5.3 Operation and Maintenance Costs

Operation and maintenance costs comprise personnel cost, office expenses, operation cost repairing cost and so on. Operation and maintenance costs at the full operation stage of the both schemes, diversion dam and pump schemes, are estimated at ₱4.0 million (₱364/ha) and at ₱11.0 million (₱1,000/ha) respectively. In case of pump scheme, the energy cost for operating the pump is equivalent 60% of the total O&M cost. The breakdown of these costs is shown in Table 5.17 and Table 5.18.

5.4 Replacement Cost

Some of the project facilities, especially mechanical and electrical works have shorter useful life than the civil works and are required replacement at a certain time within 50 years of the project useful life. The durable period of the gates and attachments and pump equipments are assumed to be 25 years on an average, and that of O&M equipments, to be 10 years.

The gate and their attachments and pump equipments would be replaced only once during the entire period of the project life and the total cost for diversion dam scheme and pump scheme is estimated to be ₱47.05 million and to be ₱29.6 million respectively.

The O&M equipments would be replaced four times during the entire period of the project life, and the total costs to be once replaced for the both schemes are estimated to be ₱4.1 million. The replacement costs and the useful lives of these facilities are listed in Table 5.20.

Table 1.1 LIST OF EXISTING PUMP IRRIGATION SYSTEM IN DEVELOPMENT AREA

A. GROUND WATER PUMPS

(Unit: Nos.)

No.	Municipality	Diameter (mm)					Total No. of Pump	Potential Service Area (ha)
		100	125	150	175	200		
1	Apalit	7	1	-	-	-	8	20
2	Arayat	17	15	1	-	-	33	148
3	Candaba	14	6	2	-	-	22	116
4	Mexico	13	4	1	-	-	18	51
5	Minalin	6	-	-	-	-	6	27
6	Santa Ana	38	15	9	-	-	62	264
7	San Luis	6	4	3	-	1	13	101
8	San Fernando	1	1	1	-	1	4	29
9	San Simon	19	8	14	-	-	42	191
10	Santo Tomas	4	1	1	-	-	6	39
	Total	125	55	32	-	2	214	986

B. SURFACE WATER PUMP

No.	Municipality	Diameter (mm)									Total No. of Pump	Potential Service Area (ha)
		100	125	150	200	250	300	400	500	1,650		
1	Apalit	1	-	3	3	-	-	5	-	-	12	206
2	Arayat	2	3	2	-	-	-	2	2	-	11	119
3	Candaba	1	-	1	1	-	-	-	-	-	3	31
4	Mexico	3	2	3	4	1	4	1	-	-	18	266
5	Minalin	1	-	1	-	-	-	1	-	-	3	96
6	Santa Ana	4	5	-	3	-	-	-	-	-	12	66
7	San Luis	1	-	4	2	1	-	-	2	1	11	517
8	San Fernando	-	-	1	1	-	-	1	-	-	3	38
9	San Simon	5	4	12	2	3	-	6	1	-	33	533
10	Santo Tomas	-	1	-	-	-	-	-	-	-	1	2
	Total	18	15	27	16	5	4	16	5	1	107	1,874

Table 1.2 LIST OF AUTHORIZED WATERRIGHT ON PAMPANGA RIVER

(Downstream of Arayat)

	Location	Period	Quantity	Bank
1.	Sta. Lucia, Cupang Arayat, Pampanga Lat: 15°-08'-15" (1,674.0) Long: 120°-49'-00" (480.3)	Jan.-Dec.	120 ℓ/s	Right
2	Candating, Arayat, Pampanga Lat: 15°-08'-50" (1,675.0) Long: 120°-48'-53" (480.0)	Jan.-Dec.	850 ℓ/s	Left
3.	Matamo, Arayat, Pampanga Lat: 15°-08'-43" (1,674.8) Long: 120°-48'-44" (479.8)	Jan.-Dec.	304 ℓ/s	Right
4.	Candaba, Pampanga Lat: 15°-07'-41" (1,673.0) Long: 120°-48'-50" (480.0)	Jan.-Dec.	253 ℓ/s	Left
5.	Mandasig, Candaba, Pampanga Lat: 15°-05'-27" (1,668.9) Long: 120°-48'-52" (480.0)	Jan.-Dec.	712 ℓ/s	Right
6.	Sta. Rita, San Luis, Pampanga Lat: 15°-01'-55" (1,662.2) Long: 120'-46'-34" (475.9)	Jan.-Dec.	320 ℓ/s	Right
7.	San Nicolas, San Simon, Pampanga Lat: 15°-00'-47" (1,660.2) Long: 120°-46'-45" (476.0)	Jan.-Dec.	140 ℓ/s	Left
8.	Capalangan, Apalit, Pampanga Lat: 14°-55'-15" (1,651.3) Long: 120°-44'-45" (472.7)	Jan.-Dec.	4 ℓ/s	Left
9.	Frances, Calumpit, Bulacan Lat: 14°-55'-30" (1,650.5) Long: 120°-45'-37" (474.2)	Jan.-Dec.	80 ℓ/s	Left
10.	Meyto, Calumpit, Bulacan Lat: 14°-53'-41" (1,647.2) Long: 120°-43'-23" (470.2)	Jan.-Dec.	24 ℓ/s	Left
		Total	- 2,807 ℓ/s	
		Right Bank	- 1,456 ℓ/s	
		Left Bank	- 1,351 ℓ/s	

Table 2.1 10-DAY MEAN DISCHARGE AT ARAYAT

(Unit: m^3/s)

		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Jan.	1	115.8	54.5	163.1	46.8	36.7	32.7	56.1	739.3	23.2	27.7	151.8	223.1	77.9	81.7
	2	83.8	40.5	88.5	41.6	36.1	28.3	42.0	114.2	19.4	21.3	109.1	159.9	64.7	91.1
	3	79.3	50.1	102.8	38.8	30.1	23.1	33.9	68.8	16.5	16.1	160.8	96.0	47.2	91.7
Feb.	1	85.0	45.7	48.1	35.8	28.4	20.7	31.6	78.9	23.8	12.3	101.1	56.6	32.3	87.6
	2	47.9	41.7	39.8	29.8	19.1	16.2	32.2	66.0	22.4	11.2	59.3	37.6	23.1	72.4
	3	38.6	37.1	36.5	28.2	16.5	13.7	28.8	34.1	15.0	10.2	56.4	24.5	19.8	57.8
Mar.	1	32.9	32.7	36.8	28.1	13.6	12.9	22.9	25.4	6.7	19.8	42.8	27.4	17.8	33.2
	2	26.9	26.1	27.7	32.7	14.6	11.4	53.7	26.7	5.0	13.5	40.7	23.3	15.8	37.9
	3	25.2	20.9	23.0	23.0	12.9	12.4	24.9	35.4	2.9	10.9	47.7	15.2	14.8	42.3
Apr.	1	22.0	17.7	19.6	22.3	14.6	20.2	21.7	34.8	2.6	8.7	43.8	13.4	13.5	47.3
	2	19.6	12.3	18.4	20.1	16.1	20.1	19.0	25.6	3.5	7.5	43.2	23.3	12.2	52.0
	3	24.6	9.6	23.0	19.9	10.8	14.9	15.3	22.4	2.4	15.2	61.4	12.8	11.1	55.9
May	1	36.2	11.4	15.6	22.6	9.4	11.3	64.3	21.0	2.1	18.2	44.5	15.8	10.1	59.5
	2	22.6	127.1	17.8	21.2	15.8	11.1	54.2	23.1	4.1	7.7	41.6	28.6	9.2	44.8
	3	33.2	1,663.1	17.4	24.6	16.9	12.8	48.0	68.6	3.4	10.3	64.4	1,720.7	36.9	42.5
Jun.	1	198.9	417.6	275.8	28.1	22.4	24.8	278.9	73.1	4.4	42.8	117.5	277.0	46.1	113.2
	2	123.7	144.6	282.3	25.3	60.9	133.9	507.3	79.5	19.2	538.7	81.5	244.5	39.0	153.2
	3	133.5	158.6	88.3	26.3	25.4	101.3	359.9	70.2	28.1	64.3	102.1	255.4	70.8	220.0
Jul.	1	471.9	131.9	159.7	46.4	29.7	75.1	304.4	704.0	19.8	40.3	84.8	969.2	89.1	169.1
	2	1,195.5	300.6	174.1	36.9	43.6	188.5	711.8	2,070.8	92.4	199.3	41.2	280.0	92.9	307.7
	3	1,002.6	341.9	354.6	318.7	375.0	92.1	1,076.8	2,022.7	46.3	666.3	45.5	226.7	231.4	495.5
Aug.	1	622.5	38.2	1,149.2	399.0	1,318.0	177.8	583.4	1,897.2	45.5	145.1	62.3	336.6	364.9	281.3
	2	328.3	631.1	1,224.6	463.0	778.0	290.0	590.7	1,438.9	144.3	1,102.4	240.1	642.0	336.4	662.3
	3	233.1	322.7	1,106.2	916.3	144.4	456.9	139.0	1,301.5	602.8	1,216.0	212.5	568.6	430.5	1,117.0
Sep.	1	293.4	598.1	1,073.5	1,365.5	284.3	1,429.5	195.6	566.1	372.0	336.2	150.6	394.8	640.2	1,087.0
	2	588.8	1,437.1	902.5	855.9	585.7	1,032.5	263.0	728.0	219.0	253.5	202.5	524.9	726.8	896.0
	3	776.0	491.4	1,069.8	647.9	301.0	342.9	326.5	489.3	138.3	106.0	359.4	651.9	616.5	1,075.9
Oct.	1	483.0	108.3	647.4	829.7	339.5	405.4	354.8	189.9	354.8	95.4	159.0	559.5	500.3	1,030.0
	2	235.1	68.6	696.5	261.6	207.5	933.9	1,730.2	57.4	1,496.2	974.6	84.0	376.2	242.0	1,074.9
	3	78.9	39.4	576.3	103.0	104.4	620.5	596.9	42.1	710.8	1,021.7	358.7	353.1	138.1	626.9
Nov.	1	365.2	85.5	889.0	53.9	43.2	500.0	125.5	160.7	64.6	1,323.6	173.7	367.3	110.0	1,727.3
	2	209.3	171.2	402.9	42.7	33.0	215.6	119.3	94.8	63.8	990.1	41.9	347.2	111.6	475.4
	3	86.6	1,359.3	114.9	51.0	130.4	391.8	488.7	66.6	595.1	404.6	26.3	195.4	887.6	407.1
Dec.	1	65.6	740.1	83.2	171.8	50.5	243.7	445.1	97.9	94.8	345.3	41.9	98.2	221.7	429.6
	2	91.1	166.7	65.2	48.8	76.2	136.5	219.3	63.1	63.7	391.1	98.7	94.4	131.6	375.1
	3	76.3	203.2	55.9	34.5	41.0	94.9	282.0	32.0	34.4	243.8	376.3	70.4	132.4	305.9
Average		231.5	296.8	337.2	199.2	144.7	226.4	296.1	378.4	149.4	298.1	116.0	309.4	176.9	396.4

Table 2.2 AVAILABLE 10-DAY MEAN DISCHARGE AT ARAYAT

(Unit: m^3/s)

		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Jan.	1	40.6	30.5	26.5	49.9	733.1	17.0	21.5	145.6	216.9	71.7	75.5
	2	35.4	29.9	22.1	35.8	108.0	13.2	15.1	102.9	153.7	58.5	84.9
	3	32.6	23.9	16.9	27.7	62.6	10.3	9.9	154.6	89.8	41.0	85.5
Feb.	1	29.6	22.2	14.5	25.4	72.7	17.6	6.1	94.9	50.4	26.1	81.4
	2	23.6	12.9	10.0	26.0	59.8	16.2	5.0	53.1	31.4	16.9	66.2
	3	22.0	10.3	7.5	22.6	27.9	8.8	4.0	50.2	18.3	13.6	51.6
Mar.	1	21.9	7.4	6.7	16.7	19.2	0.5	13.6	36.6	21.2	11.6	27.0
	2	26.5	8.4	5.2	47.5	20.5	0	7.3	34.5	17.1	9.6	31.7
	3	16.8	6.7	6.2	18.7	29.2	0	4.7	41.5	9.0	8.6	36.1
Apr.	1	16.1	8.4	14.0	15.5	28.6	0	2.5	37.6	7.2	7.3	41.1
	2	13.9	9.9	13.9	12.8	19.4	0	1.3	37.0	17.1	6.0	45.8
	3	13.7	4.6	8.7	9.1	16.2	0	9.0	55.2	6.6	4.9	49.7
May	1	16.4	3.2	5.1	58.1	14.8	0	12.0	38.3	9.6	3.9	53.3
	2	15.0	9.6	4.9	48.0	16.9	0	1.5	35.4	22.4	3.0	38.6
	3	18.4	10.7	6.6	41.8	62.4	0	4.1	58.4	1,714.5	30.7	36.3
Jun.	1	21.9	16.2	18.6	272.7	66.9	0	36.6	111.3	270.8	39.9	107.0
	2	19.1	54.7	127.7	501.1	73.3	13.0	532.7	75.3	238.3	32.8	147.0
	3	20.1	19.2	95.1	353.7	64.0	21.9	58.1	95.9	249.2	64.6	213.8
Jul.	1	40.2	23.5	68.9	298.2	697.8	13.6	34.1	78.6	963.0	82.9	162.9
	2	30.7	37.4	182.3	705.6	2,064.6	86.2	193.1	35.0	273.8	86.7	301.5
	3	312.5	368.8	85.9	1,070.6	2,016.5	40.1	660.1	39.3	220.5	225.2	489.3
Aug.	1	392.8	1,311.8	171.6	577.2	1,891.0	39.3	138.9	56.1	330.4	358.7	275.1
	2	456.8	771.8	283.8	584.5	1,432.7	138.1	1,096.2	233.9	635.8	330.2	656.1
	3	910.1	138.2	450.7	132.8	1,295.3	596.6	1,209.8	206.3	562.4	424.3	1,110.8
Sep.	1	1,359.3	278.1	1,423.3	189.4	559.9	365.8	330.0	144.4	388.6	634.0	1,080.8
	2	849.7	579.5	1,026.3	256.8	712.8	212.8	247.3	196.3	518.7	720.6	889.8
	3	641.7	294.8	336.7	320.3	483.1	132.1	99.8	353.2	645.7	610.3	1,069.7
Oct.	1	823.5	333.3	399.2	348.6	183.7	348.6	89.2	152.8	553.3	494.1	1,023.8
	2	255.4	201.3	927.7	1,724.0	51.2	1,490.0	968.4	77.8	370.0	235.8	1,068.7
	3	96.8	98.2	614.3	590.7	35.9	704.6	1,015.5	352.5	356.9	131.9	620.7
Nov.	1	47.7	37.0	493.8	119.3	154.5	58.4	1,317.4	167.5	361.1	103.8	1,721.1
	2	36.5	26.8	209.4	113.1	88.6	57.6	983.9	35.7	341.0	105.4	469.2
	3	44.8	124.2	385.6	482.5	60.4	588.9	398.7	20.1	189.2	881.4	400.9
Dec.	1	165.6	44.3	237.5	438.9	91.7	88.6	339.1	35.7	92.0	215.5	423.4
	2	42.6	70.0	130.3	213.1	56.9	57.5	384.9	92.5	88.2	125.4	368.9
	3	28.3	34.8	88.7	275.8	25.8	28.2	237.6	370.1	64.2	126.2	299.7
Average		193.0	138.5	220.2	289.9	372.2	143.5	291.9	109.8	303.2	170.7	390.2

Table 2.3 PAN EVAPORATION

Average of Hacienda Luisita and Sabang Baliwag (Unit: mm)

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1968	154.3	164.9	225.9	226.1	162.1	143.1	130.8	109.6	120.3	161.5	154.4	148.4	1,901.4
1969	154.4	169.6	219.5	230.4	191.4	157.7	132.1	137.9	116.1	135.7	126.7	148.2	1,919.5
1970	164.3	161.5	193.4	185.9	179.1	127.2	134.5	110.3	123.2	108.4	111.3	118.4	1,718.0
1971	131.4	138.1	166.5	189.2	147.5	139.5	123.6	158.1	132.3	140.8	126.2	132.7	1,725.9
1972	130.5	156.2	198.1	212.8	185.0	162.3	86.9	101.1	153.8	147.1	134.5	134.6	1,802.9
1973	148.3	155.1	220.0	261.4	209.3	171.6	152.0	119.1	133.3	137.0	128.6	123.5	1,959.2
1974	149.3	155.8	195.8	217.2	163.4	143.4	162.0	90.6	138.6	108.3	127.9	114.9	1,767.2
1975	128.1	153.7	185.7	177.6	162.7	113.8	120.2	109.2	130.2	130.8	142.4	116.9	1,671.3
1976	145.0	152.0	216.1	216.3	160.7	140.8	135.1	112.6	104.5	137.4	147.3	132.4	1,800.2
1977	138.7	150.1	183.5	208.3	174.6	148.1	111.5	131.5	115.4	155.5	129.0	166.5	1,812.7
1978	161.1	149.0	198.0	197.0	183.7	119.9	140.4	74.1	105.9	98.4	120.2	151.7	1,699.4
1979	161.0	151.2	183.4	176.3	136.2	115.5	108.9	118.3	131.5	140.8	146.3	153.5	1,722.9
Total	1,766.9	1,857.2	2,385.9	2,498.5	2,055.7	1,682.7	1,538.0	1,372.4	1,505.1	1,601.7	1,594.8	1,641.7	19,708.6
Average	147.2	154.8	198.8	208.2	171.3	140.2	128.2	114.4	125.4	133.5	132.9	136.8	1,791.7

Table 2.4 IRRIGATION WATER REQUIREMENT FOR DIVERSION DAM SCHEME AT SAN FERNANDO

(Unit: mm)

Day		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	67	68	67	61	44	62	60	59	58	61	70	62
	2	70	67	72	61	59	67	67	59	66	40	72	64
	3	85	92	96	79	78	89	87	73	87	83	92	86
Feb.	1	73	79	79	67	59	75	76	72	73	73	76	73
	2	78	84	81	72	77	79	80	74	76	78	78	78
	3	77	76	71	45	47	51	51	49	62	49	49	57
Mar.	1	48	41	38	32	38	38	35	35	45	35	36	38
	2	29	31	29	20	24	28	22	25	25	25	26	26
	3	29	30	27	6	3	7	5	6	4	6	6	12
Apr.	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	6	6	3	3	3	3	3	3	3	3	3	4
	2	25	27	24	16	27	28	29	26	22	26	29	25
	3	22	22	65	43	56	65	61	58	18	66	52	48
Jun.	1	74	79	71	55	48	85	23	50	58	74	54	61
	2	62	68	34	40	69	67	55	46	73	56	59	57
	3	69	45	51	44	57	64	54	47	36	81	80	57
Jul.	1	46	31	26	39	20	52	33	60	52	45	63	42
	2	36	32	18	10	0	12	41	32	33	11	36	24
	3	16	10	24	6	1	38	30	36	23	26	16	21
Aug.	1	11	6	13	33	5	24	31	11	18	28	35	20
	2	26	31	21	57	17	48	3	14	24	44	9	27
	3	6	62	36	81	25	4	11	19	24	29	4	27
Sep.	1	18	15	13	63	16	9	27	30	37	8	9	22
	2	18	22	13	35	8	31	39	13	14	0	14	19
	3	13	9	18	11	16	24	21	22	7	14	15	15
Oct.	1	14	13	13	3	13	7	10	15	10	17	1	11
	2	7	8	3	2	5	3	2	3	5	5	1	4
	3	9	8	18	18	30	18	16	13	28	31	12	18
Nov.	1	68	66	53	60	64	60	30	36	63	61	40	55
	2	92	74	66	77	83	75	47	60	86	65	73	73
	3	92	72	71	59	92	47	61	92	94	69	92	76
Dec.	1	94	70	88	61	90	70	68	103	69	105	101	84
	2	73	59	45	54	65	69	48	50	61	81	64	61
	3	85	91	63	46	70	70	47	16	67	81	77	65
Total		1,538	1,494	1,410	1,359	1,309	1,469	1,273	1,307	1,421	1,476	1,444	1,409

Table 2.5 IRRIGATION WATER REQUIREMENT FOR DIVERSION DAM SCHEME AT APALIT

(Unit: mm)

Day		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	67	68	67	62	57	63	63	54	60	63	70	63
	2	70	70	71	62	62	67	67	60	66	58	72	66
	3	90	92	95	81	81	89	89	73	87	71	92	85
Feb.	1	76	80	80	69	71	75	76	71	72	73	76	74
	2	81	85	83	72	77	79	80	77	76	77	78	79
	3	66	55	52	46	61	51	47	50	62	48	48	53
Mar.	1	48	39	36	32	39	38	35	35	46	34	35	38
	2	26	29	26	18	22	28	25	25	25	25	24	25
	3	4	7	6	6	3	7	6	6	4	6	6	5
Apr.	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	3	3	3	3	3	3	3	3	3	3	3	3
	2	26	28	29	16	28	29	28	27	24	25	28	26
	3	61	69	71	41	41	72	67	64	21	57	55	56
Jun.	1	83	83	64	57	47	83	51	53	60	71	56	64
	2	93	90	43	46	70	94	56	31	55	53	64	63
	3	95	67	63	51	56	88	77	43	25	71	68	64
Jul.	1	53	48	30	46	18	24	53	62	52	38	53	43
	2	44	35	12	13	1	50	49	30	18	11	26	26
	3	19	1	41	8	1	74	42	61	23	14	13	27
Aug.	1	7	3	13	48	5	43	38	15	17	23	32	22
	2	10	51	19	38	27	25	2	13	30	18	13	22
	3	11	57	37	64	11	6	8	18	16	33	8	24
Sep.	1	25	10	26	43	21	55	42	20	28	23	17	28
	2	18	19	33	43	15	37	46	21	4	5	22	24
	3	17	14	15	19	3	28	30	22	2	17	8	16
Oct.	1	12	11	8	6	11	3	14	9	7	17	1	9
	2	3	5	3	2	5	1	2	5	4	5	1	3
	3	19	29	17	17	30	18	15	18	29	31	16	22
Nov.	1	68	63	38	59	63	64	25	37	61	61	40	56
	2	92	81	56	77	73	75	49	59	80	56	81	71
	3	97	82	76	56	86	48	63	91	85	67	98	77
Dec.	1	105	101	90	58	91	70	61	103	95	86	102	87
	2	74	73	44	52	68	70	41	46	53	81	74	61
	3	77	77	68	32	70	78	42	15	62	87	67	61
Total		1,640	1,625	1,415	1,343	1,317	1,635	1,392	1,357	1,352	1,408	1,447	1,448

Table 2.6 IRRIGATION WATER REQUIREMENT FOR DIVERSION DAM SCHEME AT ARAYAT

(Unit: mm)

Day		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	67	68	67	62	27	62	60	58	46	56	70	58
	2	70	67	71	60	60	67	67	60	65	61	72	65
	3	84	92	95	73	74	89	79	77	87	60	92	82
Feb.	1	74	80	80	62	54	75	74	72	73	73	76	72
	2	79	85	83	72	77	79	79	78	76	78	78	79
	3	59	55	52	45	66	51	48	50	61	49	47	52
Mar.	1	47	39	36	32	41	38	34	35	46	35	30	38
	2	26	29	26	19	22	28	24	25	23	25	22	24
	3	4	7	6	5	0	7	5	6	4	6	6	5
Apr.	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	3	3	3	3	3	3	3	3	3	3	3	3
	2	23	24	26	12	25	26	27	24	14	29	29	24
	3	42	46	61	39	48	49	65	63	17	58	56	49
Jun.	1	75	80	60	49	48	76	41	44	60	54	46	58
	2	62	68	26	38	87	69	49	41	38	70	49	54
	3	69	43	53	43	60	59	71	54	22	86	56	56
Jul.	1	45	28	28	12	16	35	17	55	48	30	39	32
	2	35	29	6	8	1	15	14	26	41	15	30	20
	3	15	4	45	8	1	30	41	13	21	4	12	18
Aug.	1	8	2	27	42	2	44	12	10	9	4	0	15
	2	23	29	12	57	10	58	3	13	19	35	7	24
	3	2	57	12	81	8	6	14	21	10	32	3	22
Sep.	1	15	12	14	42	19	18	35	31	34	19	35	25
	2	16	20	11	20	15	18	19	17	2	2	42	17
	3	9	5	16	6	24	19	18	10	4	11	29	14
Oct.	1	10	9	12	5	18	7	12	12	10	16	14	11
	2	1	2	0	0	1	0	0	0	1	2	1	1
	3	19	29	16	18	30	18	11	12	29	31	30	22
Nov.	1	68	66	37	60	64	65	25	35	63	63	65	56
	2	94	75	53	79	80	79	48	60	84	66	84	73
	3	94	72	72	57	93	54	61	91	92	69	93	77
Dec.	1	96	70	86	64	76	70	64	90	96	105	102	84
	2	73	58	42	56	66	73	41	48	58	81	74	61
	3	77	84	63	49	70	74	50	15	65	81	78	64
Total		1,484	1,437	1,297	1,278	1,280	1,461	1,211	1,249	1,321	1,409	1,470	1,354

Table 2.7 IRRIGATION WATER REQUIREMENT FOR PUMP SCHEME AT SAN FERNANDO

(Unit: mm)

Day		Year 1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	66	67	65	58	46	61	58	58	58	70	68	61
	2	61	59	63	54	52	59	59	51	58	31	63	55
	3	83	91	94	81	79	91	90	76	89	86	95	87
Feb.	1	67	73	73	61	54	68	69	65	66	67	69	67
	2	87	92	89	79	85	87	88	82	84	86	86	86
	3	59	55	52	64	63	72	71	68	82	69	69	66
Mar.	1	70	55	51	45	57	53	49	49	48	48	50	54
	2	52	54	48	37	46	52	39	46	47	46	48	47
	3	9	10	10	23	20	28	19	23	25	24	26	20
Apr.	1	8	10	5	6	4	7	6	6	4	6	6	6
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	6	6	3	3	3	3	3	3	3	3	3	4
	3	44	48	28	19	27	29	28	27	8	30	24	28
Jun.	1	58	60	58	40	37	65	18	38	41	59	39	47
	2	61	65	34	39	60	63	51	44	67	55	55	54
	3	64	49	50	47	59	61	50	50	41	68	78	56
Jul.	1	73	44	52	47	33	69	49	86	64	71	92	62
	2	46	34	30	20	2	26	50	43	48	20	49	33
	3	18	8	20	9	1	37	33	34	17	26	19	20
Aug.	1	13	8	14	33	6	26	29	8	16	26	29	19
	2	27	30	18	50	12	41	2	12	22	43	7	24
	3	6	58	37	88	28	8	13	25	28	29	7	30
Sep.	1	18	15	12	62	15	7	28	27	32	6	6	21
	2	25	29	15	47	9	40	52	17	18	3	21	25
	3	16	11	26	16	25	36	32	33	18	18	21	23
Oct.	1	22	21	26	6	26	16	19	29	20	33	2	20
	2	13	20	6	8	18	4	2	7	16	18	3	10
	3	22	31	4	4	4	5	4	9	4	5	3	9
Nov.	1	33	32	25	28	29	28	14	16	29	29	17	25
	2	68	60	54	60	65	58	35	42	67	55	56	56
	3	84	70	68	60	85	47	54	84	86	61	84	71
Dec.	1	90	65	83	57	87	65	64	98	73	98	95	80
	2	100	87	76	69	95	97	70	76	69	109	93	86
	3	77	83	74	64	79	80	61	31	75	89	86	73
Total		1,546	1,500	1,363	1,384	1,311	1,489	1,309	1,363	1,442	1,487	1,469	1,424

Table 2.8 IRRIGATION WATER REQUIREMENT FOR PUMP SCHEME AT APALIT

(Unit: mm)

Day \ Year		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	66	67	66	60	56	61	62	54	59	61	68	62
	2	61	61	63	54	54	59	59	53	58	50	63	58
	3	92	95	97	83	84	91	92	76	89	74	95	88
Feb.	1	69	73	72	62	64	68	69	65	65	67	69	68
	2	90	94	91	80	85	87	88	85	84	85	86	87
	3	87	77	73	64	80	72	65	70	82	67	67	73
Mar.	1	71	55	51	45	59	53	49	49	68	47	49	54
	2	51	53	48	34	42	52	46	46	47	46	45	46
	3	26	28	25	23	22	28	24	22	25	24	26	25
Apr.	1	4	7	6	6	4	8	6	5	4	6	6	6
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	3	3	3	3	3	3	3	3	3	3	3	3
	3	27	30	31	18	19	31	30	29	10	26	26	25
Jun.	1	64	65	54	41	36	65	43	44	42	54	41	50
	2	85	81	43	44	61	86	52	30	56	51	58	59
	3	89	66	59	52	55	81	67	47	26	67	69	62
Jul.	1	81	71	57	69	22	47	84	73	64	59	77	64
	2	55	46	24	22	5	63	58	44	28	20	40	37
	3	15	2	37	10	1	71	41	64	17	14	15	26
Aug.	1	6	5	14	46	6	40	34	11	17	22	30	21
	2	9	44	15	36	24	23	1	11	26	16	10	20
	3	9	61	38	67	11	7	10	23	17	36	11	26
Sep.	1	28	11	26	42	21	56	45	16	30	19	17	28
	2	26	27	46	57	19	48	61	29	6	9	28	32
	3	26	22	24	25	10	43	46	34	9	23	15	25
Oct.	1	23	21	16	10	22	7	27	16	15	34	3	18
	2	10	16	6	7	18	2	3	9	13	18	3	10
	3	4	4	4	4	4	4	4	3	5	5	3	4
Nov.	1	31	29	17	27	29	29	11	17	28	28	17	24
	2	68	64	40	60	57	59	36	42	63	48	64	55
	3	88	78	73	57	79	48	56	84	79	61	87	72
Dec.	1	98	94	85	54	87	65	59	99	90	71	95	82
	2	103	102	75	64	98	100	57	73	82	109	103	88
	3	86	86	78	45	79	88	56	29	73	98	77	72
Total		1,651	1,638	1,457	1,371	1,316	1,645	1,444	1,355	1,380	1,418	1,466	1,467

Table 2.9 IRRIGATION WATER REQUIREMENT FOR PUMP SCHEME AT ARAYAT

(Unit: mm)

Day \ Year		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	66	67	65	60	28	61	58	56	46	54	68	57
	2	61	59	63	52	53	59	59	53	57	53	63	57
	3	85	95	97	75	72	91	81	79	89	62	95	84
Feb.	1	68	73	72	56	50	68	67	65	66	67	69	66
	2	88	94	91	80	84	87	88	86	84	86	86	87
	3	78	77	72	63	79	72	68	70	81	69	66	72
Mar.	1	70	55	51	45	61	53	48	49	68	48	43	54
	2	51	53	48	36	42	52	41	46	45	46	40	45
	3	26	28	24	22	12	28	19	24	25	24	26	23
Apr.	1	4	7	2	6	4	8	6	6	4	6	6	5
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	3	3	3	3	3	3	3	3	3	3	3	3
	3	19	19	27	18	23	20	29	29	7	26	27	22
Jun.	1	57	60	51	38	36	60	34	35	42	40	36	44
	2	62	65	26	37	78	62	47	40	35	69	45	51
	3	64	49	55	43	62	57	63	54	21	80	58	55
Jul.	1	75	42	53	26	21	53	31	78	59	56	61	50
	2	45	32	16	16	4	28	25	39	51	23	42	29
	3	13	7	43	11	2	26	39	15	15	5	12	17
Aug.	1	9	4	27	39	3	43	10	8	9	5	0	14
	2	24	28	12	51	7	53	2	9	19	33	5	22
	3	1	60	11	89	9	7	14	28	9	35	4	24
Sep.	1	16	11	12	39	17	20	37	28	37	15	37	24
	2	23	26	15	26	20	22	23	22	2	5	56	22
	3	14	8	22	9	34	28	26	14	10	15	43	20
Oct.	1	19	18	24	9	35	16	25	22	19	30	28	22
	2	9	17	6	8	12	4	1	7	11	18	14	10
	3	4	4	4	4	5	5	3	3	5	5	4	4
Nov.	1	31	30	17	28	29	30	10	16	29	29	30	25
	2	68	59	39	62	62	62	36	42	65	56	66	56
	3	84	70	70	58	85	51	54	84	84	61	85	71
Dec.	1	91	64	81	61	75	64	61	88	91	97	96	79
	2	102	88	73	85	92	103	66	72	88	109	103	89
	3	86	92	74	58	80	84	63	28	75	89	87	74
Total		1,516	1,464	1,346	1,313	1,279	1,480	1,237	1,298	1,351	1,419	1,504	1,382

Table 2.10 IRRIGATION WATER REQUIREMENT FOR DIVERSION DAM SCHEME FOR DEVELOPMENT AREA

(Unit: mm)

Day \ Year		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	67	68	67	61	41	72	60	57	54	60	70	62
	2	70	68	72	60	60	67	67	60	66	53	72	65
	3	84	92	95	77	77	88	85	75	86	70	92	84
Feb.	1	74	80	79	66	60	75	75	72	73	73	76	73
	2	79	85	82	72	77	79	79	76	76	75	78	78
	3	61	55	52	46	56	51	49	50	62	49	48	53
Mar.	1	48	40	37	32	40	38	35	35	46	35	33	38
	2	28	29	27	19	22	29	23	25	24	25	24	25
	3	6	8	7	6	2	7	6	6	4	6	6	6
Apr.	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	4	4	3	3	3	3	3	3	3	3	3	3
	2	24	26	26	14	26	27	28	25	19	27	27	24
	3	47	52	65	41	48	61	64	62	18	61	51	52
Jun.	1	77	80	65	53	48	81	37	48	60	65	52	61
	2	70	73	34	41	76	74	53	40	54	61	12	53
	3	76	49	54	46	58	67	67	48	28	80	72	59
Jul.	1	48	35	28	29	18	38	31	59	50	37	43	38
	2	37	32	12	10	1	22	32	29	33	13	34	23
	3	17	5	36	8	1	44	37	33	22	14	17	21
Aug.	1	9	4	18	41	3	37	25	11	14	17	13	17
	2	21	35	17	52	16	47	3	14	23	34	15	25
	3	6	57	27	76	14	6	11	20	16	31	19	26
Sep.	1	19	12	17	49	18	24	34	28	33	16	30	25
	2	17	21	17	31	12	27	33	16	7	2	33	20
	3	12	9	16	10	16	23	22	17	5	14	18	15
Oct.	1	12	10	11	5	15	6	11	12	10	16	7	10
	2	4	5	3	3	4	3	2	3	3	4	3	3
	3	20	29	17	18	29	18	13	14	29	31	24	22
Nov.	1	68	65	43	60	64	63	27	35	63	62	55	55
	2	92	76	59	78	79	77	48	60	49	64	77	69
	3	94	74	73	57	92	50	62	92	91	68	54	73
Dec.	1	98	78	87	62	85	70	65	98	86	100	102	85
	2	73	62	43	54	67	71	43	48	58	81	71	61
	3	77	82	64	48	69	74	47	15	66	83	75	64
Total		1,539	1,500	1,353	1,328	1,297	1,519	1,277	1,286	1,331	1,430	1,406	1,388

Weighted average of irrigation water requirement at San Fernando, Apalit and Arayat.

Table 2.11 IRRIGATION WATER REQUIREMENT FOR PUMP SCHEME FOR DEVELOPMENT AREA

(Unit: mm)

Day		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	66	67	65	60	41	61	59	56	54	61	68	60
	2	61	60	63	54	53	59	59	53	58	45	63	57
	3	86	95	97	80	77	91	87	77	89	73	95	86
Feb.	1	68	73	73	60	55	68	68	66	67	67	69	67
	2	88	93	90	79	86	87	88	85	84	86	86	87
	3	80	76	72	64	74	72	68	69	82	69	68	72
Mar.	1	70	54	51	45	59	53	48	49	67	53	47	54
	2	51	53	48	35	43	52	41	46	47	46	44	46
	3	27	29	25	23	16	29	20	23	25	24	26	24
Apr.	1	5	10	4	6	4	8	6	6	4	6	6	6
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	3	3	2	2	2	2	2	2	2	2	2	2
	3	22	22	29	18	16	26	29	29	9	28	26	23
Jun.	1	59	61	54	39	36	63	30	39	41	50	38	46
	2	67	69	33	40	68	68	50	39	51	60	52	54
	3	70	53	54	47	60	64	59	51	29	73	67	57
Jul.	1	76	49	54	44	25	57	51	79	62	62	76	58
	2	48	36	23	19	3	36	42	41	44	21	44	32
	3	14	7	33	10	1	41	37	34	16	15	15	20
Aug.	1	10	5	19	39	5	36	22	9	14	16	17	17
	2	22	33	15	47	13	41	2	10	22	32	7	22
	3	5	62	27	84	16	8	12	26	18	33	7	27
Sep.	1	20	12	16	48	18	25	35	24	34	13	20	24
	2	24	28	23	41	16	35	43	22	9	5	37	26
	3	18	12	24	16	25	35	33	26	13	18	29	23
Oct.	1	21	20	22	8	29	14	24	23	18	32	12	20
	2	11	18	6	8	16	3	2	8	14	18	7	10
	3	6	6	5	5	5	5	4	3	5	5	4	5
Nov.	1	32	21	20	28	29	29	12	16	29	29	17	24
	2	68	60	44	61	61	60	35	42	43	54	62	54
	3	86	72	70	59	84	49	54	84	84	60	86	72
Dec.	1	92	73	83	58	82	65	61	94	63	91	95	78
	2	102	89	74	74	94	100	65	74	80	109	99	87
	3	86	90	75	57	80	84	61	29	75	91	84	74
Total		1,564	1,511	1,393	1,358	1,292	1,526	1,309	1,334	1,352	1,447	1,475	1,415

Table 2.12 DIVERSION WATER REQUIREMENT FOR DIVERSION DAM SCHEME

(Unit: mm)

Day \ Year		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	124	126	124	113	75	115	112	105	99	111	130	112
	2	130	126	133	112	112	124	124	111	122	98	133	121
	3	155	171	176	143	143	163	157	139	161	130	171	155
Feb.	1	137	149	147	122	111	139	139	133	136	136	141	136
	2	146	156	152	133	143	146	147	141	141	139	144	144
	3	112	101	96	84	103	95	91	92	115	91	90	97
Mar.	1	88	73	69	60	73	70	64	66	85	64	60	70
	2	51	54	49	35	41	53	43	47	45	47	45	46
	3	10	14	12	10	4	12	10	10	7	10	10	10
Apr.	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	6	6	5	5	5	5	5	5	5	5	5	5
	2	45	57	48	26	48	49	51	47	35	49	49	46
	3	86	97	120	76	89	113	118	114	33	113	95	96
Jun.	1	160	168	135	110	101	169	78	101	124	135	108	126
	2	146	153	70	85	158	155	110	83	113	128	25	112
	3	158	103	113	95	121	141	138	101	58	168	149	122
Jul.	1	99	72	58	61	38	79	65	123	105	78	90	79
	2	78	67	25	20	3	47	67	60	68	27	70	48
	3	36	10	75	16	3	91	77	69	46	29	36	44
Aug.	1	18	9	38	85	7	78	52	23	29	36	27	37
	2	43	73	36	111	35	98	5	29	48	70	30	53
	3	12	119	55	159	29	12	24	42	33	66	40	54
Sep.	1	40	25	36	103	38	50	70	58	68	35	63	53
	2	36	43	36	65	25	56	68	35	15	3	68	41
	3	25	18	35	22	35	48	47	36	11	29	38	31
Oct.	1	25	22	23	11	30	13	23	25	20	35	14	22
	2	9	11	5	5	9	6	3	5	7	9	7	8
	3	42	62	36	38	62	38	28	29	60	66	94	51
Nov.	1	143	135	90	124	133	131	56	73	131	130	115	115
	2	193	158	36	162	165	160	101	124	103	133	160	136
	3	196	155	151	119	191	105	130	203	189	143	113	154
Dec.	1	181	144	162	115	156	130	120	181	160	185	189	157
	2	135	115	80	144	124	131	80	90	107	150	131	117
	3	143	151	118	88	128	137	86	29	122	153	139	118
Total		3,008	2,943	2,544	2,657	2,538	2,959	2,489	2,529	2,601	2,801	2,779	2,713

Table 2.13 DIVERSION WATER REQUIREMENT FOR PUMP SCHEME

(Unit: mm)

Day \ Year		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Ave.
Jan.	1	122	123	120	111	77	113	109	104	99	113	126	111
	2	113	110	117	99	98	109	109	98	107	83	117	106
	3	161	176	179	148	142	169	162	142	165	136	176	160
Feb.	1	126	135	135	111	103	126	126	122	124	124	128	124
	2	163	173	167	147	158	162	163	156	156	158	158	160
	3	149	141	133	118	137	133	126	128	151	128	125	134
Mar.	1	130	101	94	83	109	98	90	92	124	90	86	100
	2	95	98	88	66	80	96	77	85	86	85	81	85
	3	49	52	46	42	29	53	37	42	46	44	48	44
Apr.	1	10	19	8	11	8	15	11	11	8	11	11	11
	2	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
May	1	0	0	0	0	0	0	0	0	0	0	0	0
	2	6	6	5	5	5	5	5	5	5	5	5	5
	3	41	41	53	33	29	48	54	53	16	51	48	43
Jun.	1	123	128	113	81	76	131	63	81	86	105	79	97
	2	141	144	68	83	143	143	88	81	106	124	108	112
	3	146	110	113	98	124	133	123	106	61	151	141	119
Jul.	1	158	103	111	92	52	119	106	166	130	130	158	121
	2	99	76	48	40	7	76	88	86	92	43	92	68
	3	29	14	69	22	2	85	77	71	33	31	31	42
Aug.	1	20	11	40	81	11	76	47	18	29	35	36	37
	2	45	68	30	98	27	86	3	22	45	67	15	46
	3	10	20	55	174	33	16	26	53	38	69	14	46
Sep.	1	41	25	33	99	38	52	73	50	70	27	41	50
	2	50	58	48	86	33	72	90	45	18	11	78	54
	3	38	25	50	33	52	72	68	54	27	38	60	47
Oct.	1	43	41	47	16	60	29	50	48	38	67	25	42
	2	23	38	13	16	33	7	3	16	29	38	15	21
	3	12	12	10	10	10	10	8	6	10	10	8	10
Nov.	1	67	43	41	58	60	61	25	35	60	60	36	50
	2	56	126	92	128	128	126	73	88	90	111	130	104
	3	178	149	146	123	175	103	113	175	175	126	178	149
Dec.	1	171	135	154	107	152	120	113	175	117	168	176	144
	2	189	164	137	137	175	186	120	137	149	149	184	157
	3	159	167	139	105	148	155	112	54	138	169	155	157
Total		2,963	2,832	2,702	2,661	2,514	2,985	2,538	2,605	2,628	2,757	2,869	2,732

D.S.: Dry Season Jan. 1 - Apr. 1 & Nov. 1 - Dec. 3
W.S.: Wet Season May 2 - Oct. 3

Table 2.14 STATISTICAL ANALYSIS OF EXTREME DRY YEAR

Year	Annual /1 Rainfall (mm)	Dry Season /1 Rainfall (mm)	Annual Mean Discharge (m^3/s)	Dry Season Mean Discharge (m^3/s)
1965	-	-	231.5	-
1966	-	-	296.8	153.7
1967	-	-	337.2	172.7
1968	1,303.8*	257.6	199.2	96.4
1969	1,429.5	133.0*	144.7*	33.1*
1970	1,570.5	200.0	226.4	28.7*
1971	1,712.5	417.0	296.1	101.4
1972	3,425.1	550.3	378.4	144.0
1973	1,339.7	107.6*	149.4*	31.5*
1974	2,464.3	293.8	298.1	53.5*
1975	1,488.9	623.6	116.0*	226.7
1976	2,404.5	1,036.5 /2	309.4	162.2
1977	1,395.5	197.2	176.9*	85.5
1978	2,018.5	347.6	396.4	122.7
Average	1,868.4	210.6 /3	254.0	108.6
Value in 5 Year Return Period	1,329.0	158.9	179.2	56.3

* : Smaller value than the value in 5 year return period

/1: Weighted average of San Fernando, Apalit and Arayat

/2: Eliminated by test of statistical hypothesis in 5% of risk

/3: Average excluding eliminated sample

Table 2.15 MONTHLY MAXIMUM IRRIGATION SERVICE AREA WITHOUT SHORTAGE FOR PUMP SCHEME

(Unit: 1,000 ha)

		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Jan.	1	28.7	21.5	19.1	38.9	>	13.0	17.1	>	>	>	>
	2	27.0	23.5	16.4	31.1	>	10.5	12.0	>	>	>	>
	3	19.3	12.9	9.0	17.7	41.7	5.8	5.8	>	>	28.7	46.2
Feb.	1	20.2	14.2	9.3	19.8	>	12.0	4.2	>	35.2	18.3	
	2	12.4	6.5	5.2	15.4	32.7	8.6	3.1	29.3	17.4	9.2	36.2
	3	11.5	5.0	3.9	13.3	15.8	4.6	2.2	27.1	9.4	7.3	28.5
Mar.	1	14.6	6.3	6.1	17.4	15.2	0.4	13.1	34.5	14.7	11.1	27.0
	2	24.1	7.4	5.1	>	22.0	0	8.2	35.2	17.1	9.8	33.7
	3	20.5	12.2	12.9	42.5	>	0	12.0	>	18.7	18.7	>
Apr.	1	>	38.2	>	>	>	0	19.0	>	>	>	>
	2	-	-	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-	-	-
May	1	-	-	-	-	-	-	-	-	-	-	-
	2	>	>	>	>	>	0	25.0	>	373.3	>	>
	3	42.8	24.9	11.8	119.4	>	0	7.2	103.9	>	>	72.6
Jun.	1	15.4	10.4	14.2	>	>	0	>	>	>	33.0	>
	2	11.7	32.4	>	>	44.4	7.9	>	80.1	182.1	22.8	>
	3	11.9	15.1	>	>	44.7	14.2	40.9	77.5	>	35.8	>
Jul.	1	21.9	19.7	>	>	>	9.8	27.7	40.9	>	>	>
	2	26.7	42.5	>	>	>	>	>	35.0	>	>	>
	3	>	>	>	>	>	45.0	>	>	>	>	>
Aug.	1	>	>	>	>	>	44.6	>	>	>	>	>
	2	>	>	>	>	>	>	>	>	>	>	>
	3	>	>	>	>	>	>	>	>	>	>	>
Sep.	1	>	>	>	>	>	>	>	>	>	>	>
	2	>	>	>	>	>	>	>	>	>	>	>
	3	>	>	>	>	>	>	>	>	>	>	>
Oct.	1	>	>	>	>	>	>	>	>	>	>	>
	2	>	>	>	>	>	>	>	>	>	>	>
	3	>	>	>	>	>	>	>	>	>	>	>
Nov.	1	>	>	>	>	>	>	>	>	>	>	>
	2	>	18.3	>	>	>	39.5	>	35.0	>	>	>
	3	21.7	>	>	>	29.9	>	>	10.0	>	>	>
Dec.	1	>	28.4	>	>	>	>	>	17.7	>	>	>
	2	19.4	36.8	>	>	28.2	26.7	>	>	49.8	>	>
	3	42.2	19.8	>	>	16.5	17.3	>	>	43.9	>	>

> : More than 50,000 ha

Table 2.16 PROBABILITY ANALYSIS OF 3-DAY CONSECUTIVE RAINFALL

(Unit: mm)

Year	San Fernando	Apalit	Arayat
1966	-	-	492.9*
1967	-	116.5	209.9
1968	-	181.1	224.1
1969	-	135.2	133.8
1970	432.3	103.2	236.8
1971	147.6	111.2	164.5
1972	486.1	752.9*	374.7
1973	232.3	189.5	222.8
1974	750.5*	437.1	485.5*
1975	181.4	213.3	157.5
1976	517.4	394.5	332.2
1977	210.2	192.8	202.7
1978	264.6	215.0	270.8
1979	351.8	361.5	-
Average /1	313.7	221.2	229.9
Design Value /2	385.1	350.7	357.7

* : Eliminated by test of statistical hypothesis in 5% of risk.

/1: Average excluding eliminated data.

/2: Probable maximum 3 days consecutive rainfall in 5 years return period.

Table 3.1(1) GENERAL FEATURES OF DIVERSION DAM SCHEME

1.	Source of Irrigation Water	:	Pampanga river discharge and reservoir volume
2.	Net Irrigation Area		
	- Wet season	:	11,000 ha
	- Dry season	:	11,000 ha
3.	Maximum Diversion Water Requirement	:	24.97 m^3/sec
4.	Diversion Dam		
	(1) Location	:	2.4 km upstream of Arayat Bridge
	(2) Design flood		
	- 20-year return period	:	3,100 m^3/sec
	- 100-year return period	:	3,800 m^3/sec
	(3) Design water level		
	- Flood water level	:	EL. 12.0 m (3,100 m^3/sec)
	- Intake water level	:	EL. 8.5 m
	(4) Gated portion (Low water channel)		
	- Length	:	150 m
	- Crest elevation of gates	:	EL. 8.6 m
	- Spillway gate, Type	:	Shell type roller gate
	- Spillway gate, Number	:	3 Nos.
	- Spillway gate, Span	:	40 m
	- Spillway gate, Height	:	4.6 m
	- Scouring sluice gate, Type	:	Shell type double roller gate
	- Scouring sluice gate, Number	:	1 No.
	- Scouring sluice gate, Span	:	30 m
	- Scouring sluice gate, Height	:	7.6 m

(to be continued)

Table 3.1(2) GENERAL FEATURES OF DIVERSION DAM SCHEME

(5) Fixed weir portion (High water level)

- Length	:	850 m
- Crest elevation	:	EL. 8.6 m
- Weir height	:	0.6 m

(6) Intake structure

- Intake discharge	:	25 m^3/sec
- Intake gate, Type	:	roller gate
- Intake gate, Number	:	6 Nos.
- Intake gate, Span	:	4.0 m
- Intake gate, Height	:	2.5 m
- Intake sill elevation	:	EL. 6.65 m

5. Irrigation Facilities

(1) Main canal

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 1.5)
- Length	:	14.6 km
- Discharge	:	24.97 m^3/sec to 7.23 m^3/sec

(2) Sub main canal

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 1.5)
- Length	:	21.72 km
- Discharge	:	9.54 m^3/sec to 3.32 m^3/sec

(3) Secondary canal

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 1.5)
- Length	:	29.16 km
- Discharge	:	3.02 m^3/sec to 0.98 m^3/sec
- Number	:	6 Nos.

(to be continued)

Table 3.1(3) GENERAL FEATURES OF DIVERSION DAM SCHEME

(4) Lateral canal

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 1.5)
- Length	:	116 km
- Discharge	:	1.19 m^3/sec to 9.16 m^3/sec
- Number	:	57 Nos.

6. Drainage Facilities

(1) Main Drain

- Canal type	:	Trapezoidal earth canal (Slop 1 : 3)
- Length	:	20.45 km
- Discharge	:	234.22 m^3/sec to 84.01 m^3/sec

(2) Secondary drain

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 2)
- Length	:	26.1 km
- Discharge	:	31.61 m^3/sec to 3.74 m^3/sec
- Number	:	2 Nos.

(3) Collector drain

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 1.5)
- Length	:	57 km
- Discharge	:	3.86 m^3/sec to 0.91 m^3/sec
- Number	:	45 Nos.

(4) Catch drain

- Type of canal	:	Trapezoidal earth canal (Slop 1 : 1.5)
- Length	:	6 km
- Discharge	:	19.1 m^3/sec to 3.17 m^3/sec
- Number	:	2 Nos.

(to be continued)

Table 3.1(4) GENERAL FEATURES OF DIVERSION DAM SCHEME

7. Farm Road		
(1) Main farm road		
- Width	:	6 m with gravel pavement of 4 m width
- Length	:	36.32 km
(2) Secondary farm road		
- Width	:	6 m
- Length	:	29.16 km
(3) Tertiary farm road		
- Width	:	4 m
- Length	:	116 km
8. On-Farm Development		
(1) Main farm ditch	:	220 km
(2) Supplementary farm ditch	:	490 km
(3) Farm drain	:	190 km
(4) Drainage ditch	:	355 km

Table 3.2(1) GENERAL FEATURES OF PUMP SCHEME

1.	Source of Irrigation Water	:	Pampanga river discharge
2.	Net Irrigation Area		
	- Wet season	:	7,300 ha
	- Dry season	:	11,000 ha
3.	Maximum Diversion Water Requirement	:	20.13 m^3/sec
4.	Pump Station		
	(1) Location	:	Right back of immediate upstream of Arayat bridge
	(2) Pump bore	:	ø1,500 pump
	(3) Number of pumps	:	4 Nos.
	(4) Pump type	:	Vertical mixed flow pump
	(5) Total dynamic head	:	7.6 m
	(6) Design discharge	:	302 m^3/min/no
	(7) Design water level		
	- HHWL (Flood water level)	:	EL. 12.0 m (3,100 m /sec)
	- HWL (Pump stop operation level)	:	EL. 8.4 m
	- NWL (Normal water level)	:	EL. 2.3 m
	- LWL (Low water level)	:	EL. 1.6 m
	- LLWL (Pump stop operation level)	:	EL. 0.6 m
5.	Irrigation Facilities		
	(1) Main canal		
	- Type of canal	:	Tranpezoidal earth canal (Slop 1 : 1.5)
	- Length	:	12.00 km
	- Discharge	:	20.13 m^3/sec to 6.85 m^3/sec

(to be continued)

Table 3.2(2) GENERAL FEATURES OF PUMP SCHEME

(2) Sub main canal

- Type of canal : Tranpezoidal earth canal (Slop 1 : 1.5)
- Length : 21.72 km
- Discharge : 9.04 m^3/sec to 3.15 m^3/sec

(3) Secondary canal

- Type of canal : Trapezoidal earth canal (Slop 1 : 1.5)
- Length : 29.16 km
- Discharge : 2.86 m /sec to 0.92 m /sec
- Number : 6 Nos.

(4) Lateral canal

- Type of canal : Trapezoidal earth canal (Slop 1 : 1.5)
- Length : 117 km
- Discharge : 1.12 m^3/sec to 0.15 m^3/sec
- Number : 56 Nos.

6. Drainage Facilities

(1) Main drain

- Type of canal : Trapezoidal earth canal (Slop 1 : 3)
- Length : 20.45 km
- Discharge : 234.22 m^3/sec to 84.01 m^3/sec

(2) Secondary drain

- Type of canal : Trapezoidal earth canal (Slop 1 : 2)
- Length : 26.1 km
- Discharge : 31.61 m^3/sec to 3.74 m^3/sec
- Number : 2 Nos.

(to be continued)

Table 3.2(3) GENERAL FEATURES OF PUMP SCHEME

(3) Collector drain

- Type of canal : Trapezoidal earth canal (Slop 1 : 1.5)
- Length : 57 km
- Discharge : 3.86 m^3/sec to 0.91 m^3/sec
- Number : 45 Nos.

(4) Catch drain

- Type of canal : Trapezoidal earth canal (Slop 1 : 1.5)
- Length : 4.5 km
- Discharge : 19.1 m^3/sec
- Number : 1 No.

7. Farm Road

(1) Main farm road

- Width : 6 m with gravel pavement of 4 m width
- Length : 33.72 km

(2) Secondary farm road

- Width : 6 m
- Length : 29.16 km

(3) Tertiary farm road

- Width : 4 m
- Length : 117 km

8. On-Farm Development

(1) Main farm ditch : 220 km

(2) Supplementary farm ditch : 490 km

(3) Farm drain : 190 km

(4) Drainage ditch : 355 km

Table 3.3 BACKWATER CALCULATIONS FOR PRESENT CONDITION

River Section	EL (m)	D	A (m^2)	n	R (m)	he (m)
20-year Flood Q = 3,100 m^3/sec						
42k + 825	11.0	1.2202	2,357.6	0.030	10.6018	
	12.0	1.1936	2,637.6	0.030	11.3797	
	(11.51)	1.2066	2,500.4	0.030	10.9985	
						(0.060)
44k	11.0	2.611	4,492.9	0.0346	5.4311	
	12.0	2.526	5,759.9	0.0362	6.0032	
	(11.62)	2.5583	5,278.4	0.0356	5.7857	0.0579
						(0.0856)
46k	11.0	2.7347	4,692.4	0.0376	5.1676	
	12.0	2.5403	5,968.9	0.0391	5.8344	
	(11.71)	2.5967	5,598.7	0.0387	5.6410	0.0877
						(0.0796)
48k	11.0	3.0726	6,300.9	0.0369	3.8354	
	12.0	2.6999	8,640.9	0.0389	4.5141	
	(11.81)	2.7707	8,196.3	0.0385	4.3851	
						(0.0752)
100-year Flood Q = 3,800 m^3/sec						
42k + 825	12.0	1.1936	2,637.6	0.030	11.3797	
	13.0	1.1691	2,917.6	0.030	12.2043	
	(12.62)	1.1784	2,811.2	0.030	11.8910	
						(0.0566)
44k	12.0	2.5258	5,759.9	0.0362	6.0032	
	13.0	2.3727	7,029.9	0.0375	6.7435	
	(12.747)	2.4114	6,708.6	0.0372	6.5562	0.0568
						(0.0749)
46k	12.0	2.5403	5,968.9	0.0391	5.8344	
	13.0	2.3307	7,248.9	0.0402	6.6248	
	(12.826)	2.3672	7,026.2	0.0400	6.4873	0.0748
						(0.0609)
48k	12.0	2.6999	8,640.9	0.0389	4.5141	
	13.0	2.3828	11,040.9	0.0402	5.3001	
	(12.907)	2.4123	10,817.7	0.0401	5.2270	0.0605

Remarks: EL: Water surface elevation (m)
D: Coefficient
A: Flow area (m^2)
n: Manning's roughness coefficient
R: Hydraulic radius (m)
he: Energy loss (m)

Table 3.4 BACKWATER CALCULATION WITH DAM WITH DEPOSIT FOR 20-YEAR FLOOD

20-year flood Q = 3,100 m^3/sec

Assumptions;

c = 0.449
f = 0.1833) hydraulic loss coefficient

Sand deposit surface 1/7,000

River Section	EL	D	A	n	R	he
44k	11.0	2.611	4,492.9	0.0346	5.4311	
	12.0	2.526	5,759.9	0.0362	6.0032	
	11.62	2.5583	5,278.4	0.0356	5.7857	
						(0.0994)
45.1k	11.0	2.3436	3,090.0	0.0373	3.7807	
(Dam Axis)	12.0	2.1191	4,090.0	0.0390	4.6134	
	(11.701)	2.1862	3,791.0	0.0385	4.3644	0.0995
						(0.1226)
46k	11.0	2.6005	3,198.1	0.0378	3.2675	
	12.0	2.2895	4,472.1	0.0399	4.0453	
	(11.835)	2.3408	4,261.9	0.0396	3.9170	0.1228
						(0.1705)
48k	12.0	2.0985	8,214.4	0.0407	3.9495	
	13.0	1.8834	10,614.4	0.0417	4.8134	
	(12.054)	2.0869	8,344.0	0.0408	3.9962	0.1702

Remarks: EL: Water surface elevation (m)
D: Coefficient
A: Flow area (m^2)
n: Manning's roughness coefficient
R: Hydraulic radius (m)
he: Energy loss (m)

Table 3.5 BACKWATER CALCULATION WITH DAM WITH DEPOSIT FOR 100-YEAR FLOOD

100-year flood Q = 3,800 m^3/sec

Assumptions;

c = 0.398
f = 0.1833) hydraulic loss coefficient

Sand deposit surface 1/7,000

River Section	EL	D	A	n	R	he
44k	12.0	2.5258	5,759.9	0.0362	6.0032	
	13.0	2.3727	7,029.9	0.0375	6.7435	
	12.747	2.4114	6,708.6	0.0372	6.5562	
						(0.0765)
45.1k	12.0	2.1191	4,090.0	0.0390	4.6134	
(Dam Axis)	13.0	1.9379	5,090.0	0.0402	5.5125	
	(12.812)	1.9720	4,902.0	0.0400	5.3435	0.0764
						(0.0882)
46k	12.0	2.2895	4,472.1	0.0399	4.0453	
	13.0	2.0342	5,752.1	0.0412	4.9234	
	(12.913)	2.0564	5,640.7	0.0411	4.8470	0.0883
						(0.1193)
48k	13.0	1.8834	10,614.4	0.0417	4.8134	
	14.0	1.7434	13,074.4	0.0425	5.6955	
	(13.068)	1.8739	10,781.7	0.0418	4.8734	0.1196

Remarks: EL: Water surface elevation (m)
D: Coefficient
A: Flow area (m^2)
n: Manning's roughness coefficient
R: Hydraulic radius (m)
he: Energy loss (m)

Table 3.6 BACKWATER CALCULATION WITH DAM WITHOUT DEPOSIT FOR 20-YEAR FLOOD

20-year flood Q = 3,100 m^3/sec

Assumptions;

c = 0.449
f = 0.1833) hydraulic loss coefficient

River Section	EL	D	A	n	R	he
44k	11.0	2.611	4,492.9	0.0346	5.4311	
	12.0	2.526	5,759.9	0.0362	6.0032	
	11.62	2.5583	5,278.4	0.0356	5.7857	
						(0.0994)
45.1k	11.0	2.3436	3,090.0	0.0373	3.7807	
(Dam Axis)	12.0	2.1191	4,090.0	0.0390	4.6134	
	(11.701)	2.1862	3,791.0	0.0385	4.3644	0.0995
						(0.0818)
46k	11.0	2.7347	4.692.4	0.0376	5.1676	
	12.0	2.5403	5.968.9	0.0391	5.8344	
	(11.841)	2.5712	5.765.9	0.0389	5.7824	0.0817
						(0.0702)
48k	11.0	3.0726	6,300.9	0.0369	3.8354	
	12.0	2.6999	8,640.9	0.0389	4.5141	
	(11.940)	2.7223	8,500.5	0.0388	4.4734	0.0698

Remarks: EL: Water surface elevation (m)
D: Coefficient
A: Flow area (m^2)
n: Manning's roughness coefficient
R: Hydraulic radius (m)
he: Energy loss (m)

Table 3.7 BACKWATER CALCULATION WITH DAM WITHOUT DEPOSIT FOR 100-YEAR FLOOD

100-year flood Q = 3,800 m^3/sec

Assumptions;

c = 0.398
f = 0.1833) hydraulic loss coefficient

River Section	EL.	D	A	n	R	he
44k	12.0	2.5258	5,759.9	0.0362	6.0032	
	13.0	2.3727	7,029.9	0.0375	6.7435	
	12.747	2.4114	6,708.6	0.0372	6.5562	
						(0.0756)
45.1k	12.0	2.1191	4,090.0	0.0390	4.6134	
(Dam Axis)	13.0	1.9379	5,090.0	0.0402	5.5124	
	(12.812)	1.9720	4,902.0	0.0400	5.3435	0.0764
						(0.0636)
46k	12.0	2.5403	5,968.9	0.0391	5.8344	
	13.0	2.3307	7,248.9	0.0402	6.6248	
	(12.920)	2.3475	7,146.5	0.0401	6.5616	0.0630
						(0.0581)
48k	13.0	2.3828	11,040.9	0.0402	5.3001	
	14.0	2.1512	13,500.9	0.0412	6.1297	
	(13.006)	2.3814	11,055.7	0.0402	5.3051	0.0577

Remarks: EL: Water surface elevation (m)
D: Coefficient
A: Flow area (m^2)
n: Manning's roughness coefficient
R: Hydraulic radius (m)
he: Energy loss (m)

Table 3.8 SEDIMENT YIELD AT ARAYAT

(Unit: $10^3 m^3$)

Year	Bed Load Q_B	Suspended Load Q_S	Actual Sediment Volume V
1966	13.0	1,126.5	1,903
1967	14.8	1,291.8	2,182
1968	8.8	693.3	1,173
1969	6.4	456.9	774
1970	9.9	760.2	1,286
1971	13.1	1,056.3	1,786
1972	16.7	1,910.6	3,219
1973	6.6	544.5	920
1974	13.1	1,225.1	2,068
1975	5.2	187.5	322
Ave.	10.8	925.3	1,563

Table 3.9 SEDIMENT BALANCE IN THE RESERVOIR

(Unit: 1,000m^3)

Year	Sediment Load for Q < 770m^3/sec			Sediment Load for Q ≥ 770m^3/sec		
	Q_B	Q_S	V	Q_B	Q_S	V
1966	5.8	265.4	453	7.2	861.1	1,450
1967	4.5	204.8	350	10.3	1,087.0	1,832
1968	4.6	223.9	382	4.2	469.4	791
1969	3.7	151.8	260	2.7	305.1	514
1970	5.5	262.2	447	4.4	498.0	839
1971	6.5	317.8	542	6.6	738.5	1,244
1972	4.0	173.4	296	12.7	1,737.2	2,922
1973	3.1	128.9	220	3.5	415.6	700
1974	4.7	233.2	397	8.4	991.9	1,671
1975	5.1	176.2	303	0.1	11.3	19
Ave.			365			1,198

(Unit: 1,000 m^3)

Year	Sediment load for Q < 340 m^3/sec			Sediment load for Q ≧ 340 m^3/sec		
	Q_B	Q_S	V	Q_B	Q_S	V
1966	3.4	112.3	193.2	9.6	1,014.1	1,709.6
1967	2.6	80.8	139.3	12.2	1,210.9	2,042.6
1968	2.0	52.3	90.7	6.8	641.0	1,081.8
1969	2.6	73.8	127.6	3.9	383.2	646.5
1970	2.9	104.7	179.7	7.0	655.5	1,106.4
1971	3.4	111.0	191.0	9.7	945.3	1,594.9
1972	2.3	54.6	95.0	14.4	1,855.9	3,123.4
1973	1.9	49.9	86.5	4.7	494.5	833.7
1974	2.5	78.5	135.3	10.6	1,146.6	1,932.5
1975	4.7	112.6	195.9	0.4	74.9	125.8
Ave.			143.4			1,419.7

Table 3.10 SEDIMENT LOAD TO IRRIGATION WATER IN BASIC YEAR 1977

Decade		River Discharge		River Sediment				Canal Discharge		Sediment Load	
				Q_B	Q_C	Total	Q'ty	D.D.S*	P.S*	D.D.S*	P.S*
		(m^3/sec)	(MCM)	($10^{-3}m^3$/sec)	($10^{-3}m^3$/sec)	($10^{-3}m^3$/sec)	(10^3m^3)	(MCM)	(MCM)	(MCM)	(MCM)
Jan.	1	77.9	67.3	0.11	2.21	2.32	2.0	12.2	12.4	0.4	0.4
	2	64.7	55.9	0.09	1.64	1.73	1.5	10.8	9.1	0.3	0.2
	3	47.2	44.8	0.07	0.98	1.06	0.9	14.3	15.0	0.3	0.3
Feb.	1	32.3	27.9	0.05	0.53	0.58	0.5	15.0	13.6	0.2	0.2
	2	23.1	20.0	0.03	0.31	0.34	0.3	15.3	17.4	0.2	0.3
	3	19.8	13.7	0.03	0.24	0.27	0.2	10.0	14.1	0.1	0.2
Mar.	1	17.8	15.4	0.03	0.21	0.24	0.2	7.0	9.9	0.1	0.1
	2	15.8	13.7	0.02	0.17	0.19	0.2	5.2	9.4	0.1	0.1
	3	14.8	14.1	0.02	0.15	0.17	0.1	1.1	4.8	0	0
Apr.	1	13.5	11.7	0.02	0.13	0.15	0.1	0	1.2	0	0
	2	12.2	10.5	0.02	0.11	0.13	0.1	0	0	0	0
	3	11.1	9.6	0.02	0.10	0.12	0.1	0	0	0	0
May	1	10.1	8.7	0.02	0.08	0.10	0.1	0.6	0	0	0
	2	9.2	7.9	0.01	0.07	0.08	0.1	5.4	0.4	0.1	0
	3	36.9	35.1	0.05	0.66	0.71	0.6	12.4	3.7	0.2	0
Jun.	1	46.1	39.8	0.07	0.95	1.02	0.9	14.9	7.7	0.3	0.2
	2	39.0	33.7	0.06	0.72	0.78	0.7	14.1	9.1	0.3	0.4
	3	70.8	61.2	0.10	1.89	1.99	1.7	18.5	11.0	0.5	0.3
Jul.	1	89.1	77.0	0.13	2.74	2.87	2.5	8.6	9.5	0.3	0.3
	2	92.9	80.3	0.13	2.93	3.06	2.6	3.0	3.1	0.1	0.1
	3	231.4	219.9	0.32	12.72	13.04	11.3	3.2	2.3	0.2	0.1
Aug.	1	364.9	315.2	0.51	26.49	27.00	23.3	4.0	2.6	0.3	0.2
	2	336.4	290.6	0.47	23.24	23.71	20.5	7.7	4.9	0.5	0.3
	3	430.5	409.1	0.60	34.57	35.17	30.4	7.3	5.0	0.5	0.4
Sep.	1	640.2	553.1	0.89	65.49	66.38	57.4	3.9	2.0	0.4	0.2
	2	726.8	627.9	1.01	80.33	81.34	70.3	0.3	0.8	0	0.1
	3	616.5	532.7	0.86	61.63	62.49	54.0	3.2	2.8	0.3	0.3
Oct.	1	500.3	432.3	0.70	44.03	44.73	38.6	3.9	4.9	0.3	0.4
	2	242.0	209.1	0.34	13.68	14.02	12.1	1.0	2.8	0.1	0.2
	3	138.1	131.3	0.19	5.54	5.73	5.0	7.3	0.7	0.3	0
Nov.	1	110.0	95.0	0.16	3.84	4.00	3.5	14.3	6.6	0	0.2
	2	111.6	96.4	0.16	3.93	4.09	3.5	14.6	12.2	0.5	0.4
	3	887.6	766.9	1.23	110.82	112.05	96.8	15.7	13.9	2.0	1.8
Dec.	1	221.7	191.6	0.31	11.88	12.19	10.5	20.4	18.5	1.1	1.0
	2	131.6	113.7	0.19	5.13	5.32	4.6	16.6	16.4	0.7	0.7
	3	132.4	125.8	0.19	5.18	5.37	4.6	16.9	18.6	0.6	0.7
Total			5,758.9				461.8	308.7	266.4	11.4	10.1

* D.D.S: Diversion Dam Scheme
P.S: Pump Scheme

Table 3.11 COST COMPARISON TABLE ON PUMP ALTERNATIVES

(Unit: 10⁶₱)

Year		Alternative 1	Present Worth Value	Alternative 2	Present Worth Value	Alternative 3	Present Worth Value
Discount Rate 8%							
1	Initial Cost	32.1	29.722	29.9	27.685	27.6	25.556
2	O&M Cost	6.74	65.707	6.91	67.365	7.58	73.896
3							
⋮							
25	O&M Cost	6.74		6.91		7.58	
	Total		95.429		95.050		99.452
Discount Rate 12%							
1	Initial Cost		28.661		26.697		24.643
2-25	O&M Cost		46.845		48.026		52.683
	Total		75.506		74.723		77.326
Discount Rate 15%							
1	Initial Cost		27.913		26.000		24.000
2-25	O&M Cost		37.707		38.659		42.407
	Total		65.620		64.659		66.407

Table 3.12 ELECTRIC POWER CONSUMPTION FOR PUMP ALTERNATIVES

(Unit: 10^3kWH)

Year	Alternative 1 ø1,350 x 5	Alternative 2 ø1,500 x 4	Alternative 3 ø1,650 x 3
1968	9,612	9,372	10,440
1969	9,180	9,240	10,260
1970	8,316	8,976	9,540
1971	8,016	8,184	9,900
1972	7,992	8,316	9,360
1973	7,992	8,052	9,360
1974	7,776	7,920	9,540
1975	8,316	8,712	9,720
1976	7,776	8,184	9,180
1977	8,640	9,108	10,260
1978	8,680	8,844	9,720
Mean	8,387	8,628	9,753

Table 3.13 ELECTRIC POWER CHARGE FOR PUMP ALTERNATIVES

(Unit: 10^3₱)

Year	Power Charge			Fuel Cost Adjustment			Total Charge		
	ø1,350x5	ø1,500x4	ø1,650x3	ø1,350x5	ø1,500x4	ø1,650x3	ø1,350x5	ø1,500x4	ø1,650x3
1968	5,959.4	5,810.6	6,472.8	1,278.4	1,246.5	1,388.5	7,237.8	7,057.1	7,861.3
1969	5,691.6	5,728.8	6,361.2	1,220.9	1,228.9	1,364.6	6,912.5	6,957.7	7,725.8
1970	5,155.9	5,565.1	5,914.8	1,106.0	1,193.8	1,268.8	6,261.9	6,758.9	7,183.6
1971	4,969.9	5,074.1	6,138.0	1,066.1	1,088.5	1,316.7	6,036.0	6,162.6	7,454.7
1972	4,955.0	5,155.9	5,803.2	1,062.9	1,106.2	1,244.9	6,017.9	6,262.1	7,048.1
1973	4,955.0	4,992.2	5,803.2	1,062.9	1,070.9	1,244.9	6,017.9	6,063.1	7,048.1
1974	4,821.1	4,910.4	5,914.8	1,034.2	1,053.4	1,268.8	5,855.3	5,963.8	7,183.6
1975	5,155.9	5,401.4	6,026.4	1,106.0	1,158.7	1,292.8	6,261.9	6,560.1	7,719.2
1976	4,821.1	5,074.1	5,691.6	1,034.2	1,088.5	1,220.9	5,855.3	6,162.6	6,912.5
1977	5,356.8	5,647.0	6,361.2	1,149.1	1,211.4	1,364.6	6,505.9	6,858.4	7,725.8
1978	5,356.8	5,483.3	6,026.4	1,149.1	1,176.3	1,292.8	6,505.9	6,659.6	7,319.2
Mean	5,199.9	5,349.4	6,046.9	1,115.5	1,147.5	1,297.1	6,315.4	6,496.9	7,344.0

Mean annual power charge:

Alternative 1	ø1,350 x 5	₱6.32 mill
Alternative 2	ø1,500 x 4	₱6.50 mill
Alternative 3	ø1,650 x 3	₱7.19 mill

Table 3.14 OPERATION AND MAINTENANCE COST FOR PUMP ALTERNATIVES

(1) Operation Personnel

Mechanic	2	₱2,000/month x 12 x 2	= ₱48,000
Operator	10	₱1,200/month x 12 x 10	= ₱144,000
		Total	= ₱192,000
		Say	= ₱0.2 mill

(2) Maintenance Cost

Assuming 1% of initial cost of pump plant, excluding civil work cost, annual maintenance cost is as follows:

Alternative 1	(ø1,350 x 5)	₱0.22 mill
Alternative 2	(ø1,500 x 4)	₱0.21 mill
Alternative 3	(ø1,650 x 3)	₱0.19 mill

(3) Total Operation and Maintenance Cost

Alternative 1	₱6.32 + 0.2 + 0.22 = ₱6.74 mill
Alternative 2	₱6.50 + 0.2 + 0.21 = ₱6.91 mill
Alternative 3	₱7.19 + 0.2 + 0.19 = ₱7.58 Mill

Table 3.15 LIST OF RELATED STRUCTURES OF IRRIGATION CANALS

Canals	Bridge	Head Gate (H. G.)	Turnout (T. O.)	Check	Spillway	Syphon	Culvert	Drop	Diversion Work
DIVERSION DAM SCHEME									
1. Main Canal	8	16	2	6	2	1	-	-	-
2. Sub Main Canal	6	17	-	9	2	-	-	-	-
3. Secondary Canals	9	30	6	10	8	3	2	-	-
No. 1	3	5	1	2	2	2	-	-	-
No. 2	1	4	-	2	1	-	-	-	-
No. 3	1	8	1	2	2	1	-	-	-
No. 4	1	7	-	1	1	-	-	-	-
No. 5	1	3	1	1	1	-	1 (Existing)	-	-
No. 6	2	3	3	2	1	-	1 (Existing)	-	-
4. Lateral Canal	-	-	230	140	1	-	30	10	-
5. Main Farm Ditch	-	-	-	-	-	-	120	-	1,320
Total	23	63	238	165	13	4	152	10	1,320
PUMP SCHEME									
1. Main Canal	7	15	2	6	2	1	-	-	-
2. Sub Main Canal	6	17	-	9	2	-	-	-	-
3. Secondary Canal	9	30	6	10	8	3	2	-	-
No. 1	3	5	1	2	2	2	-	-	-
No. 2	1	4	-	2	1	-	-	-	-
No. 3	1	8	1	2	2	1	-	-	-
No. 4	1	7	-	1	1	-	-	-	-
No. 5	1	3	1	1	1	-	1 (Existing)	-	-
No. 6	2	3	3	2	1	-	1 (Existing)	-	-
4. Lateral Canal	-	-	230	140	1	-	30	10	-
5. Main Farm Ditch	-	-	-	-	-	-	120	-	1,320
Total	22	62	238	165	13	4	152	10	1,320

Table 3.16 LIST OF RELATED STRUCTURES OF DRAINAGE CANALS

	Bridge	Junction	Culvert	Cross Drain	Remarks
1. Main Drain	7	29	-	-	6 Bridge are Existing
2. Secondary Drain	10	44	-	-	
No. 1	1	19	-	-	
No. 2	9	25	-	-	
3. Collector Drain	-	108	13	1	
4. Farm Drain	-	-	23	15	
5. Catch Drain	-	-	-	1	Pump Scheme (O)
Total	17	181	36	17	

Table 4.1(1) REQUIRED MAJOR CONSTRUCTION EQUIPMENT FOR DIVERSION DAM SCHEME

No.	Machinery	Specification	Required Number
1.	Bulldozer	32 t	5
2.	Bulldozer	22 t	15
3.	Bulldozer	12 t	10
4.	Backhoe	1.2 m^3	2
5.	Backhoe	0.6 m^3	10
6.	Backhoe	0.3 m^3	6
7.	Crawler loader	2 m^3	6
8.	Wheel loader	2 m^3	6
9.	Motor grader	11 t	5
10.	Dump truck	10 t	40
11.	Dump truck	6 t	50
12.	Cargo truck	6 t	15
13.	Fuel tanker	5 kℓ	4
14.	Water tanker	6 kℓ	4
15.	Truck mixer	3 m^3	15
16.	Crawler crane	40 t	4
17.	Truck crane	10 t	4
18.	Diesel pile hammer	3 t	2
19.	Vibration pile driver	4 t	2
20.	Dragline	1.2 m^3	2
21.	Vibration roller	1 t	10
22.	Macadam roller	10 t	2
23.	Tire roller	10 t	6
24.	Air compressor	80 ps	2
25.	Submergible pump	6" ø	10
26.	Engine centrifugal pump	6" ø	10
27.	Engine centrifugal pump	4" ø	10
28.	Engine concrete mixer	0.2 m^3	10

(to be continued)

Table 4.1(2) REQUIRED MAJOR CONSTRUCTION EQUIPMENT FOR DIVERSION DAM SCHEME

No.	Machinery	Specification	Required Number
29.	Concrete mixing plant	20 m^3/hr	1
30.	Concrete mixing plant	10 m^3/hr	1
31.	Concrete vibrator	5" ø	5
32.	Concrete vibrator	2" ø	20
33.	Concrete bucket	2 m^3	2
34.	Concrete bucket	1 m^3	5
35.	Aggregate screen plant	150 t/hr	1
36.	Aggregate screen plant	30 t/hr	1
37.	Diesel generator	200 KVA	2
38.	Diesel generator	40 KVA	3
39.	Grease car	6 t	1
40.	Repair shop car	6 t	2
41.	Engine beltconveyor	7 m	20

Table 4.2(1) REQUIRED MAJOR CONSTRUCTION EQUIPMENT FOR PUMP SCHEME

No.	Machinery	Specification	Required Number
1.	Bulldozer	32 t	5
2.	Bulldozer	22 t	10
3.	Bulldozer	12 t	10
4.	Backhoe	1.2 m^3	2
5.	Backhoe	0.6 m^3	5
6.	Backhoe	0.3 m^3	5
7.	Crawler loader	2 m^3	6
8.	Wheel loader	2 m^3	5
9.	Motor grader	11 t	5
10.	Dump truck	10 t	40
11.	Dump truck	6 t	50
12.	Cargo truck	6 t	10
13.	Fuel tanker	5 kℓ	4
14.	Water tanker	6 kℓ	4
15.	Truck mixer	3 m^3	10
16.	Crawler crane	40 t	3
17.	Truck crane	10 t	4
18.	Diesel pile hammer	3 t	3
19.	Vibration pile driver	4 t	2
20.	Dragline	1.2 m^3	2
21.	Vibration roller	1 t	10
22.	Macadam roller	10 t	2
23.	Tire roller	10 t	6
24.	Submergible pump	6" ø	10
25.	Engine centrifugal pump	6" ø	10
26.	Engine centrifugal pump	4" ø	10
27.	Concrete pump truck	20 m^3/hr	1
28.	Engine concrete mixer	0.2 m^3	10

(to be continued)

Table 4.2(2) REQUIRED MAJOR CONSTRUCTION EQUIPMENT FOR PUMP SCHEME

No.	Machinery	Specification	Required Number
29.	Concrete mixing plant	20 m^3/hr	1
30.	Concrete mixing plant	10 m^3/hr	1
31.	Concrete vibrator	5" ø	5
32.	Concrete vibrator	2" ø	20
33.	Concrete bucket	2 m^3	2
34.	Concrete bucket	1 m^3	5
35.	Aggregate screen plant	100 t/hr	1
36.	Aggregate screen plant	30 t/hr	1
37.	Diesel generator	200 KVA	2
38.	Diesel generator	50 KVA	3
39.	Engine compressor	10 m^3/min	2
40.	Grease car	6 t	1
41.	Repair shop car	6 t	1
42.	Engine beltconveyor	7 m	20

Table 5.1 SUMMARY OF FINANCIAL CONSTRUCTION COST FOR DIVERSION DAM SCHEME

(Unit: ₱10⁶)

	Item	Foreign Currency	Peso Currency	Total
1.	Direct Construction Cost	146.43	160.53	306.96
2.	Cost for O&M Facilities	4.10	4.50	8.60
3.	Compensation Cost for Land Acquisiton	-	33.00	33.00
4.	Engineering Cost	22.10	12.30	34.40
	Sub-total	172.63	210.33	382.96
5.	Physical Contingency	19.17	30.37	49.54
	Total	191.80	240.70	432.50
6.	Price Contingency	64.70	130.90	195.60
	Grand Total	256.50	371.60	628.10

Table 5.2 SUMMARY OF FINANCIAL CONSTRUCTION COST FOR PUMP SCHEME

(Unit: ₱10⁶)

	Item	Foreign Currency	Peso Currency	Total
1.	Direct Construction Cost	96.35	110.36	206.71
2.	Cost for O&M Facilities	4.10	4.50	8.60
3.	Compensation Cost for Land Acquisition	-	20.50	20.50
4.	Engineering Cost	17.80	8.80	26.60
	Sub-total	118.25	144.16	262.41
5.	Physical Contingency	13.75	21.24	34.99
	Total	132.00	165.40	297.40
6.	Price Contingency	37.00	77.10	114.10
	Grand Total	169.00	242.50	411.50

Table 5.3 ANNUAL DISBURSEMENT SCHEDULE OF CONSTRUCTION COST FOR DIVERSION DAM SCHEME

(Unit: ₱10⁶)

	Total			1983			1984			1985			1986			1987			1988			1989		
	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total
1. Direct Construction Cost																								
1) Diversion Dam	86.00	63.97	149.97	-	-	-	12.56	15.96	28.52	12.16	11.69	23.85	30.52	14.24	44.76	30.76	22.08	52.84	-	-	-	-	-	-
2) Irrigation Facilities	25.19	33.40	58.59	-	-	-	4.59	6.16	10.75	8.66	11.39	20.05	8.67	11.40	20.07	3.27	4.45	7.72	-	-	-	-	-	-
3) Drainage Facilities	28.44	42.88	71.32	-	-	-	7.88	11.87	19.75	7.80	11.75	19.55	7.32	11.05	18.37	5.44	8.21	13.65	-	-	-	-	-	-
4) Farm Roads	6.15	6.64	12.79	-	-	-	0.65	0.77	1.42	1.31	1.55	2.86	1.31	1.55	2.86	2.88	2.77	5.65	-	-	-	-	-	-
5) On Farm Development	0.65	13.64	14.29	-	-	-	-	-	-	-	-	-	-	-	-	0.44	5.12	5.56	0.21	5.12	5.33	-	3.40	3.40
2. Cost for O&M Facilities	4.10	4.50	8.60	-	-	-	-	4.50	4.50	-	-	-	-	-	-	4.10	-	4.10	-	-	-	-	-	-
3. Compensation Cost for Land Aquisition	-	33.00	33.00	-	5.00	5.00	-	10.00	10.00	-	10.00	10.00	-	8.00	8.00	-	-	-	-	-	-	-	-	-
4. Engineering Cost	22.10	12.30	34.40	7.50	2.99	10.49	6.05	2.56	8.61	4.15	2.42	6.57	3.30	2.32	5.62	1.10	2.01	3.11	-	-	-	-	-	-
Sub-Total	172.63	210.33	382.96	7.50	7.99	15.49	31.73	51.82	83.55	34.08	48.80	82.88	51.12	48.56	99.68	47.99	44.64	92.63	0.21	5.12	5.33	-	3.40	3.40
5. Physical Contingency	19.17	30.37	49.54	0.80	1.01	1.81	4.47	7.68	12.15	4.92	7.20	12.12	4.18	6.84	11.02	4.71	6.36	11.07	0.09	0.78	0.87	-	0.50	0.50
Total	191.8	240.7	432.5	8.3	9.0	17.3	36.2	59.5	95.7	39.0	56.0	95.0	55.3	55.4	110.7	52.7	51.0	103.7	0.3	5.9	6.2	-	3.9	3.9
6. Price Contingency	64.7	130.9	195.6	1.1	1.9	3.0	7.5	19.7	27.2	11.2	26.0	37.2	20.5	33.8	54.3	24.2	39.4	63.6	0.2	5.6	5.8	-	4.5	4.5
Grand Total	256.5	371.6	628.1	9.4	10.9	20.3	43.7	79.2	122.9	50.2	82.0	132.2	75.8	89.2	165.0	76.9	90.4	167.3	0.5	11.5	12.0	-	8.4	8.4

Remarks: FC: Foreign Currency
PC: Peso Currency

Table 5.4 ANNUAL DISBURSEMENT SCHEDULE OF CONSTRUCTION COST FOR PUMP SCHEME

(Unit: $P10^6$)

	Total			1983			1984			1985			1986			1987			1988		
	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total	FC	PC	Total
1. Direct Construction Cost																					
1) Pump Station	39.01	18.24	57.25	-	-	-	10.55	9.27	19.82	13.93	3.84	17.77	14.53	5.13	19.66	-	-	-	-	-	-
2) Irrigation Facilities	23.57	31.03	54.60	-	-	-	5.61	7.36	12.97	13.54	17.48	31.02	4.42	6.19	10.61	-	-	-	-	-	-
3) Drainage Facilities	27.15	40.98	68.13	-	-	-	9.55	14.38	23.93	10.16	15.32	25.48	7.44	11.28	18.72	-	-	-	-	-	-
4) Farm Roads	5.97	6.47	12.44	-	-	-	0.56	0.66	1.22	2.14	2.52	4.66	3.27	3.29	6.56	-	-	-	-	-	-
5) On Farm Development	0.65	13.64	14.29	-	-	-	-	-	-	-	-	-	0.43	5.13	5.56	0.22	5.11	5.33	-	3.40	3.40
2. Cost for O&M Facilities	4.10	4.50	8.60	-	-	-	-	4.50	4.50	-	-	-	4.10	-	4.10	-	-	-	-	-	-
3. Compensation Cost for Land Aquisition	-	20.50	20.50	-	2.50	2.50	-	10.00	10.00	-	8.00	8.00	-	-	-	-	-	-	-	-	-
4. Engineering Cost	17.80	8.80	26.60	7.50	2.80	10.30	5.62	2.65	8.27	3.12	1.80	4.92	1.56	1.55	3.11	-	-	-	-	-	-
Sub-Total	118.25	144.16	262.41	7.50	5.30	12.80	31.89	48.82	80.71	42.89	48.96	91.85	35.75	32.57	68.32	0.22	5.11	5.33	-	3.40	3.40
5. Physical Contingency	13.75	21.24	34.99	0.80	0.70	1.50	4.51	7.18	11.69	4.71	7.24	11.95	3.65	4.83	8.48	0.08	0.79	0.87	-	0.50	0.50
Total	132.0	165.4	297.4	8.3	6.0	14.3	36.4	56.0	92.4	47.6	56.2	103.8	39.4	37.4	76.8	0.3	5.9	6.2	-	3.9	3.9
6. Price Contingency	37.0	77.1	114.1	1.1	1.3	2.4	7.6	18.5	26.1	13.6	26.1	39.7	14.6	22.9	37.5	0.1	4.6	4.7	-	3.7	3.7
Grand Total	169.0	242.5	411.5	9.4	7.3	16.7	44.0	74.5	118.5	61.2	82.3	143.5	54.0	60.3	114.3	0.4	10.5	10.9	-	7.6	7.6

Remarks: FC: Foreign Currency
PC: Peso Currency

Table 5.5 SUMMARY OF CONSTRUCTION COST FOR DIVERSION DAM SCHEME (1981 PRICE LEVEL)

(Unit: ₱10⁶)

Item	Foreign Currency	Peso Currency	Total
1. Direct Construction Cost	(146.43)	(160.53)	(306.96)
(1) Diversion Dam	86.00	63.97	149.97
(2) Irrigation Facilities	25.19	33.40	58.59
(3) Drainage Facilities	28.44	42.88	71.32
(4) Farm Road	6.15	6.64	12.79
(5) On-Farm Development	0.65	13.64	14.29
2. Cost for O&M Facilities	4.10	4.50	8.60
3. Compensation Cost for Land Acquisition	-	33.00	33.00
4. Engineering Cost	22.10	12.30	34.40
Sub-Total	172.63	210.33	382.96
5. Physical Contingency	19.17	30.37	49.54
Total	191.80	240.70	432.50

Table 5.6 SUMMARY OF CONSTRUCTION COST FOR PUMP SCHEME (1981 PRICE LEVEL)

(Unit: ₱10⁶)

Item	Foreign Currency	Peso Currency	Total
1. Direct Construction Cost	(96.35)	(110.36)	(206.71)
(1) Pump Station	39.01	18.24	57.25
(2) Irrigation Facilities	23.57	31.03	54.60
(3) Drainage Facilities	27.15	40.98	68.13
(4) Farm Road	5.97	6.47	12.44
(5) On-Farm Development	0.65	13.64	14.29
2. O&M Facilities	4.10	4.50	8.60
3. Land Acquisition	-	20.50	20.50
4. Engineering Cost	17.80	8.80	26.60
Sub-Total	118.25	144.16	262.41
5. Physical Contingency	13.75	21.24	34.99
Total	132.00	165.40	297.40

Table 5.7 SUMMARY OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

(Unit: ₱10^3)

Work Item	Foreign Currency	Peso Currency	Total
1. Diversion Dam	86,000	63,970	149,970
2. Irrigation Facilities	25,190	33,400	58,590
2.1 Main Canal	6,920	9,410	16,330
2.2 Sub-Main Canal	6,960	8,920	15,880
2.3 Secondary Canal	5,160	6,800	11,960
2.4 Lateral Canal	6,150	8,270	14,420
3. Drainage Facilities	28,440	42,880	71,320
3.1 Main Drain	19,440	28,920	48,360
3.2 Secondary Drain	6,210	9,690	15,900
3.3 Collector Drain	1,350	2,150	3,500
3.4 Catch Drain	1,440	2,120	3,560
4. Farm Roads	6,150	6,640	12,790
4.1 Main Farm Road	2,800	2,700	5,500
4.2 Secondary Farm Road	820	970	1,790
4.3 Tertiary Farm Road	2,530	2,970	5,500
5. On Farm Development	650	13,640	14,290
5.1 Main Farm Ditch	270	3,030	3,300
5.2 Supplementary Farm Ditch	-	6,070	6,070
5.3 Farm Drain	380	2,110	2,490
5.4 Drainage Ditch	-	2,430	2,430
Total	146,430	160,530	306,960

Table 5.8(1) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Amount (₱10³) Peso Currency
1. Diversion Dam			86,000	63,970
1.1 Temporary Works	-	LS	2,270	2,880
1.2 Excavation	m^3	1,504,100	5,866	9,927
1.3 Fill and Compaction	m^3	1,066,700	3,840	5,974
1.4 Concrete Works	m^3	38,900	15,992	15,379
1.5 Wet Masonry	m^3	3,570	564	685
1.6 River Protection Works	m^2	165,600	13,592	19,680
1.7 Sheet Pile	ton	620	3,255	1,910
1.8 Operation and Control Facility	m^2	640	-	1,136
1.9 Metal Works				
- Spillway and scouring sluice	ton	870	36,900	3,400
- Intake gate	ton	40	1,100	100
1.10 Miscellaneous	-	LS	2,621	2,899
2. Irrigation Facilities				
2.1 Main Canal			6,920	9,410
2.1.1 Stripping	m^2	371,000	297	297
2.1.2 Excavation	m^3	253,000	987	1,670
2.1.3 Filling	m^3	271,000	1,675	2,143
2.1.4 Waste Soil	m^3	145,000	653	798
2.1.5 Sod Facing	m^2	82,800	0	166
2.1.6 Related Structure				
- Concrete works	m^3	3,700	2,158	3,215
- Wet masonry	m^3	1,000	158	192

- to be continued

Table 5.8(2) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Peso Currency
- Hand rail	m	1,000	129	101
- Gate	ton	72	605	475
- Concrete pipe	m	120	30	36
- Earthworks	m^3	15,700	74	107
- Miscellaneous	-	LS	154	210
2.2 Sub-Main Canal			6,960	8,920
2.2.1 Stripping	m^2	449,000	359	359
2.2.2 Excavation	m^3	68,000	265	449
2.2.3 Filling	m^3	398,000	4,156	5,130
2.2.4 Sod Facing	m^2	122,900	0	246
2.2.5 Related Structure				
- Concrete works	m^3	2,300	1,328	1,971
- Wet masonry	m^3	600	95	115
- Hand rail	m	700	90	71
- Gate	ton	63	529	416
- Concrete pipe	m	120	30	36
- Earthworks	m^3	100	0.3	0.3
- Miscellaneous	-	LS	107.7	126.7
2.3 Secondary Canal			5,160	6,800
2.3.1 Stripping	m^2	449,000	359	359
2.3.2 Excavation	m^3	39,000	152	257
2.3.3 Filling	m^3	336,000	2,382	3,048
2.3.4 Sod Facing	m^2	131,400	0	263
2.3.5 Related Structure				
- Concrete works	m^3	2,200	1,266	1,877
- Wet masonry	m^3	1,200	190	230

- to be continued

Table 5.8(3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

Work Item	Unit	Quantity	Amount (₱103) Foreign Currency	Peso Currency
- Hand rail	m	200	26	20
- Gate	ton	63	529	416
- Concrete Pipe	m	330	95	113
- Earthworks	m^3	12,500	56	77
- Miscellaneous	-	LS	105	140
2.4 Lateral Canal			6,150	8,270
2.4.1 Stripping	m^2	902,000	722	722
2.4.2 Excavation	m^3	83,000	324	548
2.4.3 Filling	m^3	403,000	2,391	3,238
2.4.4 Sod Facing	m^2	404,600	0	809
2.4.5 Related Structure				
- Concrete works	m^3	1,800	976	1,409
- Wet masonry	m^3	600	95	115
- Hand rail	m	-	-	-
- Gate	ton	150	1,260	990
- Concrete pipe	m	1,150	245	293
- Earthworks	m^3	800	3	2
- Miscellaneous	-	LS	134	144
Total (Work Item 2)			25,190	33,400
3. Drainage Facilities				
3.1 Main Drain			19,440	28,920
3.1.1 Excavation	m^3	2,458,000	9,586	16,223
3.1.2 Filling	m^3	449,000	1,616	2,514
3.1.3 Waste Soil	m^3	1,635,000	7,358	8,993

- to be continued

Table 5.8(4) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

Work Item	Unit	Quantity	Amount (₱10³)	
			Foreign Currency	Peso Currency
3.1.4 Related Structure				
- Concrete works	m^3	725	449.9	675.3
- Wet mansonry	m^3	2,000	316	384
- Hand rail	m	70	9	7
- Earthworks	m^3	200	0.7	0.6
- Pilling	m	300	60	63
- Miscellaneous	-	LS	44.4	60.1
3.2 Secondary Drain			6,210	9,690
3.2.1 Excavation	m^3	736,000	2,870	4,858
3.2.2 Filling	m^3	460,000	1,656	2,576
3.2.3 Waste Soil	m^3	56,000	252	308
3.2.4 Related Structure				
- Concrete works	m^3	1,520	926	1,389
- Wet masonry	m^3	750	119	144
- Hand rail	m	240	31	24
- Earthworks	m^3	100	0.3	0.3
- Pilling	m	1,440	289	301
- Miscellaneous	-	LS	66.7	89.7
3.3 Collector Drain			1,350	2,150
3.3.1 Excavation	m^3	253,000	987	1,670
3.3.2 Filling	m^3	33,000	119	185
3.3.3 Related Structure				
- Concrete works	m^3	45	25.9	38.3
- Wet masonry	m^3	1,100	174	211
- Concrete pipe	m	80	28	33
- Earthworks	m^3	100	0.3	0.3
- Miscellaneous	-	LS	15.8	12.4

- to be continued

Table 5.8(5) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Peso Currency
3.4 Catch Drain			1,440	2,120
3.4.1 Excavation	m^3	148,000	577	977
3.4.2 Waste Soil	m^3	119,400	537	657
3.4.3 Related Structure				
- Concrete works	m^3	210	123	183
- Wet masonry	m^3	300	47	58
- Earthworks	m^3	28,400	137	218
- Miscellaneous	-	LS	19	27
Total (Work Item 3)			28,440	42,880
4. Farm Roads				
4.1 Main Farm Road			2,800	2,700
4.1.1 Stripping	m^2	232,000	190	190
4.1.2 Filling	m^3	58,000	550	680
4.1.3 Base Course	m^3	29,000	2,060	1,830
4.2 Secondary Farm Road			820	970
4.2.1 Stripping	m^2	187,000	150	150
4.2.2 Filling	m^3	70,000	670	820
4.3 Tertiary Farm Road			2,530	2,970
4.3.1 Stripping	m^2	510,000	410	410
4.3.2 Filling	m^3	186,000	2,120	2,560
Total (Work Item 4)			6,150	6,640

- to be continued

Table 5.8(6) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DIVERSION DAM SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Peso Currency
5. On-Farm Development				
5.1 Main Farm Ditch			270	3,030
5.1.1 Filling	m^3	168,000	-	2,654
5.1.2 Related Structure				
- Concrete works	m^3	250	152	228
- Wet masonry	m^3	420	66	81
- Concrete pipe	m	720	36	48
- Miscellaneous	-	LS	16	19
5.2 Supplementary Farm Ditch			-	6,070
5.2.1 Filling	m^3	384,000	-	6,070
5.3 Farm Drain			380	2,110
5.3.1 Filling	m^3	102,000	-	1,612
5.3.2 Related Structure				
- Concrete works	m^3	220	125	186
- Wet masonry	m^3	500	79	96
- Concrete pipe	m	700	155	188
- Miscellaneous	-	LS	21	28
5.4 Drainage Ditch			-	2,430
Filling	m^3	154,000	-	2,430
Total (Work Item 5)			650	13,640

Table 5.9 SUMMARY OF FINANCIAL COST OF THE PUMP SCHEME

(Unit: ₱10³)

Work Item	Foreign Currency	Peso Currency	Total
1. Pump Station	39,010	18,240	57,250
2. Irrigation Facilities	23,570	31,030	54,600
2.1 Main Canal	5,380	7,160	12,540
2.2 Sub-Main Canal	6,890	8,820	15,710
2.3 Secondary Canal	5,090	6,710	11,800
2.4 Lateral Canal	6,210	8,340	14,550
3. Drainage Facilities	27,150	40,980	68,130
3.1 Main Drain	19,440	28,920	48,360
3.2 Secondary Drain	6,210	9,690	15,900
3.3 Collector Drain	1,350	2,150	3,500
3.4 Catch Drain	150	220	370
4. Farm Roads	5,970	6,470	12,440
4.1 Main Farm Road	2,610	2,510	5,120
4.2 Secondary Farm Road	820	970	1,790
4.3 Tertiary Farm Road	2,540	2,990	5,530
5. On Farm Development	650	13,640	14,290
5.1 Main Farm Ditch	270	3,030	3,300
5.2 Supplementary Farm Ditch	-	6,070	6,070
5.3 Farm Drain	380	2,110	2,490
5.4 Drainage Ditch	-	2,430	2,430
Total	96,350	110,360	206,710

Table 5.10(1) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR PUMP SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Peso Currency
1. Pump Station			39,010	18,240
1.1 Temporary Works	-	LS	670	650
1.2 Excavation	m^3	496,400	2,058	3,460
1.3 Backfill	m^3	60,500	206	182
1.4 Concrete Works	m^3	6,990	4,289	4,553
1.5 Riprap	m^3	4,150	656	797
1.6 Steel Pile	ton	990	5,198	3,049
1.7 Metal Works	-	LS	4,000	260
1.8 Pump	set	4	18,960	1,240
1.9 Transmission	km	15	1,900	3,000
1.10 Miscellaneous	-	LS	1,078	1,049
2. Irrigation Facilities				
2.1 Main Canal			5,380	7,160
2.1.1 Stripping	m^2	280,000	224	224
2.1.2 Excavation	m^3	80,000	312	528
2.1.3 Filling	m^3	265,000	1,687	2,140
2.1.4 Sod Facing	m^2	78,700	0	157
2.1.5 Related Structure				
- Concrete works	m^3	3,490	2,031	3,025
- Wet masonry	m^3	900	142	173
- Hand rail	m	960	124	97
- Gate	ton	72	605	475
- Concrete pipe	m	120	30	36
- Earthworks	m^3	15,700	74	107
- Miscellaneous	-	LS	151	198

- to be continued

Table 5.10(2) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR PUMP SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Peso Currency
2.2 Sub-Main Canal			6,890	8,820
2.2.1 Stripping	m^2	445,000	356	356
2.2.2 Excavation	m^3	63,000	246	416
2.2.3 Filling	m^3	393,000	4,110	5,072
2.2.4 Sod Facing	m^2	116,800	0	234
2.2.5 Related Structure				
- Concrete works	m^3	2,300	1,328	1,971
- Wet masonry	m^3	600	95	115
- Hand rail	m	700	90	71
- Gate	ton	63	529	416
- Concrete pipe	m	120	30	36
- Earthworks	m^3	100	0.3	0.3
- Miscellaneous	-	LS	105.7	132.7
2.3 Secondary Canal			5,090	6,710
2.3.1 Stripping	m^2	443,000	354	354
2.3.2 Excavation	m^3	36,000	100	238
2.3.3 Filling	m^3	329,000	2,330	2,985
2.3.4 Sod Facing	m^2	131,400	0	263
2.3.5 Related Structure				
- Concrete works	m^3	2,200	1,266	1,877
- Wet masonry	m^3	1,200	190	230
- Hand rail	m	200	26	20
- Gate	ton	63	529	416
- Concrete pipe	m	330	95	113
- Earthworks	m^3	12,500	56	77
- Miscellaneous	-	LS	104	137

- to be continued

Table 5.10(3) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR PUMP SCHEME

Work Item	Unit	Quantity	Amount (₱103) Foreign Currency	Amount (₱103) Peso Currency
2.4 Lateral canal			6,210	8,340
2.4.1 Stripping	m^2	902,000	722	722
2.4.2 Excavation	m^3	81,000	316	535
2.4.3 Filling	m^3	411,000	2,461	3,324
2.4.4 Sod Facing	m^2	406,000	0	812
2.4.5 Related Structure				
- Concrete works	m^3	1,800	976	1,409
- Wet masonry	m^3	600	95	115
- Gate	ton	150	1,260	990
- Concrete pipe	m	1,150	245	293
- Earthworks	m^3	800	3	2
- Miscellaneous	-	LS	132	138
Total (Work Item 2)			23,570	31,030
3. Drainage Facilities				
3.1 Main Drain			19,440	28,920
3.1.1 Excavation	m^3	2,458,000	9,586	16,223
3.1.2 Filling	m^3	449,000	1,616	2,514
3.1.3 Waste Soil	m^3	1,635,000	7,358	8,993
3.1.4 Related Structure				
- Concrete works	m^3	725	449.9	675.3
- Wet masonry	m^3	2,000	316	384
- Hand rail	m	70	9	7
- Backfill	m^3	200	0.7	0.6
- Pilling	m	300	60	63
- Miscellaneous	-	LS	44.4	60.1

- to be continued

Table 5.10(4) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR PUMP SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Amount (₱10³) Peso Currency
3.2 Secondary Drain			6,210	9,690
3.2.1 Excavation	m^3	736,000	2,870	4,858
3.2.2 Filling	m^3	460,000	1,656	2,576
3.2.3 Waste Soil	m^3	56,000	252	308
3.2.4 Related Structure				
- Concrete works	m^3	1,520	926	1,389
- Wet masonry	m^3	750	119	144
- Hand rail	m	240	31	24
- Backfill	m^3	100	0.3	0.3
- Pilling	m	1,440	289	301
- Miscellaneous	-	LS	66.7	89.7
3.3 Collector Drain			1,350	2,150
3.3.1 Excavation	m^3	253,000	987	1,670
3.3.2 Filling	m^3	33,000	119	185
3.3.3 Related Structure				
- Concrete works	m^3	45	25.9	38.3
- Wet masonry	m^3	1,100	174	211
- Concrete pipe	m	80	28	33
- Backfill	m^3	100	0.3	0.3
- Miscellaneous	-	LS	15.8	12.4
3.4 Catch Drain			150	220
3.4.1 Excavation	m^3	25,000	100	165
3.4.2 Waste Soil	m^3	10,000	50	55
Total (Work Item 3)			27,150	40,980

- to be continued

Table 5.10(5) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR PUMP SCHEME

Work Item	Unit	Quantity	Amount (₱103) Foreign Currency	Peso Currency
4. Farm Roads				
4.1 Main Farm Road			2,610	2,510
4.1.1 Stripping	m^2	216,000	170	170
4.1.2 Filling	m^3	54,000	520	640
4.1.3 Base Coarse	m^3	27,000	1,920	1,700
4.2 Secondary Farm Road			820	970
4.2.1 Stripping	m^2	187,000	150	150
4.2.2 Filling	m^3	70,000	670	820
4.3 Tertiary Farm Road			2,540	2,990
4.3.1 Stripping	m^2	515,000	410	410
4.3.2 Filling	m^3	187,000	2,130	2,580
Total (Work Item 4)			5,970	6,470
5. On-Farm Development				
5.1 Main Farm Ditch			270	3,030
5.1.1 Filling	m^3	168,000	-	2,654
5.1.2 Related Structures				
- Concrete works	m^3	250	152	228
- Wet masonry	m^3	420	66	81
- Concrete pipe	m	720	36	48
- Miscellaneous	-	LS	16	19
5.2 Supplementary Farm Ditch			-	6,070
5.2.1 Filling	m^3	38,400	-	6,070

- to be continued

Table 5.10(6) BREAKDOWN OF DIRECT CONSTRUCTION COST FOR PUMP SCHEME

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Peso Currency
5.3 Farm Drain			380	2,110
5.3.1 Filling	m^3	10,200	-	1,612
5.3.2 Related Works				
- Concrete works	m^3	220	125	186
- Wet masonry	m^3	500	70	96
- Concrete pipe	m	700	155	188
- Miscellaneous	-	LS	30	28
5.4 Drainage Ditch			-	2,430
5.4.1 Filling	m^3	154,000	-	2,430
Total (Work Item 5)			650	13,640

Table 5.11 COST BREAKDOWN OF OPERATION AND MAINTENANCE FACILITIES

(Unit: ₱10^3)

Item	Cost
O & M Quarter & Motor Pool (1,500m^2)	4,500
Equipment	(4,100)
- Computer	170
- Radioset	110
- Motorcycle (22 nos.)	110
- Jeep (7 nos.)	700
- Dump Truck (4 tons - 4 nos.)	470
- Bulldozer (11 tons - 2 nos.)	1,000
- Spare Parts & Equipment	500
- Miscellaneous	1,040
Total	8,600

Table 5.12 COST ESTIMATE OF LAND ACQUISITION

Description	Land Acquisition (ha)	Compensation Cost (₱/ha)	Amount (₱10^3)
DIVERSION DAM SCHEME			
1. Reservoir Area			
- Paddy field	100	20,000	2,000
- Grass land	2,100	5,000	10,500
2. Irrigation Service Area			
- Paddy field	1,000	20,000	20,000
- Grass land (Swamp)	100	5,000	500
Total	3,300		33,000
PUMP SCHEME			
Irrigation Service Area			
- Paddy field	1,000	20,000	20,000
- Grass land (Swamp)	100	5,000	500
Total	1,100		20,500

Table 5.13 BREAKDOWN OF ENGINEERING COST FOR DIVERSION DAM SCHEME

(Unit: ₱10³)

Item	Foreign Currency	Peso Currency	Total
1. Mapping Cost	5,000	-	5,000
2. Geological Survey	-	800	800
3. Laboratory Equipment	750	-	750
4. Engineering Consultants	16,350	2,100	18,450
5. Engineering Cost and Administration Expenses	-	9,400	9,400
Total	22,100	12,300	34,400

Table 5.14 BREAKDOWN OF ENGINEERING COST FOR PUMP SCHEME

(Unit: ₱10³)

Item	Foreign Currency	Peso Currency	Total
1. Mapping Cost	5,000	-	5,000
2. Geological Survey	-	500	500
3. Laboratory Equipment	500	-	500
4. Engineering Consultants	12,300	1,600	13,900
5. Engineering Cost and Administration Expenses	-	6,700	6,700
Total	17,800	8,800	26,600

Table 5.15(1) BASIC RATE FOR COST ESTIMATE

LABOR AND MATERIAL COST (Prevailing NIA Rates)

A. Labor Cost	Rate/Day (₱)
1. Construction Foreman	41.14
2. Mason	33.80
3. Carpenter	33.80
4. Steelman	33.80
5. Labor Foreman	33.80
6. Driver	41.14
7. Machine Operator	30.89
8. Heavy Equipment Operator	41.14
9. Asst. Heavy Equipment Opr.	30.89
10. Other Skilled Labor	33.80
11. Laborers	26.91
12. Civil Engineering Aide	45.59

Note: These manpower rates include allowances (Basic Pay + Allowance)

B. Material Cost	Unit	Unit Cost (₱)
1. Cement	bag	34.48
2. Steel bars	kg	5.16
3. Hardware	kg	9.16
4. Lumber	bd.ft.	4.15
5. Sand	cu.m	106
6. Gravel	cu.m	110
7. Boulders	cu.m	106
8. Regular gasoline	liter	5.10
9. Diesel	liter	3.15
10. Asphalt (cold mixed)	metric ton	640.50

Note: Unit cost stated includes hauling cost up to proposed project site.

C. EQUIPMENT DEPRECIATION COST:

Types and Class of Equipment	Rate Per Hour (₱)
I. Lifting and Excavating Equipment	
1. Cranes, Crawler mounted (all models)	
21 - 25 tons	155.60
15 - 20 tons	124.00

- to be continued

Table 5.15(2) BASIC RATE FOR COST ESTIMATE

	Rate Per Hour (₱)
2. Cranes, Truck Mounted	
30 - 35 tons	242.00
21 - 25 tons	193.55
16 - 20 tons	154.83
10 - 15 tons	137.10
Attachments	
0.4 m^3 clamshell or dragline	12.45
0.58 m^3 clamshell or dragline	13.20
0.77 m^3 clamshell or dragline	13.90
0.96 m^3 clamshell or dragline	15.57
Drop Hammer one (1) ton	6.10
two (2) tons	8.75
3. Diesel Pile Hammer	
D - 22 class	255.20
D - 12 class	221.10
4. Backhoe, Hydraulic, Crawler	
0.3 - 0.45 cu.m	212.90
0.7 - 1.00 cu.m	231.10
5. Bulldozers	
185 - 200 HP	212.00
160 - 180 HP	185.10
145 - 155 HP	168.25
120 - 140 HP	134.60
95 - 115 HP	117.80
6. Front End Loader (Wheel Type)	
1.15 - 1.3 cu.m	135.60
2.5 - 3.00	223.30
7. Motorized Grader	
115 - 125 HP	139.20
135 - 160 HP	191.35

- to be continued

Table 5.15(3) BASIC RATE FOR COST ESTIMATE

	Rate Per Hour (₱)
8. Compaction Equipment	
a. Roller, static 2-3 Drum	
5 - 8 tons	83.60
9 - 11 tons	115.80
b. Rollers Vibratory, steel Drum	
2 - 3 tons/10 m wide	59.20
5 - 7 tons	134.20
8 - 15 tons	158.40
9. Hauling Equipment	
a. Truck Tractor w/25 tons Trailer	135.00
b. Dump Truck	
i) 6 tons (3.5 - 4.0 m^3)	74.80
ii) 8 tons (4.5 - 6.0 m^3)	99.00
iii) 12 tons (8 - 10 m^3)	128.70
c. Cargo, Truck	
i) 5 tons, 6 x 6 Ged	59.20
ii) 4-6 tons, 4 x 2	75.00
iii) 6 tons w/3 tons Crane	90.80
10. Concreting Machines	
a. 0.16 cu.m (1 bagger)	13.20
b. 0.3 cu.m (2 bagger)	17.10
c. Vibrator, concrete Ged	6.00
d. Concrete Batching Plant	111.10
11. Pump Equipment	
Centrifugal Pump	
250 mm Ø (10"Ø)	20.24
200 mm Ø (8"Ø)	17.10
150 mm Ø (6"Ø)	14.20
100 mm Ø (4"Ø)	9.40

Note: These costs are based on NIA equipment depreciation costs computed as of October 1979, then added 10% for purpose of updating the cost.

Table 5.16(1) LIST OF UNIT COST

Item	Unit	Foreign Currency (₱)	Peso Currency (₱)	Total (₱)	Remarks
A. Diversion Dam & Pump Station					
1. Concrete (A)	m^3	354	301	655	6 = 210 kg/cm^2
2. Concrete (B)	m^3	326	289	615	6 = 180 kg/cm^2
3. Concrete (C)	m^3	185	265	450	6 = 90 kg/cm^2
4. Form	m^2	7	63	70	
5. Steel bar	ton	4,214	3,736	7,950	
6. Dry masonry	m^3	82	118	200	
7. Wet masonry	m^3	158	192	350	
8. Foundation gravel	m^3	77	93	170	
9. Sand & gravel bed	m^3	74	101	175	
10. Gabion	m^2	55	80	135	
11. Gabion frame	m^2	62	78	140	
12. Concrete frame	m^2	74	91	165	4 x 4 m
13. Concrete frame	m^2	110	120	230	2.5 m x 2.5 m, slope
14. Concrete block	m^2	130	265	395	
15. Wet masonry wall					
(1) h = 2.7 m	m	350	470	820	
(2) h = 3.0 m	m	405	535	940	
(3) h = 4.0 m	m	565	735	1,300	
(4) h = 5.0 m	m	700	900	1,600	
16. Concrete retaining wall					
(1) h = 3.6 m	m	2,500	2,800	5,300	
(2) h = 4.4 m	m	3,073	3,427	6,500	
(3) h = 4.8 m	m	4,186	4,514	8,700	
(4) h = 5.0 m	m	4,262	4,588	8,850	
(5) h = 5.7 m	m	5,141	5,439	10,580	
(6) h = 11.1 m	m	11,881	12,219	24,100	
17. Sheet pile	ton	5,250	3,080	8,330	Type II

- to be continued

Table 5.16(2) LIST OF UNIT COST

Item	Unit	Foreign Currency (₱)	Peso Currency (₱)	Total (₱)	Remarks
18. R. C. pile					
(1) ø 300	m	105	110	215	
(2) ø 450	m	200	210	410	
19. Asphalt	m^3	180	180	360	Cold mixed
20. Pipe railing	m	129	101	230	
21. Earth work					
(1) Excavation (A)	m^3	2.2	3.2	5.4	Common, Bulldozor 21t l = 50 m
(2) Excavation (B)	m^3	5.5	9.0	14.5	Structure Compaction by Bull
(3) Fill & compaction	m^3	3.6	5.6	9.2	
(4) Backfill structure (A)	m^3	3.4	3.0	6.4	Equipment
(5) Backfill structure (B)	m^3	0	9.5	9.5	Manual
B. Irrigation & Drainage Facilities					
1. Concrete (A)	m^3	624	936	1,560	Including Form & Steel Bar
2. Concrete (B)	m^3	429	1,001	1,430	
3. Concrete (C)	m^3	185	265	450	
4. Concrete lining	m^3	427	463	890	
5. Hand rail	m	129	101	230	
6. Gate	ton	11,200	8,800	20,000	
7. R. C. pipe					
(1) ø 600	m	167	203	370	
(2) ø 800	m	221	269	490	
(3) ø 1,000	m	343	402	145	
(4) ø 1,200	m	409	481	890	

- to be continued

Table 5.16(3) LIST OF UNIT COST

Item	Unit	Foreign Currency (₱)	Peso Currency (₱)	Total (₱)	Remarks
8. Sod Facing	m^2	0	2.0	2.0	
9. Earth work					
(1) Stripping (A)	m^2	0.8	0.8	1.6	
(2) Stripping (B)	m^3	0	0.35	0.35	by Farm Labour
(3) Excavation (A)	m^3	3.9	6.6	10.5	
(4) Excavation (B)	m^3	0	10.00	10.00	by Farm Labour
(5) Struc. Excavation	m^3	5.5	9.0	14.5	
(6) Struc. Backfill (A)	m^3	3.4	3.0	6.4	by Equipment
(7) Struc. Backfill (B)	m^3	0	9.5	9.5	by Manpower
(8) Filling (A)	m^3	3.6	5.6	9.2	Exca. Material
(9) Filling (B)	m^3	7.4	9.0	16.4	Exca. w/0.5 km haul
(10) Filling (C)	m^3	12.9	15.7	28.6	Borrow w/1 km haul
(11) Waste soil	m^3	4.5	5.5	10.0	Borrow w/1 km haul
(12) Compaction	m^3	0	5.75	5.75	by Farm Labour

Table 5.17 ANNUAL OPERATION AND MAINTENANCE COST FOR DIVERSION DAM SCHEME

Item		Cost	
		Amount (₱10³)	Per ha (Peso/ha)
1. Salaries & Wages			
1.1 Staff salaries (see Table 5.23)		1,890	172
1.2 Labour wages 400 M/M @₱1,000		400	36
2. Office Expenses	12 M @₱40,000	480	44
3. Operation Cost	LS	400	36
4. Maintenance Cost	LS	600	55
5. Miscellaneous	LS	230	21
Total		4,000	364

Table 5.18 ANNUAL OPERATION AND MAINTENANCE COST FOR PUMP SCHEME

Item		Cost	
		Amount (₱10³)	Per ha (Peso/ha)
1. Salaries & Wages			
1.1 Staff salaries (see Table 5.23)		1,890	172
1.2 Labour wages 400 M/M @₱1,000		400	36
2. Office Expenses	12 M @₱40,000	480	44
3. Operation Cost	LS	6,900	627
4. Maintenance Cost	LS	600	55
5. Miscellaneous	LS	730	66
Total		11,000	1,000

Table 5.19 PERSONNEL REQUIREMENT FOR OPERATION AND MAINTENANCE FOR IRRIGATION PROJECT

Item	Unit Annual Salary (₱)	Total (₱)
1 - Project Manager	33,000	33,000
1 - Irrigation Superintendent	27,000	27,000
Administrative Section		
1 - Cashier	17,600	17,600
1 - Property Custodian	14,500	14,500
1 - Accounting Clerk	10,700	10,700
4 - Clerk	8,800	35,200
1 - Instrumentman	11,900	11,900
2 - Janitor	5,900	11,800
3 - Security Guard	9,700	29,100
2 - Aide	6,600	13,200
1 - Electrician	8,800	8,800
1 - Radio Operator	9,700	9,700
7 - Driver	10,700	74,900
Operation and Maintenance Section		
5 - Division Supervisor	16,000	80,000
22 - Water Management Technician	14,500	319,000
110 - Ditchtender	7,000	770,000
1 - Mech./Electric Engineer	16,000	16,000
1 - Carpenter	9,600	9,600
4 - Mechanic	14,500	58,000
4 - Mechanic (Junior)	13,100	52,400
2 - Aide	6,600	13,200
Collection Service Division		
2 - Collector Officer	16,000	192,000
Agricultural Development Section		
1 - Agri. Extension Specialist	21,500	21,500
1 - Agronomist	17,600	17,600
3 - Agri. Liaison Officer	14,500	43,500
Grand Total		1,890,200 (172/ha)

Table 5.20 REPLACEMENT COST AND USEFUL LIFE

Item	Useful Life (Years)	Replacement Cost (₱10³)
DIVERSION DAM SCHEME		
1. Project Facilities		
1.1 Gate for Diversion Dam	25	41,800
1.2 Gate for Irrigation Facilities	25	5,250
2. O & M Equipment	10	4,100
PUMP SCHEME		
1. Project Facilities		
1.1 Pump and Accessories	25	24,500
1.2 Gate for Irrigation Facilities	25	5,100
2. O & M Equipment	10	4,100

Fig. 1.1 EXISTING IRRIGATION SERVICE AREA

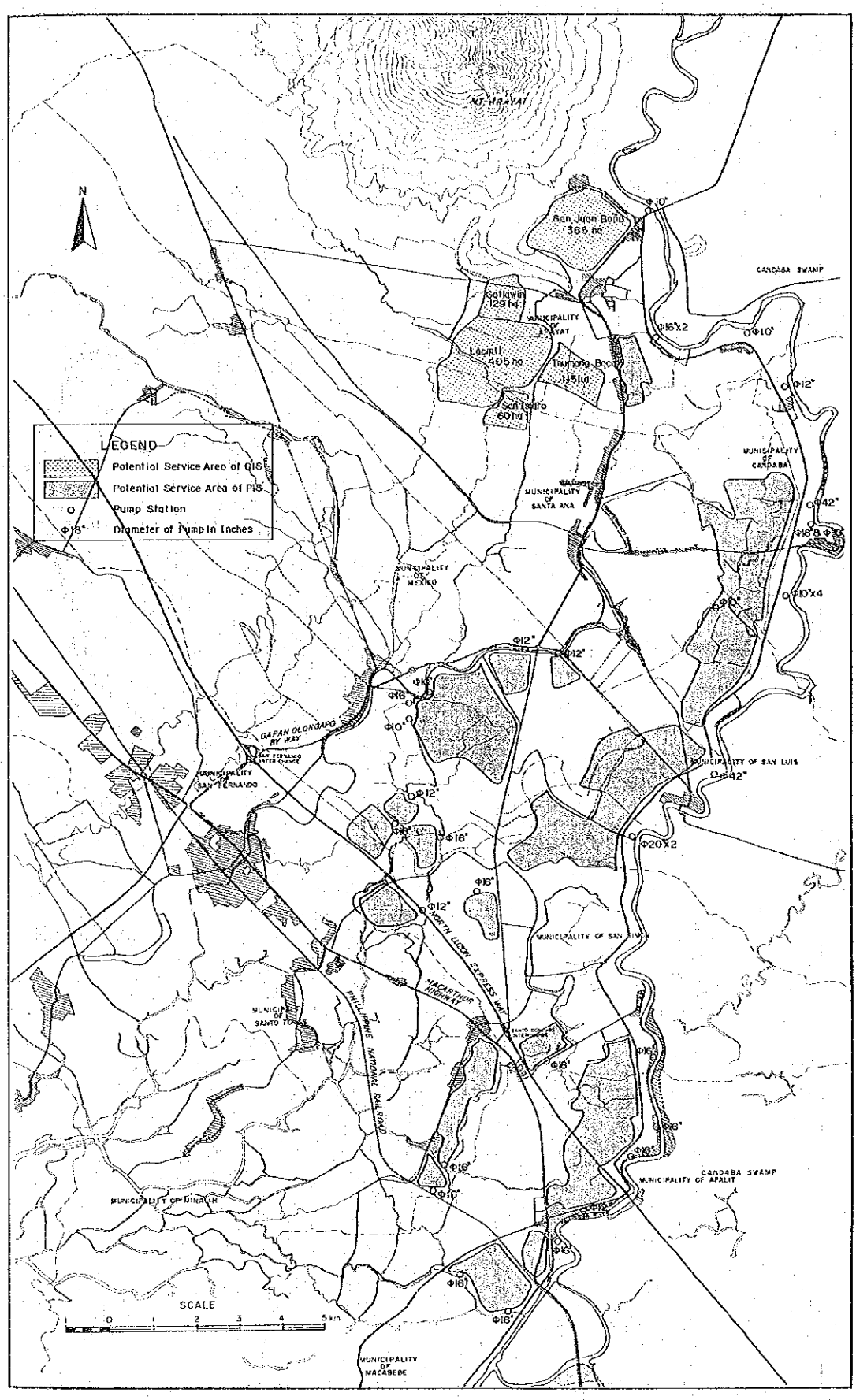


Fig. 2.1 GENERAL LAYOUT OF IRRIGATION PLAN

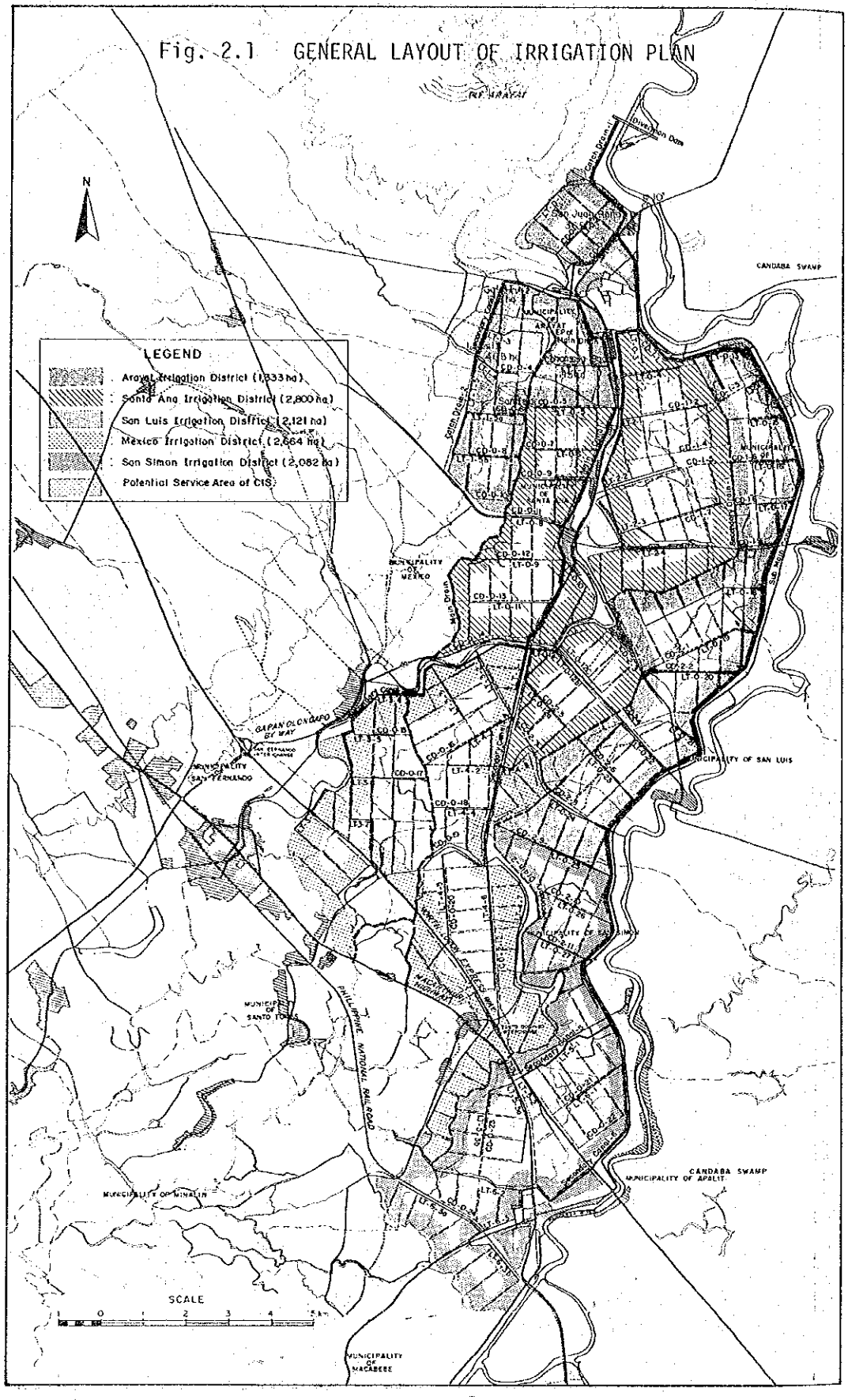


Fig. 2.2 BLOCK DIAGRAM OF PROGRAM FOR WATER REQUIREMENT CALCULATION

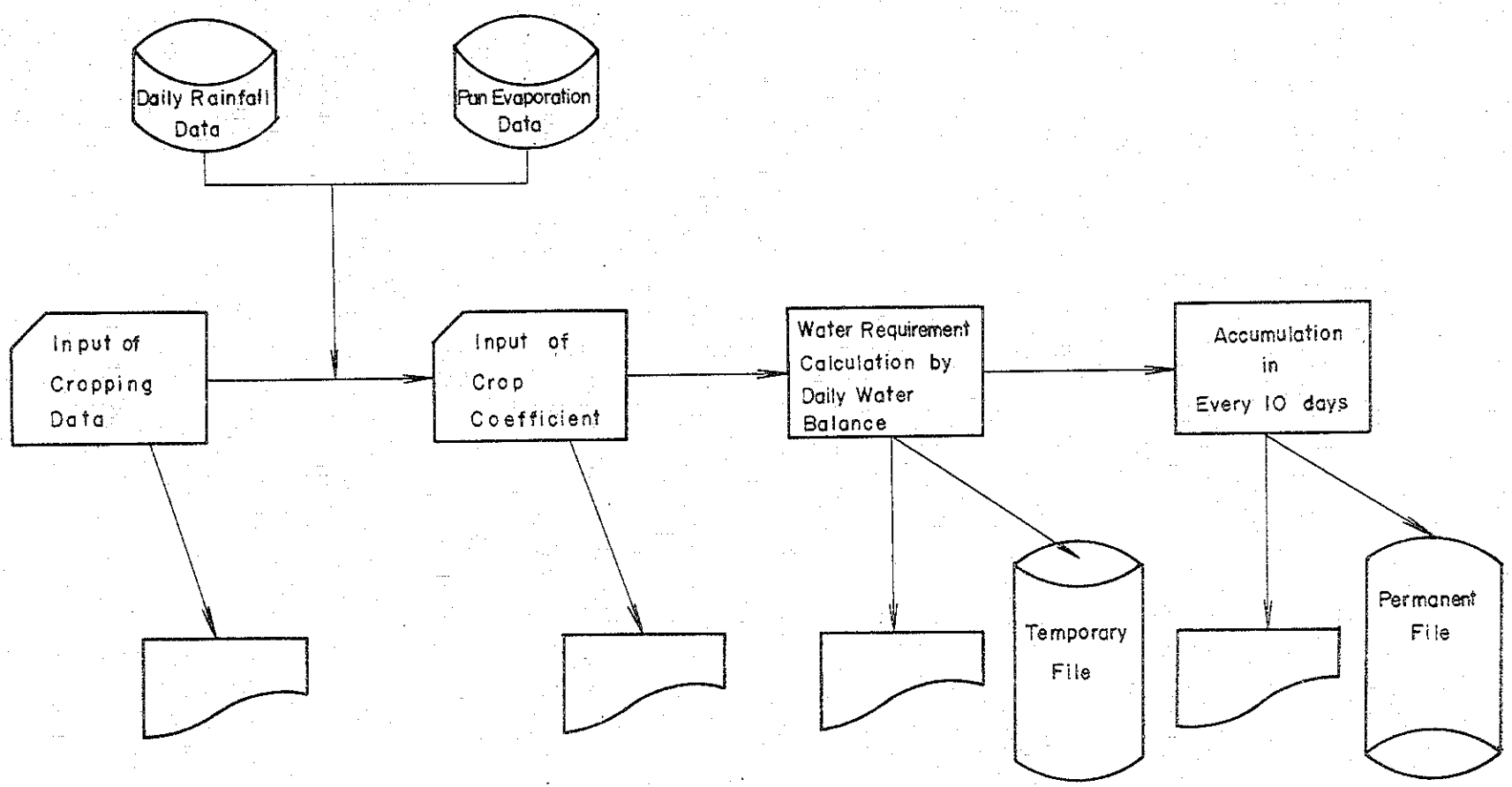
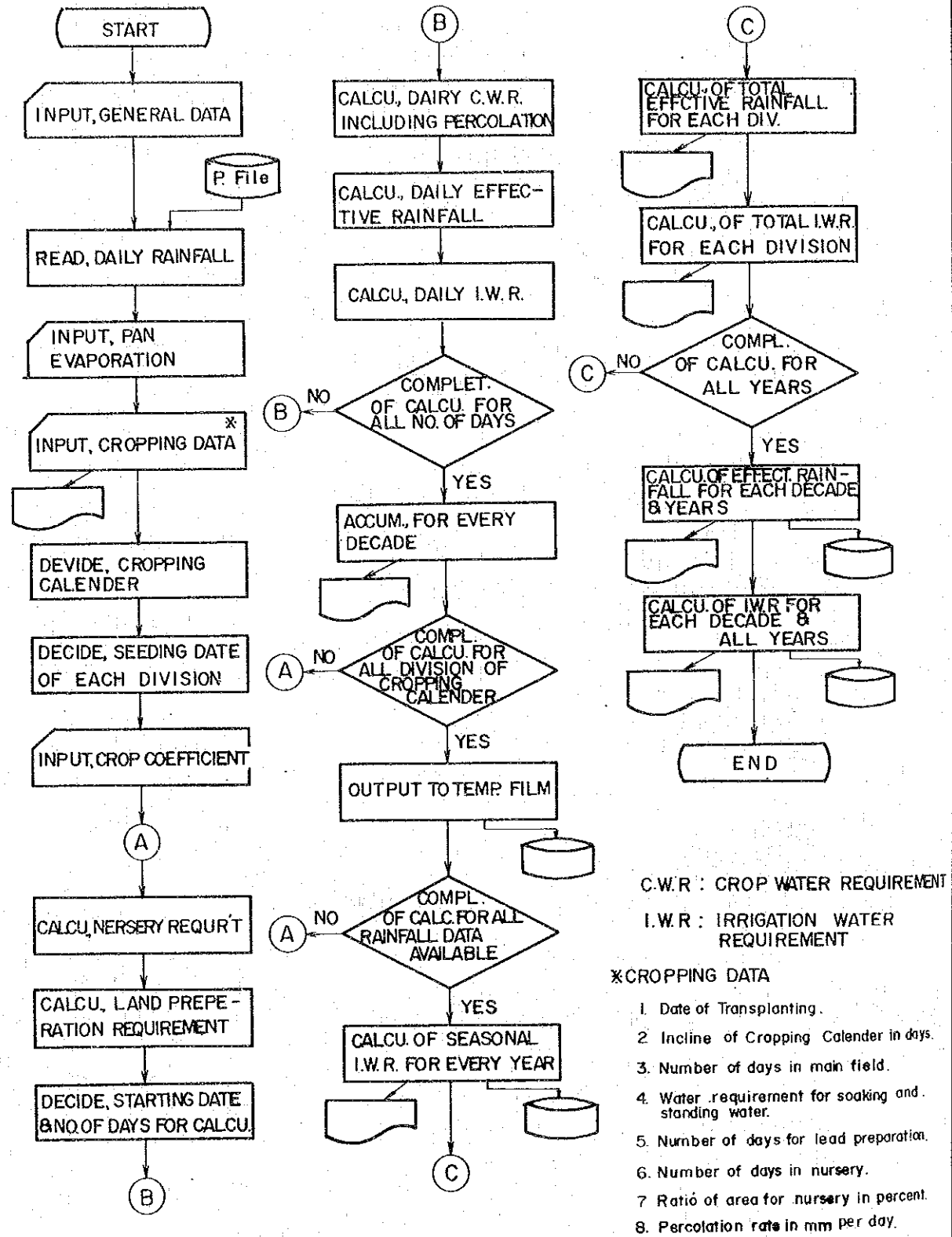


Fig. 2.3 FLOW CHART OF PROGRAM FOR WATER REQUIREMENT CALCULATION



C.W.R : CROP WATER REQUIREMENT

I.W.R : IRRIGATION WATER REQUIREMENT

※CROPPING DATA

1. Date of Transplanting.
2. Incline of Cropping Calender in days.
3. Number of days in main field.
4. Water requirement for soaking and standing water.
5. Number of days for lead preparation.
6. Number of days in nursery.
7. Ratió of area for nursery in percent.
8. Percolation rate in mm per day.
9. Maximum Interval of irrigation in days.
10. Maximum effective rainfall in mm.

Fig. 2.4 SEASONAL VARIATION OF CROP COEFFICIENT OF PADDY

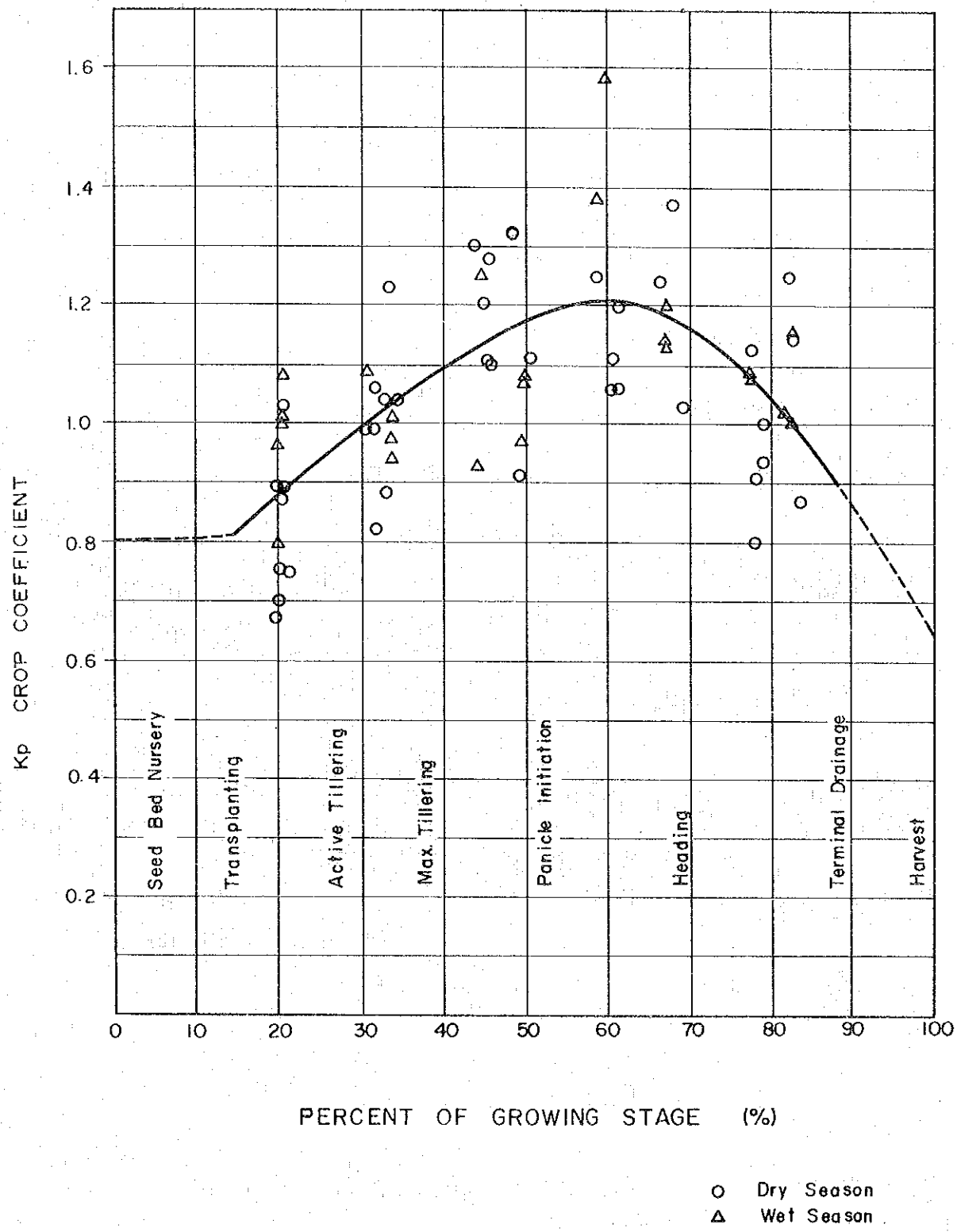


Fig. 2.5 RESERVOIR RATING CURVE (DIVERSION DAM AT ARAYAT)

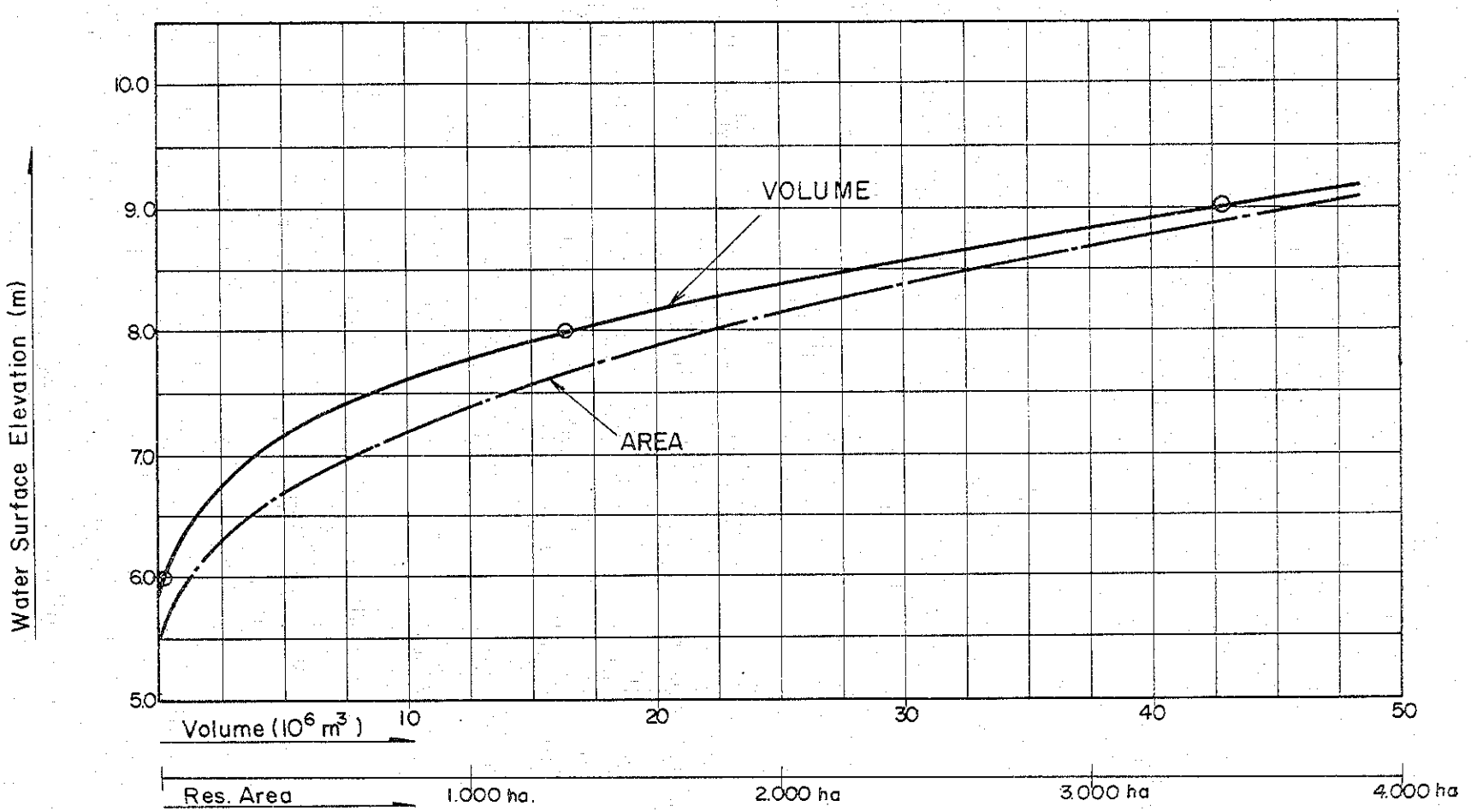


Fig. 3.1 RESERVOIR AREA OF DIVERSION DAM

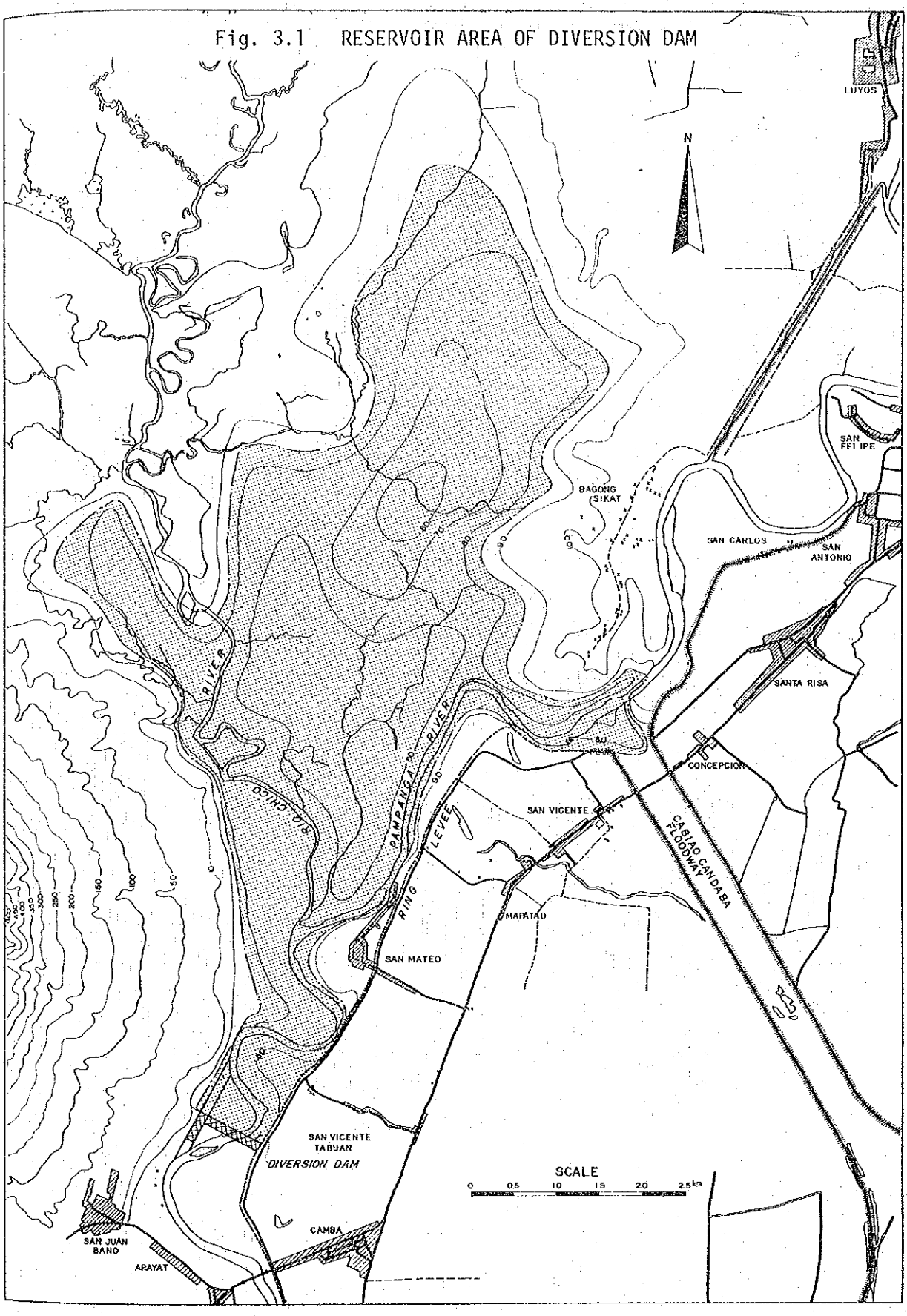


Fig. 3.2 BACKWATER EFFECT DUE TO DIVERSION DAM

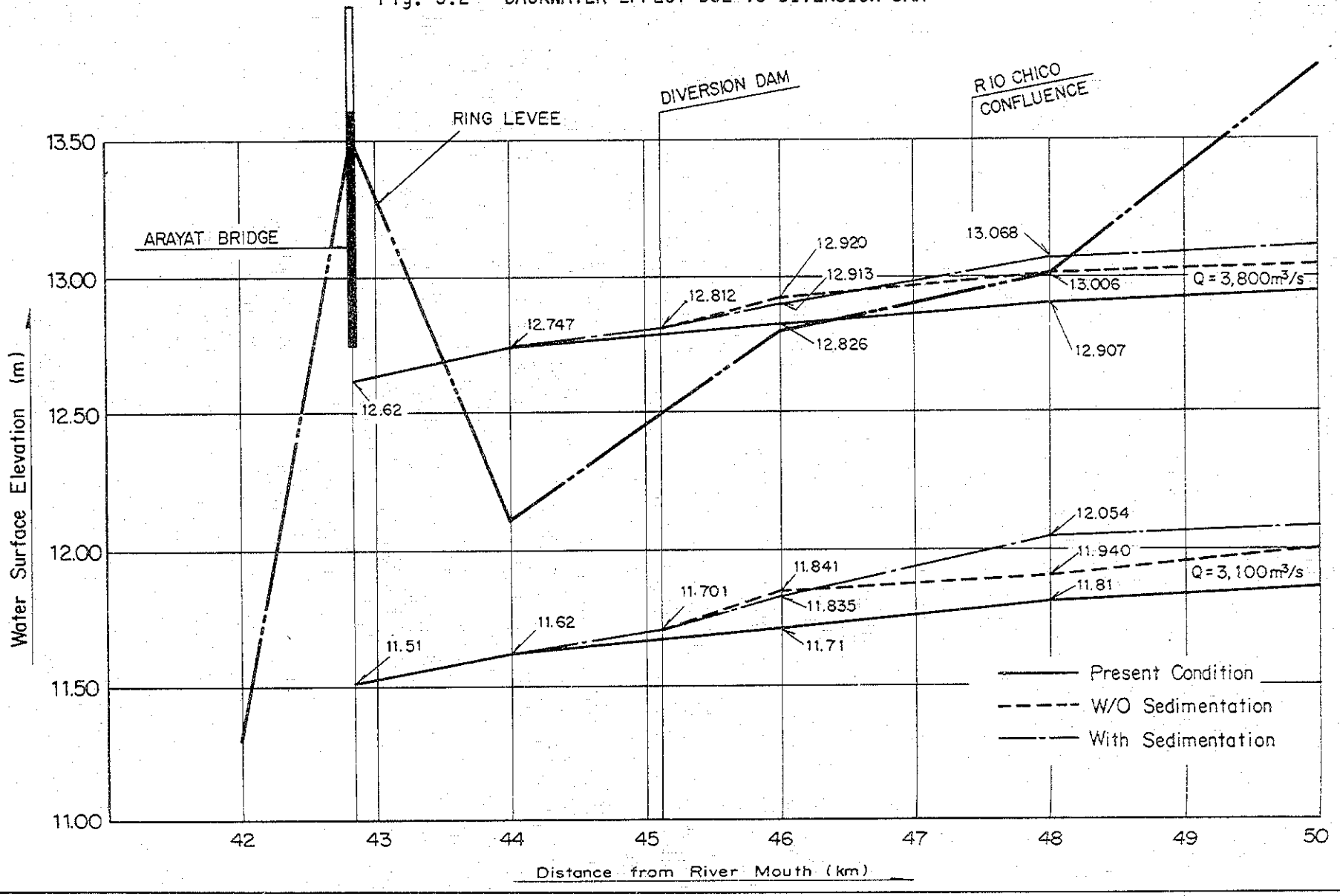


Fig. 3.3 REQUIRED PUMP OPERATION POINT DISTRIBUTION (1968 - 1978)

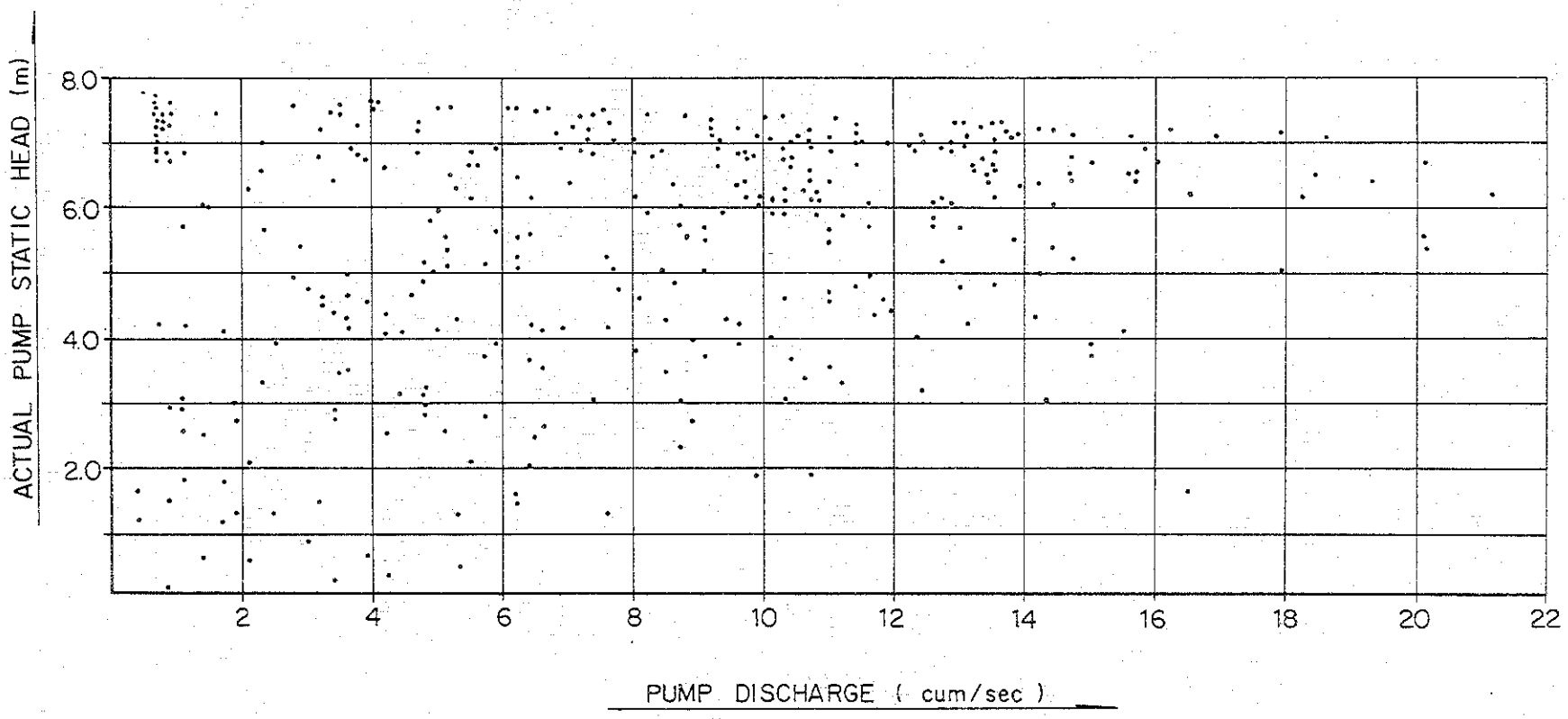


Fig. 3.4 TYPICAL FARM LAYOUT

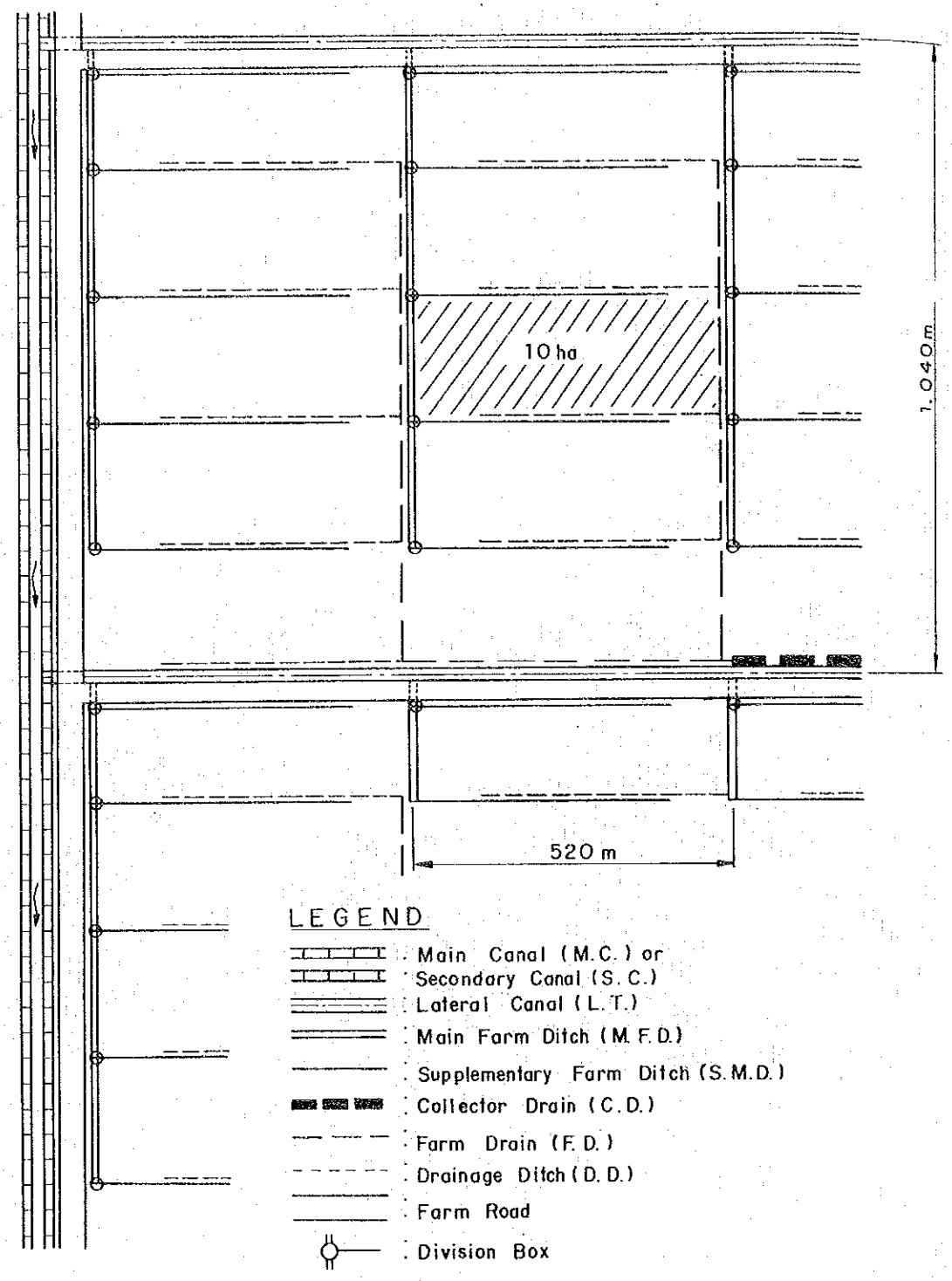


Fig. 3.5 IRRIGATION DIAGRAM FOR DIVERSION DAM SCHEME

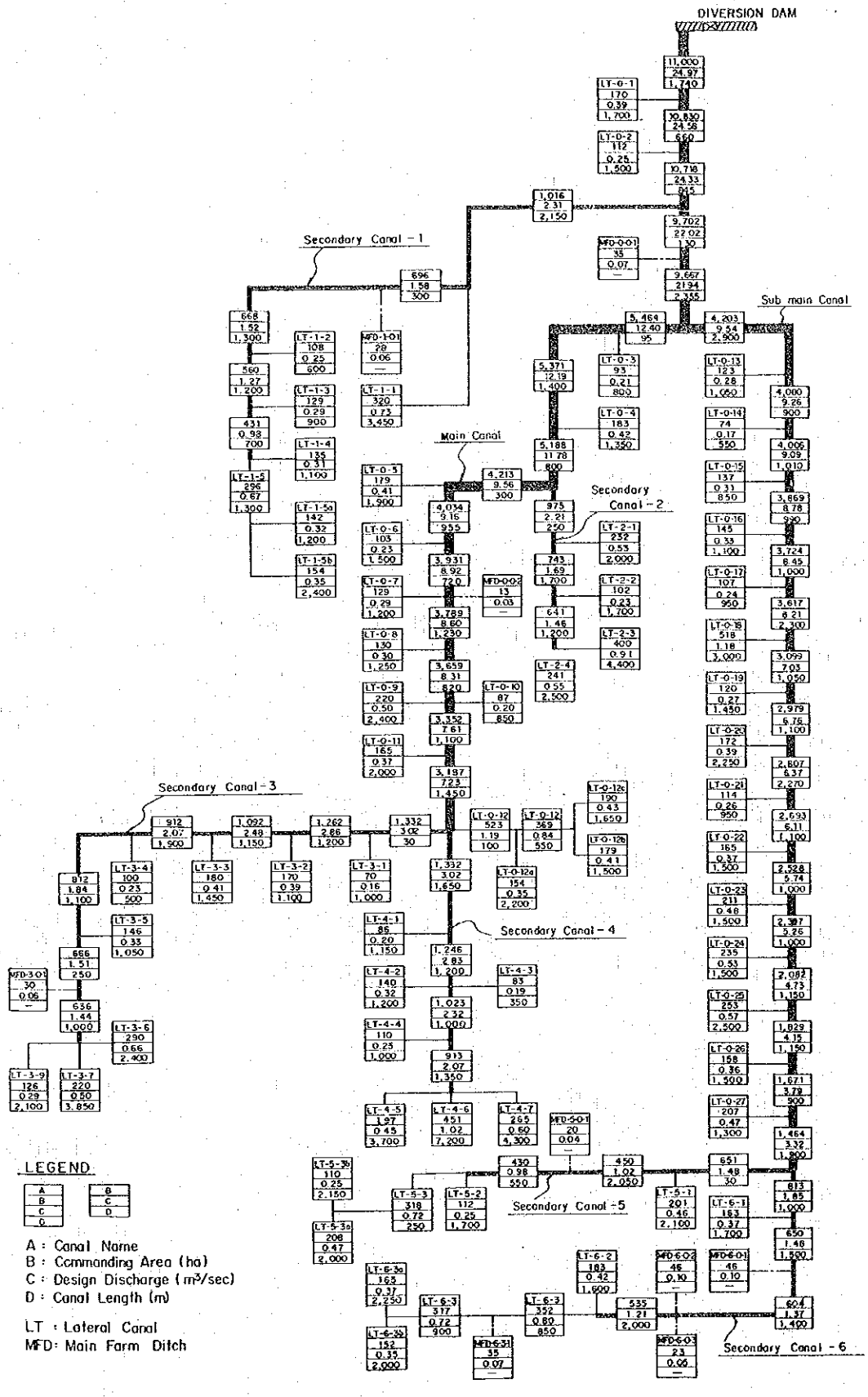


Fig. 3.6 IRRIGATION DIAGRAM FOR PUMP SCHEME

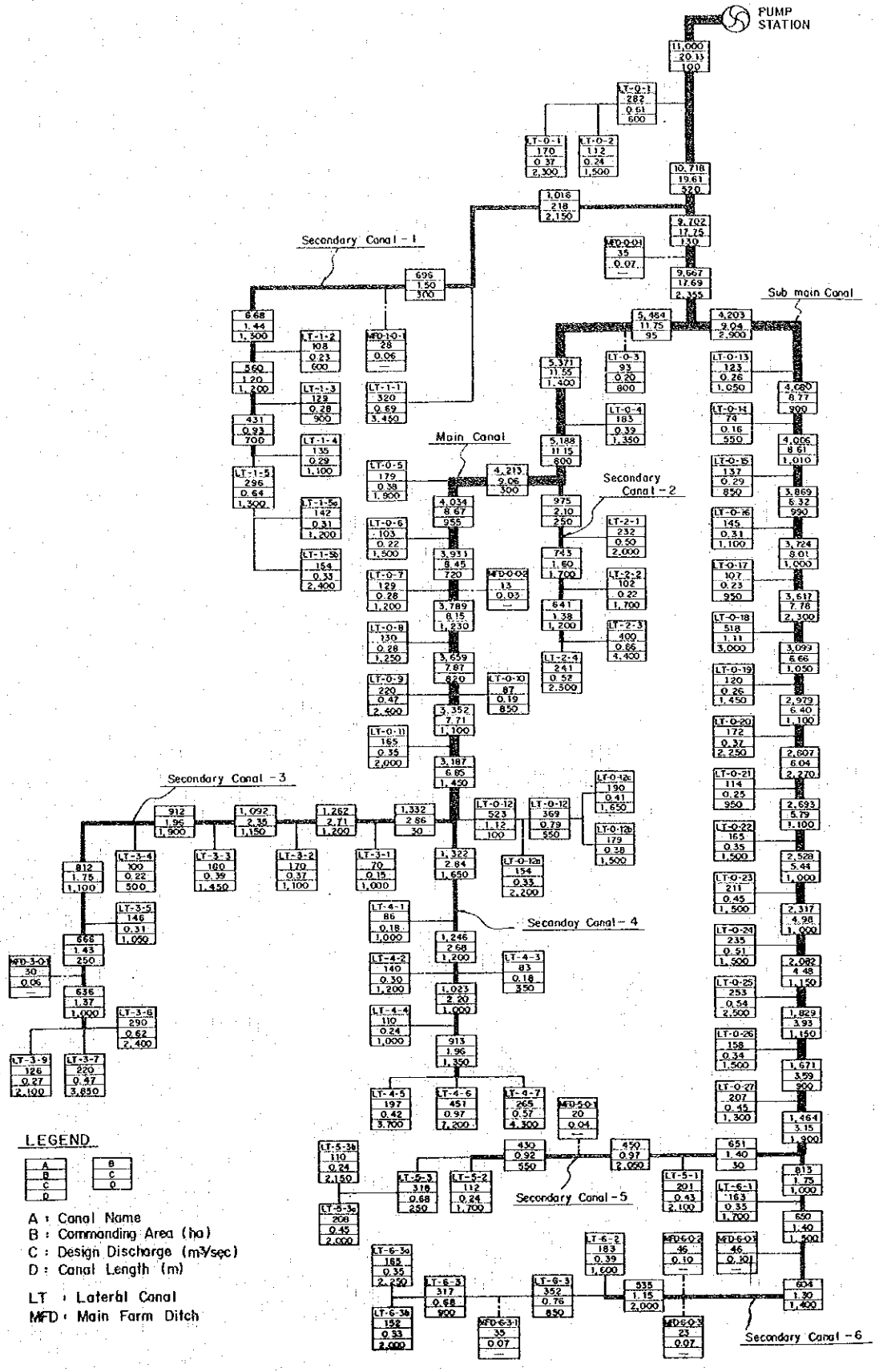
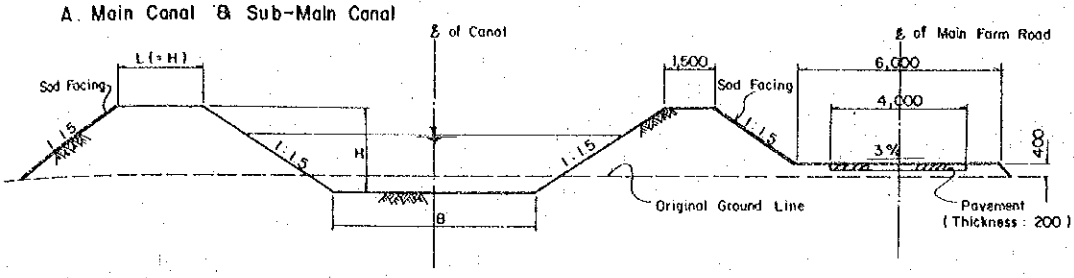


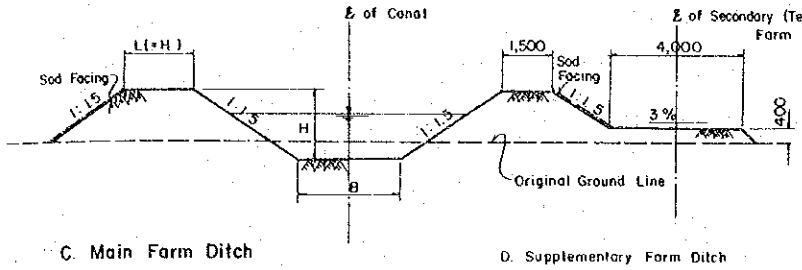
Fig. 3.7 TYPICAL CROSS SECTION OF CANAL AND ROAD

I IRRIGATION FACILITIES

A. Main Canal & Sub-Main Canal



B. Secondary Canal & Lateral Canal

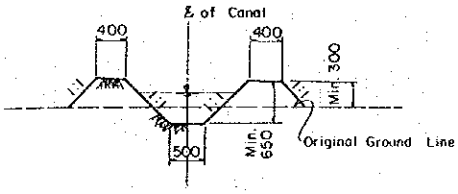


DIMENSION TABLE
(Irrigation Canal)

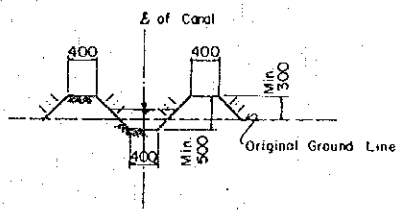
CANAL	B		H	
	Max.	Min.	Max.	Min.
Main Canal	12.0	5.0	3.5	2.2
Sub-Main Canal	6.0	4.0	2.4	1.6
Secondary Canal	3.0	1.5	2.1	1.1
Lateral Canal	2.0	0.6	1.5	0.7

Remarks :
B : Canal Base Width (m)
H : Canal Height (m)

C. Main Farm Ditch

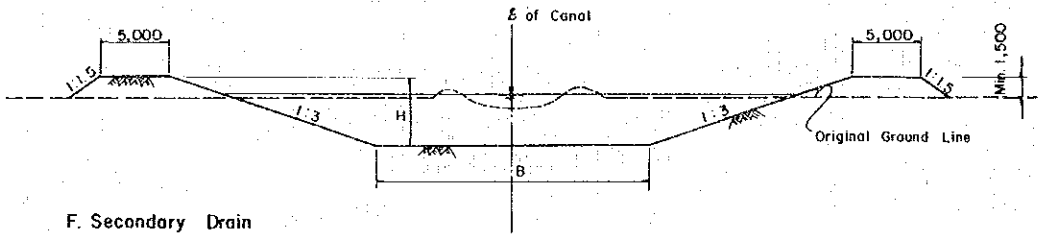


D. Supplementary Farm Ditch

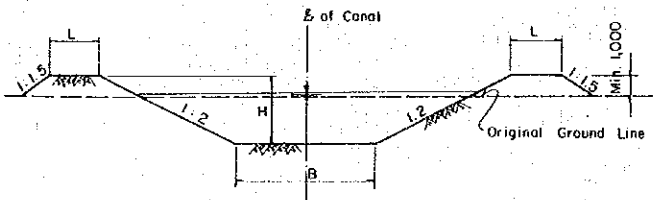


II DRAINAGE CANAL

E. Main Drain



F. Secondary Drain



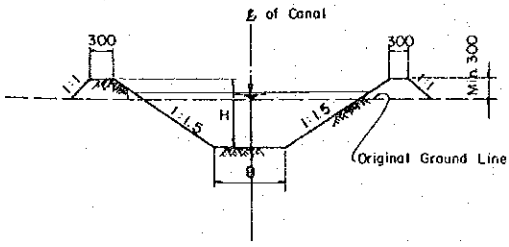
Remarks :
Excavation Canal : L = 500
Embankment Canal : L = 3,000

DIMENSION TABLE
(Drainage Canal)

CANAL	B		H	
	Max.	Min.	Max.	Min.
Main Drain	30.0	5.0	6.7	6.0
Secondary Drain	8.0	3.0	4.5	3.1
Collector Drain	3.0	1.0	2.1	1.0
Farm Drain	0.8	0.5	1.1	0.8

Remarks :
B : Canal Base Width (m)
H : Canal Height (m)

G. Collector Drain & Farm Drain



H. Drainage Ditch

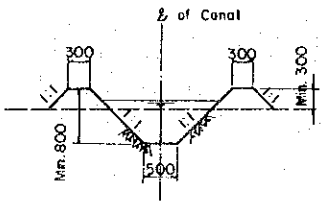
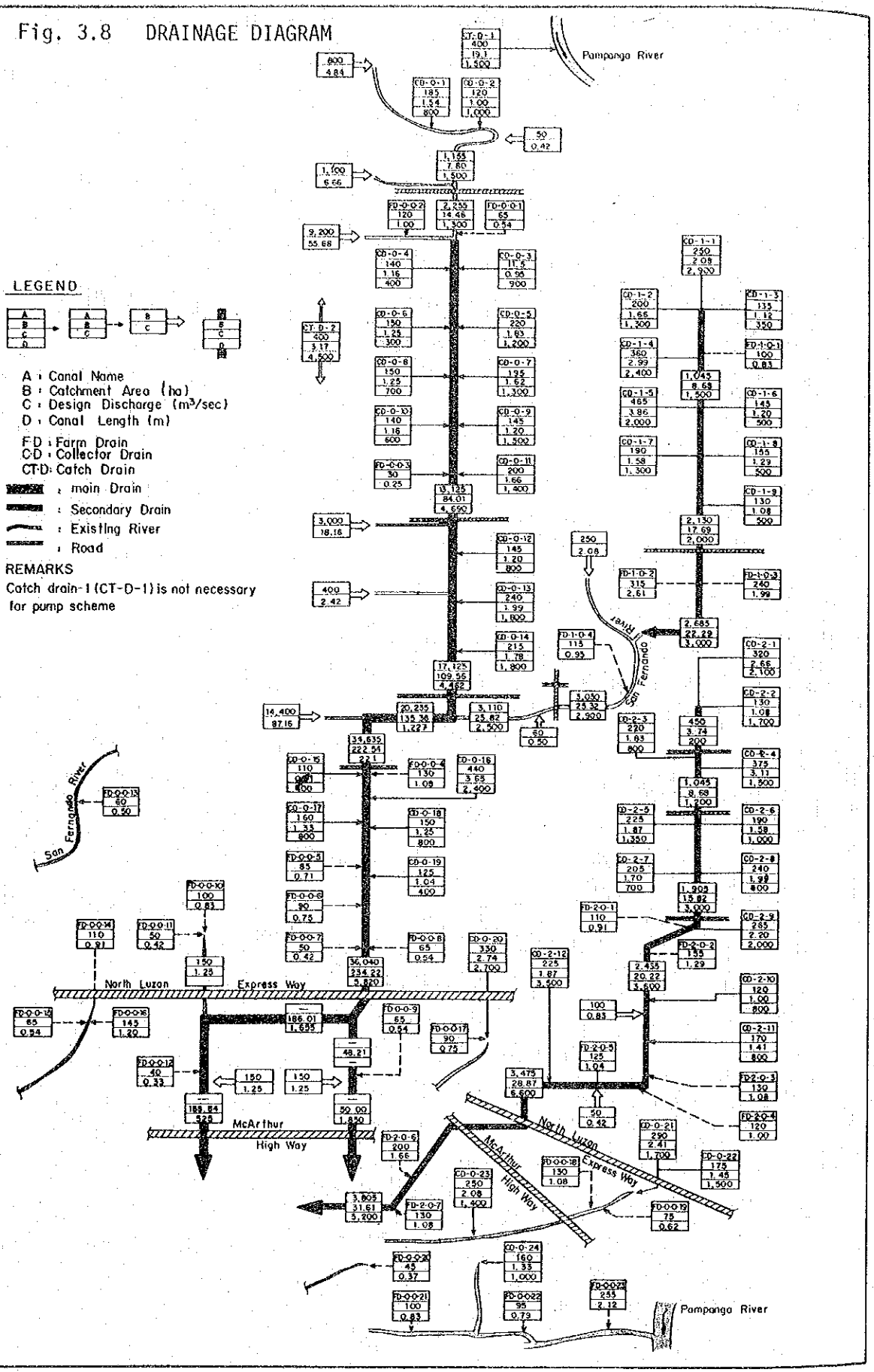


Fig. 3.8 DRAINAGE DIAGRAM



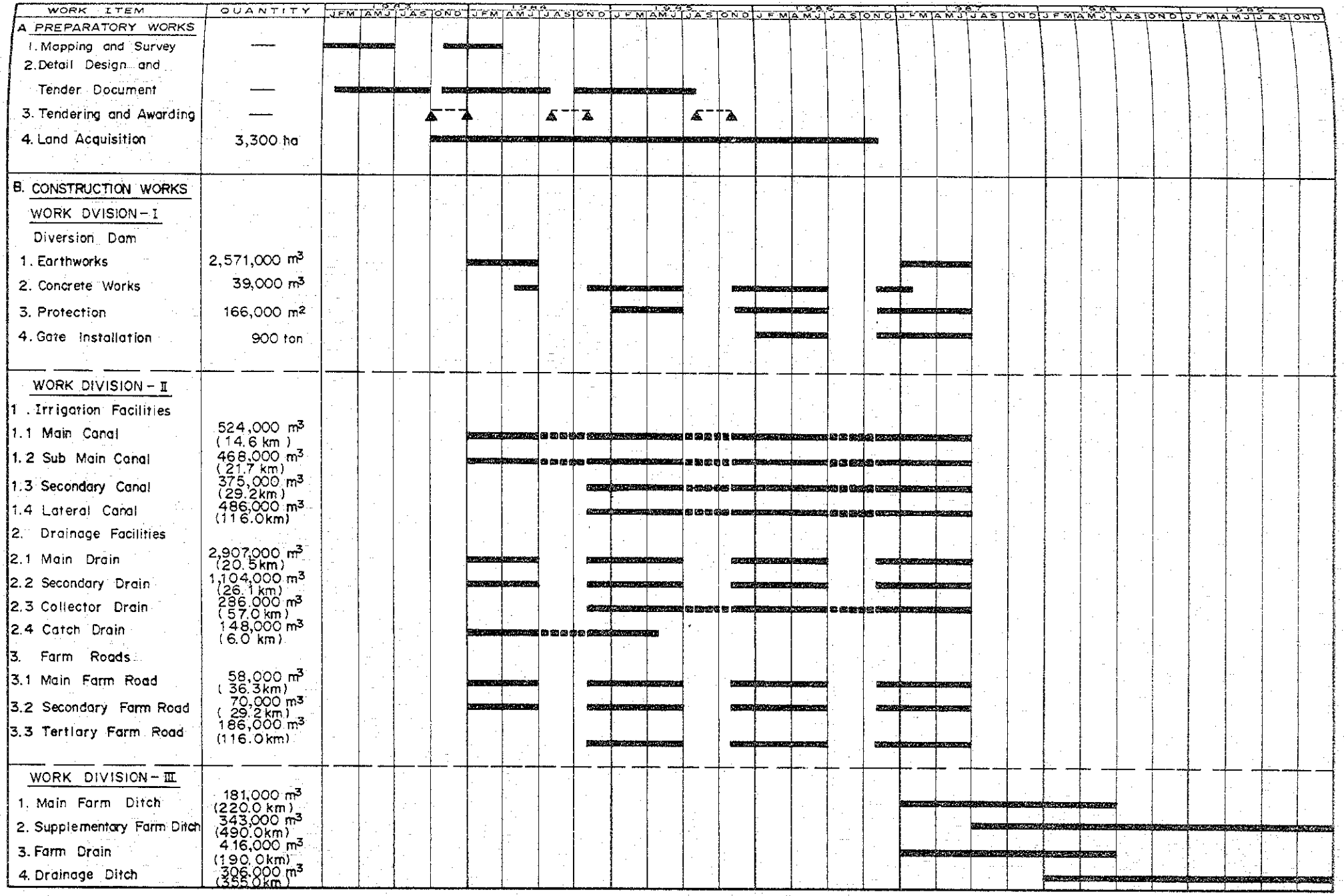
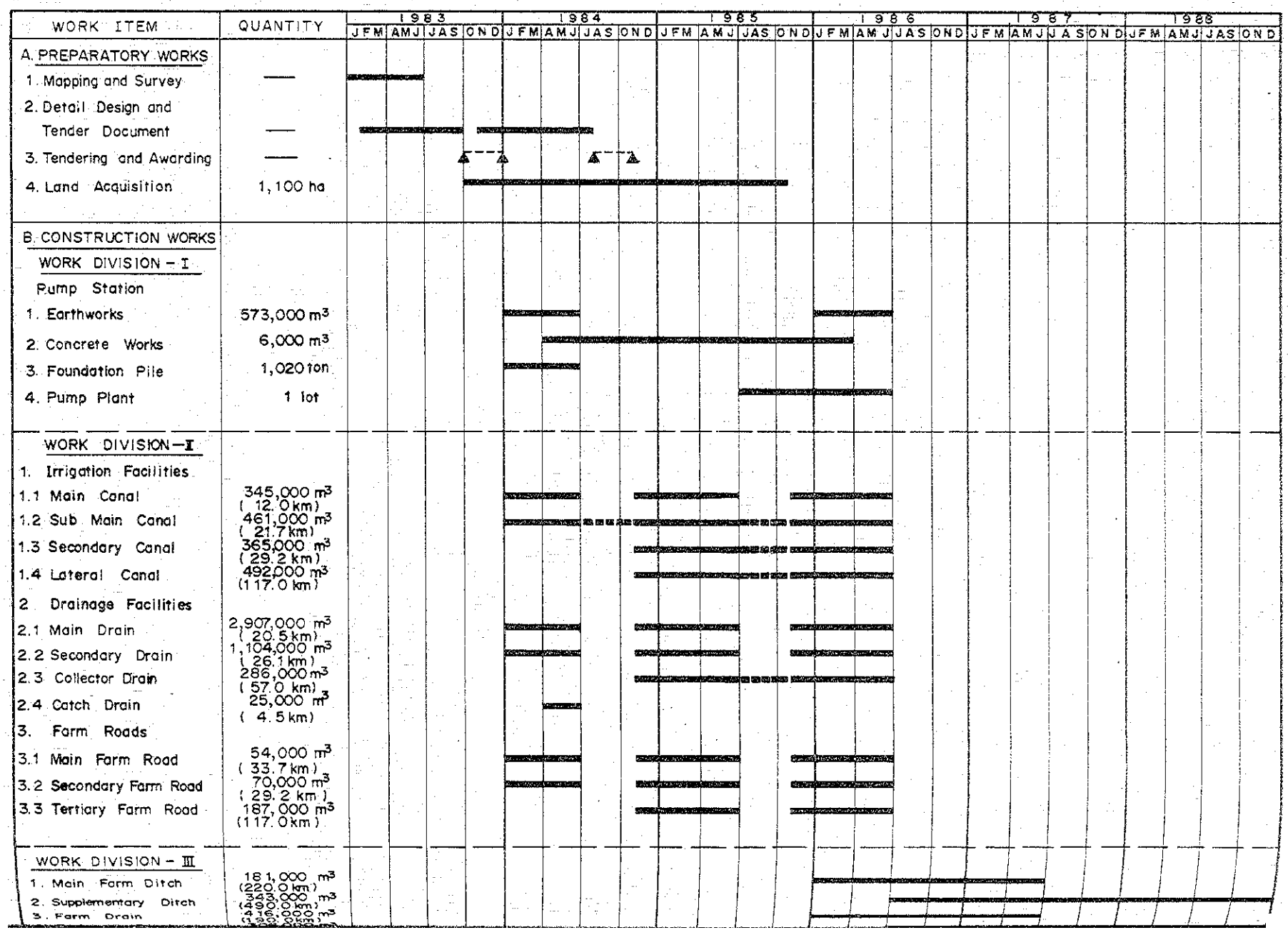

WORK ITEM
QUANTITY
1983
1984
1985
1986
1987
1988
1989
1990
J F M A M J J A S O N D
A PREPARATORY WORKS
1. Mapping and Survey
2. Detail Design and Tender Document
3. Tendering and Awarding
4. Land Acquisition
3,300 ha
B. CONSTRUCTION WORKS
WORK DVISION - I
Diversion Dam
1. Earthworks
2,571,000 m3
2. Concrete Works
39,000 m3
3. Protection
166,000 m2
4. Gate Installation
900 ton
WORK DIVISION - II
1 . Irrigation Facilities
1.1 Main Canal
524,000 m3 (14.6 km)
1. 2 Sub Main Canal
468,000 m3 (21.7 km)
1.3 Secondary Canal
375,000 m3 (29.2km)
1.4 Lateral Canal
486,000 m3 (116.0km)
2. Drainage Facilities
2.1 Main Drain
2,907,000 m3 (20.5km)
2.2 Secondary Drain
1,104,000 m3 (26.1 km)
2.3 Collector Drain
286.000 m3 (57.0 km)
2.4 Catch Drain
148,000 m3 (6.0 km)
3. Farm Roads
3.1 Main Farm Road
58,000 m3 (36.3km)
3.2 Secondary Farm Road
70,000 m3 (29.2km)
3.3 Tertiary Farm Road
186,000 m3 (116.0km)
WORK DIVISION - III
1. Main Farm Ditch
181,000 m3 (220.0 km)
2. Supplementary Farm Ditch
343,000 m3 (490.0km)
3. Farm Drain
416,000 m3 (190. 0km)
4. Drainage Ditch
306,000 m3

Fig. 4.2 IMPLEMENTATION SCHEDULE FOR PUMP SCHEME



APPENDIX VII

INLAND FISHERIES

APPENDIX VII INLAND FISHERIES

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APPENDIX VII INLAND FISHERIES

CHAPTER 1 GENERAL

In the lower reaches of the Pampanga River, there are roughly two types of inland fishery activities; one is fishing in the freshwater rivers and swamps and the other is brackish pond culture in the tidal flat deltaic area. Addition to them, the Government has recently established a policy of self-sufficiency of food within each Region, one of the solutions of which is to develop other kind of inland waters for fish production such as rice fields, backyard pond construction, lakes and reservoirs. To proceed more effective use of these inland waters, the BFAR Region III is handling several research and development projects. Especially, technical and propagation projects such as BFAR-USAID Freshwater Fish Hatchery and Extension and Training Center and BFAR-UNDP Backishwater Demonstration Farm Training Program are greatly expected to be fruitful.

As of the year 1980, per capita self-sufficiency of fish in Region III was only 11 kgs, 7.9 kgs of which came from inland waters. It is expected that inland waters in the objective area have much more potentials for fish production.

The main purpose of this study is to find development items for the more productive use of the Pampanga River system on the premise of the performance of some irrigation or flood control developments.

CHAPTER 2 PRESENT CONDITION

2.1 Fisheries Ground

In the Pampanga River basin, there are several kinds of inland waters, rivers, swamps, reservoirs, ponds and rice fields as freshwater bodies, and tidal flat deltaic area as brackishwater body. At present, following inland fisheries activities in these waters are being operated under the administration and promotion of the Bureau of Fisheries and Aquatic Resources (BFAR).

	Type of Water	Fishing	Fish Stock	Fish Culture
1)	Rivers	o	o	x
2)	Swamps	o	o	+
3)	Reservoirs	+	+	+
4)	Freshwater Ponds	x	x	+
5)	Rice Fields	x	x	+
6)	Tidal Flat Delta	x	x	oo

Remarks: oo: Very active (year-round)
o: Active (year-round or seasonally)
+: Experimental stage
x: No activities

Ecological conditions of rivers and swamps are greatly influenced by the two pronounced season, dry and wet.

2.2 Fishing and Fish Stock

Year-round fishing of various carps, plasalids, catfish, etc. is being operated in the Pampanga River, the Pantabangan and Angat Reservoirs. Statistical data of fish production in the waters were not available. In case of Pampanga River, its carrying capacity was estimated at 300 kg/ha without any basic data in 1978/1. On the other hand, that of the Angat Reservoir was estimated at 41.2 kg/ha with catching survey during 1979 - 1981/2.

/1: Socio-economic Profile of Mt. Arayat & its Vicinity, 1978, Magalang Arayat Task Force (MARATAF) Pampanga, Region III

/2: Fish Production Studies of Angat Reservoir, 1981, National Science Development Board