6.5	6.5	6.5	6.5

Item	Unit	Agno R	Retarding 1>	Floodway	Bayanbang 2>
		AG177 - AG181	AG181 - AG314	AG314 - AG320(b)	AG282(b)- AG307
Design Discharge	m3/s	8400	-	5200	600
Distance	m	2200	7100	3800	9640
Gradient of Channel Bed	-	1/2000	1/1600	1/1600	1/1850
River width	m	(1500)	-	1200	250-1300
Width of Channel Bed	m	200	180	180	80-100
Dike Height (Ave.)	m	4.4	4.7	4.2	2.3
Water Depth	m	9.1-8.7	8.7-6.7	6.7	7.8-3.8
Low Channel Depth (Ave.)	m	6.0	4.0	4.0	5.0

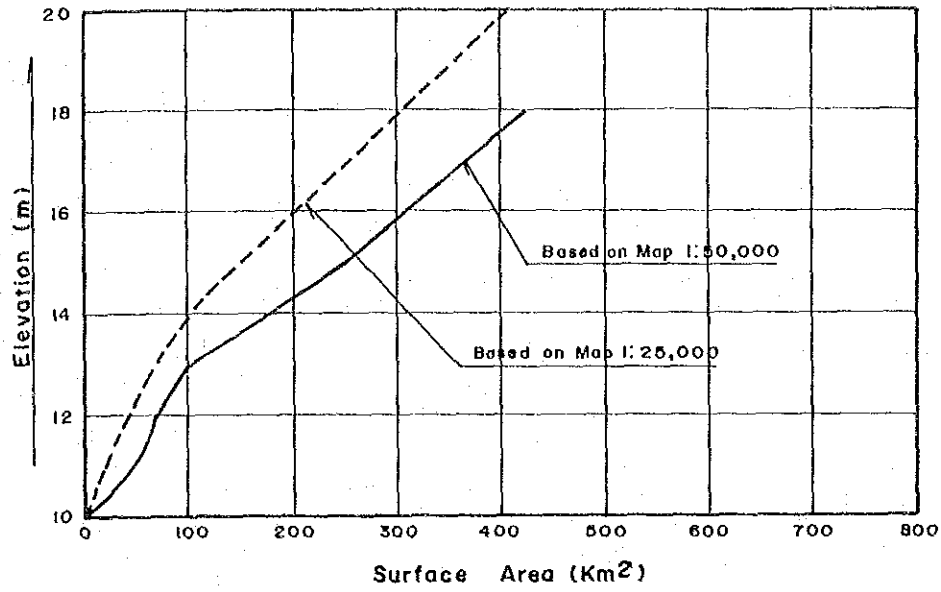
1>:Retarding Basin stretch 2>:Bayanbang Stretchc of Agno R.

Item	Unit	Agno R.			
		AG320(b)- AG351	AG351 - AG367	AG367 - AG414	AG414 - AG453
Design Discharge	m3/s	5800	5100	5100	5100
Distance	m	15930	8170	8150	5330
Gradient of Channel Bed	-	1/1600	1/1300	1/665	1/440
River width	m	900-1900	1250-3000	3000-2000	2000-1200
Width of Channel Bed	m	180	180	180	150
Dike Height (Ave.)	m	4.2	3.7	3.2	2.9
Water Depth	m	6.7	6.7-4.7	4.7	4.4
Low Channel Depth (Ave.)	m	4.0	3.5	3.0	3.0

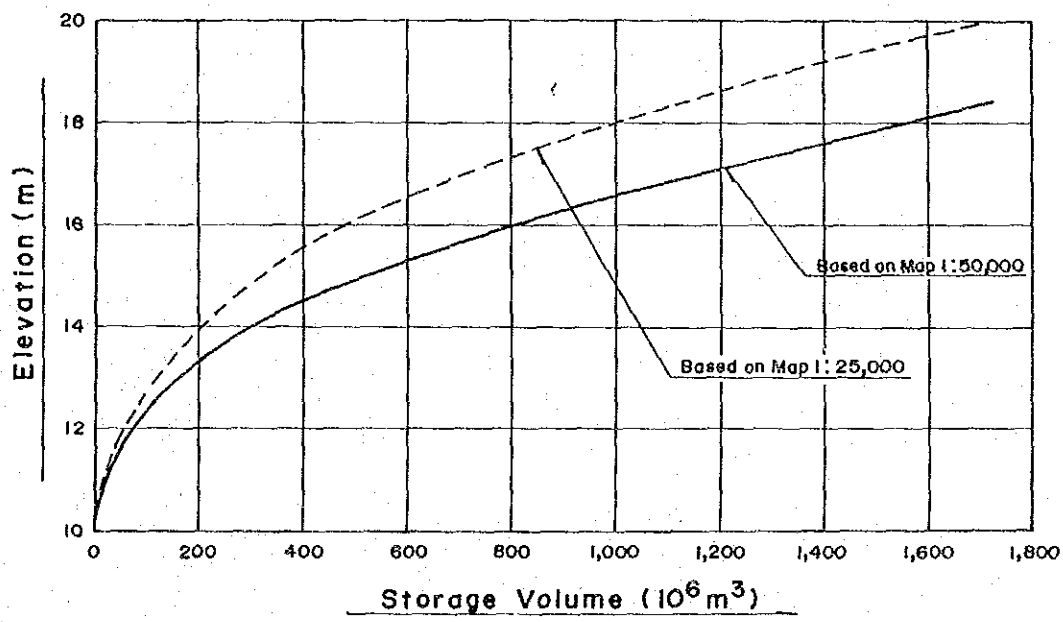
Table 15.2.4 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR LONG TERM PLAN (2/2)

River:Agno River
Design Flood: 25-yr

Item	Unit	Agno R.			
		AG367 - AG460	AG460 - AG464	AG464 - AG469	AG469 - AG474
Design Discharge	m3/s	3800	3800	3800	3800
Distance	m	3120	1990	2420	2800
Gradient of Channel Bed	-	1/280	1/230	1/230	1/230
River Width	m	1500-3000	3000-2200	2200-1100	1100-300
Width of Channel Bed	m	150	150	150	150
Dike Height (Ave.)	m	1.8	1.8	2.2	2.0
Water Depth	m	3.6	3.6	3.6-5.4	5.4-6.3
Low Channel Depth (Ave.)	m	3.0	3.0	3.5	5.0



STORAGE AREA CURVES



STORAGE CAPACITY CURVES

Fig. 15.2.1 COMPARISON OF NEW STORAGE AREA AND VOLUME CURVES OF POPONTO SWAMP WITH OLD ONES

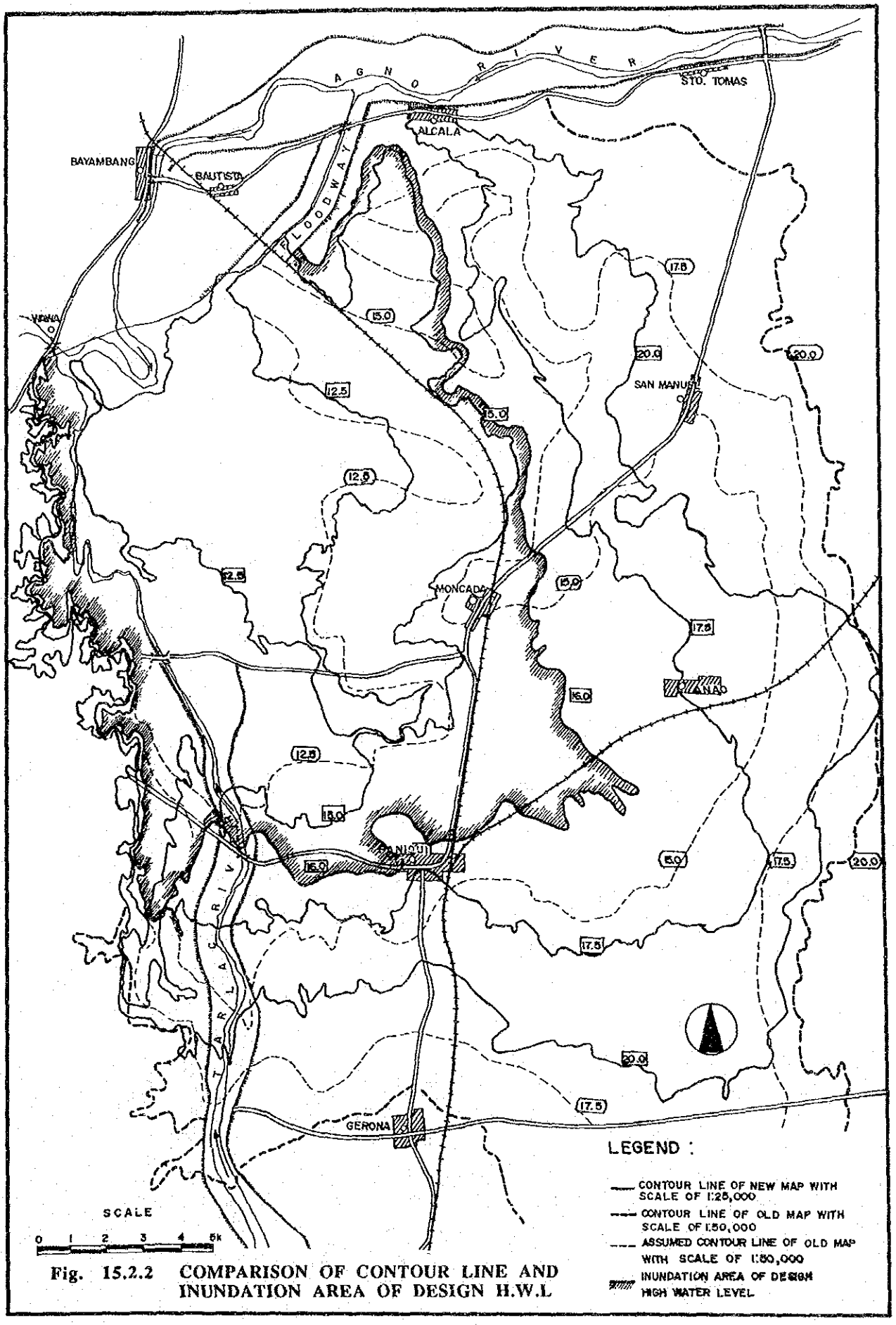


Fig. 15.2.2 COMPARISON OF CONTOUR LINE AND INUNDATION AREA OF DESIGN H.W.L

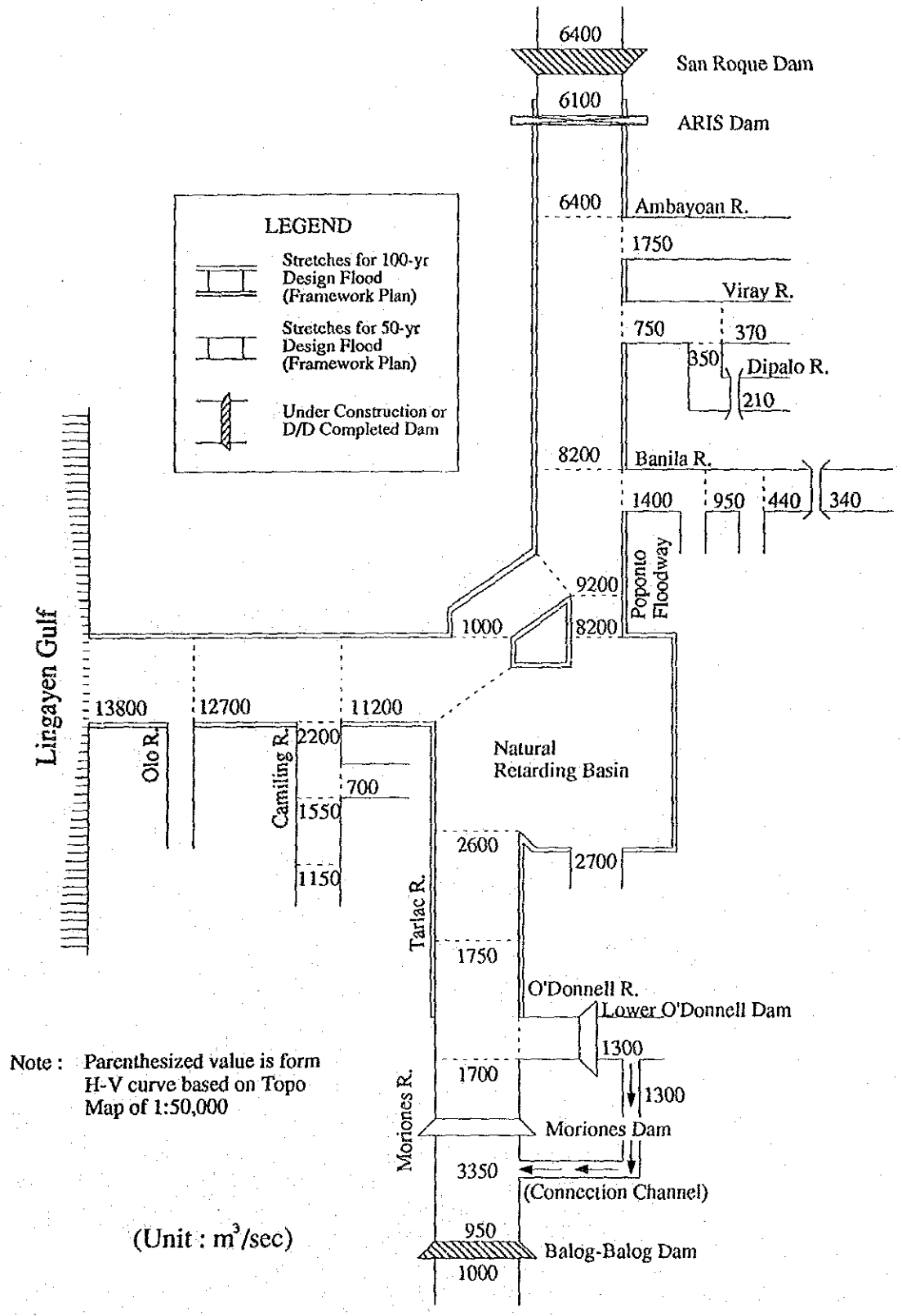


Fig. 15.2.3 REVISED DESIGN FLOOD DISTRIBUTION OF FRAMEWORK PLAN OF AGNO RIVER

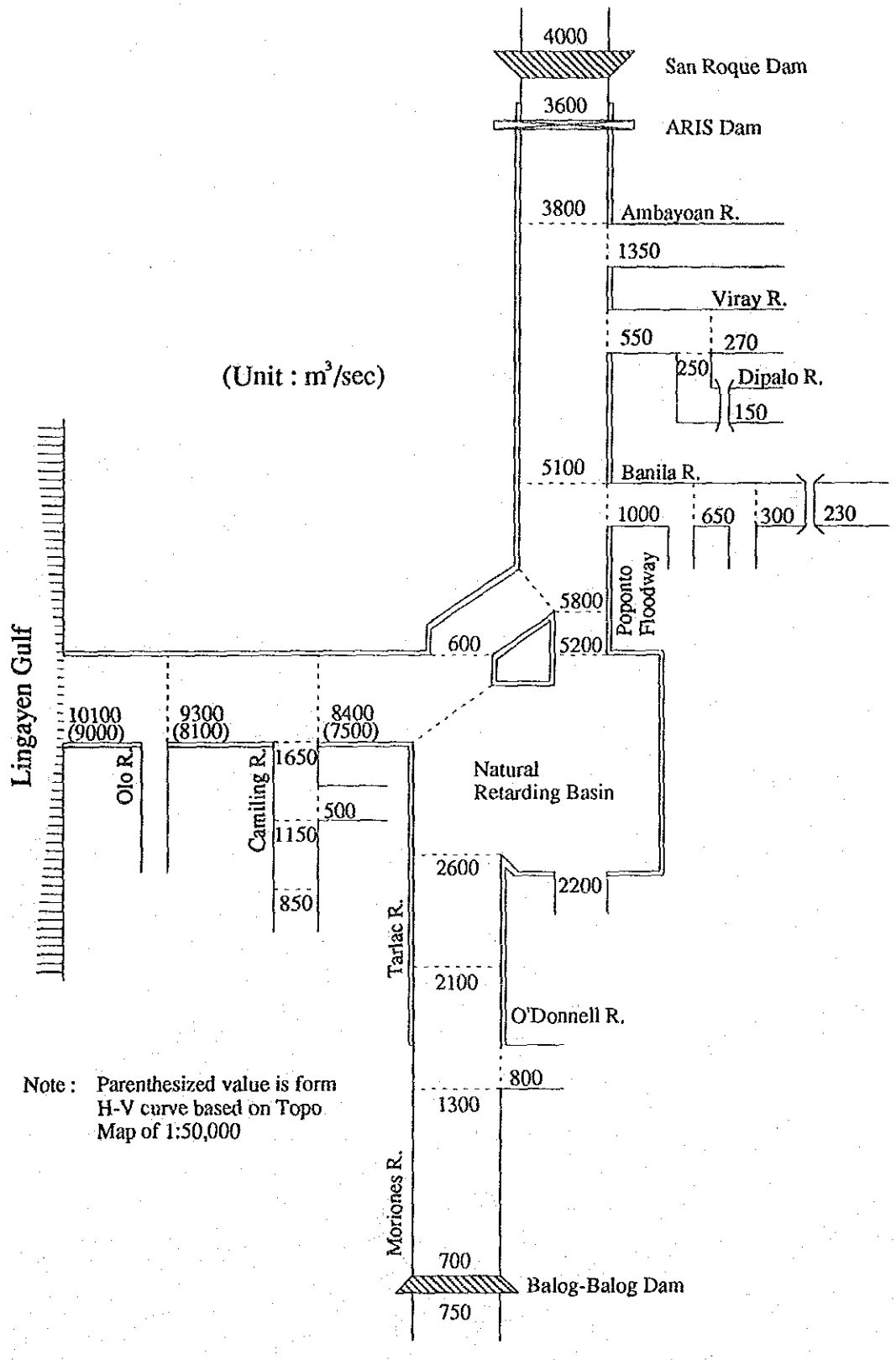


Fig. 15.2.4 REVISED DESIGN FLOOD DISTRIBUTION OF LONG TERM PLAN OF AGNO RIVER (25-YEAR FLOOD)

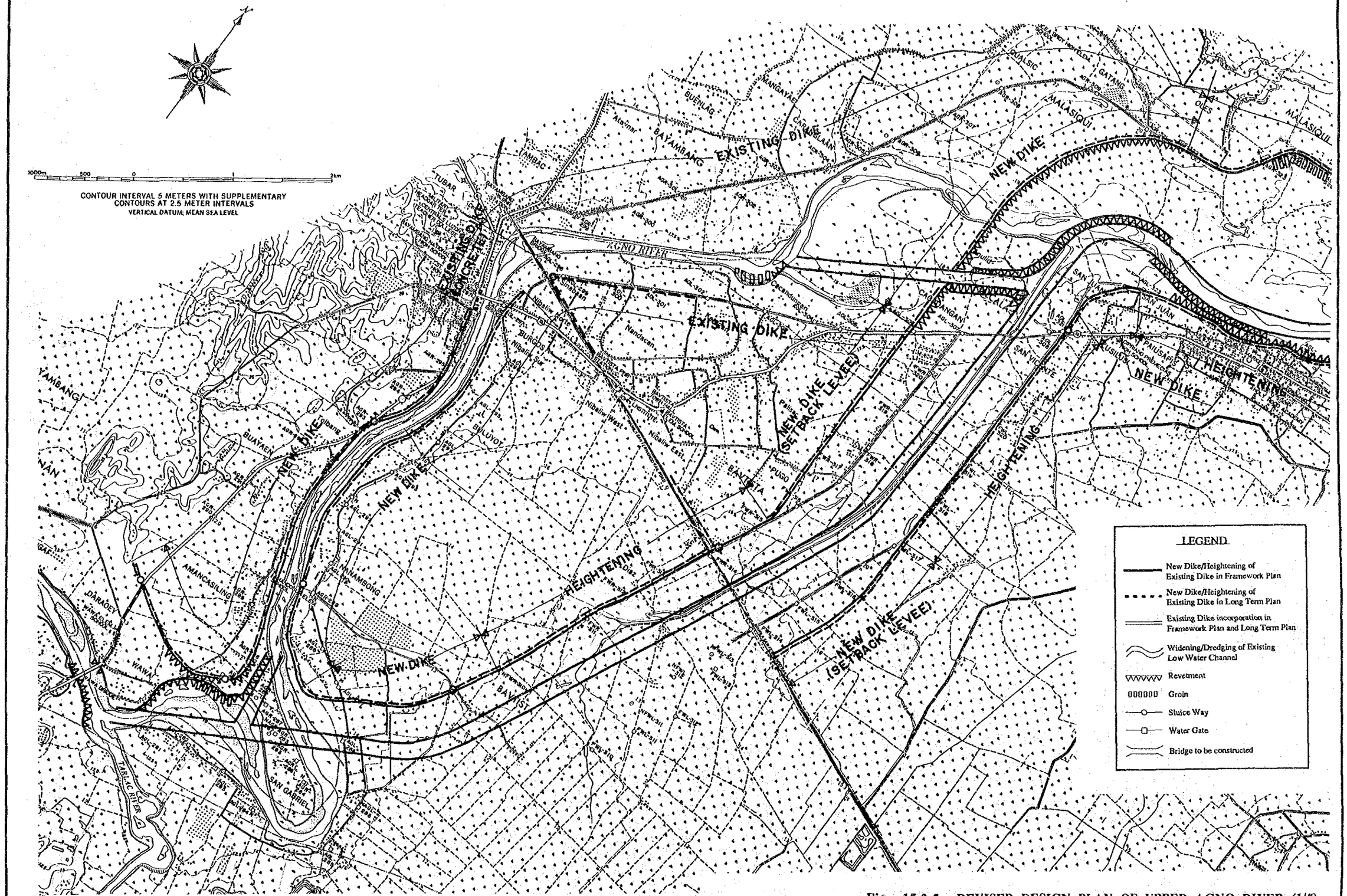


Fig. 15.2.5 REVISED DESIGN PLAN OF UPPER AGNO RIVER (1/5)

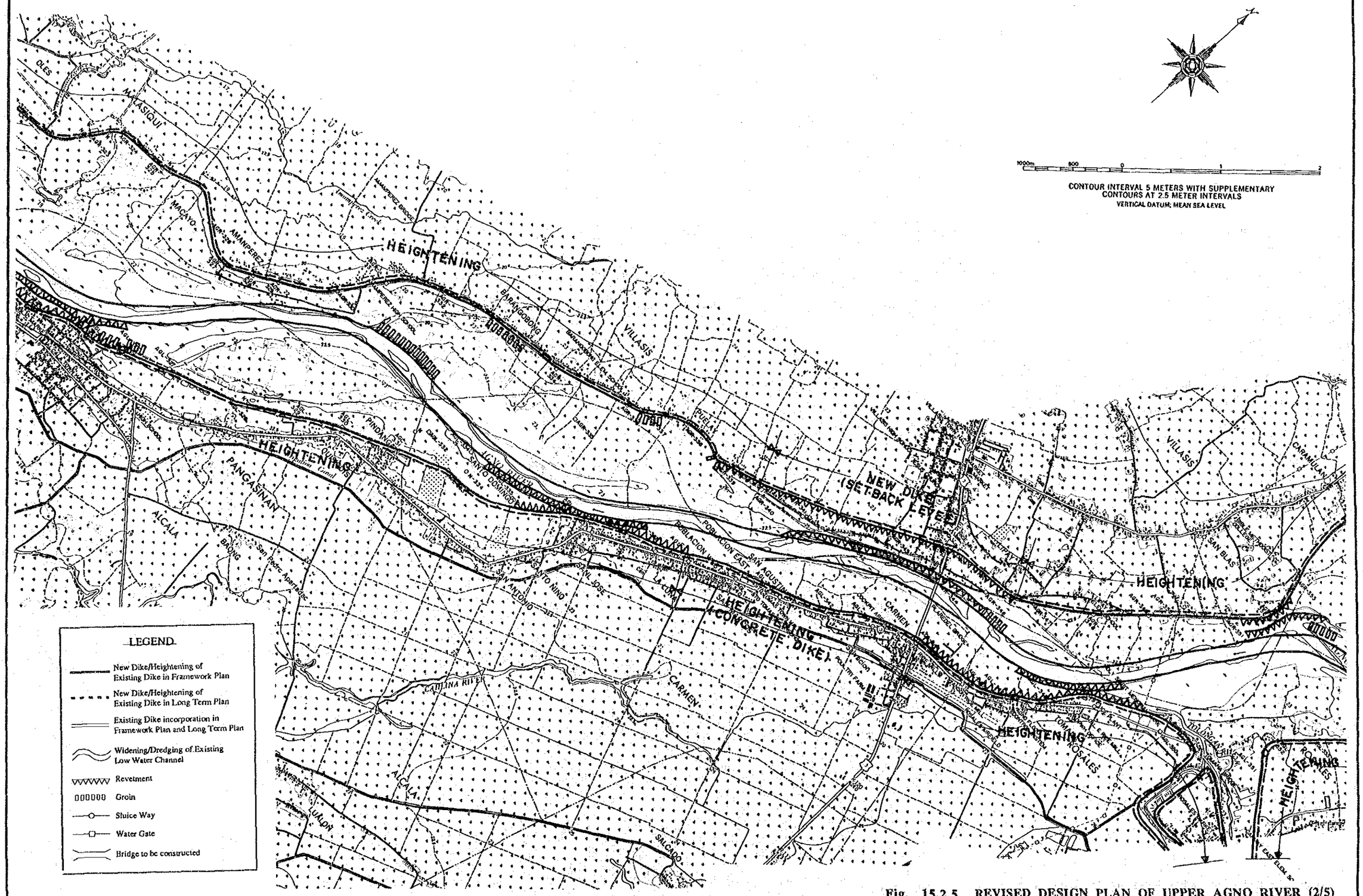


Fig. 15.2.5 REVISED DESIGN PLAN OF UPPER AGNO RIVER (2/5)

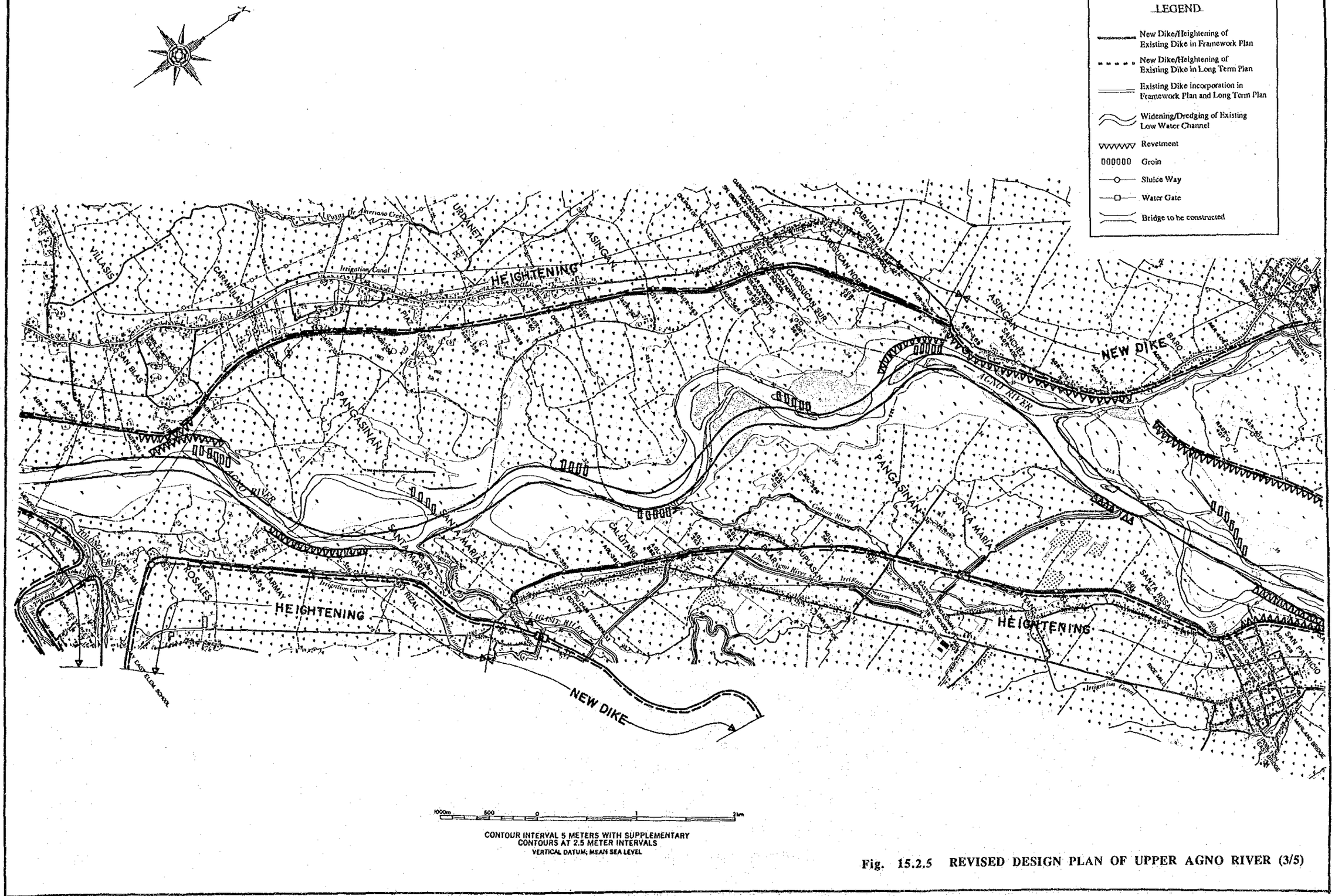


Fig. 15.2.5 REVISED DESIGN PLAN OF UPPER AGNO RIVER (3/5)

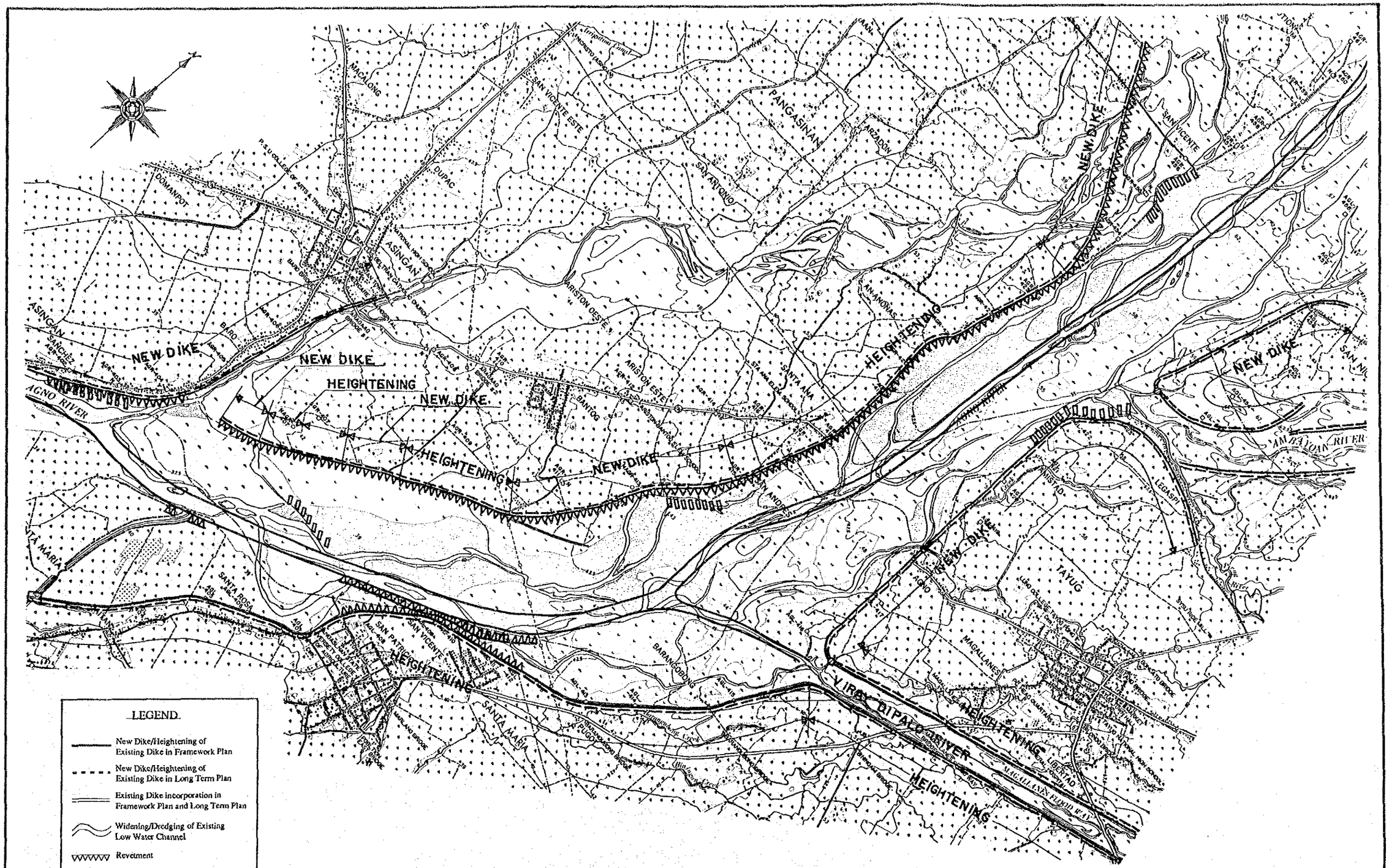


Fig. 15.2.5 REVISED DESIGN PLAN OF UPPER AGNO RIVER (4/5)

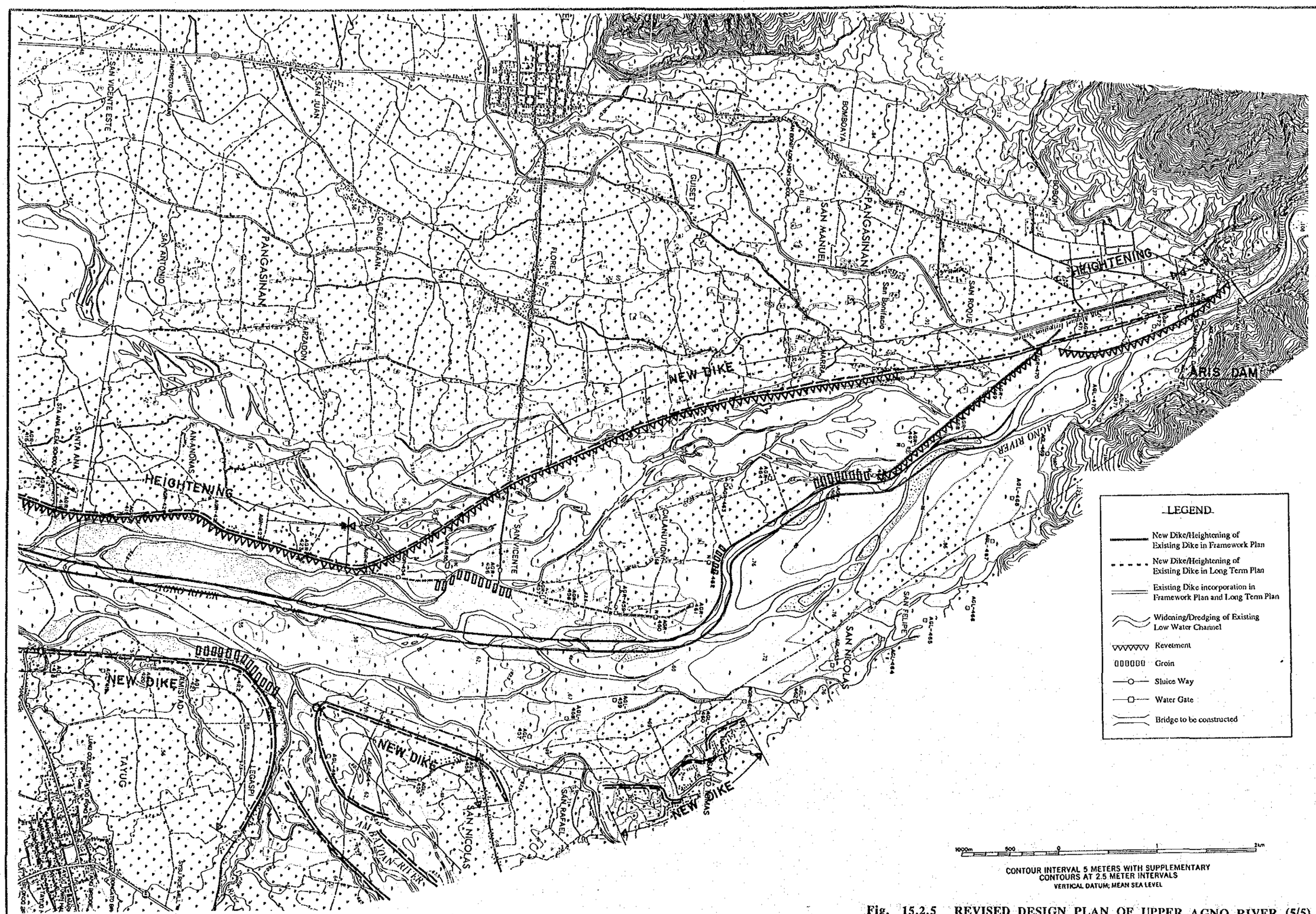


Fig. 15.2.5 REVISED DESIGN PLAN OF UPPER AGNO RIVER (5/5)

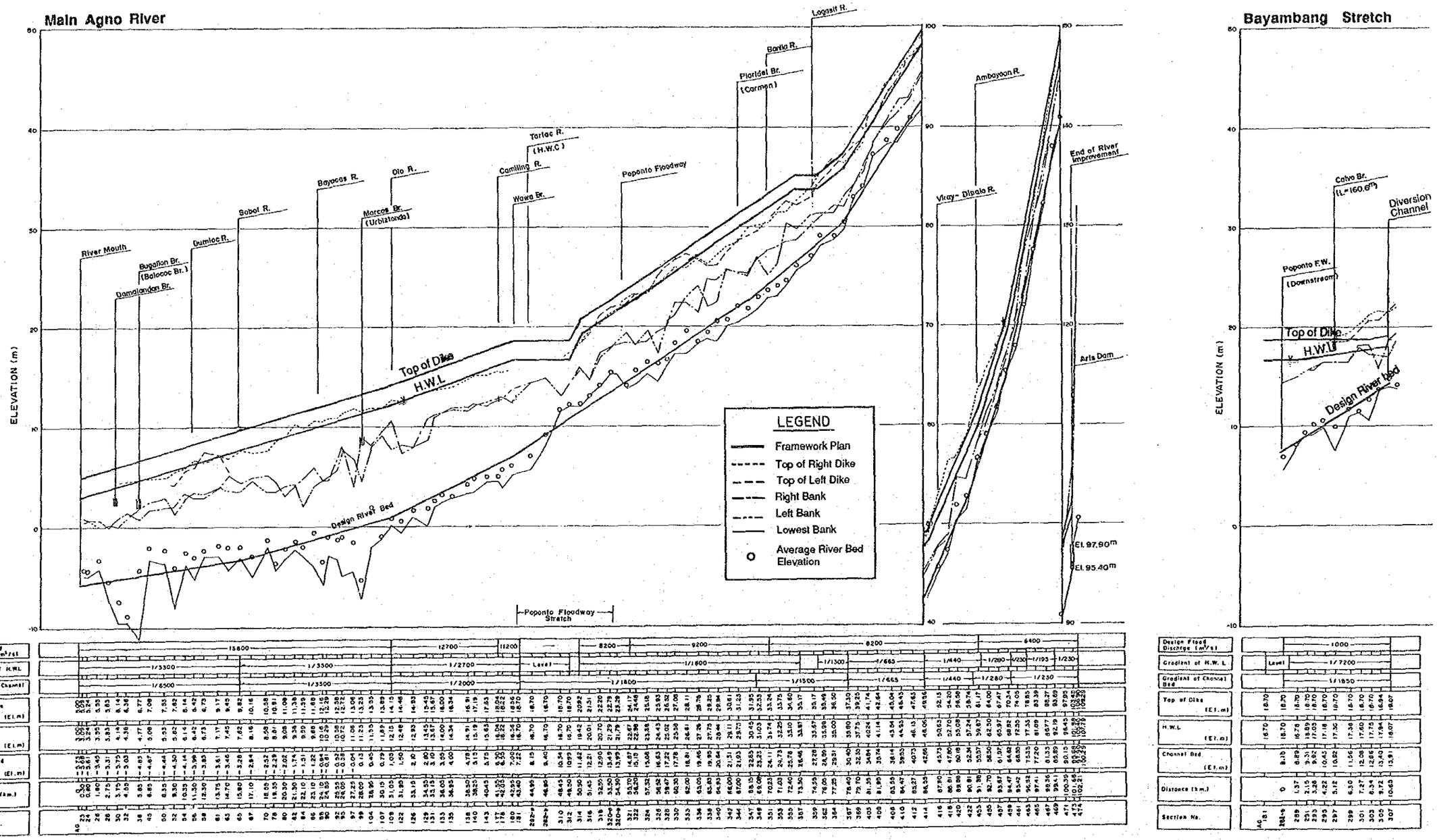


Fig. 15.2.6 REVISED LONGITUDINAL PROFILE OF FRAMEWORK PLAN