APPENDICES

APPENDIX 3.4.1 DECORP POWER RATES (AS OF FEB. 1986)

Residential

First 100 kwh	₱ 0.575 per kwh
Next 100 kwh	.585 per kwh
Excess kwh	.590 per kwh

Commercial

Classification		
X-1	First 150 kwh	₱0.575 per kwh
(Conn. Load: 1-5,000 watts)	Next 150 kwh	.590 per kwh
	Next 300 kwh	.600 per kwh
	Excess kwh	.610 per kwh
X-2	First 600 kwh	₱0.575 per kwh
(Conn.load: over 5,000 watts)	Next 600 kwh	.590 per kwh
	Next 1200 kwh	.600 per kwh
	Excess kwh	.610 per kwh

Industrial

Demand charge		₱10.00 per kwh
Plus Energy charge	First 200 hrs.	.550 per kwh
	Next 200 hrs.	.530 per kwh
	Excess hrs.	.510 per kwh

Street light rates

125 watts Mercury lamp	₱24.00 per month
250 watts Mercury lamp	48.00 per month
400 watts Mercury lamp	73.80 per month

APPENDIX 4.2.1 DISCHARGE RATE OF THE EXISTING PUMP

The discharge rate of the pump was measured by means of potable flow meter covering fifteen existing pumping stations.

The time period for measurement was arranged in accordance with operation schedule for each pump since most pumps are being operated within the limited hours from the economical viewpoint. With regard to the situation of pump operation, measurement was conducted for a period of one hour for a majority of the pumps. However, the discharge rate at the four pumping stations (No. 2, No. 4, No. 5 and No.16) were measured through the day. Two of these pumping stations (No. 2 and No. 4) are being operated through the day. Other two pumping stations were considered for one day measurement to analyze the influence by the former two pumping stations, especially during the period when the pumps stop operating.

Implementation Schedule

The implementation schedule was made in consideration of the available set of potable flow meter (3 sets) and associated with other surveys. TABLE 4.2.1. 1 shows overall schedule for this survey.

TABLE 4.2.1.1 IMPLEMENTATION SCHEDULE

Date	No. of P.S.	Measurement Time		R.M.
June 18	No. 12	9:30	10:30	
	15	9:40	10:40	
	11	11:25	12:25	
	7	11:35	12:35	
	8	14:05	15:05	
	14	14:10	15:10	

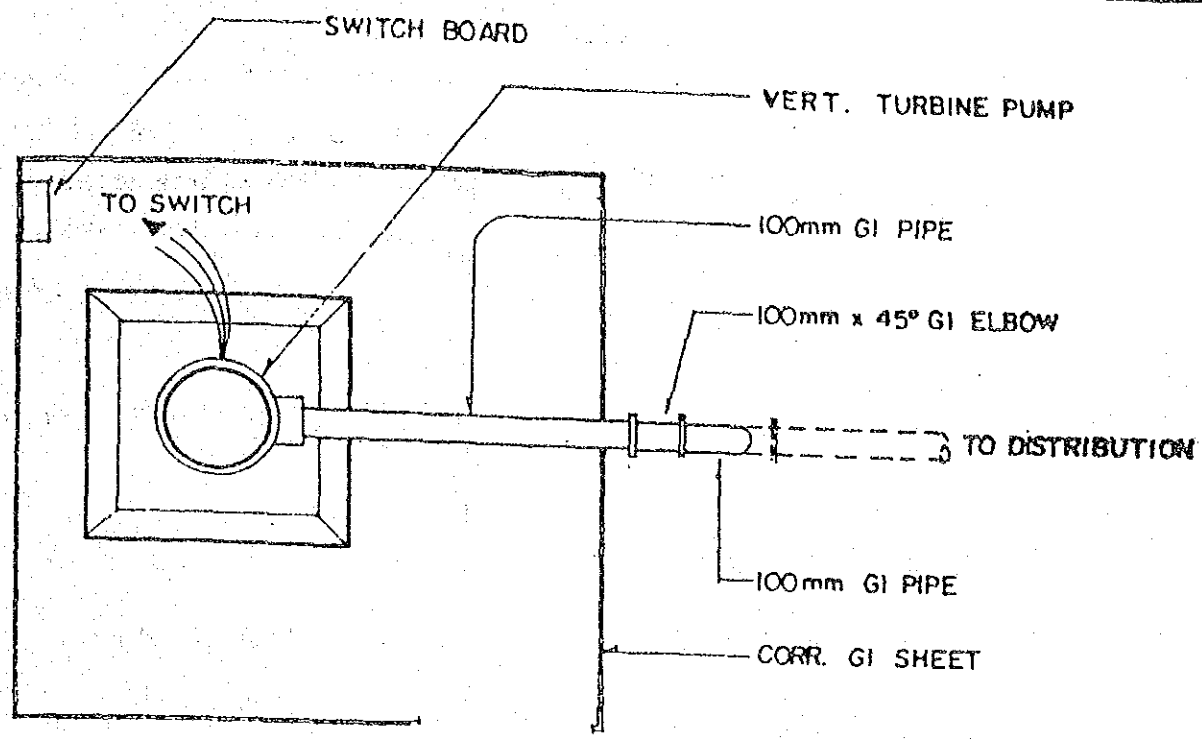
Date	No.of P.S.	Measurement Time		R.M.
June 19	No. 6	8:45	9:45	
	3	8:50	9:50	
	16	10:30	11:30	No. 16 PS was repaired after measurement
	1	10:45	11:45	
	4	14:20	15:20	
	10	14:30	15:30	
	9	16:20	17:20	
June 26	4	16:00	16:00	
27	2	22:00	22:00	
July 26	5	18:00	18:00	
27	16	19:00	19:00	

Measurement Result

Measurement results for the four pumping stations are shown in TABLE 4.2.1.2. Regarding the results of the four pumping stations, the fluctuation of hourly discharge rates is less than 5 percent to the average figure.

TABLE 4.2.1.2 ONE DAY MEASUREMENT RESULT AT THE FOUR PUMPING STATIONS

Time \ Pumping Station	No. 2 (cu.m/hr)	No. 4 (cu.m/hr)	No. 5 (cu.m/hr)	No. 16 (cu.m/hr)	Remarks
0 - 1	63	62	0	0	
1 - 2	62	62	0	0	
2 - 3	64	62	0	0	
3 - 4	64	63	0	0	
4 - 5	63	64	0	0	
5 - 6	60	64	0	0	
6 - 7	59	64	20	0	
7 - 8	61	64	20	38	
8 - 9	62	64	20	40	
9 - 10	61	64	20	41	
10 - 11	62	62	19	40	
11 - 12	62	64	20	41	
12 - 13	-	-	20	41	
13 - 14	-	-	20	40	No. 2 & No. 4
14 - 15	-	-	19	39	Brownout
15 - 16	-	-	19	39	
16 - 17	63	65	19	39	
17 - 18	61	65	19	39	
18 - 19	60	65	19	39	
19 - 20	61	64	19	40	
20 - 21	61	64	19	39	
21 - 22	62	62	19	41	
22 - 23	62	61	0	0	
23 - 24	64	62	0	0	
Hourly Average Rate (cu.m/hr)	62	63	19	40	
Daily Dicharge Rate (cu.m/hr)	1,488	1,512	456	960	



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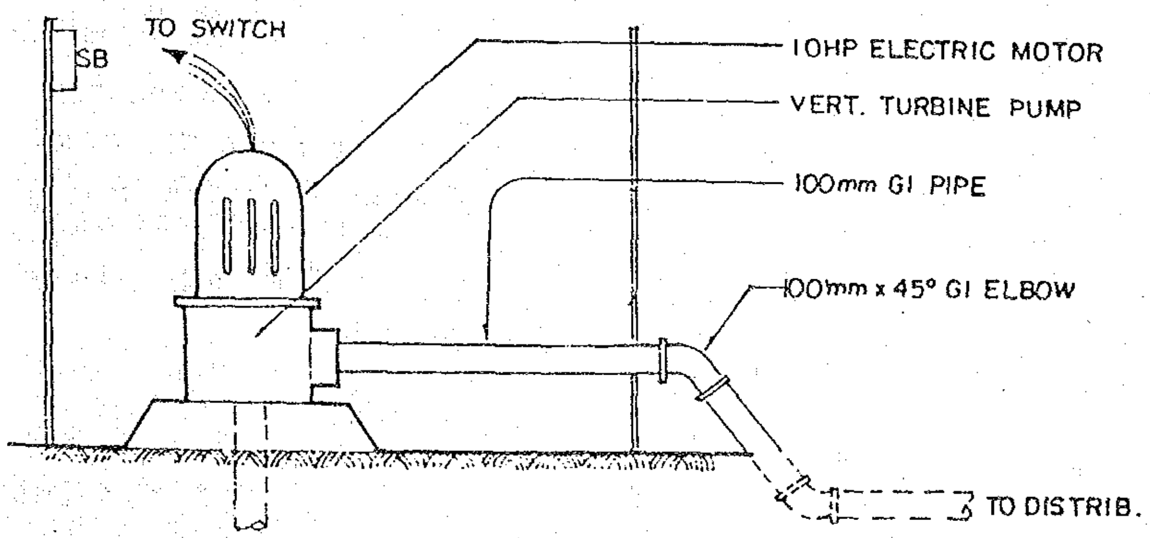
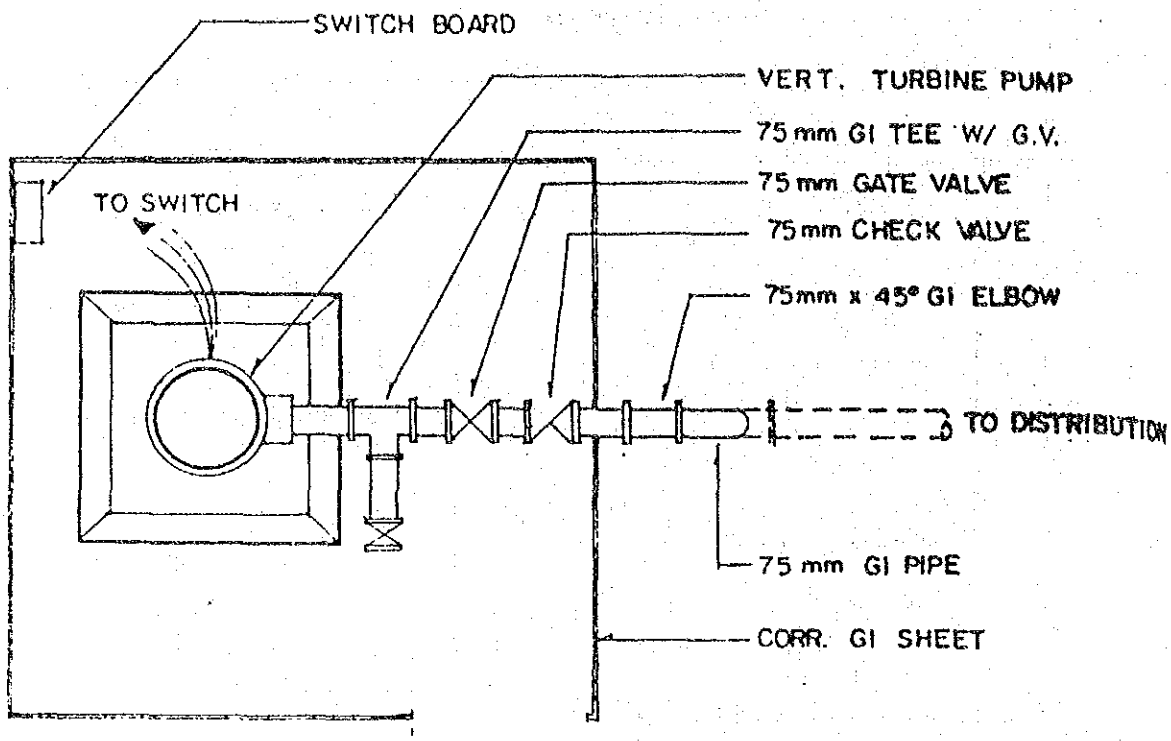
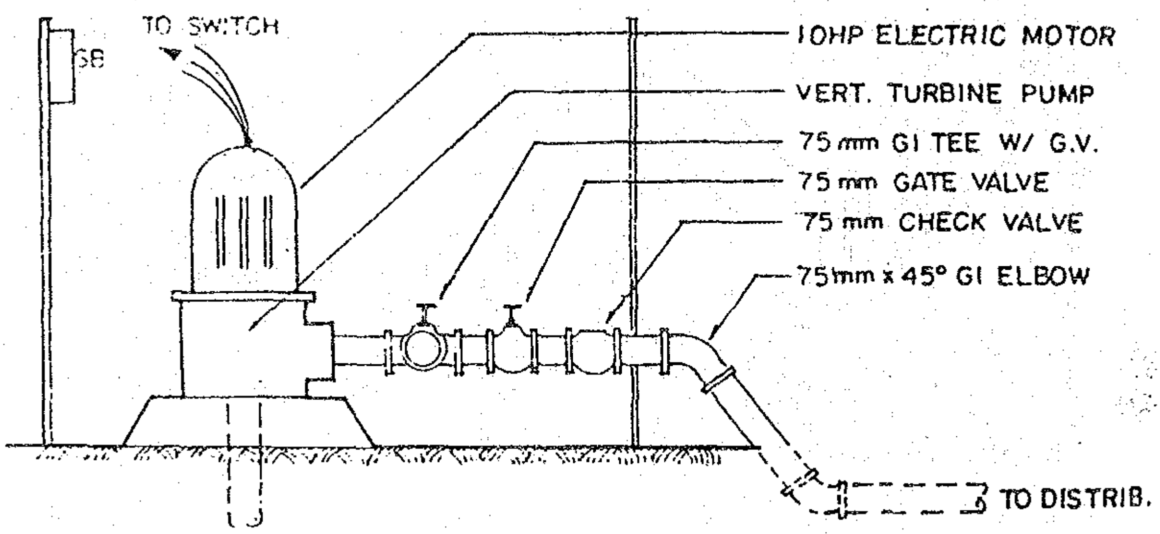


ELEVATION

GALVAN PUMPING STATION
WELL NO. 1



P L A N



ELEVATION

MALUED PUMPING STATION
WELL NO. 7

APPENDIX 4.2.2 PUMP EFFICIENCY TEST

The required condition in conducting pump efficiency testing are given below:

(1) There is an existing functioning gate valve, sounding hole and pressure gauge located properly at the pump station.

(2) There is a proper and convenient place to install the portable flow meter.

Voltage, electric current and discharge rate measurement should be made several times depending on the water pressure variation.

Selection of pump station for pump testing

During the survey, the existing facilities,of the pump stations were investigated, especially the existence of functioning gate valve, pressure gauge and sounding hole. All the pump stations had no pressure gauges and sounding holes. Out of the fifteen (15) pump stations, No. 10 located along Arellano St. has a record on pumping water level. TABLE 4.2.2.1 shows the collected information.

Pump station No. 10 was selected for this test in the light of the aforementioned requirements. However, a hole was drilled to install the pressure gauge. The reliable data about the pumping water level provided by the DAWASA engineers was also utilized.

Field measurement

Variations of water pressure and discharge rate were measured at the different opening ratio of the gate valve. TABLE 4.2.2.2 shows the test data obtained at pump station No. 10.

TABLE 4.2.2.1 INFORMATION ASSOCIATED WITH THE REQUIREMENTS FOR THE TEST

P.S. No.	Location	Type of Pump	Pump Cap. (CMD)	Const. Well	Year Pump	Operation Status	Existence			P.WL* (m)	Pump* Setting (m)	Remarks
							Gate Value	Present Gauge	Sounding Hole			
1	Galvan St.	Turbine Pump	540	NDA	NDA	4:00AM-10:00PM (18 hrs.)	No	No	No	-	15.24	
2	In front of City Hall	"	1370	"	"	24 hrs	Yes	"	"	9.15	21.34	Gate Value not functioning
3	Rizal St.	"	1370	1952	1952	4:00AM-12MN (20 hrs)	Yes	"	"	7.6	27.44	Gate Value not functioning
4	A.B.F east	"	1320	NDA	NDA	24 hrs	Yes	"	"	18.29	30.49	Gate Value not functioning
5	Burgos St.	"	540	1960	1960	4:00AM-10PM (18 hrs)	Yes	"	"	-	-	
6	Perez St.	"	1090	1978	1978	4:00AM-10PM (18 hrs)	Yes	"	"	-	18.29	Gate Value no handle
7	Bgy Malued	"	540	1967	1967	4:00AM-10PM (18 hrs)	Yes	"	"	-	18.29	
8	Noble St.	"	540	1974	1974	4:00AM-10PM (18 hrs)	Yes	"	"	-	15.24	
9	Caranglaan	"	540	1974	1974	4:00AM-10PM (18 hrs)	Yes	"	"	-	15.24	
10	Avellano St.	"	540	1971	1971	4:00AM-10PM (18 hrs)	Yes	"	"	10.7	15.24	
11	Bgy. Lasip	"	540	1972	1972	4:00AM-10PM (18 hrs)	Yes	"	"	18.29	27.44	Gate Value no handle
12	Amado St.	"	540	1973	1973	4:00AM-10PM (18 hrs)	Yes	"	"	-	27.44	
13	Tondalugan	"	-	1976	-	-	-	-	-	-	-	abandoned in 1983
14	Noble St.	"	540	1970	1970	4:00AM-10PM (18 hrs)	Yes	No	No	-	24.3	
15	Bgy. Malued		540	1977	1977	4:00AM-10PM (18 hrs)	Yes	"	"	16.8	21.34	Gate Value no handle
16	A.B.F West	"	1320	1980	1980	4:00AM - 8:00PM (16 hrs)	Yes	"	"	18.9	30.49	Gate Value no handle

NDA - No data available

* - Data provided by the NAWASA.

TABLE 4.2.2.2

TEST DATA ON PUMP STATION No. 10
DAGUPAN CITY, PANGASINAN

STEP	(LPS)	Pd (m)	PWL (m)	TDH 1/ (m)	V AVE. (Volts)	I AVE. (Amp.)	WHP 2/		IHP 3/		Overall 4/ Eff(%)	PUMP 5/ (%)	BHP 6/ (Hp)
							HP	KW	HP	KW			
1	7.72	6.1	10.7	17.8	220	20.3	1.8	1.34	6.6	4.9	27.3	32.1	5.6
2	7.70	6.5	10.7	18.2	225	20	1.84	1.37	6.6	4.9	27.9	32.8	5.6
3	7.65	6.8	10.7	18.5	225	20	1.86	1.39	6.6	4.9	28.2	33.2	5.6
4	7.61	7.7	10.7	19.4	225	20	1.94	1.45	6.6	4.9	29.4	34.6	5.6
5	7.58	7.95	10.7	19.7	221	20.5	1.96	1.46	7.7	5.0	29.3	34.5	5.7
6	7.51	8.4	10.7	20.1	221.7	19.5	1.98	1.48	6.4	4.8	30.9	36.4	5.4
7	7.50	8.8	10.7	20.5	223	19.0	2.02	1.50	6.2	4.6	32.6	38.4	5.3
8	7.45	9.2	10.7	20.9	222.7	18.5	2.05	1.53	6.1	4.6	33.6	39.5	5.2
9	7.37	9.9	10.7	21.6	221	18.5	2.09	1.56	6.0	4.5	34.8	40.9	5.1
10	7.32	10.2	10.7	21.9	221	18.0	2.11	1.57	5.9	4.4	35.8	42.1	5.0
11	6.25	13.0	10.7	24.7	220	18.0	2.03	1.51	5.8	4.3	35.0	41.2	4.9
12	5.68	13.5	10.7	25.2	218.5	18.0	1.89	1.41	5.8	4.3	32.6	38.4	4.9

1/ TDH = Pd + Ps (PWL) + hf, WHERE hi is ASSUMED 1.0 m

2/ WHP = (Q x TDH) / 76.1

3/ IHP = (VAVE x I AVE x 3 x P.F)/1000 ; ASSUMED P.F. = 0.85

4/ OVERALL EFF = (WHP x 100) / IHP

5/ PUMP EFF = $\frac{\text{OVERALL Eff}}{\text{MOTOR Eff}}$; ASSUMED MOTOR Eff = 0.85

6/ BHP = WHP / PUMP eff = IHP x MOTOR Eff.

APPENDIX 4.2.3 WATER PRESSURE IN THE SERVICE AREA

Variations in pressures at strategic points in the distribution system and in the pump stations were monitored on a 24-hour basis utilizing automatic pressure recorders and pressure gauges.

The following approach was employed to achieve the purpose of this pressure survey.

A. Preparatory Work

(1) Preliminary survey and discussion with the waterworks personnel to pinpoint the proposed pressure test points.

(2) Made some posters/placards informing the public regarding the on-going pressure survey.

(3) Hired some personnel/recorders for this survey.

B. Implementation of the Survey

(1) Briefing of the hired personnel/recorders regarding this pressure survey.

(2) Brought the personnel/recorders to their designated area.

(3) Field measurement itself.

The following were considered in selecting the test points:

a) All the existing pump stations should be included in this survey.

b) The total number of test points should be around thirty (30).

The test point locations are shown in FIGURE 4.2.3.1. TABLE 4.2.3.1 shows the 24-hour pressure recordings.

TABLE 4.2.3.1

24-HOUR PRESSURE RECORDING IN THE DISTRIBUTION SYSTEM

	No.	Location	Recorded	Pressure Range (kg/cm^2)	Consumer Type	Diameter of Connection
Pump Station	1	Galvan St.	6-29-86	0.70-0.99	-	A.P.R. was installed
"	2	Infront of City Hall	6-29-86	1.22-1.33	-	on the discharge pipe
"	3	Rizal St.	6-28-86	0.25-0.49	-	"
"	4	A.B.F. East	6-29-86	0.92-0.99	-	"
"	5	Burgos St.	6-28-86	0.17-0.42	-	"
"	6	Perez St. (Mkt.)	6-30-86	0.07-0.42	-	"
"	7	Dag-Malved Rd.	6-27-86	0.25-0.63	-	"
"	8	Nable St.	6-28-86	0.32-0.63	-	"
"	9	Cuanglaan	6-29-86	0.50-0.92	-	"
"	10	Arellano St.	6-29-86	0.63-1.0	-	"
"	11	Pogo Grande	6-27-86	0.14-0.35	-	"
"	12	Amado St.	6-31-86	0.21-0.53	-	"
"	14	Nable St.	6-26-86	0.70-1.02	-	"
"	15	Dag-Binmaley Rd.	6-27-86	0.42-0.77	-	"
"	16	A.B.F. East	6-28-86	1.12-1.48	-	"
Service Area	1	Back of Rosita Mktg.	7-4-86	0.04-0.35	Public	½"
"	2	Fernandez St.	7-4-86	0 -0.28	Faucet	
"	3	Lasip Grande Elem. Sch.	7-1-86	0 -0.21	Institutional	½"
"	4	Amado St.	7-2-86	0 -0.28	Public Faucet	½
"	5	A.B.F. West Ext.	7-2-86	1.06-1.06	"	3/4"
"	6	Cueenan St.	7-4-86	0.28-0.69	"	½"
"	7	Bonifacio St.	6-27-86	0.07-0.32	"	½"
"	8	Nable St.	6-28-86	0.07-0.63	"	3/4"
"	9	Nable St.	6-26-86	0.63-1.06	"	3/4"
"	10	Nable St.	6-27-86	0.46-0.99	"	3/4"
"	11	Avellano St.	7-03-86	0.04-0.35	"	3/4"
"	12	Avellano St.	6-26-86	0.30-1.0	"	½"
"	13	Along Nat'l. Hi-way	7-03-86	0.07-0.56	"	½"
"	14	Perez St. (Mkt.)	7-03-86	0.11-0.60	"	½"
"	15	Pantal St.	6-26-86	0.4 -1.2	Domestic	½"
"	16	A.B.F. West	6-26-86	0.5 -1.2	Public Faucet	½"
"	17	Caranglaan North	6-26-86	0 -0.7	Domestic	½"
"	18	Bgy. Lucao	6-26-86	0 -0.4	Domestic	½"
"	19	Lucao	7-31-86	0.18-0.56	Domestic	½"
"	20	A.B.F. East	6-26-86	1.5 -2.2	Commercial	3/4"
"	21	Arellano St.	6-26-86	0.3 -1.0	Public Faucet	½"
"	22	Lasip Grande	7-31-86	0 -0.07	Domestic	½"
"	23	A. B.F. East	6-26-86	1.0 -2.2	Commerical	

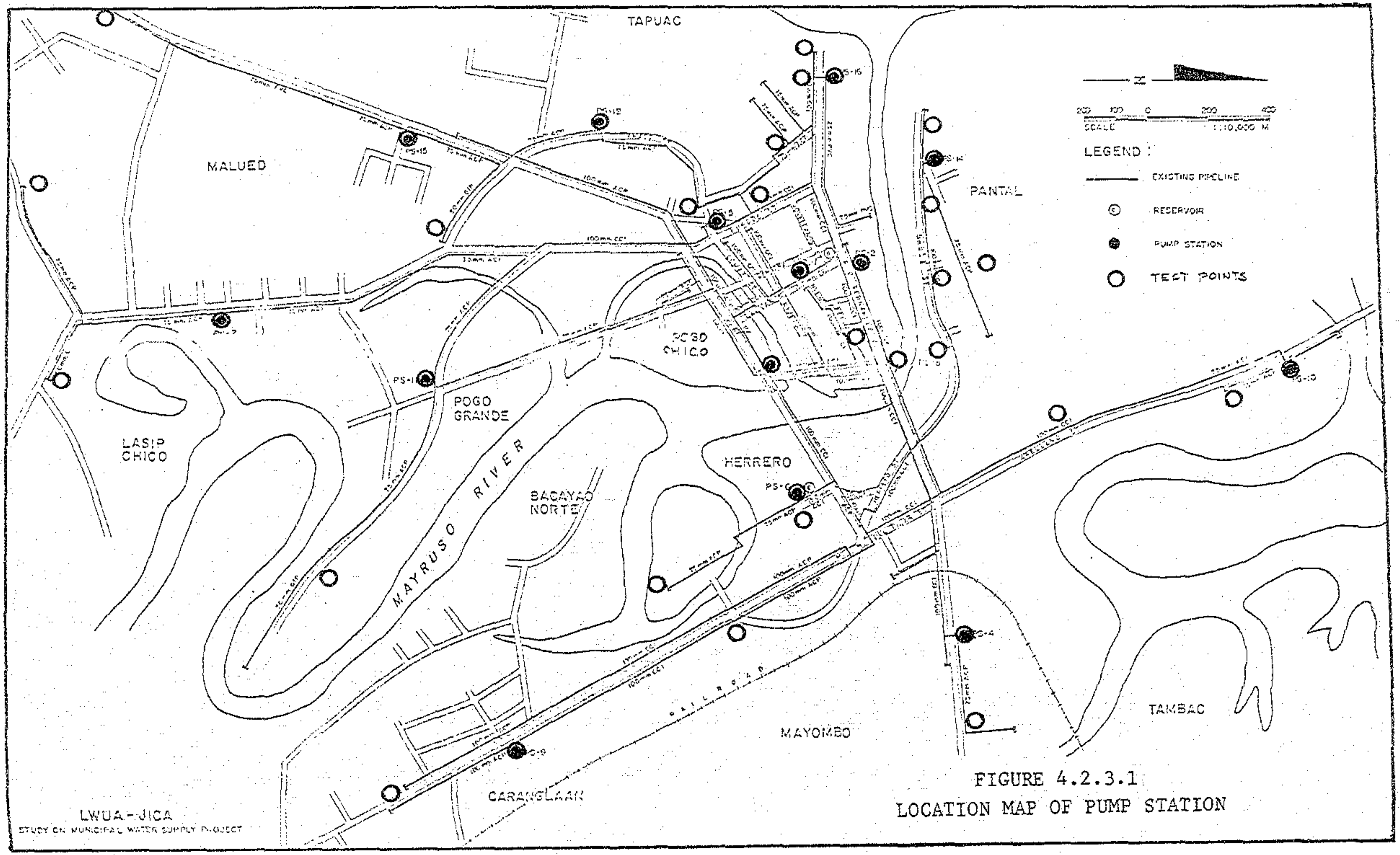


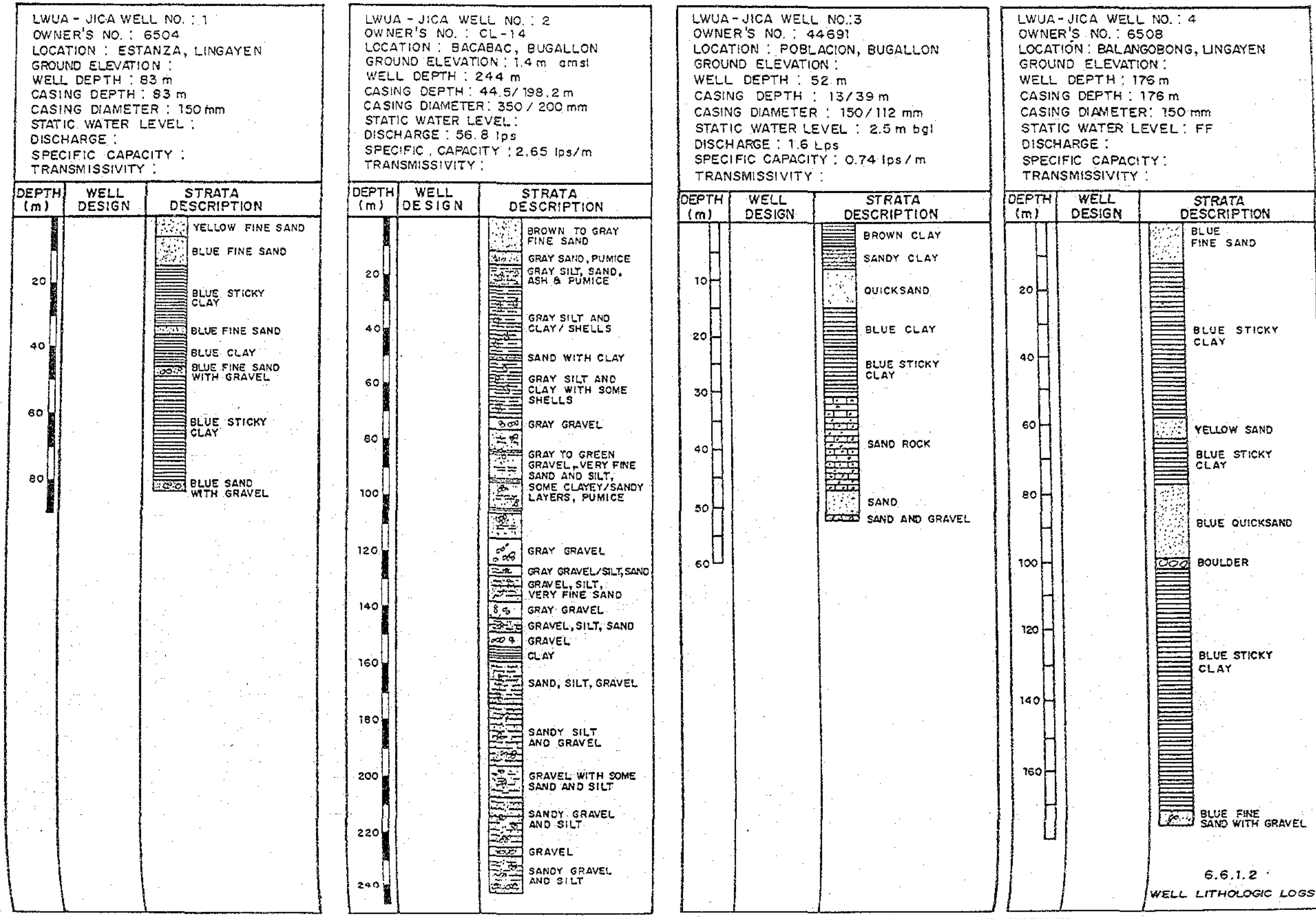
FIGURE 4.2.3.1
LOCATION MAP OF PUMP STATION

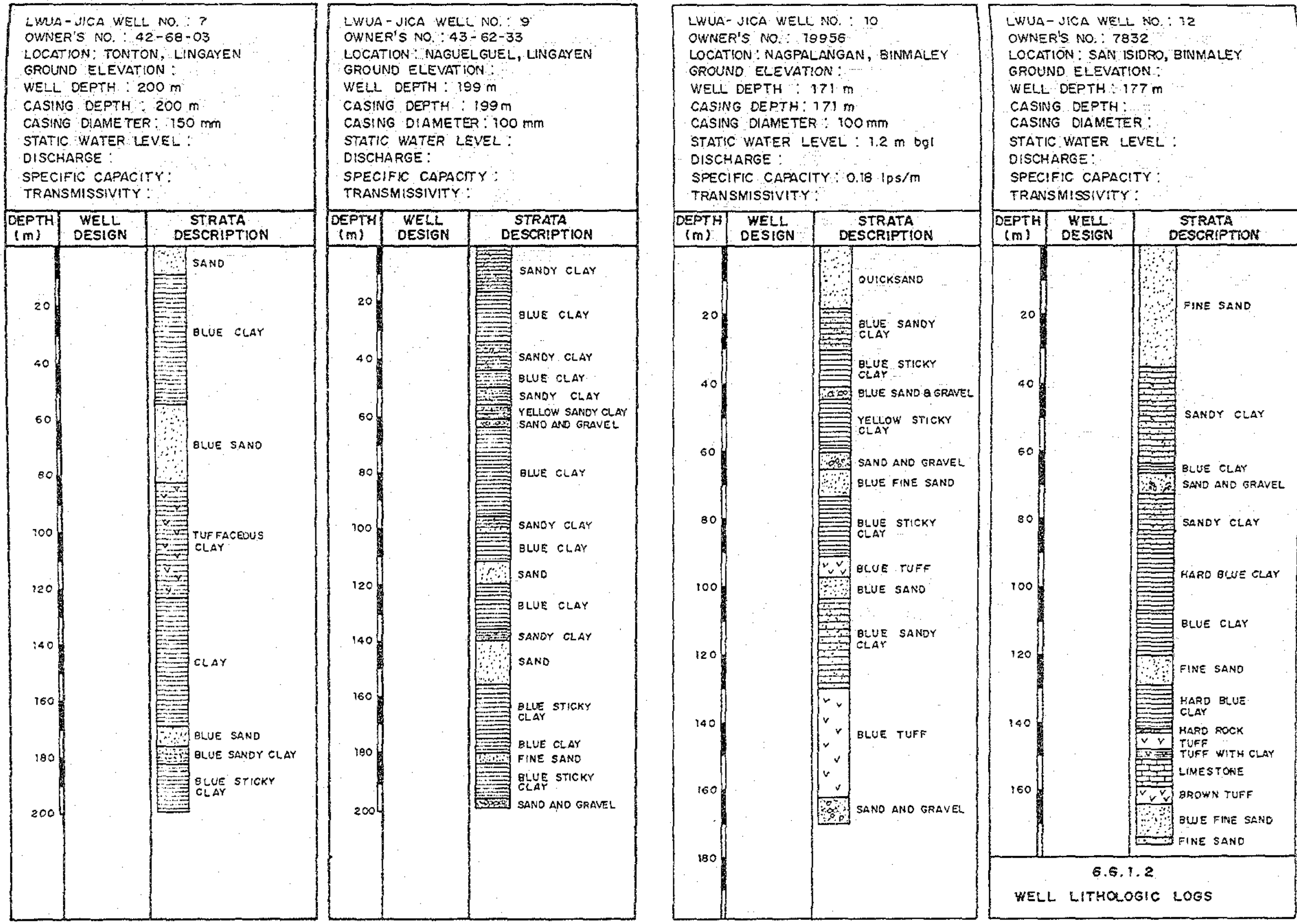
APPENDIX 6.6.1.1 WATER WELL INVENTORY

Owner's Number	LWUA JICA Well No.	Location	Elevation (m amsl)	Completion Date	Well Depth (m)	Casing Depth (m)	Casing Dia. (mm)	Static Water Level (m bgl)	Discharge (lps)	Specific Capacity (lps/m)	Conductivity (micro om)	Temperature (°C)
6504	1	Estanza, Lingayen	1.0	12-24-54	83	83	150					
CL-14	2	Bacabac, Bugallon	1.4	2-2-76	244	44/198	350/200		57	2.65		
44691	3	Poblacion, Bugallon	2.0	9-22-69	52	13/39	150/112	2.5	1 6	0.74		
6508	4	Balangobong, Lingayen	1.0	1-31-55	176	176	150	FF				
8001	5	Pangapisan, Lingayen	1.0			100		FF			1000	32
	6	Pangapisan, Lingayen	1.0			100		FF			1000	32
42-68-03	7	Tonton, Lingayen	1.0	3-14-69	200	200	150					
	8	Baybay, Lopez, Binmaley	1.0	1967			150				530	32
43-62-33	9	Naguelguel, Lingayen	1.0	10-31-62	199	199	100					
19956	10	Nagpalangan, Lingayen	1.5	9-5-59	170	170	100	1.2		0.18		
	11	San Isidro Norte, Binmaley	1.0				150	FF			556	32
7832	12	San Isidro, Binmaley	1.0	7-31-55	177						509	31
	13	Biec East, Binmaley	1.5	1956							497	32
436061	14	Naguilayan, Binmaley	1.5	12-27-60	130	130	100	0.6	0.6	0.23		
	15	Caloocan Norte, Binmaley	1.0	1953				2			450	31
7968	16	Caloocan Norte, Binmaley	1.0	7-31-56	174			5.8	0.13	0.02	444	31
	17	Canaoalan West, Binmaley	1.5	1968							461	31
12639	18	Linoc West, Binmaley	1.5	1-30-57	117	114	100	1.8	0.95			
	19	Canaoalan, Binmaley	1.5								400	31
7831	20	Caloocan Sur, Binmaley	1.0	6-12-56	258		125	6.1			1220	27
	21	Canaoalan, Binmaley	1.5	7-11-60							400	31
20491	22	Papagueyan, Binmaley	1.5	3-17-58	90	17/73	100/63	2.4	0.63	0.2		
CL-11	23	Papagueyan, Binmaley	1.3	1-12-76	374	53.5/254.8	350/200	FF	88	4.9	1120	32
	24	Canaoalan, Binmaley	1.5	1-26-67							380	31
5933	25	Carael, Daguoan City	1.5	3-31-54	143		100					
	26	Carael, Dagupan City	1.5				50	8.5			860	30
56-76-14	27	Calmay, Dagupan City	1.5	6-6-77	151	142.7						
5183	28	Pantal West, Dagupan City	2.0	4-15-50	189						320	32
	29	Gilig, Dagupan City	2.0				100	8.2			980	29
	30	Malued, Dagupan City	2.0	9-20-73			150				590	31
5831	31	Malued, Dagupan City	2.0	11-28-53	155		150	6.5			1000	28
	32	Lasip, Grande, Dagupan City	2.0	1928							460	30
	33	Lasip, Calasiao	3.0	6-12-58			150	3.5			500	30

	34	Poblacion East Calasiao	3.0	1925			200				620	29
	35	Buenlag, Calasiao	2.0				150				1000	28
	36	San Miguel, Calasiao	2.0	9-19-83			100	6.9			590	28
17562	37	Balani, Calasiao	2.0	1958			100				720	30
	38	Balani, Calasiao	1.8	1983			100				1050	29
17563	39	San Miguel, Calasiao	2.0	1958			100				670	28
105-10-81	40	San Miguel, Calasiao	2.0	11-10-81		52	100				665	27
	41	Bued, Calasiao	2.0								330	29
	42	Teleng, Dagupan City	2.0	6-10-63			100	6.8			840	31
	43	Manguin, Dagupan City	2.0	3-29-61			150	7			420	29
	44	Bolosan, Dagupan City	2.0								970	29
	45	Bolosan, Dagupan City	2.0	12-23-82			100	6.0			920	28
7583	46	Mamalingling, Daguoan City	2.0	5-20-64			100				780	29
	47	Amponao Cruz, Calasiao	2.0				200				310	30
	48	Amponao, Calasiao	2.0								330	31
	49	Cabilocaan, Calasiao	2.0	1983			100				560	29
	50	Bondan, Catatpang, D.C.	1.5	7-11-77							1500	29
	51	Bonoan Longos, Dagupan City	1.5	3-17-60			100				970	30
	52	Bonoan Gueset, Dagupan City	1.5				100					30
	53	Bonoan Gueset, Dagupan City	1.5				100				780	30
5517	54	Bonoan Boquig, Dagupan City	1.5	10-11-52	210		100	4.5	1.6		220	30
	55	Bonoan Boquig, Dagupan City	1.5	10-7-55			100	FF			220	30
5128	56	Dagupan City	2.0	1-31-50	173							
2211	57	Poblacion, Mangaldan	2.0	11-9-25							890	30
	58	Gueguelonen, Mangaldan	2.0	1926			150				610	28
19015	59	Gueguelonen, Mangaldan	2.0	1958			100				410	28
	60	Embarcadero, Mangaldan	2.0				150				550	29
GP26	61	Angio, San Fabian	10	8-29-77	163	159	400		82	4.8	520	29
GP20	62	Anonang, San Fabian	10	8-30-77	140	135	400		82	5.8	470	29
GP27	63	Cabaroan, San Fabian	10	8-31-77	130	108	400		82	4.2	580	30
GP29	64	Cabaroan, San Fabian	10	9-22-77	118	99	400		82	4.7	580	29
2268	65	Macayog, San Jacinto	10								600	29
	66	Macayog, San Jacinto	10					FF			570	28
	67	Tandoc, Binmaley	1.5									
	68	Pagal, San Carlos City	1.5				150	FF			1790	29
	69	San Carlos City	4.0		137		150					
5366	70	Bolingit, San Carlos City	1.5	2-29-52	142							
10795	71	Malabago, Calasiao	1.5	3-24-56	70	24/46	150/113					
	72		4.0									

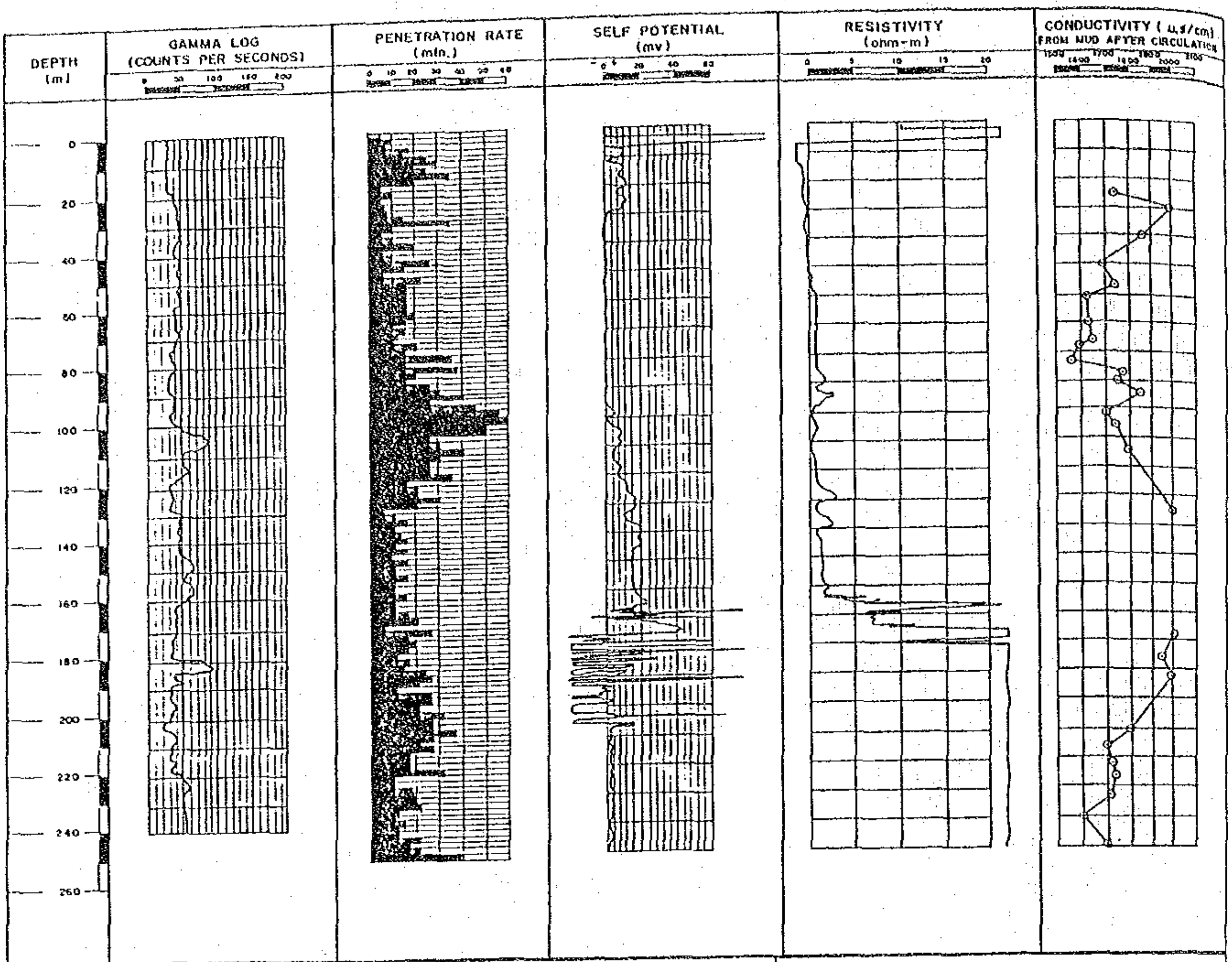
CL-8	73	Taloy, Malasiqui	7	10-2-75	252	40/220	350/200		63	2.38		
	74	Buenlag, Calasiao	3.0				100				1000	30
	75	Macabito, Calasiao	5.0				100				1540	30
	76	Macabito, Calasiao	5.0	1986							1400	29
	77	Macabito, Calasiao	5.0				100				1230	29
	78	Balengueo, Sta. Barbara	5.0	1984			100				1080	28
	79	Bogtong, Malasiqui	5.0				150				1320	30
19003	80	Bogtong, Malasique	5.0	1958			150				146	31
43-60-81	81	Pasima, Malasique	10	5-21-60	46	34	100	4.6	0.63	0.21		
	82	Poblacion, Malasique	10								1170	30
8089	83	Poblacion, Malasique	10	9-13-55	62.5	62.5	250	3.1	1.26	0.97		
GP-68	84	Aliaga, Malasique	12		158	138	400				605	29
GP-86	85	Lasip, Malasique	12		149	146	400	3.3	82	4.5	260	30
GP-84	86	Lasip, Malasique	12		148	145	400	2	82	3.7	280	30
	87	Maticmatic, Sta. Barbara	17				150				610	29
GP-25	88	Maticmatic, Sta. Barbara	15	9-2-77	156	154	400		82	7.7	605	29
	89		15									
	90	Amanaoac. Mapandan	17								620	29
GP-41	91	Banzal, Sta. Barbara	17		123	108	400		82	6.8	620	29
18974	92	Naguilayan, Binmaley	1.5	1958							580	32
	93	Naguilayan, Binmaley	1.5								1000	30
	94	Naguilayan, Binmaley	1.5	1985							820	29
	95	Camaley, Binmaley	1.5								520	32
	96	Camaley Centro, Binmaley	1.5								560	30
	97	Calit, Binmaley	1.5								1000	28
	98	Banaoang, Calasiao	1.8				150	3.8			435	30
	99	Mancod, Calasiao	1.8				100				1115	28
5268	100	Lucao, Dagupan City		2-18-51	189						933	28
20702	101	Dagupan City	2.0	2-22-59				9.0	1.26			


LWUA - JICA WELL NO. : 1
OWNER'S NO. : 6504
LOCATION : ESTANZA, LINGAYEN
GROUND ELEVATION :
WELL DEPTH : 83 m
CASING DEPTH : 83 m
CASING DIAMETER : 150 mm
STATIC WATER LEVEL :
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :
DEPTH (m)
WELL DESIGN
STRATA DESCRIPTION
YELLOW FINE SAND
BLUE FINE SAND
BLUE STICKY CLAY
BLUE FINE SAND
BLUE CLAY
BLUE FINE SAND WITH GRAVEL
BLUE STICKY CLAY
BLUE SAND WITH GRAVEL
20
40
60
80
LWUA - JICA WELL NO. : 2
OWNER'S NO. : CL-14
LOCATION : BACABAC, BUGALLON
GROUND ELEVATION : 1.4 m amsl
WELL DEPTH : 244 m
CASING DEPTH : 44.5/ 198.2 m
CASING DIAMETER : 350 / 200 mm
STATIC WATER LEVEL :
DISCHARGE : 56.8 lps
SPECIFIC CAPACITY : 2.65 lps/m
TRANSMISSIVITY :
DEPTH (m)
WELL DESIGN
STRATA DESCRIPTION
BROWN TO GRAY FINE SAND
GRAY SAND, PUMICE
GRAY SILT, SAND, ASH & PUMICE
GRAY SILT AND CLAY / SHELLS
SAND WITH CLAY
GRAY SILT AND CLAY WITH SOME SHELLS
GRAY GRAVEL
GRAY TO GREEN GRAVEL, VERY FINE SAND AND SILT, SOME CLAYEY/SANDY LAYERS, PUMICE
GRAY GRAVEL
GRAY GRAVEL/SILT, SAND
GRAVEL, SILT, VERY FINE SAND
GRAY GRAVEL
GRAVEL, SILT, SAND
GRAVEL
CLAY
SAND, SILT, GRAVEL
SANDY SILT AND GRAVEL
GRAVEL WITH SOME SAND AND SILT
SANDY GRAVEL AND SILT
GRAVEL
SANDY GRAVEL AND SILT
20
40
60
80
100
120
140
160
180
200
220
240
LWUA - JICA WELL NO. : 3
OWNER'S NO. : 44691
LOCATION : POBLACION, BUGALLON
GROUND ELEVATION :
WELL DEPTH : 52 m
CASING DEPTH : 13/39 m
CASING DIAMETER : 150/112 mm
STATIC WATER LEVEL : 2.5 m bgl
DISCHARGE : 1.6 Lps
SPECIFIC CAPACITY : 0.74 lps / m
TRANSMISSIVITY :
DEPTH (m)
WELL DESIGN
STRATA DESCRIPTION
BROWN CLAY
SANDY CLAY
QUICKSAND
BLUE CLAY
BLUE STICKY CLAY
SAND ROCK
SAND
SAND AND GRAVEL
10
20
30
40
50
60
LWUA - JICA WELL NO. : 4
OWNER'S NO. : 6508
LOCATION : BALANGOBONG, LINGAYEN
GROUND ELEVATION :
WELL DEPTH : 176 m
CASING DEPTH : 176 m
CASING DIAMETER : 150 mm
STATIC WATER LEVEL : FF
DISCHARGE :
SPECIFIC CAPACITY :
TRANSMISSIVITY :
DEPTH (m)
WELL DESIGN
STRATA DESCRIPTION
BLUE FINE SAND
BLUE STICKY CLAY
YELLOW SAND
BLUE STICKY CLAY
BLUE QUICKSAND
BOULDER
BLUE STICKY CLAY
BLUE FINE SAND WITH GRAVEL
20
40
60
80
100
120
140
160
6.6.1.2
WELL LITHOLOGIC LOGS



6.6.1.2

WELL LITHOLOGIC LOGS



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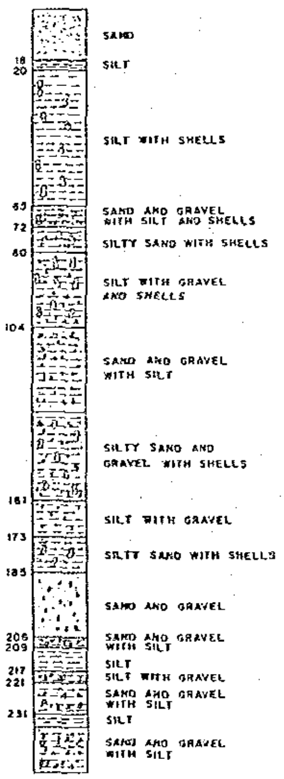
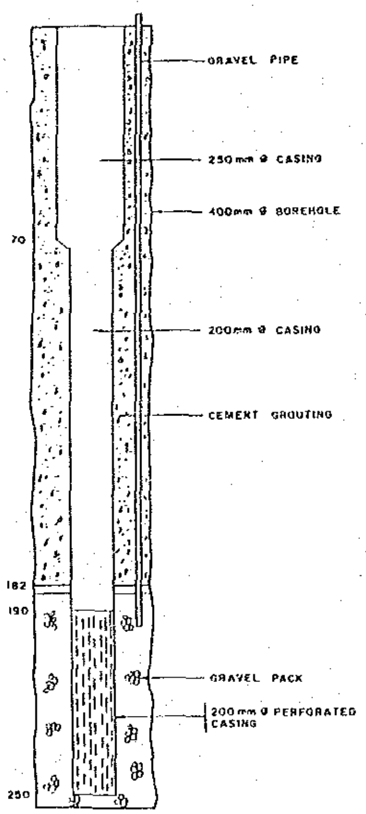


WELL DESIGN



WELL DATA

LWUA - JICA WELL NO: 8
ELEVATION : 2 m amsl
WELL DEPTH : 250 m
WELL DIAMETER : 250 AND 200mm
STATIC WATER LEVEL : +1.37 m bgl
PUMPING WATER LEVEL : 25.6 m bgl
DISCHARGE : 32 lps
cmd
SPECIFIC CAPACITY : l/m²
DATE OF TEST : FEBRUARY, 1980

WATER QUALITY

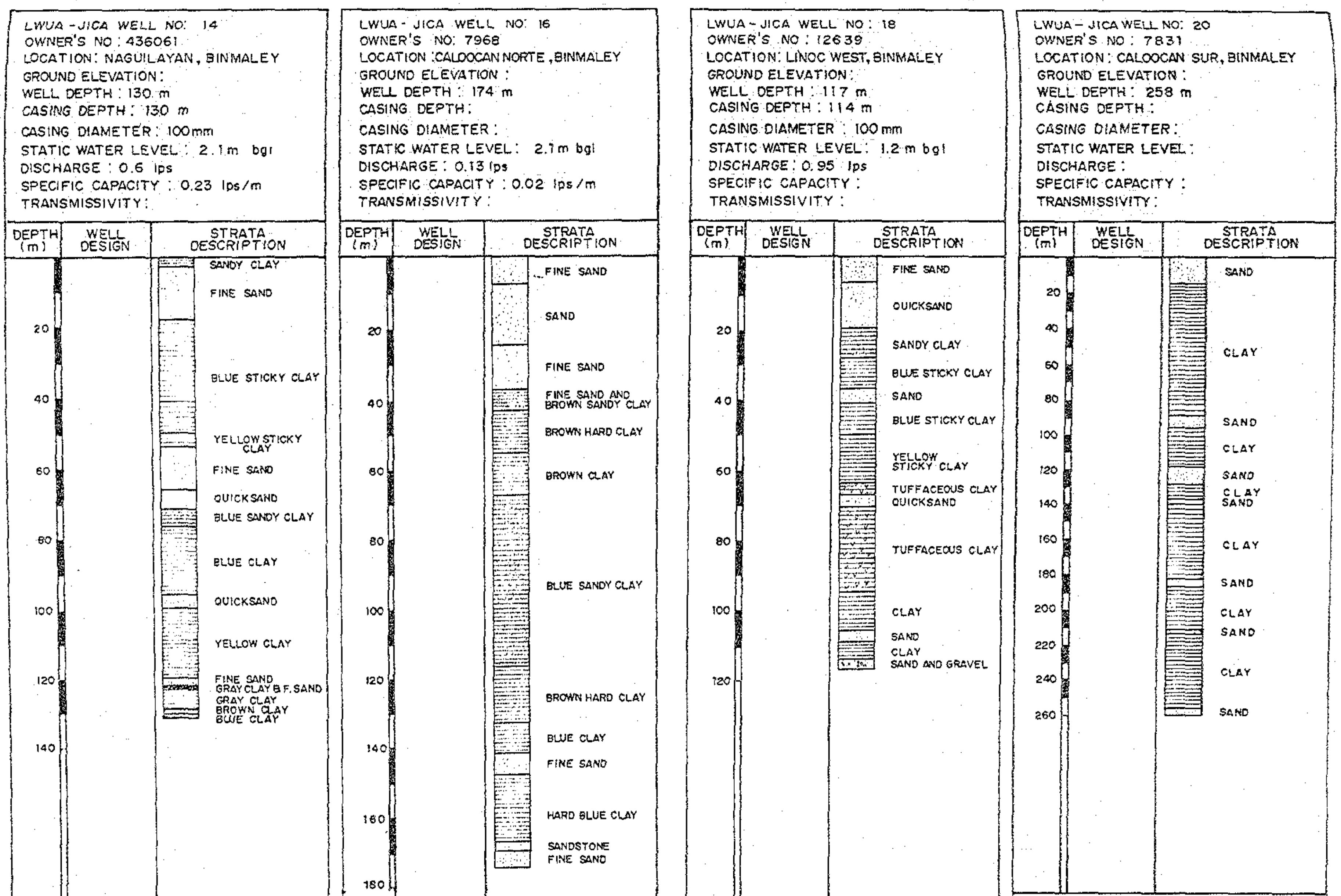
PHYSICAL :

- COLOR ________ 29 APHA
- TURBIDITY ________ 2 JTU
- TDS ________ 1110 ppm $CaCO_3$
- CONDUCTIVITY ________ 1580 µ mhos / cm

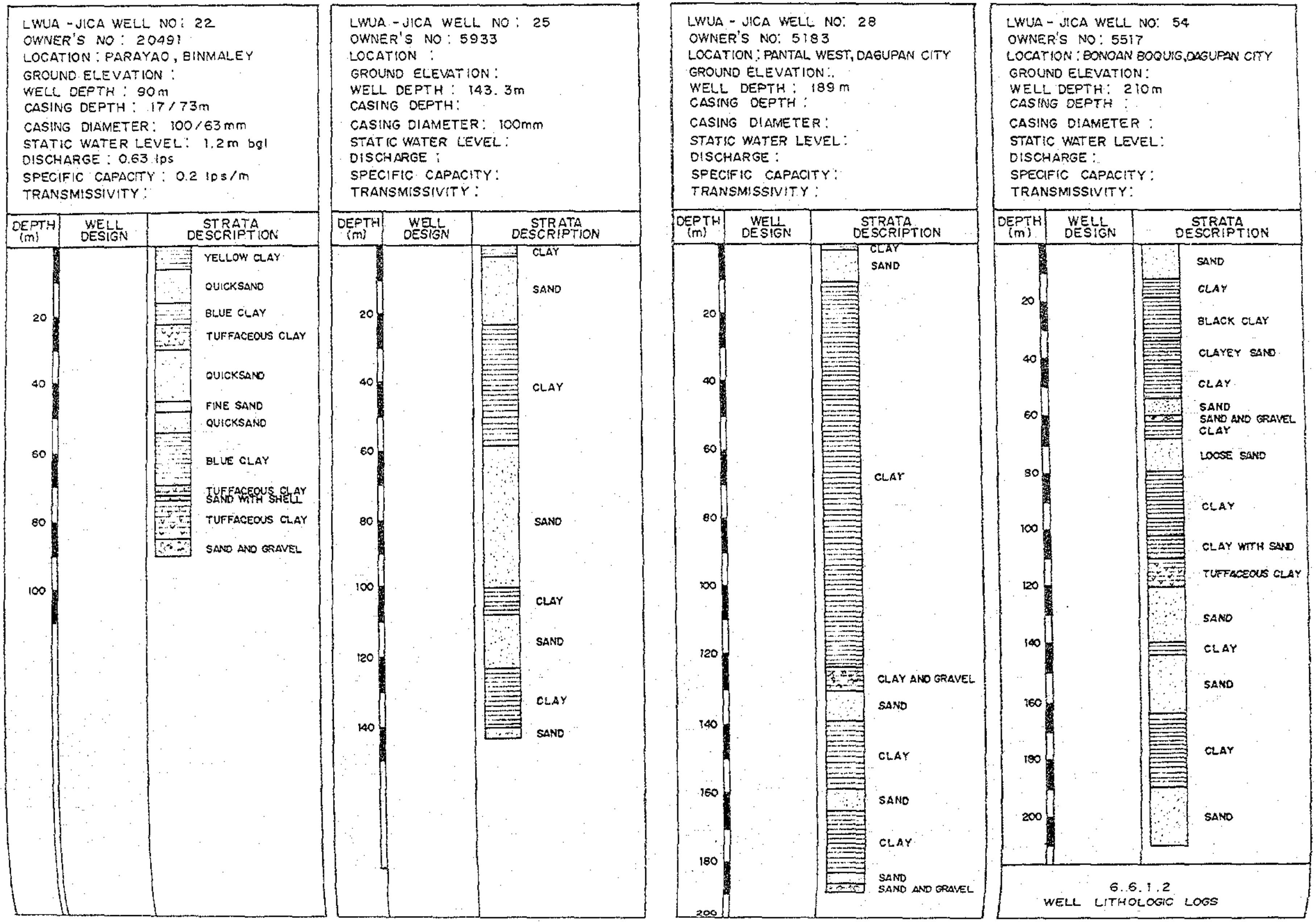
CHEMICAL :

- pH ________ 7.6 mg/l
- TOTAL ALKALINITY ________ 96
- PHENOPTHALEIN ALKALINITY ________ 0
- TOTAL HARDNESS ________ 56
- CALCIUM HARDNESS ________ 52
- MAGNESIUM HARDNESS ________ 4
- IRON ________ 0.65
- FLOURIDE ________ 0.10
- CHLORIDE ________ 984
- SULPHATE ________ 58
- NITRATE ________ 0.13
- NITRITE ________ 0.12
- MANGANESE ________ 0
- SODIUM ________ 380
- *POTASSIUM* ________ 72
- CARBONATE ALKALINITY ________ 0
- BICARBONATE ALKALINITY ________ 98
- AMMONIA ________ 1.04
- HYDROGEN SULFIDE GAS ________ *NEGATIVE ON LEAD* ACETATE PAPER

6.6.1.2
WELL LITHOLOGIC LOGS



6.6.1.2
WELL LITHOLOGIC LOGS



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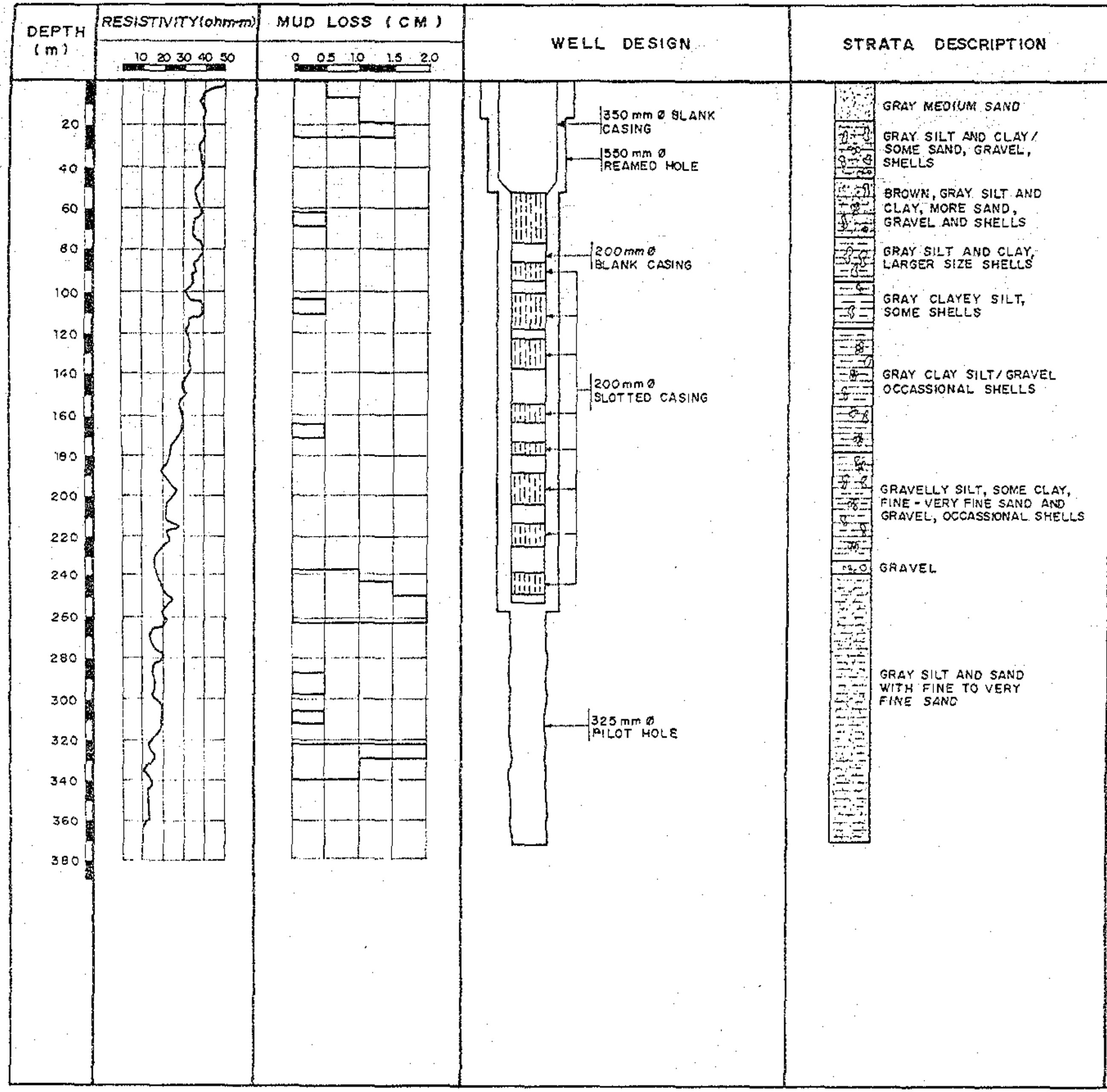
WELL LITHOLOGIC LOGS



WELL DATA

LWUA - JICA WELL NO. : 23

OWNER'S NO. : CL-11

LOCATION : BINMALEY, PANGASINAN

GROUND ELEVATION : 1.33 m amsl

WELL DEPTH : 374 m

CASING DEPTH : 255 m

CASING DIAMETER : 350/200 mm

STATIC WATER LEVEL :

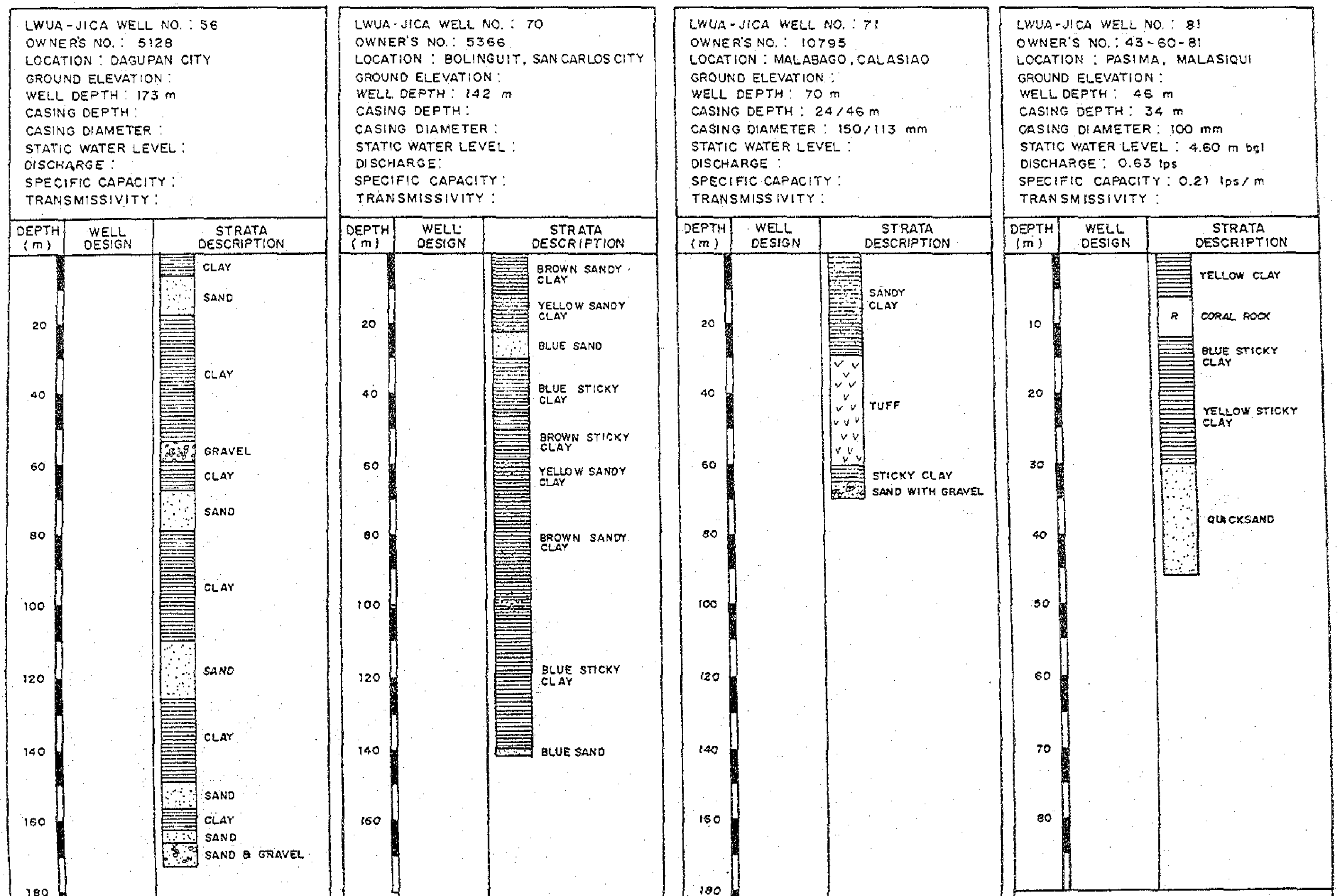
DISCHARGE : 88.4 lps

SPECIFIC CAPACITY :

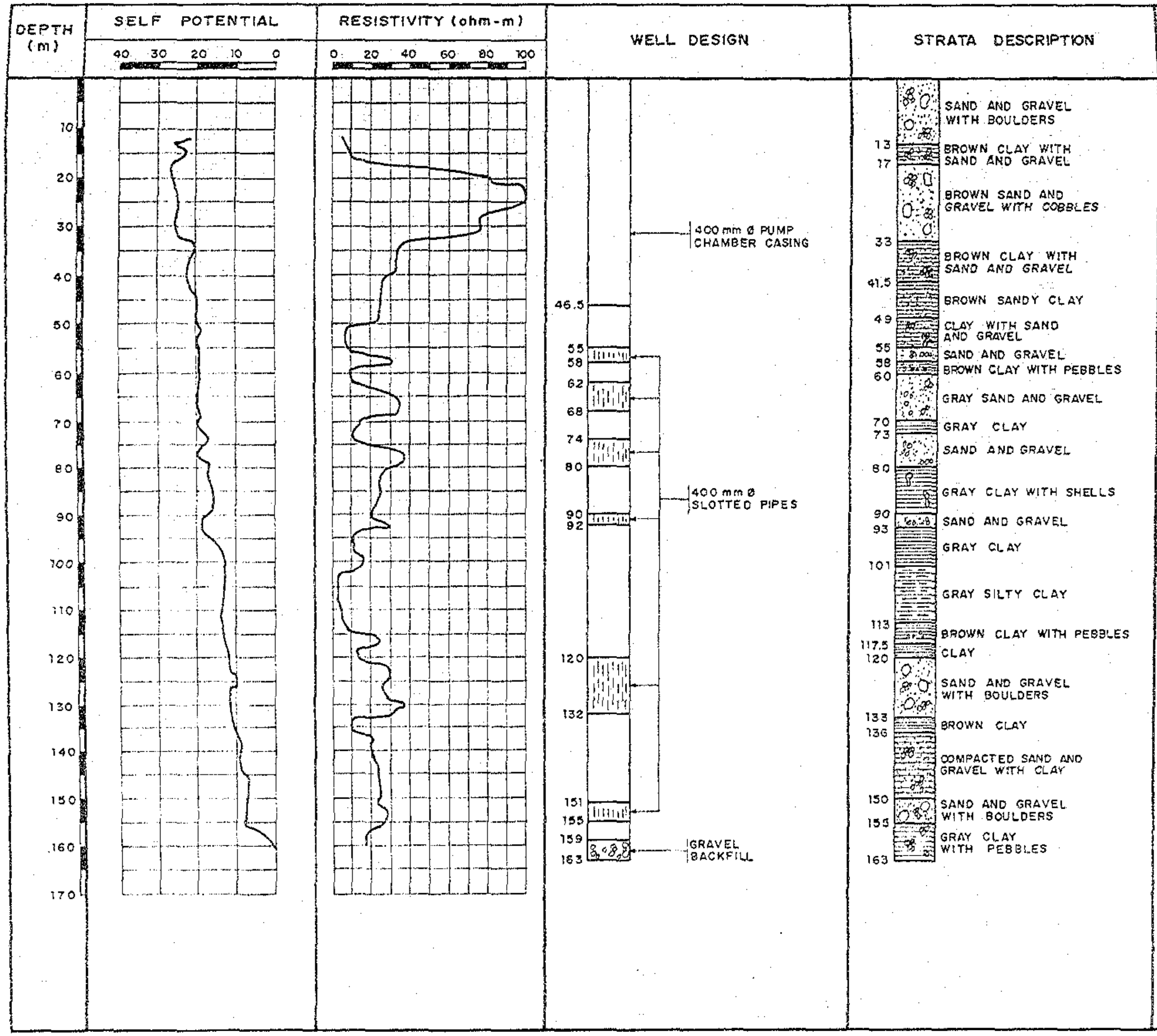
TRANSMISSIVITY : 700 mm^2/d

6.6.1.2

WELL LITHOLOGIC LOGS



S.6.1.2
WELL LITHOLOGIC LOGS



WELL DATA

LWUA-JICA WELL NO.: 61

OWNER'S NO.: GP-26

LOCATION: ANGIO, SAN FABIAN PANGASINAN

GROUND ELEVATION:

WELL DEPTH: 163 m

CASING DEPTH: 159 m

CASING DIAMETER: 400 mm

STATIC WATER LEVEL:

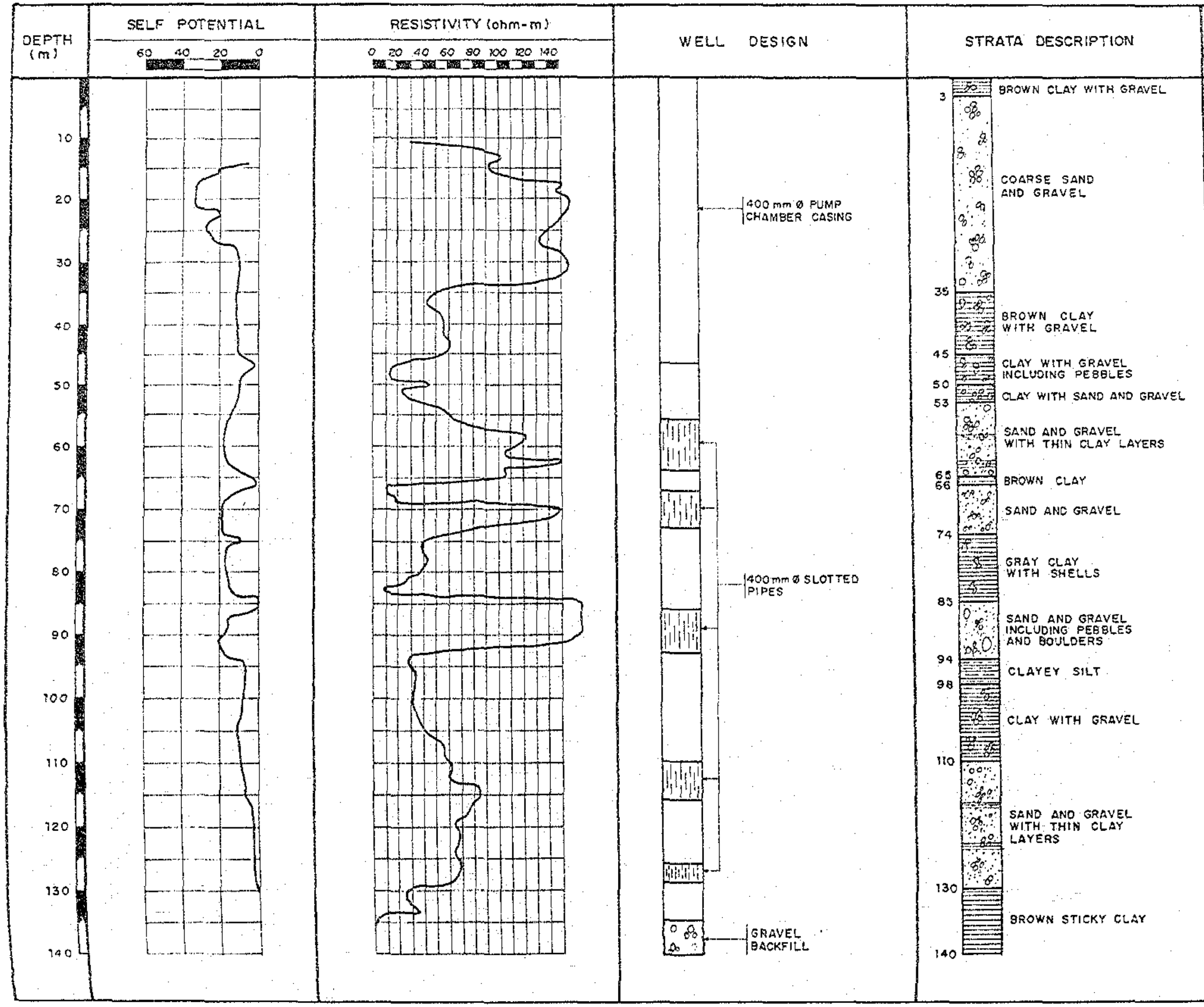
DISCHARGE: 82 lps

SPECIFIC CAPACITY: 4.8 lps/m

TRANSMISSIVITY: 480 m^2/d

6.6.1.2

WELL LITHOLOGIC LOGS

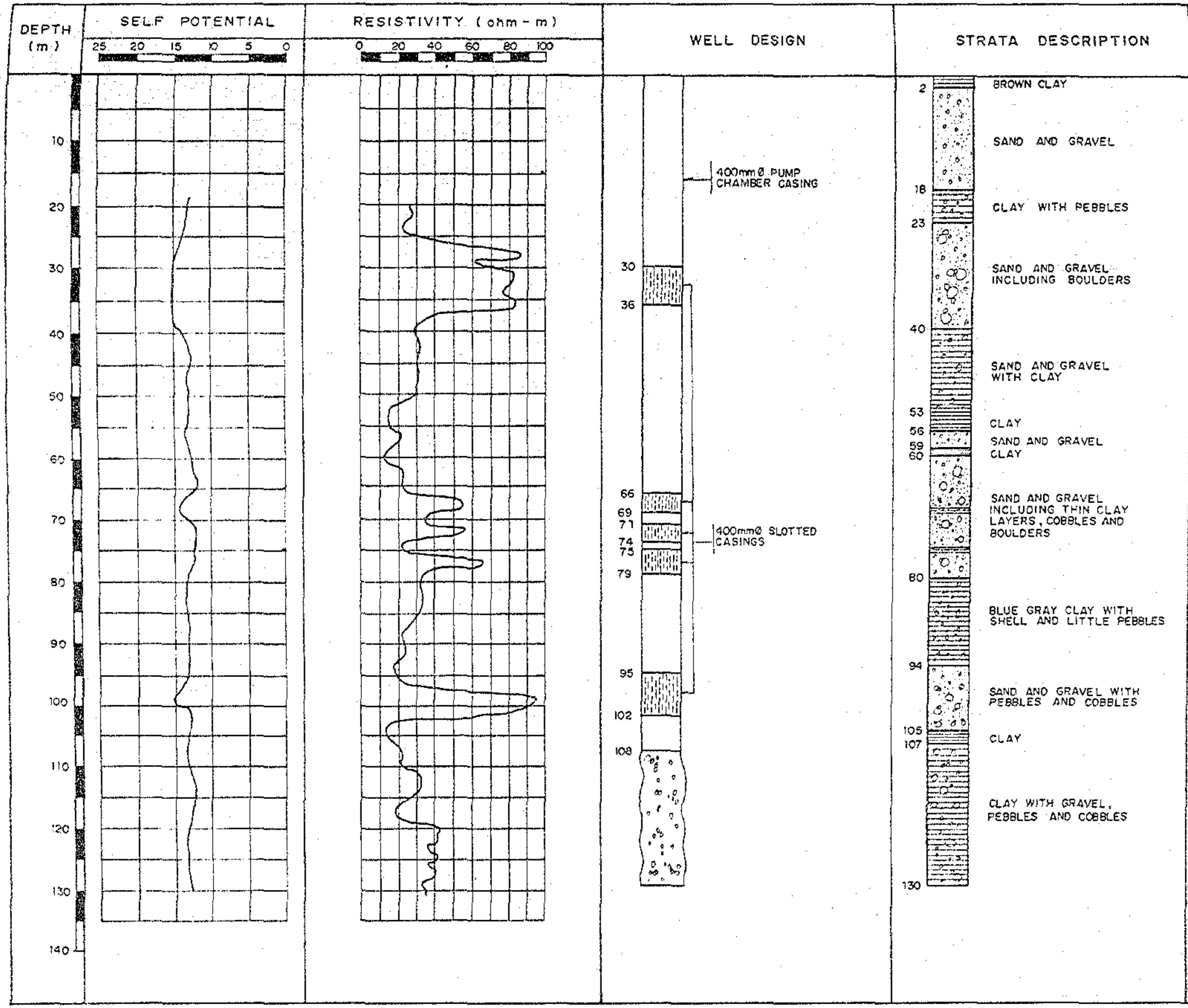


WELL DATA

LWUA - JICA WELL NO. : 62
OWNER'S NO. : GP-20
LOCATION : ANONANG, SAN FABIAN PANGASINAN
GROUND ELEVATION :
WELL DEPTH : 140 m
CASING DEPTH : 135 m
CASING DIAMETER : 400 mm
STATIC WATER LEVEL :
DISCHARGE : 82
SPECIFIC CAPACITY : 5.8 lps/m
TRANSMISSIVITY : 720 m^2/d

6.6.1.2

WELL LITHOLOGIC LOGS



WELL DATA

LWUA - JICA WELL NO. 63

OWNER'S NO. GP - 27

LOCATION : CABARUAN , SAN FABIAN , PANGASINAN

GROUND ELEVATION : 10 m amsl

WELL DEPTH : 130 m

CASING DEPTH : 108 m

CASING DIAMETER : 400 mm

STATIC WATER LEVEL :

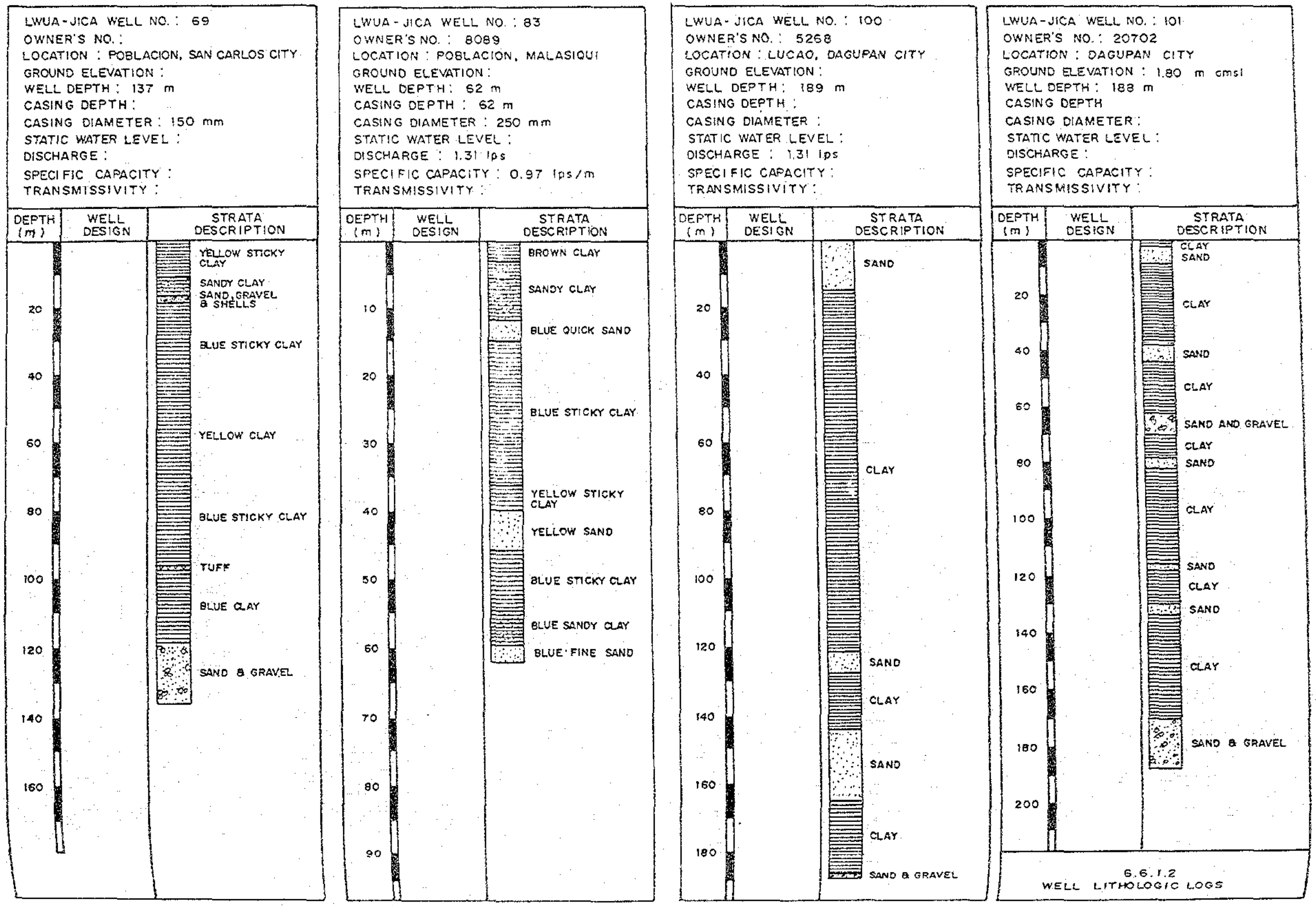
DISCHARGE : 82 lps

SPECIFIC CAPACITY : 4.2 lps / m

TRANSMISSIVITY : 1860 m^2 / d

6.6.1.2

WELL LITHOLOGIC LOGS



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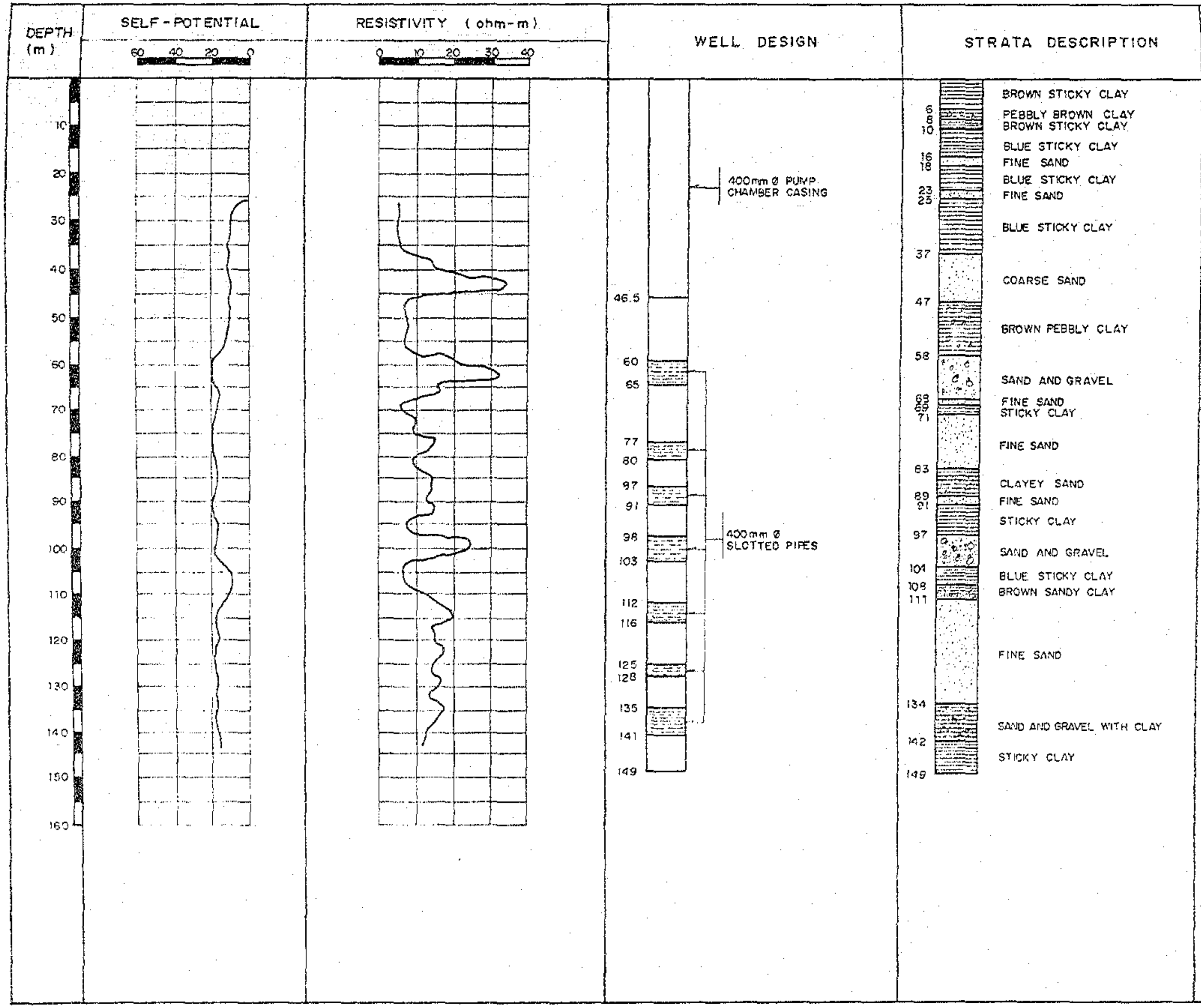


WELL DATA

LWUA – JICA WELL NO: 85

OWNER'S NO: GP - 86

LOCATION: LASIP, MALASIQUI, PANGASINAN

GROUND ELEVATION :

WELL DEPTH : 149 m

CASING DEPTH : 146 m

CASING DIAMETER : 400mm

STATIC WATER LEVEL : 3.3 m bgl

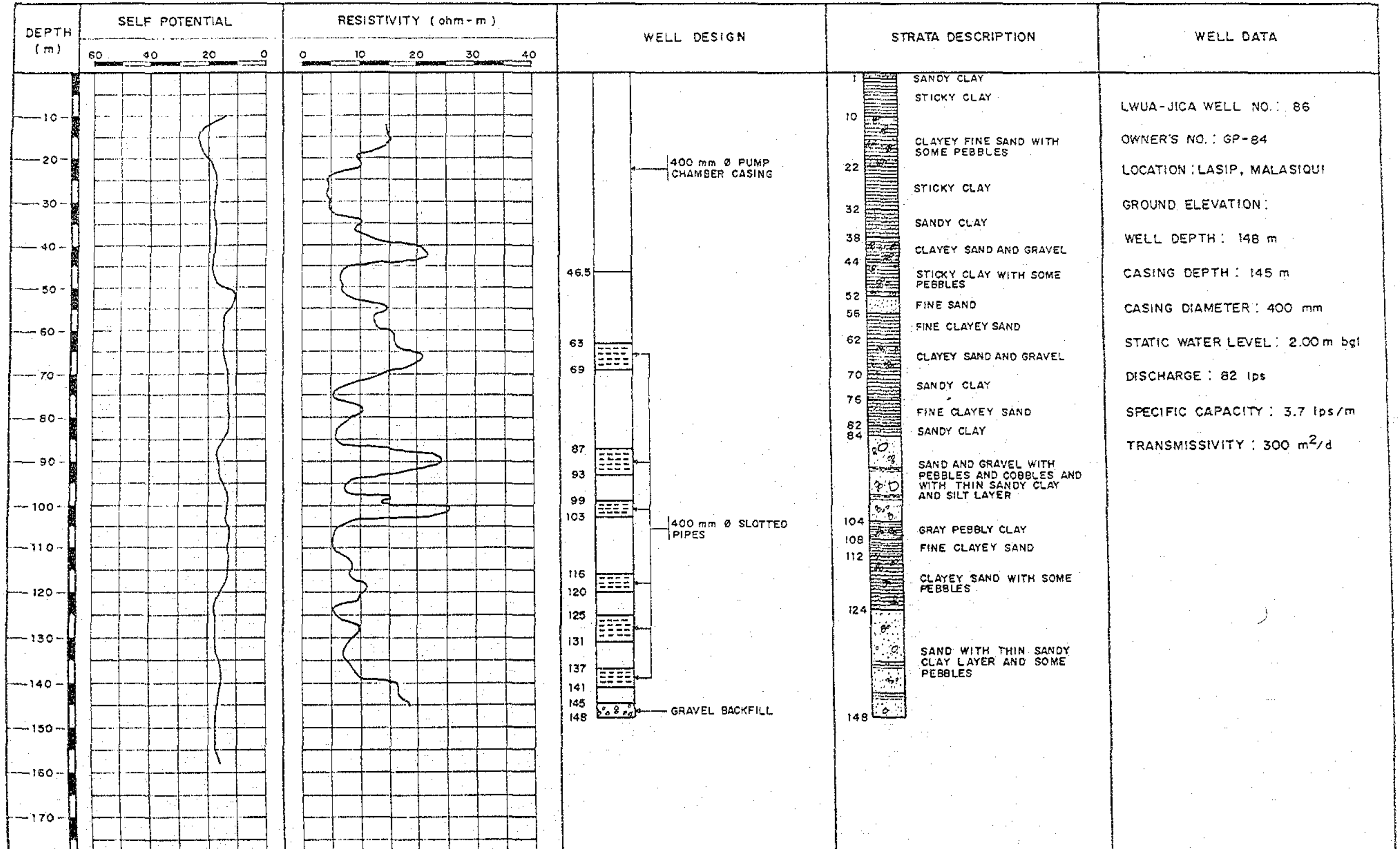
DISCHARGE : 82 lps

SPECIFIC CAPACITY : 4.5 lps/m

TRANSMISSIVITY : 330 m^2 /d

6 . 6 . 1 . 2

WELL LITHOLOGIC LOGS



6.6.1.2

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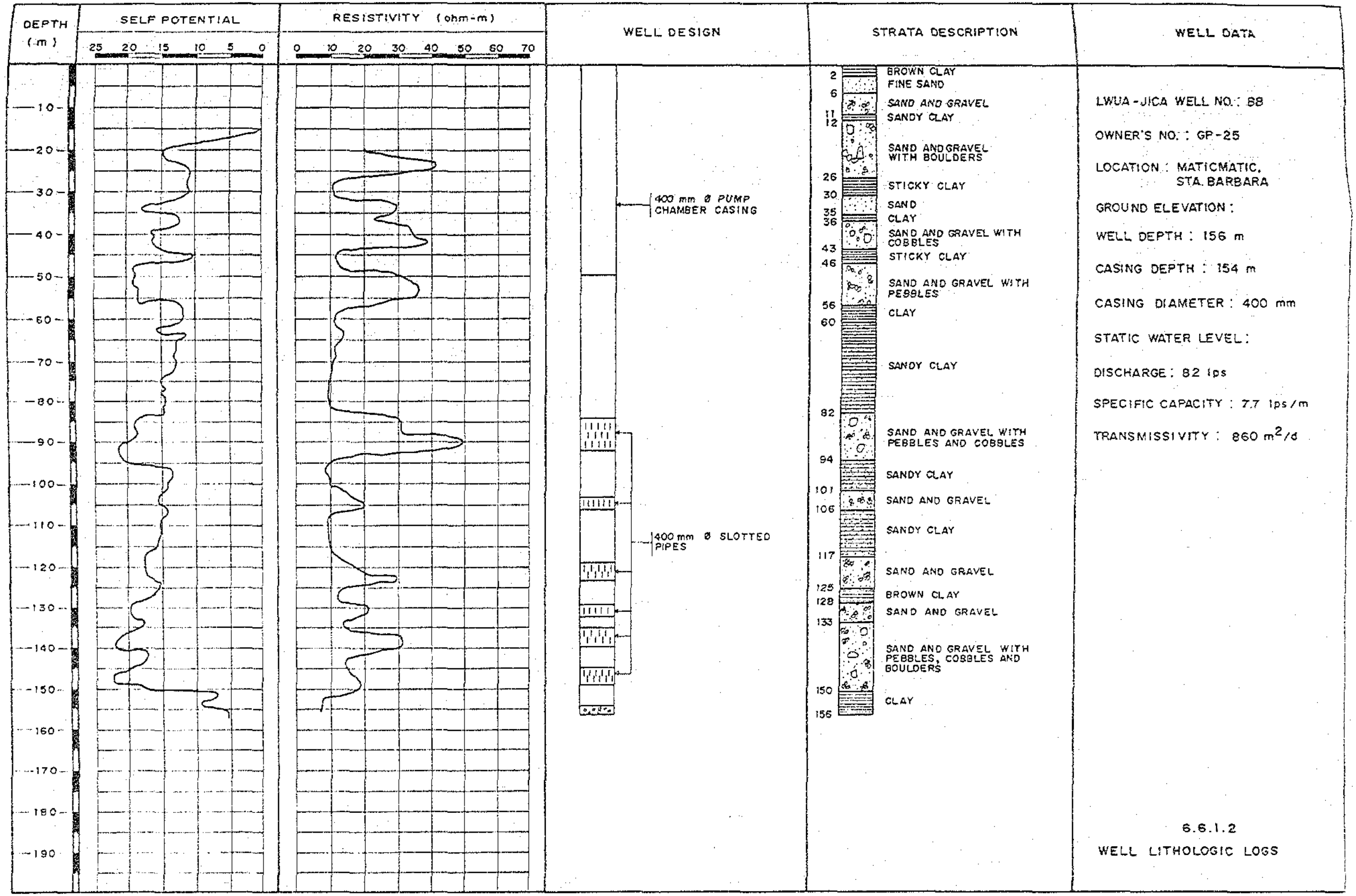

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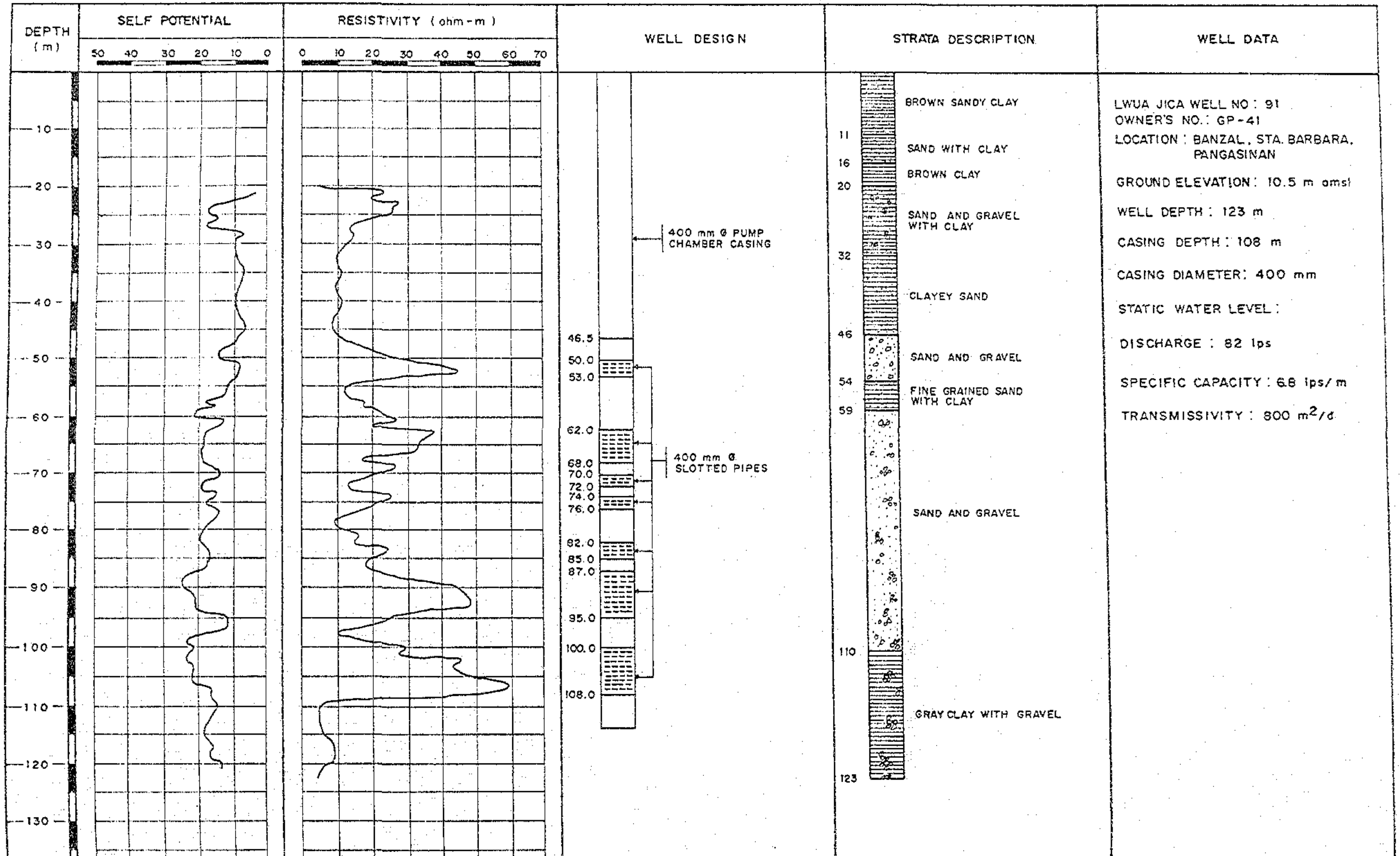
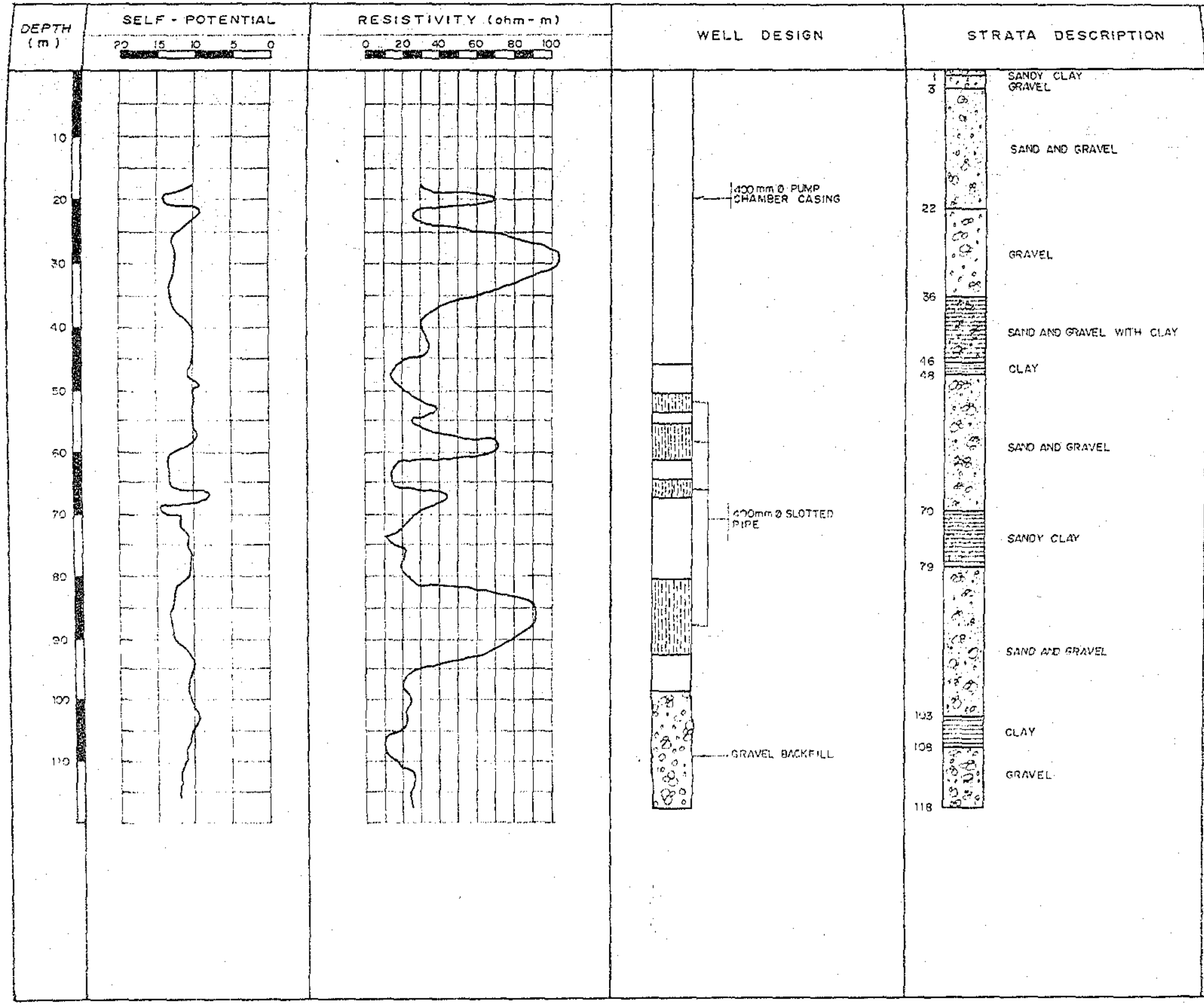


6.6.1.2
WELL LITHOLOGIC LOGS



WELL DATA

LWUA - JICA WELL NO: 64

OWNER'S NO: GP - 29

LOCATION: ANONANG, SAN FABIAN, PANGASINAN

GROUND ELEVATION:

WELL DEPTH: 118 m

CASING DEPTH: 99 m

CASING DIAMETER: 400mm

STATIC WATER LEVEL:

DISCHARGE: 82 lps

SPECIFIC CAPACITY: 4.7 lps/m

TRANSMISSIVITY: 1120 m^2/d

6.6.1.2.

WELL LITHOLOGIC LOGS

APPENDIX 6.6.2.1 GEORESISTIVITY SURVEY

A surface georesistivity survey was performed at the alluvial plains encompassing the municipalities of Binmaley, Calasiao, Sta. Barbara, Mangaldan and Dagupan City. The investigation was aimed to explore the stratigraphic sequence of the different lithological units in terms of resistivity and thickness; to define the extent of saline water intrusion into the shallow aquifer and to select the most favorable area for groundwater exploitation.

1) Location of Measurements

A total of 37 Vertical Electrical Soundings (VES) including some calibrations were carried out at Cullao, Malanay, Gueguesangan in Sta. Barbara; San Miguel, Ambonao, Calit and Banaoang in Calasiao; Tebeng in Dagupan City; and Amulid in Mangaldan.

2) Fieldwork

Resistivity prospecting involves the passage of an electric current into the ground through a pair of circuit electrodes (AB) and the measurement of the resulting potential drop on the earths surface between a pair of potential electrodes (MN). The arrangement of measurements was patterned after the Schlumberger configuration with a maximum current electrode separation of 1,800 m.

The impressed current (I) and the resulting potential drop (V) were recorded for consecutive MN/2 and AB/2 separation. The results were then recorded on the data sheet where the apparent resistivity (Pa) was calculated using the formula below:

$$PA = \frac{(AB/2)^2 - (MN/2)^2}{MN} \quad \frac{AV}{I} \quad \text{or } Pa = \frac{kV}{I}$$

3) Method of Interpretation

The field data gathered were plotted on transparent double log paper with the measured apparent resistivity representing the ordinate and half the current electrode separation as abscissa.

The true layer resistivities and thicknesses were obtained by comparing the field curves with precalculated auxilliary and master curves.

4) Equipment

Georesistivity Equipment (GRM 3,000) is powered by dry cells with a maximum output of 270 volts and can read up to 3 amperes. For deeper soundings, it can be powered by a 1500 watt engine generator power supply which can provide either direct or electrorating circuit.

5) Results of Georesistivity Survey

The interpreted true resistivity values and the corresponding depths of geologic contact are presented in TABLE 6.6.2.1.1 (1) to (4) and were based from field survey graphs.

TABLE 6.6.2.1 (1)

DEDUCED VALUES OF GEORESISTIVITY SOUNDING MEASUREMENTS
DAGUPAN CITY

Vertical Electrical Sounding Number	Location	Elevation (mams l)	Resistivity (ohm-m) / Depth from Ground Surface (m)	SUB-SURFACE LAYER						
				1	2	3	4	5	6	7
1	Tullao, Sta. Barbara	6	ρ	17	11	20	9			
			h	17.0	49.3	249.3				
2	Malanay, Sta. Barbara	6	ρ	6	24	17	8			
			h	5.4	24.8	264.8				
3	San Miguel, Calasian	5	ρ	20	10	16	2			
			h	12.0	61.2	253.2				
4	Tebeng, Dagupan City	5	ρ	15	3	14	3			
			h	9.5	39.9	279.9				
5	Ambonao, Calasiao	5	ρ	10	5	18	10			
			h	9.5	43.7	268.7				
6	Gueguesangen, Sta. Barbara	5	ρ	7	19	11	18	11		
			h	2.6	29.1	120.9	270.9			
7	Calit, Calasiao	5	ρ	410	20	2	13	18		
			h	3.1	10.2	52.7	277.7			
8	Banaoang, Calasiao	5	ρ	31	46	4	11	17		
			h	2.5	12.0	79.2	271.2			
9	Ambonao, Calasiao	5	ρ	4	6	17	9			
			h	12.7	43.2	268.2				
10	Anulid, Mangaldan	5	ρ	27	9	15	10			
			h	11.0	48.4	273.4				

TABLE 6.6.2.1 (2)

DEDUCED VALUES OF GEORESISTIVITY SOUNDING MEASUREMENTS

DAGUPAN CITY

VERTICAL ELECTRICAL SOUNDING NUMBER	LOCATION	ELEVATION (m a m s l)	RESISTIVITY (ohm-m) / DEPTH FROM GROUND SURFACE (m)	SUB - SURFACE LAYER						
				1	2	3	4	5	6	7
11	Caranglaan, Dagupan City	4	ρ	8	3	12	6			
			h	11.0	46.2	270.6				
12	Mangin, Dagupan City	4	ρ	6	2	15	6			
			h	6.2	34.1	272.1				
13	Naguilayan, Binmaley	4	ρ	100	3	0.5	6	38		
			h	1.6	6.4	32.2	301.9			
14	Gayaman, Binmaley	4	ρ	125	6	0.9	7	28		
			h	2.8	5.9	47.2	314.0			
15	Lucao, Dagupan City	4	ρ	50	10	1	6	39		
			h	2.9	9.0	57	305.4			
16	Malued, Dagupan City	4	ρ	48	24	2	8	18		
			h	3.1	12.7	60.7	300.7			
17	Tapuac, Dagupan City	4	ρ	37	4	0.8	6	23		
			h	2.2	8.6	37.1	303.5			
18	Pogo Lasip, Dagupan City	4	ρ	14	21	2	5			
			h	2.8	6.2	50.0				
19	Caranglaan, Dagupan City	4	ρ	8	5	11	7			
			h	6.8	45.6	275.6				
20	Bolosan, Dagupan City	4	ρ	10	2	12	7			
			h	7.7	32.3	263.3				

TABLE 6.6.2.1 (3)

DEDUCED VALUES OF GEORESISTIVITY SOUNDING MEASUREMENTS

DAGUPAN CITY

VERTICAL ELECTRICAL SOUNDING NUMBER	LOCATION	ELEVATION (m amsl)	RESISTIVITY (ohm-m) / DEPTH FROM GROUND SURFACE (m)	SUB - SURFACE LAYER						
				1	2	3	4	5	6	7
21	Anulid, Mangaldan	4	ρ	0.6	1.6	11	6			
			h	8.2	39.4	259.6				
22	Anulid, Mangaldan	4	ρ	8	5	12	7			
			h	13	55.9	258.9				
23	Mamalingling, Dagupan City	4	ρ	0.9	2	8	4			
			h	9.7	33.0	249.0				
24	Maasin, Mangaldan	3	ρ	0.9	2	10	6			
			h	8.5	33.1	241.8				
25	Maasin, Mangaldan	3	ρ	23	8	17	8			
			h	5.6	34.7	236.3				
26	Canaoalan West, Binmaley	3	ρ	30	0.8	8	32			
			h	2.6	37.7	296.7				
27	Caraek West, Dagupan City	3	ρ	20	2	0.2	12	48		
			h	4.2	11.3	30.1	293.8			
28	Calmay, Dagupan City	3	ρ	64	6	0.8	5			
			h	3.8	8.7	50.7				
29	Pantal, Dagupan City	3	ρ	6	0.6	4	25			
			h	7.6	38.4	342.4				
30	Bone, Dagupan City	2	ρ	50	2	1.6	8	72		
			h	1.0	19.0	65.8	336.6			

TABLE 6.6.2.1 (4)

DEDUCED VALUES OF GEORESISTIVITY SOUNDING MEASUREMENTS

DAGUPAN CITY

VERTICAL ELECTRICAL SOUNDING NUMBER	LOCATION	ELEVATION (m amsl)	RESISTIVITY (ohm-m) / DEPTH FROM GROUND SURFACE (m)	SUB-SURFACE LAYER 1	2	3	4	5	6	7
31	Bonoan Longos, Dagupan City	2	ρ	31	6	13	8			
			h	6.8	52.4	285.6				
32	Talugtog, Mangaldan	2	ρ	70	4	18	10			
			h	2.9	29.0	272.0				
33	Caloocan Sur, Binmaley	2	ρ	760	19	1.2	9	30		
			h	3.8	11.4	51.9	311.9			
34	Buenlag, Binmaley	2	ρ	68	3	0.8	6	30		
			h	2.9	8.4	60.1	303.7			
35	Sabangan, Dagupan City	2	ρ	80	8	1.2	6	45		
			h	1.9	11.4	68.4	340.4			
36	Bonoan Gueset, Dagupan City	2	ρ	1100	55	3	15	40		
			h	3.0	13.2	70.4	328.8			
37	Bonoan Gueset, Dagupan City	2	ρ	3000	150	4	18	70		
			h	2.2	9.9	69.4	273.4			
			ρ							
			h							
			ρ							
			h							
			ρ							
			h							

a) Calibration Soundings

For hydrogeological interpretation of electrical soundings, it is necessary to establish the pertinent resistivity of the different lithological units at depth by performing resistivity measurements at a convenient point as close as possible to a well with known lithology or to the geologic outcrops.

Six resistivity measurements were executed near deepwells drilled at Bonoan Boquig, Lasip Chico, Manguin and Calmay. The relation of resistivity to the specific lithological unit is presented in FIGURE 6.6.2.1.1 summarized below.

Range of Resistivity (ohm-m)	Lithological Composition
0.5 - 1.5	Clay, silt, sand and gravel intruded with saline water
2 - 10	Sand and gravel deposited in combination with high percentage composition of clay and silt
11 - 18	Silt, sand and gravel saturated with fresh water
23 - 72	Upper Miocene to Pliocene rock units (basement formation)
1000 - 3000	Isolated sand dune

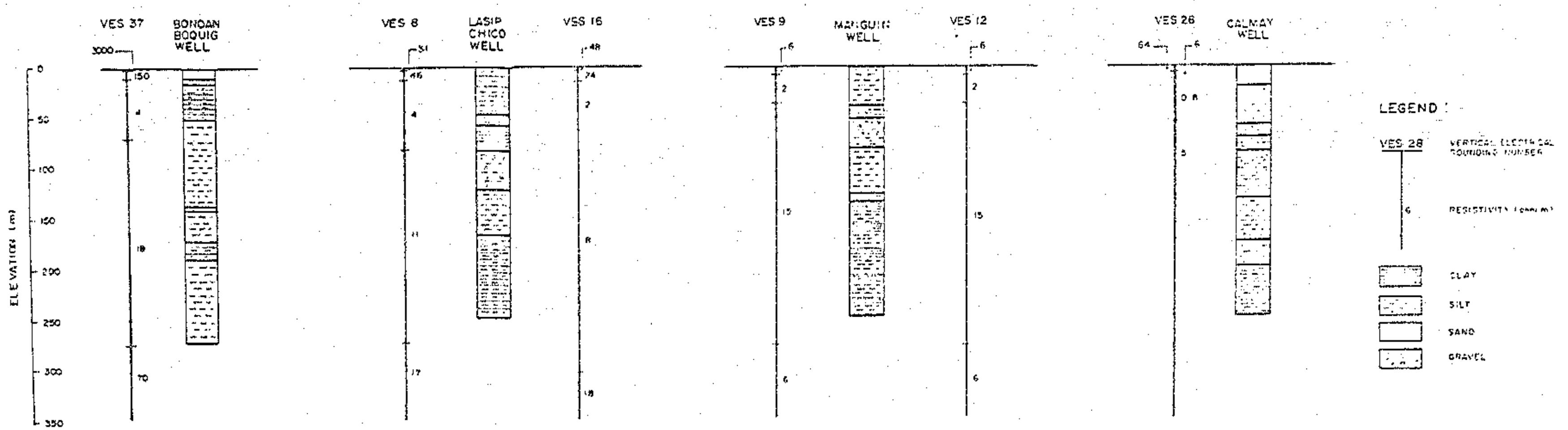


FIGURE 6.6.2.1.1
CALIBRATION SOUNDINGS
DAGUPAN CITY

b) Interpretation of Survey Results

The result of the georesistivity survey can be summarized in the following electrostratigraphic sections, isoresistivity maps and isotransverse resistance map.

Electrostratigraphic Sections

With reference to the results of the calibration soundings, the lateral and vertical relationships of the alluvial sediments maybe subdivided into five layers as shown in FIGURES 6.6.2.1.2~6.6.2.1.13

Layer 1 which exhibits low to relatively high resistivity values in the range of 0.6 to 3,000 ohm-m forms the superficial layer. The layer with resistivity responses not exceeding 10 ohm-m corresponds to clay and sand sediments saturated with fresh or brackish water. The values of 50 ohm-m or more can be correlated to comprise partly cemented sand and gravel saturated with freshwater. The coast near areas exhibiting resistivity values of 1,000 to 3,000 ohm-m corresponds to isolated sand dune.

Layer 2 comprises the fluvial sediments of clay, silt, sand and gravel intruded with saline water. The invasion occurs in the western belt of the investigation area and its approximate extent is presented in FIGURE 6.6.3 of Main Text. This layer is believed not to exceed 70 m in depth and has resistivity value ranging from 0.5 to 1.5 ohm-m.

Layer 3 exhibits resistivity values ranging from 2 to 10 ohm-m conforming to sand and gravel deposited in combination with high percentage composition of silt and clay. This layers abuts on the basement formation at a depth of approximately 300 to 350 m below ground surface in an area northwest of Dagupan City. The extent of deposition in the southern portion tends to increase in depth as it underlies Layer 4 as shown in FIGURE 6.6.2.1.5.

Layer 4 corresponds to resistivity values in the range of 11 to 20 ohm-m. The layer is deposited as a lens-shaped formation overlying and underlying Layer 3 as shown in most electrostratigraphic sections. This layer is in near contact Layer 2 and overexploitation of groundwater upstream may lead to this association especially in zones high permeability. Most of the deepwell drilled in the study area withdraw water partly from this formation. Tapping this layer for groundwater extraction maybe possible and the aquifer may yield fair hydraulic characteristics.

Layer 5 presented resistivity values in the range of 23 to 72 ohm-m and is believed to be the basement formation. It is assumed part of the Upper Miocene rock sequence comprising mostly of fine to medium grains of clastic sediments composed of mudstone and sandstone. The lithological units are mainly exposed at the mountain plains northeast and southeast of Dagupan City.

The interfinger fronts of Layers 3, 4 and the basement formation are presented in FIGURE 6.6.3 of the Main Text.

Isoresistivity Maps

The isoresistivity maps presented in FIGURES 6.6.2.1.14~6.6.2.1.16 for current electrode separations equivalent to 100,200 and 300 m, respectively, show uniform trend of resistivity increases as it enters the area immediately southeast of Dagupan City. This conforms to the sounding points located within the boundaries of 10 ohm-m or more contour line.

The resistivity measurements may indicate fair aquifer potentials with good water retention capabilities in this area. The electrostratigraphic sections revealed that this formation has resistivity values in the range of 11 - 20 m with an average thickness of 250 m.

Isotransverse Resistance Map

The isotransverse resistance map presented in FIGURE 6.6.2.1.17 can be regarded as a hydrogeological map because the transverse resistance is controlled by both thickness and permeability of the aquifer. The areas bounded by greater isotransverse resistance contour line should coincide to an aquifer with greater potential.

The area enclosed by 4,000 ohm-m or more contour line is presumed to comprise permeable layer capable of sustaining medium-capacity withdrawal through deepwells.

The resistivity responses were translated into its corresponding lithological units as interpreted from the calibration soundings shown in FIGURE 6.6.2.1.1.

c) Findings/Recommendations

Dagupan City is situated downstream of the hydrogeological system that extends from the southern periphery of Lingayen Gulf towards the northwestern part of Tarlac Province. Uncontrolled groundwater withdrawal upstream of this system led to the intrusion of saline water into the shallow aquifer deeper inland. Hence, it is not advisable to extract water from this aquifer as rate of intrusion is not determined.

The deeper aquifer may offer fair hydraulic parameters enough to sustain medium-capacity withdrawal through deepwells. The formation has an average thickness of 250 m and has been identified in an area southeast of Dagupan City.

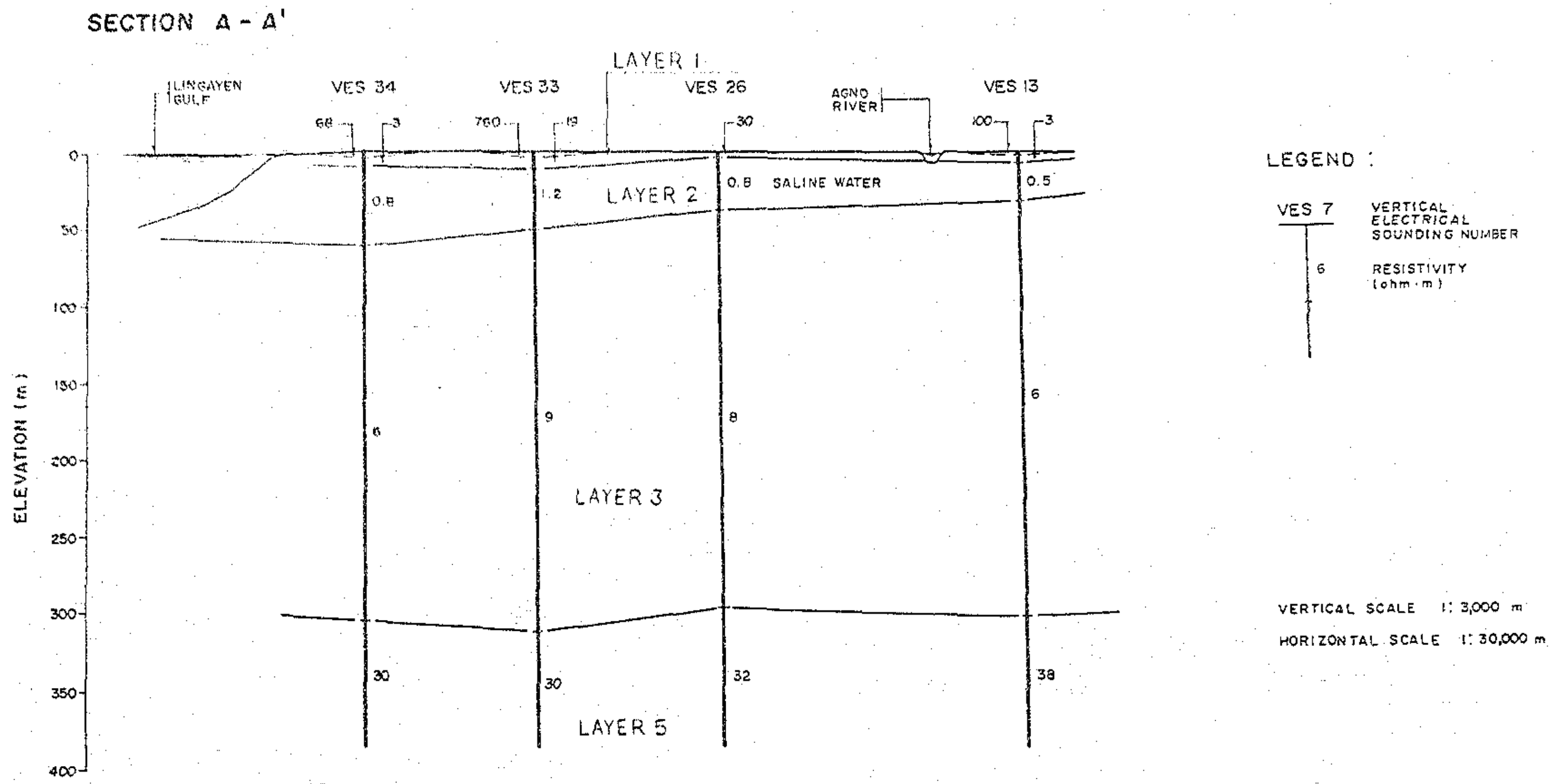


FIGURE 6.6.2.1.2
ELECTROSTRATIGRAPHIC SECTION A-A'
DAGUPAN CITY

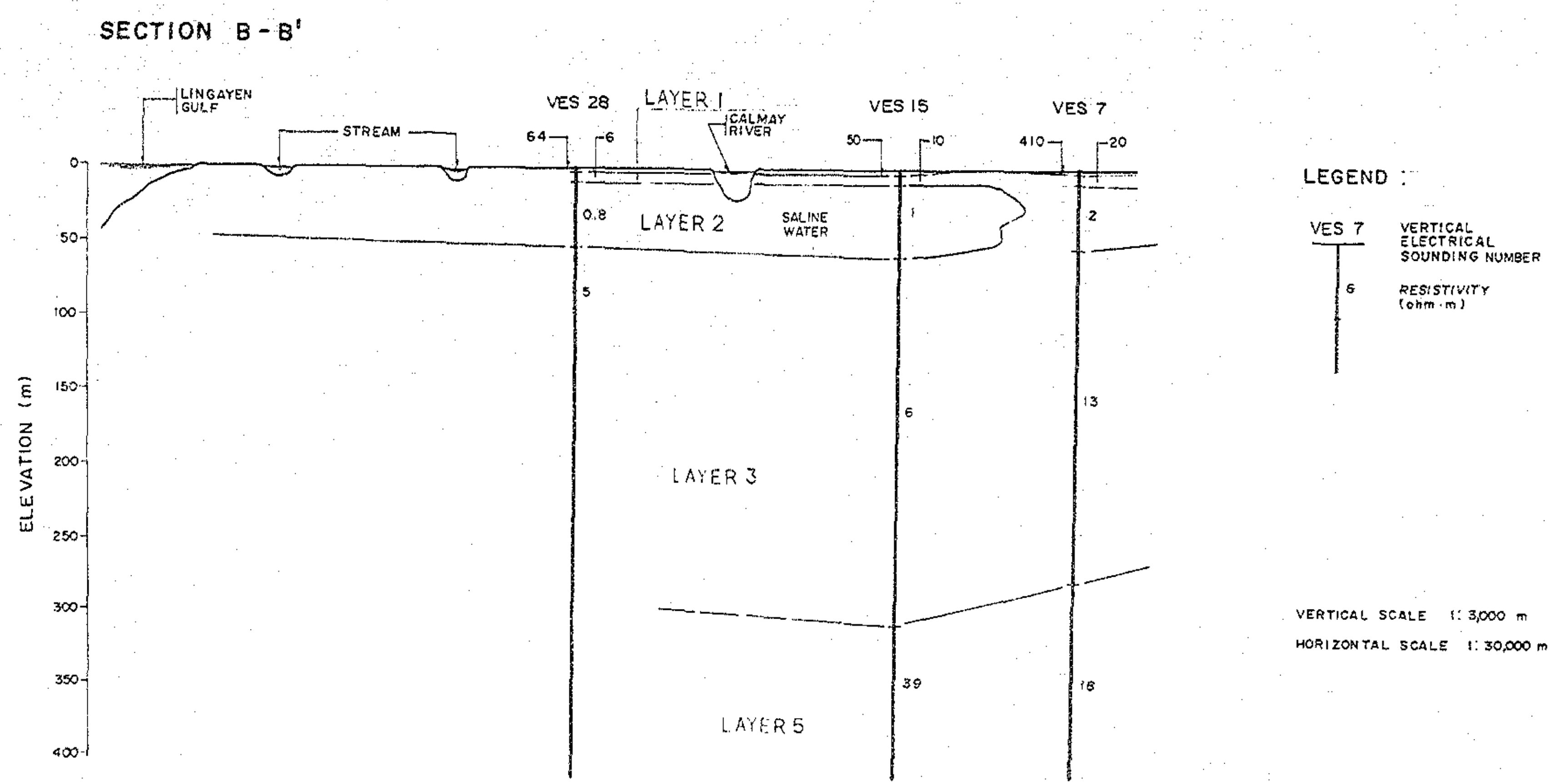


FIGURE 6.6.2.1.3
ELECTROSTRATIGRAPHIC SECTION B-B'
DAGUPAN CITY

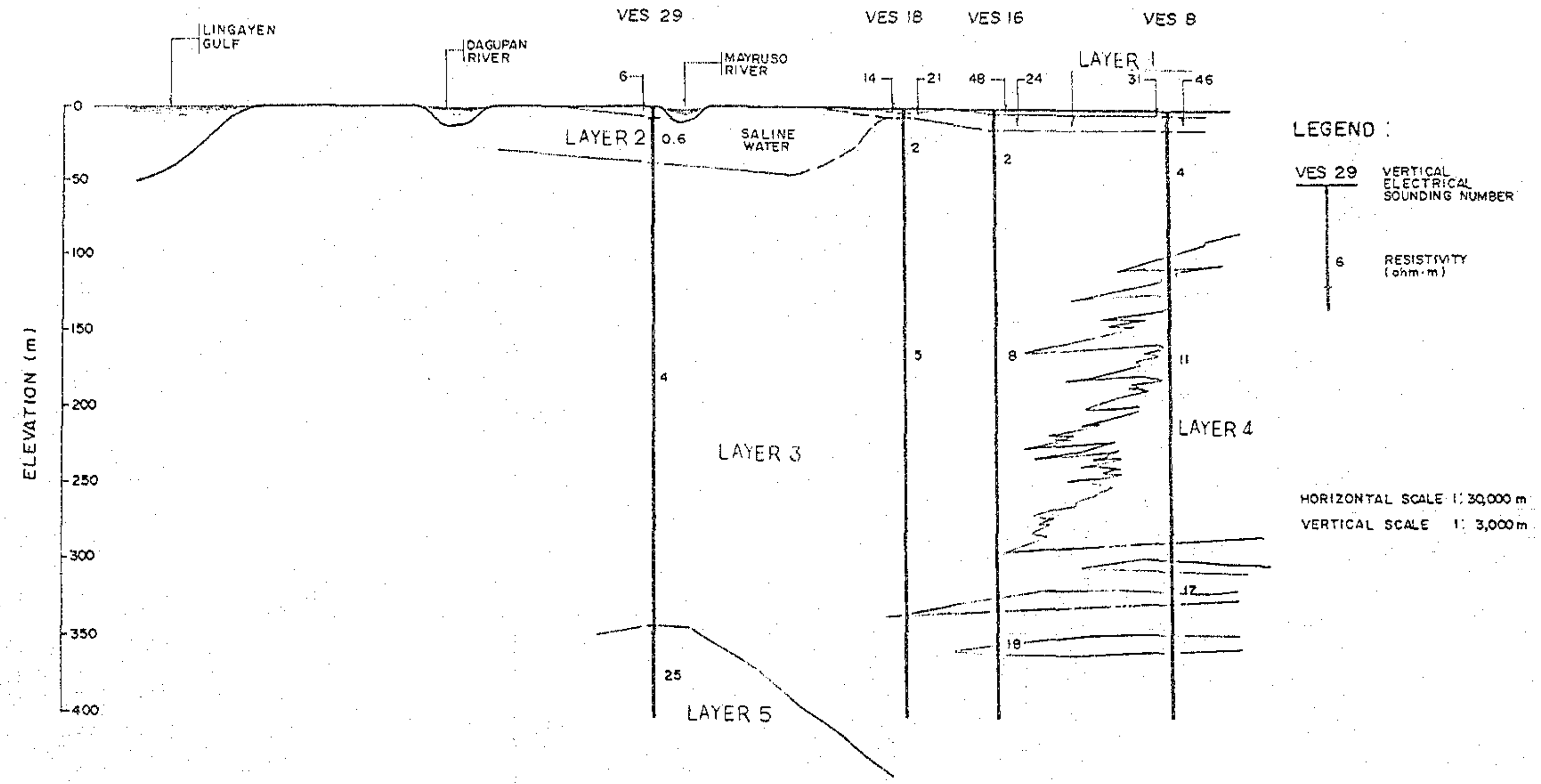


FIGURE 6.6.2.1.4
ELECTROSTRATIGRAPHIC SECTION C–C'
DAGUPAN CITY

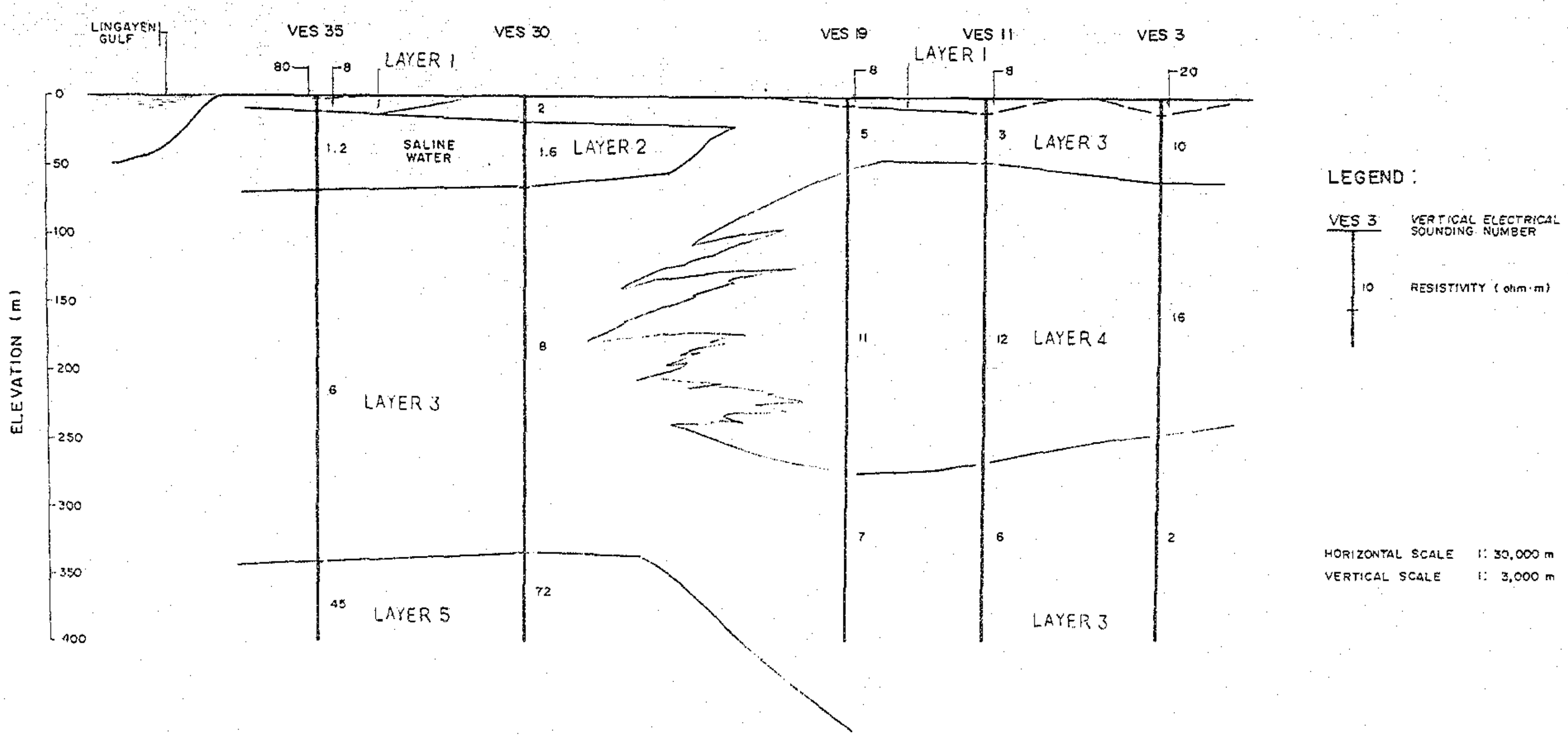
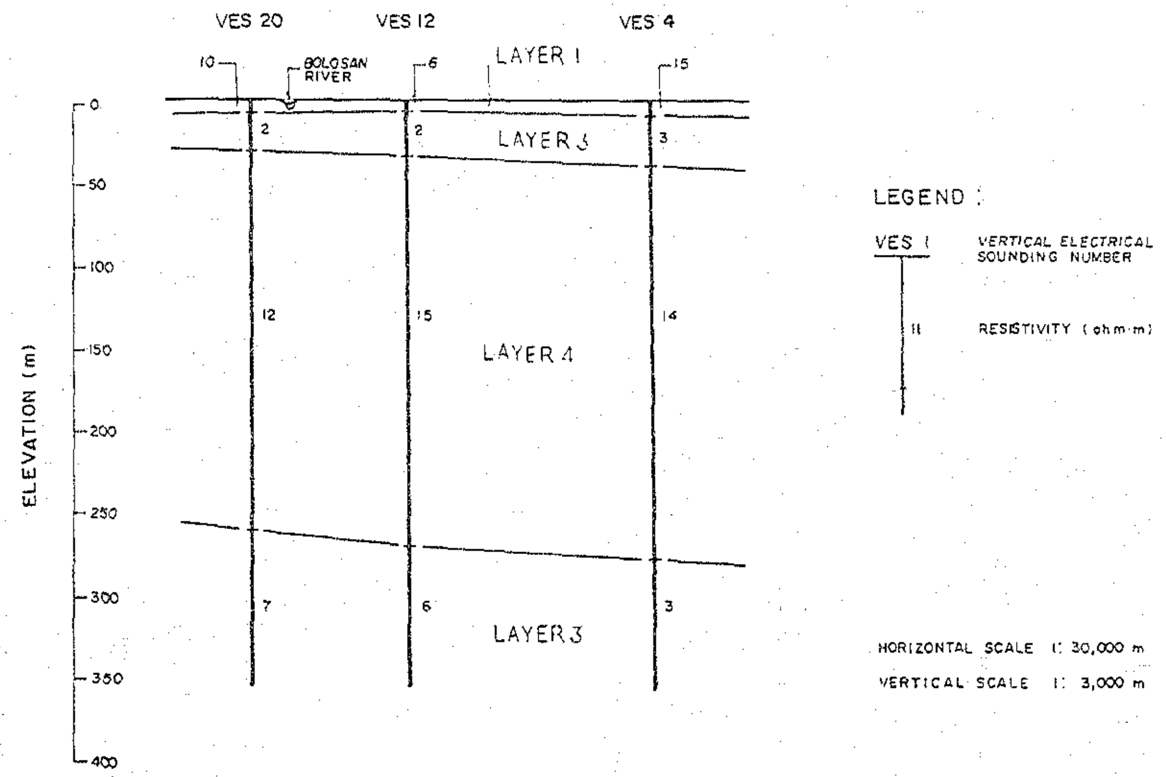


FIGURE 6.6.2.1.5
ELECTROSTRATIGRAPHIC SECTION D-D'
DAGUPAN CITY



SECTION E - E'

FIGURE 6.6.2.1.6
ELECTROSTRATIGRAPHIC SECTION E-E'
DAGUPAN CITY

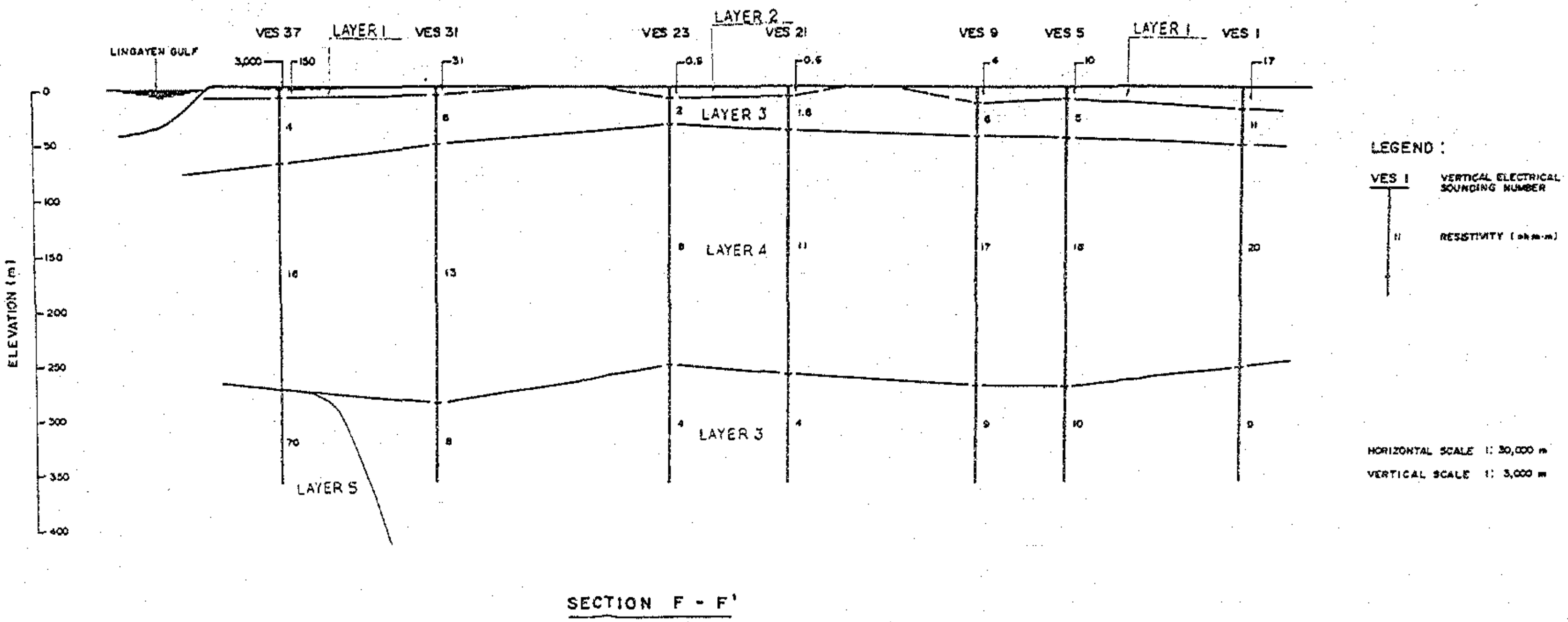


FIGURE 6.6.2.1.7
ELECTROSTRATIGRAPHIC SECTION F-F'
DAGUPAN CITY

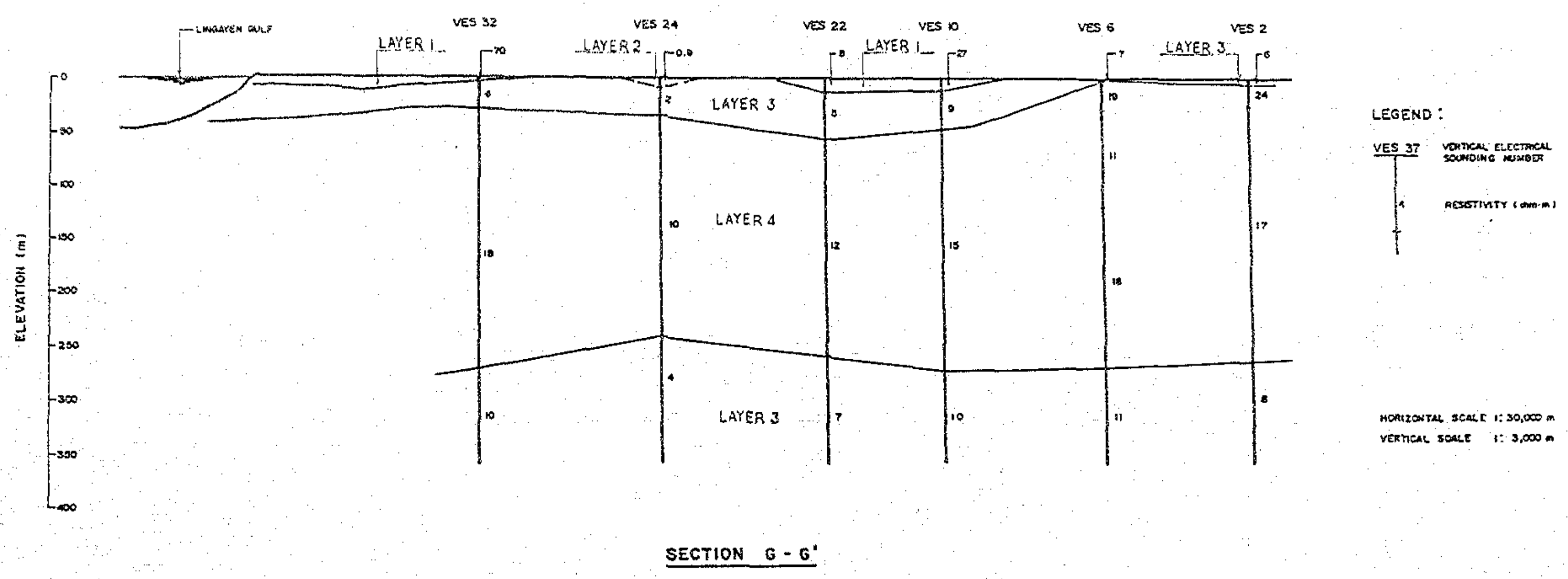


FIGURE 6.6.2.1.8
ELECTROSTRATIGRAPHIC SECTION G-G'
DAGUPAN CITY

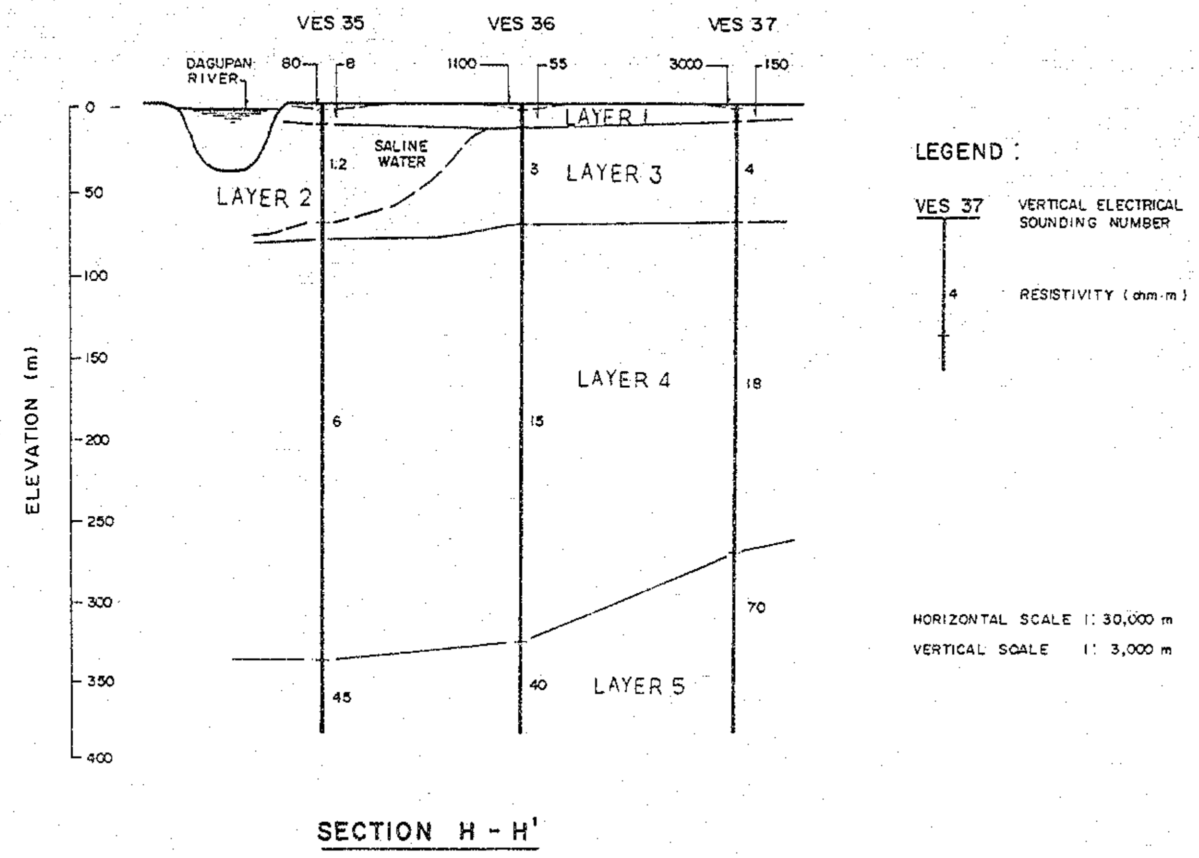


FIGURE 6.6.2.1.9
ELECTROSTRATIGRAPHIC SECTION H-H'
DAGUPAN CITY

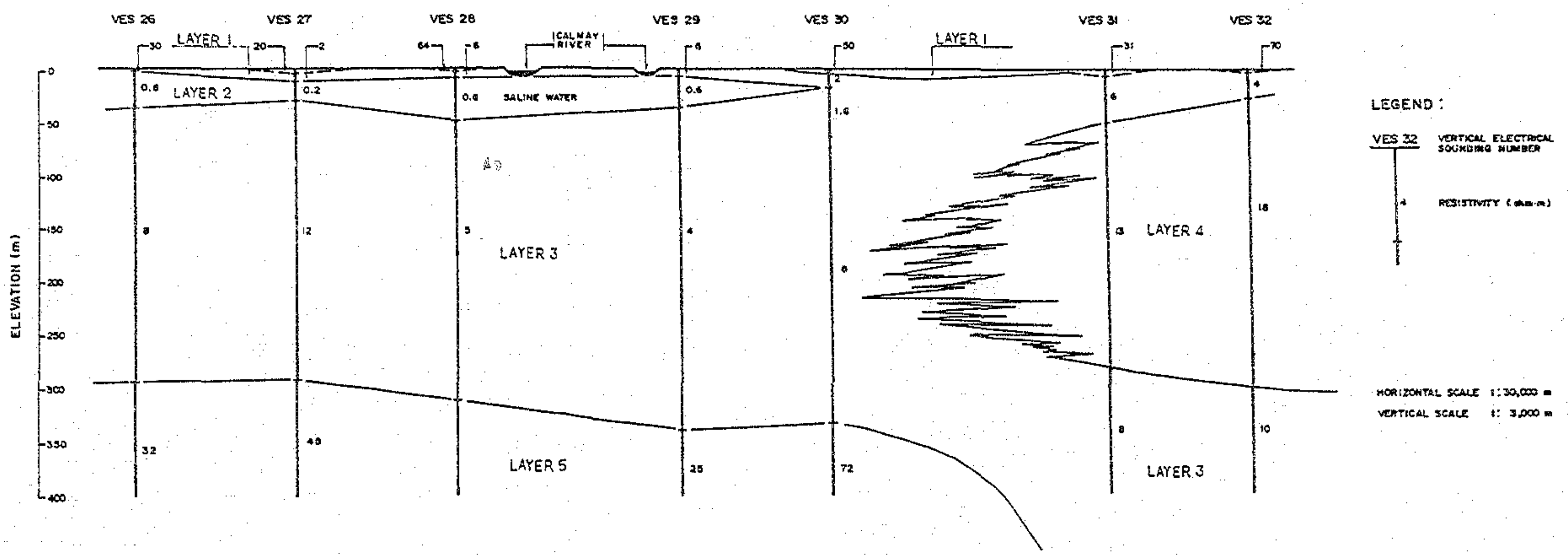


FIGURE 6.6.2.1.10
ELECTROSTRATIGRAPHIC SECTION I-I'
DAGUPAN CITY

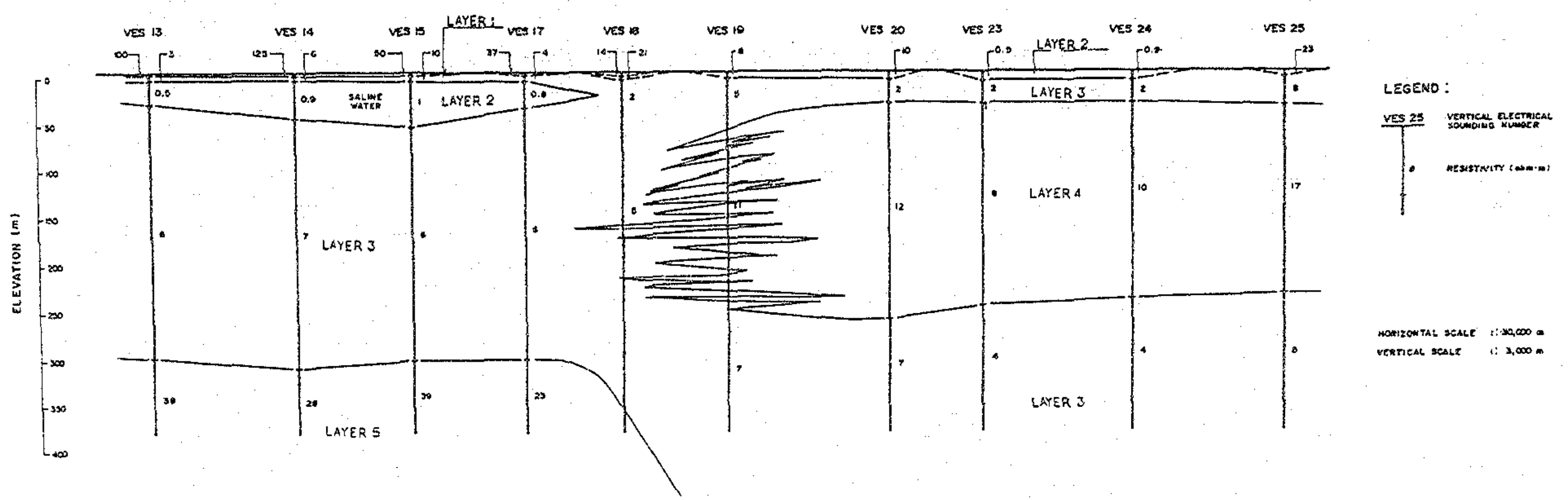


FIGURE 6.6.2.1.11
ELECTROSTRATIGRAPHIC SECTION J-J'
DAGUPAN CITY

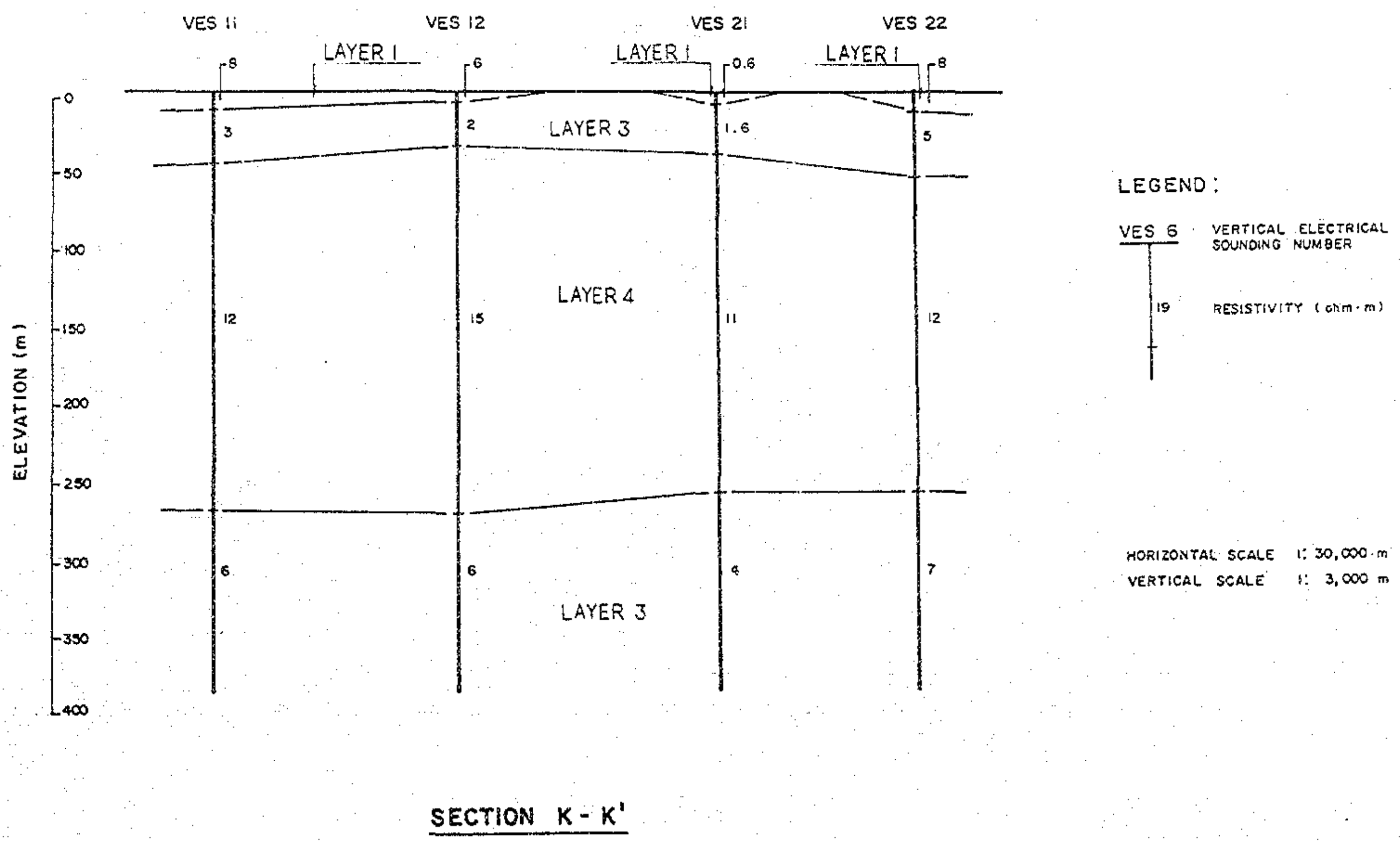


FIGURE 6.6.2.1.12
ELECTROSTRATIGRAPHIC SECTION K-K'
DAGUPAN CITY

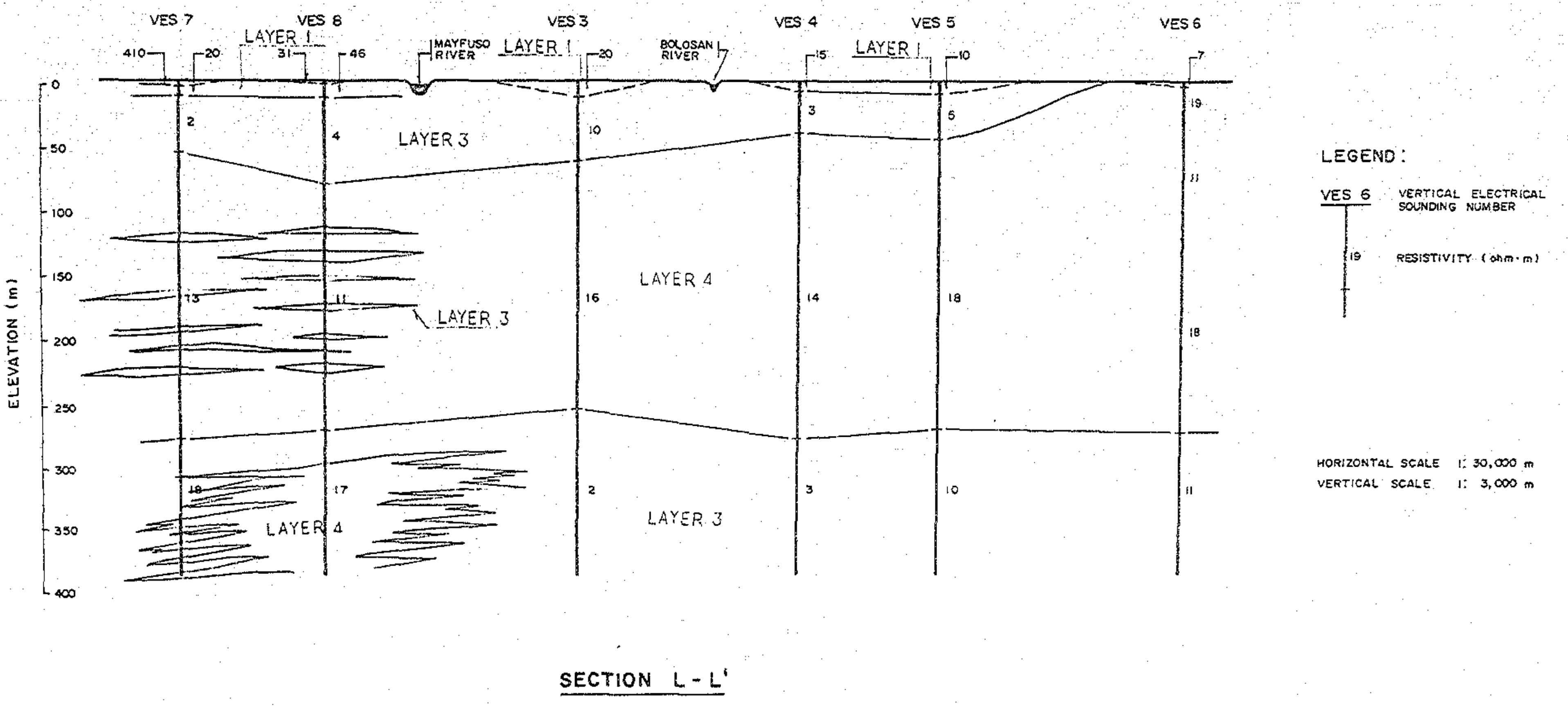
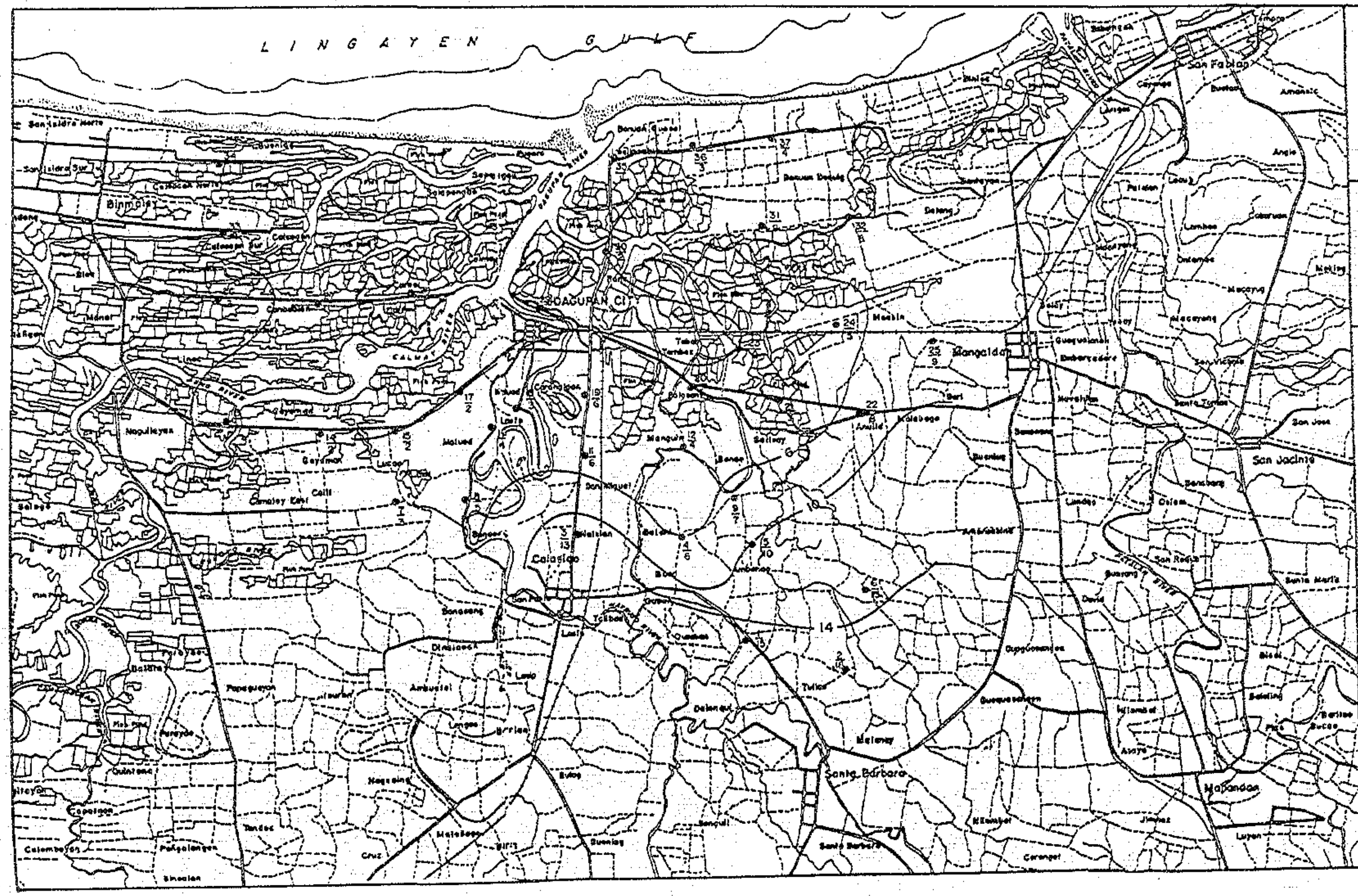
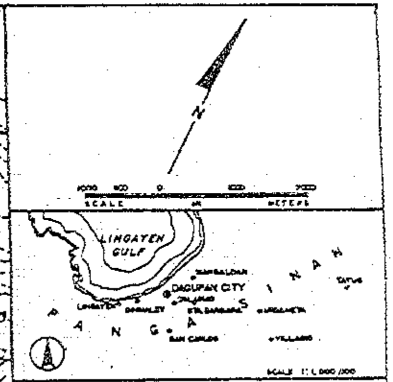


FIGURE 6.6.2.1.13
ELECTROSTRATIGRAPHIC SECTION L-L'
DAGUPAN CITY





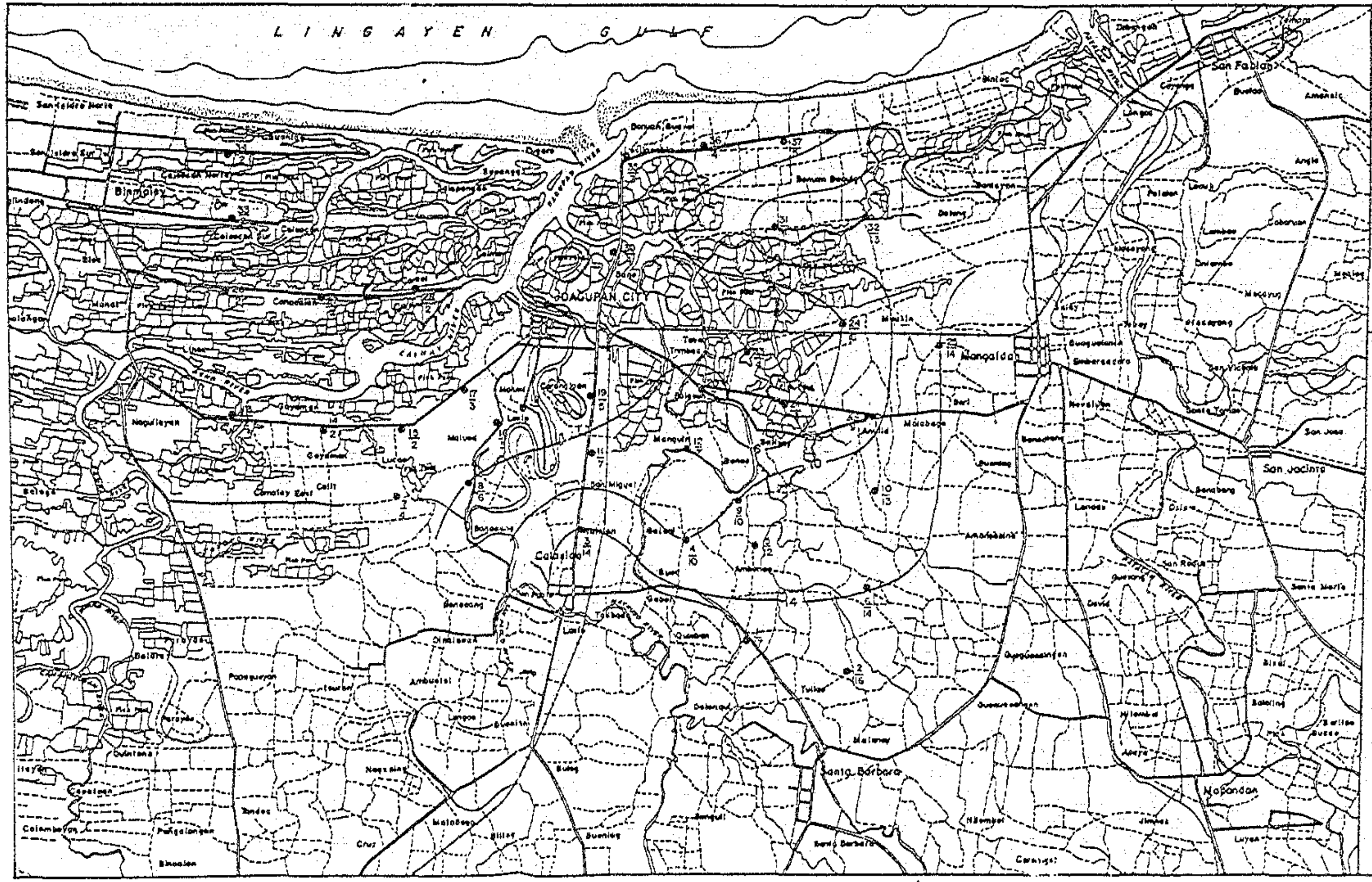
LEGEND:

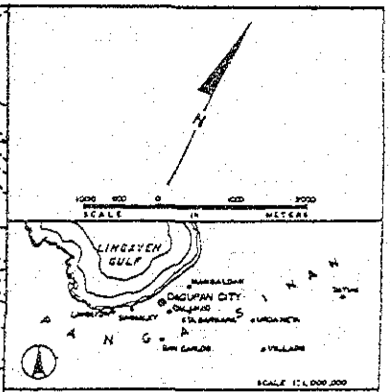
- ● VERTICAL ELECTRICAL SOUNDING
- ● $\frac{25}{9}$ VES NUMBER / RESISTIVITY (ohm-m)
- ⁓6⁓ ISORESISTIVITY CONTOUR LINE

FIGURE 6.6.2.1.14
ISORESISTIVITY MAP
DAGUPAN CITY

($\frac{AB}{2}$ = 100 m)

DAGUPAN CITY





LEGEND :

● VERTICAL ELECTRICAL SOUNDING

$\frac{3}{14}$ VES NUMBER / RESISTIVITY (ohm-m)

6 ISORESISTIVITY CONTOUR LINE

FIGURE 6.6.2.1.15
ISORESISTIVITY MAP
DAGUPAN CITY

($\frac{AB}{2}$ = 200m)

DAGUPAN CITY

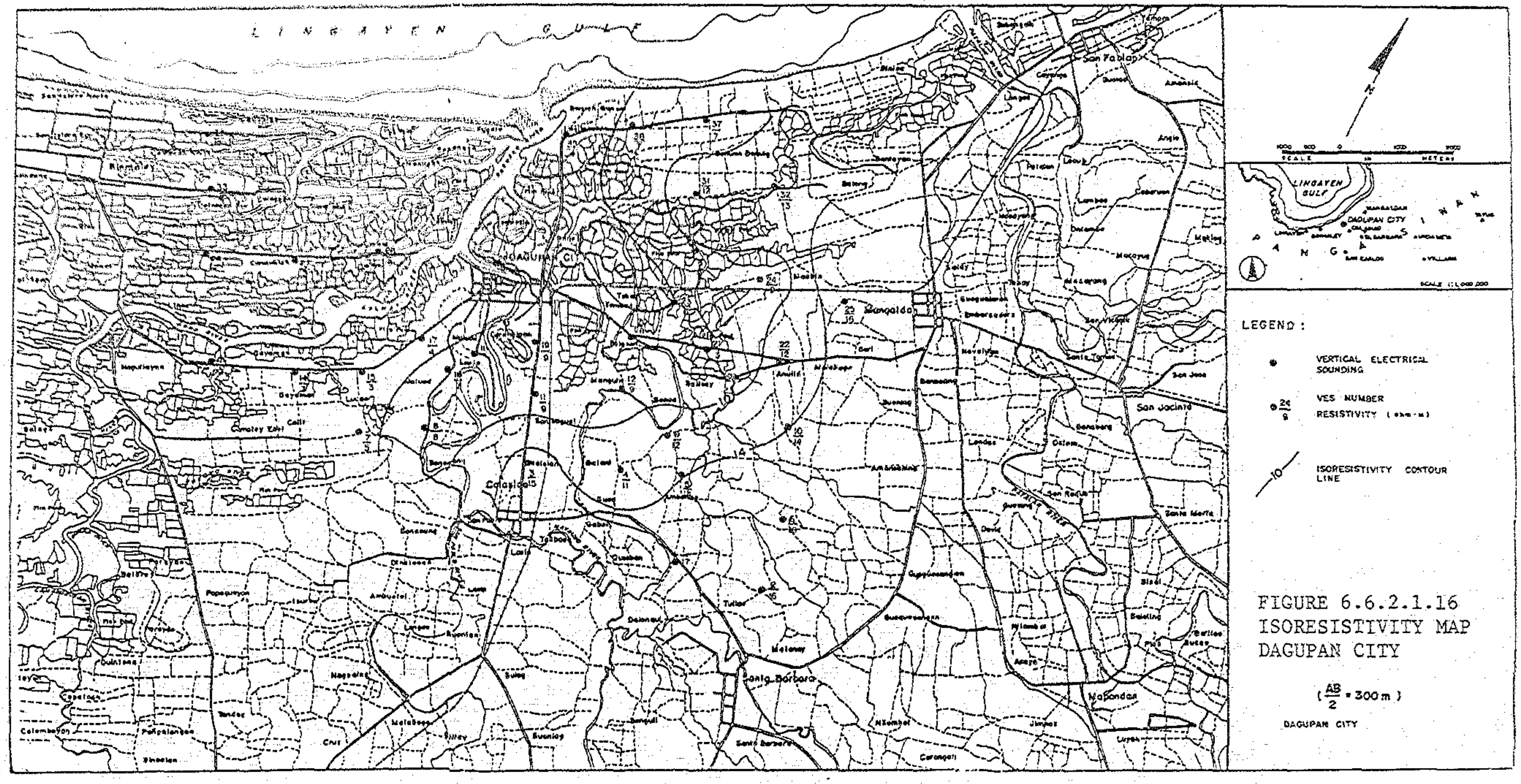


FIGURE 6.6.2.1.16
ISORESISTIVITY MAP
DAGUPAN CITY

$(\frac{AB}{2} = 300m)$

FIGURE 6.6.2.1.17
ISORESISTIVITY MAP
DAGUPAN CITY

APPENDIX 6.7.1 WATER QUALITY EXAMINATION

(1) Objective

The objective of this survey is to evaluate the water quality of the existing sources. Furthermore, the survey is focused on the clarification of geochemical feature in relation to the hydrogeological conditions of the study area.

The examination result will be reflected in the prospective water supply plan.

(2) Implementation period

1) Preparatory work : July 26-27
2) Field examination : July 28
3) Sampling and laboratory analysis : July 28

(3) General Approach and Methodology

1) Sampling Points

Water samples were collected from the selected sampling points for physical, chemical and bacteriological examination.

<u>Selection of sampling point</u>

The sampling points were selected considering the following conditions:

- To cover all existing deep wells.

- To evaluate the hydrogeological and geochemical features in the study area.

- To determine the bacteriological quality of supplied water.

The selected sampling point were shown in TABLE 6.7.1.1 and FIGURE 6.7.1.1.

TABLE 6.7.1.1 LOCATION OF SAMPLING POINT

Item of Examination	Sample No.	Sampling Point	Remarks
Physical/Chemical Examination	1	Deep Well, Pump St. No. 1, Bgy I	
	2	" " No. 2, "	
	3	" " No. 3, "	
	4	" " No. 4, Pantal	
	5	" " No. 5, Bgy IV	
	6	" " No. 6, Herrera	
	7	" " No. 7, Malued	
	8	" " No. 8, Pantal	
	9	" " No. 9, Caranglaan	
	10	" " No. 10, Pantal	
	11	" " No. 11, Pogo G.	
	12	" " No. 12, Tapuac	
	13	" " No. 14, Pantal	
	14	" " No. 15, Malued	
	15	" " No. 16, Pob. Oeste	
	16	: , Carael (BWP)	
	17	Spring, Bonuan Guesset	
	18	River, Mayruso River	
	19	Shallow Well, Bacayao Norte	
Bacteriological Examination	20	Service Connection in Lucao	
	21	" in Bgy I	
	22	Public Faucet in Pantal	
	23	" in Pob. Oeste	

2) Sampling and Pre-treatment

Water samples were collected and pretreated in such manner to correspond respective chemical constituents to be analyzed in the laboratory as follows:

Sample Container / Pretreatment	Items to be analyzed
o 1,000 ml polyethylene bottle	Water Temperature, pH EC, TDS, Ca^{2+}, Mg^{2+} Na^{+}, K^{+}, SO_4^{2+}, CO_3^{2-}, HCO_3^{-}, Cl^{-}, Fe^{+}, Mn

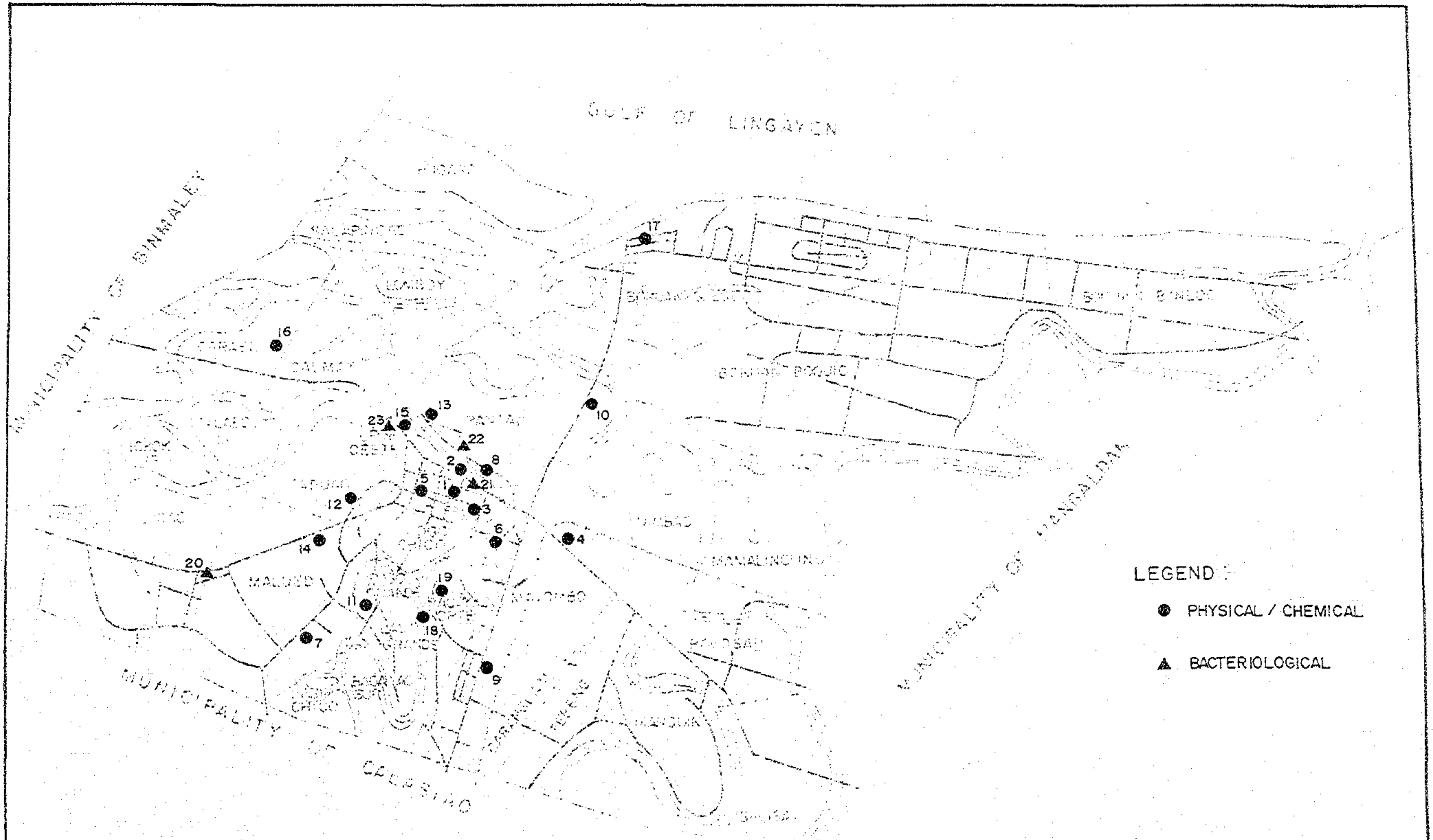


FIGURE 6.7.1.1
LOCATION OF SAMPLING POINT

o 500 ml polyethylene bottle with 1 ml of conc. H_2SO_4 to maintain pH below 1.0	NH_3-N, NO_3-N, Fe^+
o 100 ml predisinfected polyethylene bottle	Coliform Group Bacteria (MPN)

In addition to the chemical pretreatment, all the collected water samples in the respective polyethylene bottles were be kept in the black polyethylene bags with crushed ice to maintain water temperature below 4°C during the transportation to the laboratory.

3) Field Examination

Water temperature, pH and EC were measured in the field at the time of water sampling.

Implementation procedure

Since the collected water samples need to be delivered to the laboratory within 8 hours from the time of sampling, the water sampling was carried out in the early morning from 6:30 to 8:00 on 28 July, 1986. Thus the water samples were delivered to the Laboratory in Manila at 1:30 P.M.

(4) Result of water quality examination

The result of field and laboratory analysis is presented in TABLE 6.7.1.2.

The procedure of water quality analysis was based on the Philippine Standard Method for the Analysis of Air and Water (Volume 2).

(5) Discussion and conclusion

The following facts are obtained from the water quality analysis:

1) 7 samples out of 18 samples which were collected as drinking water sources excluding river water, are not satisfied with the National

Standard for Drinking Water (NSDW).

2) Among those samples unsuitable to NSDW, three samples of P. S. No. 12, No. 16 and Deep Well (Crael) are also unsuitable for color.

3) The rest four samples of PS No. 6, No. 10, No. 14 and Shallow Well (Bacayao Norte) are unsuitable for Ca, Cl and TDS, or Cl and TDS.

4) pH range of the all samples is high. This can be recognized as the sign of sea water intrusion.

5) Turbidity of the samples is within the criteria of drinking water except for surface water sample.

6) All the samples of Fe and Mn contents are within the criteria of drinking water.

7) Sea water intrusion was expected for existing well No. 6, No. 10, No. 14 and Shallow Well of Bacayao Norte from the result of electric conductivity in the field examination. This matter was proved by the analysis of TDS, Na^- and Cl^-.

TABLE 6.7.1.2 WATER QUALITY ANALYSIS

DAGUPAN CITY

	Sample Number and Location	Turb. (FTU)	TDS (mg/l)	PH (-)	EC (MS/cm)	Alk. (mg/l)	Hard. (mg/l)	Acid (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	CO_3 (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Fil (mg/l)	Mn (mg/l)	Coli-form (MPN)	Temp. (°C)	NH_3N	NO_2N
1	Pump Station #1	0.49	253	8.12	367	142	60	0	67.5	2.5	20.8	1.9	33.6	104.9	27.9	22.5	0.05	nil		30.1	0.03	1.32
2	Pump Station #2	0.63	211	7.98	324	123	67	0	50.0	3.0	24.0	1.7	22.8	103.7	18.7	16.5	0.1	nil		29.5	0.02	0.81
3	Pump Station #3	0.47	224	8.04	348	152	75	0	49.0	3.8	18.0	7.3	33.6	117.1	18.6	13.0	0.2	nil		30.5	0.03	0.80
4	Pump Station #4	0.58	234	7.58	351	133	67	0	54.5	3.2	20.8	3.6	33.6	93.9	18.6	26.0	0.05	nil		30.5	0.01	2.24
5	Pump Station #5	0.66	256	7.85	328	171	60	0	73.5	3.3	18.0	3.6	33.6	140.3	23.2	15.0	0.08	nil		30.5	0.03	0.46
6	Pump Station #6	0.46	1,856	7.29	2,710	190	270	12	525.0	5.0	84.0	14.6	0	231.8	928.8	8.0	0.1	nil		28.5	0.13	1.33
7	Pump Station #7	0.74	280	7.97	408	180	37	0	88.0	4.2	8.8	3.6	22.8	173.2	27.9	9.0	0.20	nil		29.2	0.03	1.04
8	Pump Station #8	0.82	224	7.86	373	142	67	0	54.5	2.9	24.0	1.7	22.8	126.9	18.6	19.5	0.15	nil		29.5	0.02	0.75
9	Pump Station #9	1.02	288	7.81	440	153	60	0	75.0	2.5	18.0	3.6	33.6	118.3	32.5	15.5	0.05	nil		28.2	0.03	1.20
10	Pump Station #10	0.61	1,152	7.45	1,800	350	127	0	355.0	3.2	26.8	14.6	33.6	358.7	390.1	6.0	0.08	nil		28.8	0.09	1.80
11	Pump Station #11	0.70	307	8.12	427	180	52	0	82.5	2.5	18.0	1.7	33.6	151.3	27.9	8.0	0.05	nil		29.8	0.03	1.37
12	Pump Station #12	0.55	288	8.65	400	209	30	0	85.0	1.2	6.0	3.6	33.6	186.7	13.9	2.0	0.20	nil		30.0	0.05	2.96
13	Pump Station #14	1.75	1,792	7.09	2,760	313	277	14	480.0	5.0	84.0	16.3	0	381.9	698.9	9.0	0.08	nil		29.0	0.08	0.97
14	Pump Station #15	0.53	333	8.04	251	228	52	0	105.0	2.4	14.8	3.6	33.6	209.8	27.9	6.0	0.10	nil		29.9	0.03	1.21
15	Pump Station #16	0.62	371	8.06	546	199	30	0	112.5	2.0	6.0	3.6	33.6	174.5	62.7	8.0	0.15	nil		29.8	0.03	1.70
16	Carael (BWP)	0.56	460	8.15	364	318	67	0	138.0	3.9	24.0	1.7	45.6	295.2	34.8	2.0	0.10	0.05		30.1	0.07	3.96
17	Bonuan Guesset (Spring)	0.43	179	8.32	241	100	52	0	41.0	3.4	14.8	3.6	33.6	53.7	13.9	25.5	0.05	nil		28.5	0.02	0.47
18	Mayruso (River)	7.50	320	7.44	490	191	202	12	18.5	4.1	58.4	13.6	0	233.0	32.5	7.0	0.08	nil		29.5	nil	2.87
19	Bacayao Norte (Shallow Well)	0.90	986	7.25	1,590	328	105	16	300.0	4.0	24.0	10.9	0	400.2	301.8	2.0	0.05	nil		28.0	0.09	0.71

Philippine National Standard for Drinking Water

Water Quality: Physical, Chemical and Radiological Requirements

Parameter		Maximum Permissible level*
Turbidity		5 units
Color		5 units (s) **
Odor		Unobejctionable
Threshold odor number		Note more than 3
Taste		Unobjectionable
Total Solids		500 (s)
pH		6.5 - 8.5
Phenolic substances		0.001
Radioactive Subs.	Gross Alpha	3 pCi/l
	Gross Beta	30pCi/l
Trace Elements	Arsenic	0.05
	Barium	1.0
	Cadmium	0.01
	Chromium	0.05
	Copper	1.0
	Cyanide	0.05
	Fluoride	0.6
	Iron	1.0
	Lead	0.05
	Manganese	0.5 (s)
	Mercury	0.002
	Selenium	0.01
	Zinc	5.0 (s)
Organic Cehmicals	: Synthetic	
	Detergents (MBAS)	0.5
	Oil & Grease	Nil
Persistent Pesticides	: Aldrin	0.001
	DDT	0.05
	Dieldrin	0.001
	Chlordane	0.003
	Endrin	0.0002
	Heptachlor	0.0001
	Lindane	0.004
	Toxaphane	0.005
	Methoxychlor	0.1
	2,4 ---E	0.1
	2, 4, 5 --- T	0.01
PCB		Nil
Other Chemicals	: Calcium	75
	Chloride	200 (s)
	Magnesium	50 (s)
	Nitrate (NO_3)	30
	Sulfate	200 (s)
	Hydrogen sulfide	0.05 (s)

* All units are in mg/ℓ unless, otherwise stated.

** (s) – Secondary standards; compliance with the standard and analysis are not obligatory.

Bacteriological Quality Standards

Minimum Requirements on Bacteriological Quality

a) Chlorinated or Otherwise Disinfected Supplies

Efficient treatment culminating in chlorination or some other form of disinfection should yield a water free or any coliform organism however polluted the original raw water may have been. In practice it should not be possible to demonstrate the presence of coliform organisms in any sample of 100mℓ. The efficacy of the purification process and method of sampling should be looked into when a sample of the water entering the distribution system does not conform to this standard. In testing chlorinated water, presumptive positive tubes should always be subjected to appropriate confirmatory tests.

b) Non-disinfected Supplies

Where supplies of this sort exist, no water entering the distribution system should be considered satisfactory if it yields E coli in 100mℓ. If E. coli is absent, the presence of not more than 3 coliform organisms per 100mℓ may be tolerated in occasional samples from established non-disinfected pipes supplies, provided that they have been regularly and frequently tested and that the catchment area and storage conditions are found to be satisfactory. If repeated samples show the presence of coliform organisms, steps should then be taken to discover and, if possible, remove the source of pollution. If the number of coliform organisms increases to more than 3 per 100mℓ, the supply should be considered unsuitable for use without disinfection.

c) Individual or Small Community Supplies

Where supply of waters are individual wells, bores and springs everything possible should be done to prevent pollution of the water. It should be possible to reduce the coliform count of water from even a shallow well to less than 10 per 100mℓ. Persistent failure to achieve this, particularly if E. coli is repeatedly found, should, as a general rule lead to chlorination or boiling of the water for domestic consumption.

APPENDIX 7.1.1 Excerpt from LWUA Methodology Manual

F. COST COMPARISON

General

Anaylsis and evaluation of alternative are based largely on present-worth cost studies, taking into consideration the salvage valuse after the design period. Cost comparison is based on present worth of net disbursement during the period of 1980-2010 without any escalation factor applied to the 1980 unit prices.

If the differences between net PW cost of an alternative and that of the least-cost alternative is within the limit of cost estimating accuracy (10-15%) further cost comparison shall be made applying escalation factor to 1980 unit prices. For escalation rates, refer to Chapter VII-C: Escalation Rates. Moreover, non-economic parameters may also be influence the selection of the recommended plan.

Construction Cost

Construction cost estimates of the proposed improvements are based on the projected July 1980 unit prices. All estimates on imported materials are based on an exchange rate of ₱7.40 per 1 US dollar. Further, it is assumed that no custom duty will be charged on items imported for the public water supply project. The cost of any facility to be replaced during the design period (1980-2010) is included under the capital cost for the particular year.

Annual Cost

Annual costs are all costs associated with the maintenance, operation, and management of the project. These include labor, power, chemical and maintenance costs. These estimates are carried out for the period 1980-2010. The present-worth cost of annual expenditure is based on uniform and gradient series at a given interest.

Personnel and maintenance costs may abruptly increase as additional facilities are put into operation - e.g., the power cost at a pump station increases in relation to the daily pumpage of water.

Salvage Value

The salvage values of facilities at the end of the design period 2010 are important in calculating net present worth of the total expenditures. It is assumed that the value of a facility depreciates linearly throughout its service life therefore, a facility with longer service life depreciates less than a facility with shorter service life (Refer to Table VI-1 for service life of different facilities). Moreover, a facility constructed at a later stage has higher salvage value than one constructed at an earlier stage.

TABLE VI-1 SERVICE LIFE CATEGORIES OF FACILITIES

Civil Works	Economic Life	Equipment	Economic Life
Wells	30 years	Wells (pumping engine or motors)	15 years
Springs	50	Springs (vales, pipes)	50
Transmission Mains	50	Transmission (pipes, valves)	50
Storage Facilities	50	Storage (valves, pipes, level gauge, etc.)	50
Disinfection Facilities	50	Disinfection facilities (chlorinators, mechanical equipment and filter equipment, pipes, valves)	15
Distribution Mains	50	Distribution mains (pipes, valves)	50
Internal Network	50	Internal networks (pipes, valves)	50
Service Connections	50	Service connections (meters, pipes)	50
Fire Hydrants	50	Operational buildings (workshop, etc.)	15
Operational Buildings	50	Fire hydrants	30
		Vehicles	7

Net Present Worth

The net present worth cost of an alternative scheme is the difference between the total present worth of capital cost and annual cost minus the present worth of salvage values.

For Construction Cost: $C_n = C_c - C_s$

$$C_c = C \times \frac{1}{(1 + i)^n} \qquad C_c = C \times \frac{1}{(1 + i)^{nx}} \times \left(1 - \frac{nx - n}{SL}\right)$$

For Annual Cost:

$$C_c = A_c \times \frac{1}{(1 + i)^n}$$

where,

C_n = net present worth comparable cost

C_c = present worth of construction cost

C_s = present worth of salvage value (design year)

C = construction cost

SL = service life

i = discount rate

nx = number of years between design year and base year

n = number of years between year of construction and base year

A_c = annual cost

APPENDIX 7.2.1 ALTERNATIVE STUDY OF WATER INTAKE FACILITY

7.2.1.1. Hydraulic Simulation of Technical Alternatives

The infiltration gallery and the radial well are considered as the alternatives for water intake facility. To determine the design parameter of each facility, the following hydraulic simulation was carried out.

Radial Well

$$Q = \quad x \; k \; x \; (H^2 - h^2)/\text{In}(R/r_o)$$

where,

Q = planned yield; 5,400 cu.m/day

k = permeability coefficient; $5x10^{-4}$ m/sec

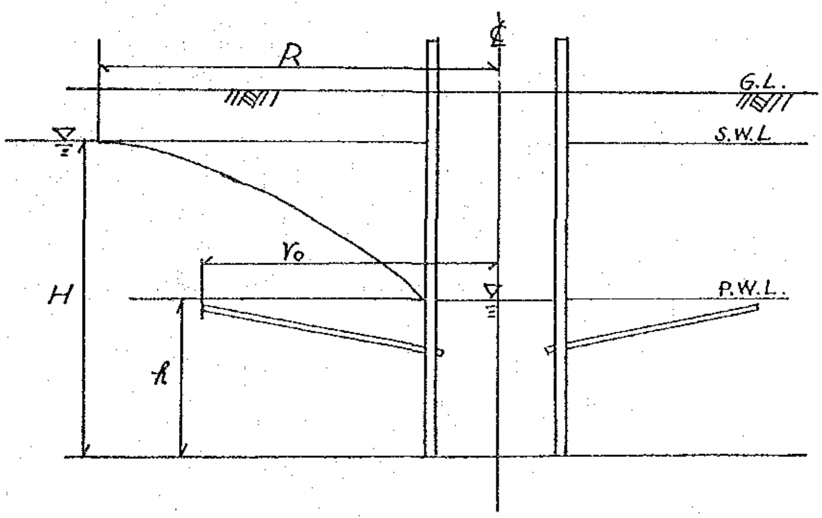
H = aquifer thickness; 15 m

h = effective aquifer thickness during pumping (m)

R = radius of influence area; 400 m

r_o = radius of radial collector (m)

$H - h$ = drawdown (m)



Through the trial simulation of the above formula, the design parameter of the radial well was determined to be 9 m for the effective aquifer thickness and 15.5 m for the darius of radial collector. By these parameters, the planned yield is computed to be approximately 6,010 cu.m/day. Thus, four units of radial well can meet the required water demand.

Infiltration Gallery

$$Q = k \times L \times (H^2 - h_o^2) \times R^{-1} \times \sqrt{(t + 0.5 \times r_o)/h_o} \times \sqrt[4]{(2 \times h_o - t)/h_o}$$

where,

Q = planned yield; 5,400 2,880 cu.m/day

k = permeability coefficient; 5×10^{-4} m/sec

L = length of gallery (m)

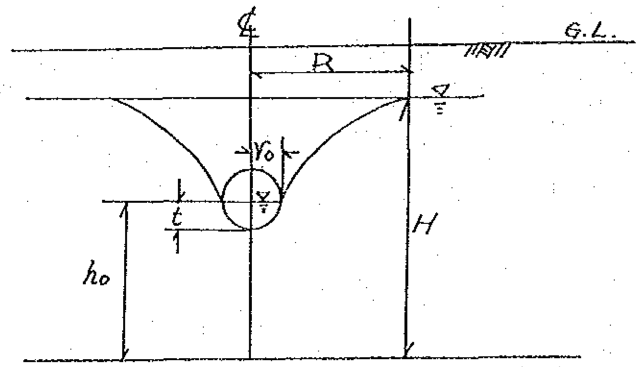
H = aquifer thickness; 15 m

h_o = height of gallery from the bottom of aquifer; 11 m

R = radius of influence area; 400 m

t = depth of water in gallery (m)

r_o = radius of gallery (m)



As well as the radial well, the design parameter of infiltration gallery was determined to be 1.5 m for both the depth of water in gallery and the radius of gallery, and 910 m for the gallery length. By these parameters, the planned yield is computed to be approximately 5,400 cu.m/day.

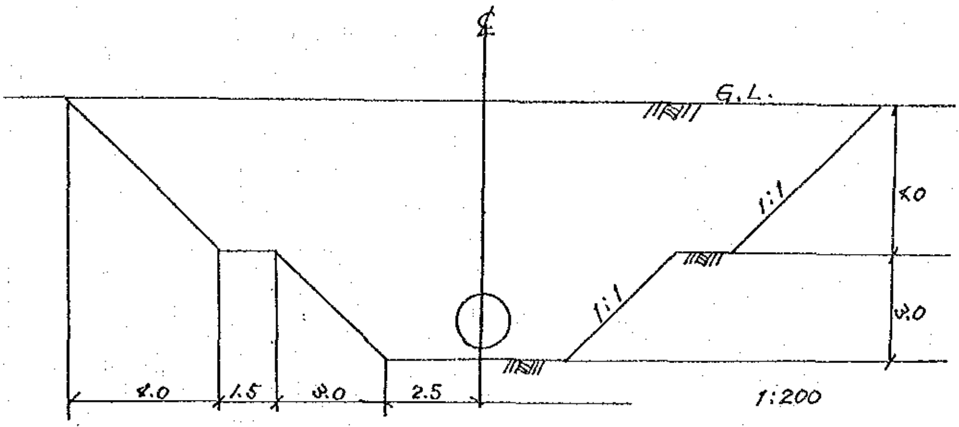
7.2.1.2. Cost Estimates

Radial Well

The construction cost of the radial well is estimated to be approximately ₱1,240,000 per one unit, as shown in TABLE 7.2.1.1.

Infiltration Gallery

In order to install the infiltration gallery in the river bed, the volume of excavation and backfilling with relevant civil works is required. The following is a rough scketch of the cross-section of river bed excavation.



The given cross-section has an area of 96 sq.m. When 910 m of the required length of infiltration gallery is taken into account, the total excavation volume will be about 87,360 cu.m. At ₱103/cu.m of the unit cost for excavation, this work item will require at about ₱9.0 million.

7.2.1.3 Conclusion

In accordance with the above cost estimates, it is clear that the radial well is quite economical than the infiltration gallery.

TABLE 7.2.1.1 COST ESTIMATES OF RADIAL WELL

Item		Description	Unit	Q'ty	Unit Cost (Peso)	Cost (Peso)
1.	Concrete Caisson					
1.1	Steel Shoe	ϕ6.0 m(OD) x ϕ7.0 m(ID) x 1.0 m(H) (t=6 mm)	kg	2,500	26	65,000
1.2	Escavation	ϕ7.0 m x 17.5 m(D)	cu.m	673	103	69,320
1.3	Disposal Material	ϕ7.0 m x 17.5 m(H)	cu.m	673	24	16,150
1.4	Concrete (3,000 psi)	Caisson: ϕ6.0 m(ID) x ϕ7.0 m(OD) x 18.5 m(H) for wall ϕ6.0 m(ID) x 1.5 m(H) for anchor	cu.m	231	1,170	270,270
		Cover with slab: ϕ7.0 m x 0.2 m(H) + (0.3x0.3x4.8x4 - 0.3x0.3x0.3x2)	cu.m	10	1,170	11,700
1.5	Reinforcement Steel Bar	20 kg for every 1.0 cu.m of concrete	kg	4,820	15	72,300
1.6	Formwork	Caisson: (ϕ6.0 m x ϕ7.0 m) x 18.5 m(H)	sq.m	756	110	83,160
		Cover/slab: ϕ7.0 m for horizontal	sq.m	29	140	4,060
		0.3x(0.90x4x1.7x4)x4 for vertical	sq.m	13	110	1,430
	Total for Item 1					593,390
2.	Radial Collector					
2.1	Collector Pipe	GI, ϕ75 mm x 3 m (ϕ12 mm, 400 holes) x 2 pcs. x 48 collectors	m	288	270	77,760
		GI, ϕ75 mm x 3 m (ϕ12 mm, 300 holes) x 48 collectors	m	144	270	38,880
		GI, ϕ75 mm x 3.5 m (blank) x 48 collectors	m	168	180	30,240
		GI, Cap, ϕ75 mm	pcs.	48	30	1,440
2.2	Gate Valve	ϕ75 mm	pcs.	48	2,690	129,120
2.3	Water Stopper	ϕ75 mm	pcs.	48	1,340	64,320
2.4	Horizontal Boring	Caisson Wall, t=0.5 m	holes	48	1,500	72,000
		Radial Well, 12 m x 48 collectors	m	576	1,160	668,160
	Total for Item 2					1,081,920
	TOTAL OF ITEM 1 & 2					1,675,310
3.	Temporary Facility	5% of Total of Item 1 & 2				83,765
	TOTAL COST					1,759,075

APPENDIX 7.2.2 DATA ON THE UNIT COST FOR ESTIMATION OF PROJECT COST

(1) Deep Well Construction : Peso

Depth (m)	Casing size (m/m)	Cost
200	250	940,000
200	300	1,160,000
250	150	640,000

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	17	-	-	-	20	37
Civil Works	33	8	5	-	17	63
Total	50	8	5	-	37	100

(2) Deep Well Pump Station (Electric Motor Drive) : Thousand Peso

KW	Cost
7	450
15	560
22	640
29	720
37	790
44	840
51	890
59	960
66	1,020
74	1,080

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	9	-	-	42	5	56
Civil Works	21	9	5	-	9	44
Total	30	9	5	42	14	100

(5) Pipeline Cost

Following pipe materials are presently available in the Philippines:

- GI (galvanized iron),
- PE (poly-ethylene),
- PB (poly-butylene),
- PVC (poly-vinyl-chloride),
- SP (steep pipe),
- CI (cost iron), and
- AC (asbestos cement).

Among these materials, the use of CI pipe is limited due to its high cost and AC pipe is also rare by safety reason.

Followings are comparison of unit cost at the 1985 price level.

(Unit: ₱/m)

Diameter (mm)	GI	PE	PB	PVC	SP
13	20.8	13.8	9.1	-	-
19	24.7	19.9	13.6	-	-
25	32.3	25.3	22.0	-	-
38	59.2	41.5	44.7	-	-
50	87.5	61.4	76.4	33.9	-
63	117.7	-	-	48.0	-
75	180.3	-	-	81.3	-
100	230.8	-	-	122.4	235.0
150	-	-	-	256.9	250.0
200	-	-	-	506.5	290.0
250	-	-	-	-	315.0
300	-	-	-	-	425.0
400	-	-	-	-	520.0
500	-	-	-	-	700.0
600	-	-	-	-	890.0

Based on the above comparison, SP is advantageous for the diameter of 200 mm and above than PVC. Thus, for the cost estimates of major transmission and distribution pipes, SP is considered for diameter of 200 mm and above, while PVC for diameter of less than 150 mm taking into account the transportation cost and easy installation.

(3) Booster Pump Station

$$C = (72.16 - 13.68 \log Q) \times Q^{(0.42 + 0.1 \log Q)}$$

$$\times H^{0.305(\log Q - 0.7)^{(6/H - 0.25)}}$$

where,

C = cost for electric motor drive (thousand peso)

Q = design capacity (l/sec)

H = total dynamic head (m)

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor Skilled	Labor Unskilled	Direct	Indirect	Total
Equipment	11	-	-	53	2	66
Civil Works	17	9	6	-	2	34
Total	28	9	6	53	4	100

(4) Radial Well

Inner Diameter(m)	Inner Depth (m)	Collection Pipe Length (m/hole)	Unit Cost (₱)
5	10	7.5	1,240,000
6	16	12.5	1,760,000

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor Skilled	Labor Unskilled	Direct	Indirect	Total
Equipment	1	-	-	18	1	20
Civil Works	25	2	2	-	51	80
Total	26	2	2	18	52	100

Diameter (mm)	Unit Cost (₱/m)
150(PVC)	410
200(SP)	520
250(")	630
300(")	760
350(")	900
400(")	970
450(")	1,160
500(")	1,330
600(")	1,600
700(")	1,910

Source : LWUA Design Dept.

BREAKDOWN OF COSTS IN %

	Local Component			F E C		Total
	Material	Labor		Direct	Indirect	
		Skilled	Unskilled			
Equipment	23	-	-	4	27	54
Civil Works	17	7	4	-	18	46
Total	40	7	4	4	45	100

(6) Valve In-place Cost

Diameter (mm)	Gate Valve (₱)	Butterfly Valve (₱)
50	1,700	-
75	2,900	-
100	3,900	-
150	5,300	-
200	6,700	-
250	11,200	-
300	-	34,800
350	-	74,400
400	-	95,200
450	-	125,900
500	-	174,000
600	-	243,600
700	-	313,200

Source : LWUA Design Dept.

BREAKDOWN OF COSTS IN %

	Local Component			F E C		Total
	Material	Labor Skilled	Labor Unskilled	Direct	Indirect	
Equipment	9	-	-	63	5	77
Civil Works	12	3	6	-	2	23
Total	21	3	6	63	7	100

(7) Internal Network

Population Density (Person/ha)	Total Length of Pipeline (m/ha)	Unit Cost (₱/ha) Diameter (100/150)	Unit Cost (₱/ha) Diameter (75/100)
50	64	18,300	14,900
60	67	19,300	15,700
75	72	20,900	16,800
100	80	23,100	18,700
150	90	25,700	21,000
200	100	28,300	-
250	108	30,400	-
300	116	32,500	-

BREAKDOWN OF COSTS IN %

	Local Component			F E C		Total
	Material	Labor Skilled	Labor Unskilled	Direct	Indirect	
Equipment	22	-	-	7	27	56
Civil Works	17	7	4	-	16	44
Total	39	7	4	7	43	100

(8) In-place of Service Connections

Diameter (inch)	Without Meter ₱/unit	With Meter ₱/unit	Meters ₱/unit
1/2	450	810	400
5/8 - 3/4	520	1,280	880

SERVICE CONNECTION WITHOUT METER

BREAKDOWN OF COSTS IN %

	Local Component			F E C		Total
	Material	Labor		Direct	Indirect	
		Skilled	Unskilled			
Equipment	9	-	-	60	2.5	71.5
Civil Works	17	3	6	-	2.5	28.5
Total	26	3	6	60	5	100

SERVICE CONNECTION WITHOUT METER
BREAKDOWN OF COSTS IN %

	Local Component			F E C		Total
	Material	Labor		Direct	Indirect	
		Skilled	Unskilled			
Equipment	4	-	-	83	2	89
Civil Works	6	1	3	-	1	11
Total	10	1	3	83	3	100

(9) Fire Hydrant In-place Cost

Type	Size (mm)	Unit Cost (₱)
Commercial	150	16,800
Residential	100	9,400

BREAKDOWN OF COSTS IN %

	Local Component			F E C		Total
	Material	Labor		Direct	Indirect	
		Skilled	Unskilled			
Equipment	8	-	-	57	5	70
Civil Works	10	8	10	-	2	30
Total	18	8	10	57	7	100

(10) Elevated Tank/Ground Reservoir

Elevated Tank: $C = 0.615\ H^{1.144} V^{0.749}$

Ground Reservoir: $C = 20.05\ V^{0.639}$

where, C = cost (thousand peso)

H = overflow elevation above ground level

V = storage volume (cu.m)

BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	4	-	-	3	2	9
Civil Works	53	5	7	-	26	91
Total	57	5	7	3	28	100

(11) Gas Chlorinator In-place Cost

Type	Water Flow Condition	Maximum Chlorine Feed (kg/day)	Unit cost 1/ (₱)
I-A	constant	22	98,100
I-B	constant	45	119,100
II-A	Variable	22	147,700
II-B	Variable	45	169,300

1/ Empty gas cylinders and automatic switchover include

TYPE I-A, I-B
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	15	-	-	41	5	61
Civil Works	25	6	3	-	5	39
Total	40	6	3	41	10	100

TYPE II-A, II-B
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	21	-	-	53	2	76
Civil Works	12	6	2	-	4	24
Total	33	6	2	53	6	100

(12) Administration & Operation Building

Future Service Population	Administration Bldg. (Thousand Peso)	Operation Center (Thousand Peso)
30,000	1,000	810
40,000	1,110	890
50,000	1,220	990
60,000	1,320	1,090
70,000	1,410	1,180
80,000	1,500	1,280
100,000	1,610	1,380
110,000	1,820	1,590

ADMINISTRATION BUILDING
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	20	-	-	-	16	36
Civil Works	42	7	5	-	10	64
Total	62	7	5	-	26	100

OPERATION CENTER
BREAKDOWN OF COSTS IN %

	Local Component			F E C		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	14	-	-	30	6	50
Civil Works	26	10	5	-	9	50
Total	40	10	5	30	15	100

(13) Energy Cost

$C = Np \times h \times Pu \times (Em)^{-1}$

$Np = Q \times g \times H \times (Eff. \times 1,000)^{-1}$

where,

C = cost (thousand peso)
Np = pump power demand (kw)
h = hours of operation
P_u = unit power cost (₱/kwH)
E_m = motor efficiency (0.85)
Q = water pumped (kg/sec)
g = gravity constant (9.81m/sq.sec)
H = manometric head (m)
Eff.= pump efficiency (average = 0.70)

(14) Chemical Cost

$C = (\text{Annual Water Demand}) \cdot D \cdot U_{CL} \times 10^{-3}$

where,

C = annual cost for chlorine (₱)
D = chlorine dosage (mg/l)
U_{CL} = unit cost of chlorine gas (₱/kg)

(15) Minimum Cost Diameter

Following cost function is applied to determine the most economical diameter of pipelines that are not simulated by the network analysis.

$Dmin. = 187.7\ Q^{0.486}\ C^{-0.315}\ (Ec/Oe)^{0.17}$

where,

Dmin. = minimum cost diameter
Q = water flow (l/sec)
C = "C" value (Hazen William Formula)
Ec = energy cost (₱/kwh)
Oe = overall efficiency

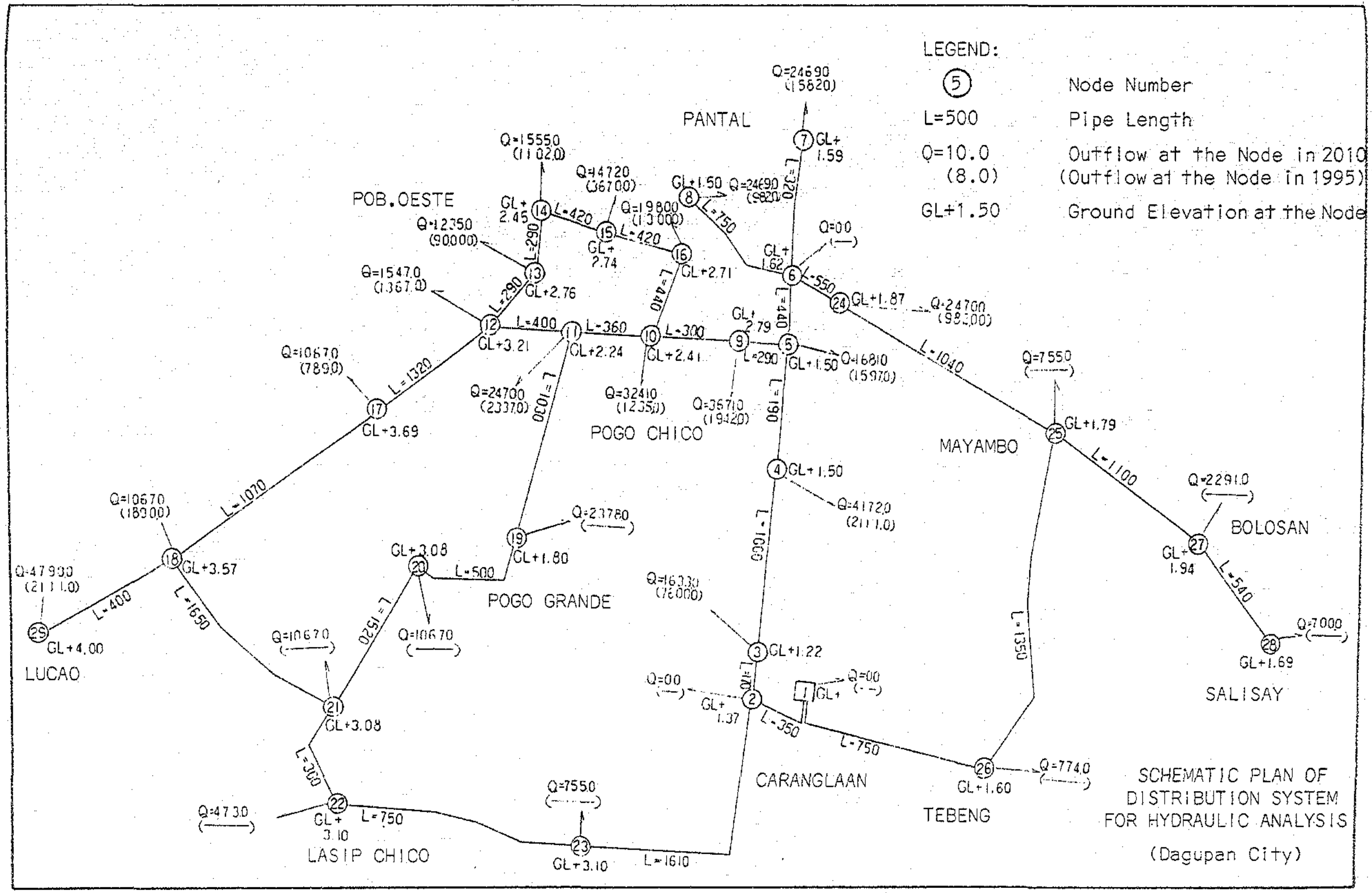
APPENDIX 7.3.1 COMPUTER-AIDED HYDRAULIC ANALYSIS OF DISTRIBUTION SYSTEM (Dagupan City)

o List of Computed Cases

Alternative	D-A	(1995, 2010)
	D-A	(Fire at LUCAO/2010)
	D-B	(1995, 2010)

o Note

This appendix shows the results of Hydraulic Analysis aided by the computer. The distribution network is shown in the figure of following page. The nodes, however, with no flow and 20.00 m in Dynamic Head was treated as a dummy node. Those nodes can be ignored and have no relation to the computation results.


LEGEND:
5 Node Number
L=500 Pipe Length
Q=10.0 Outflow at the Node in 2010
(8.0) (Outflow at the Node in 1995)
GL+1.50 Ground Elevation at the Node
PANTAL
POB.OESTE
POGO CHICO
MAYAMBO
BOLOSAN
SALISAY
POGO GRANDE
LUCAO
CARANGLAAN
TEBENG
LASIP CHICO
SCHEMATIC PLAN OF
DISTRIBUTION SYSTEM
FOR HYDRAULIC ANALYSIS
(Dagupan City)

ALTERNATIVE D-A (Recommended Plan, Single Pipeline Alignment)
Year 1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	30.00	0.00	30.00	0.00	0.00
2	1.37	0.00	29.83	28.46	28.63
3	1.22	76.00	29.65	28.43	28.78
4	1.50	2111.00	28.60	27.10	28.50
5	1.50	1597.00	28.44	26.94	28.50
6	1.62	0.00	28.14	26.52	28.38
7	1.59	1582.00	27.27	25.68	28.41
8	1.50	982.00	27.29	25.79	28.50
9	2.79	1942.00	28.06	25.27	27.21
10	2.41	1235.00	27.59	25.18	27.59
11	2.24	2337.00	27.14	24.90	27.76
12	3.21	1367.00	26.70	23.49	26.79
13	2.76	90.00	26.68	23.92	27.24
14	2.45	1102.00	26.55	24.10	27.55
15	2.74	357.00	27.04	24.30	27.26
16	2.71	1300.00	27.15	24.44	27.29
17	3.69	789.00	25.23	21.54	26.31
18	3.57	189.00	24.54	20.97	26.43
19	1.80	0.00	21.80	20.00	28.20
20	3.08	0.00	23.08	20.00	26.92
21	3.08	0.00	23.08	20.00	26.92
22	3.10	0.00	23.10	20.00	26.90
23	3.10	0.00	23.10	20.00	26.90
24	1.87	982.00	27.96	26.09	28.13
25	1.79	0.00	21.79	20.00	28.21
26	1.60	0.00	21.60	20.00	28.40
27	1.94	0.00	21.94	20.00	28.06
28	1.69	0.00	21.69	20.00	28.31
29	4.00	2111.00	24.32	20.32	26.00

Iteration Times : 11

ALTERNATIVE D-A (Recommended Plan, Single Pipeline Alignment)
Year 1995

<< PIPELINE >>

PIPE No.	NODE No. from	--to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	700.	350.	130.	-20159.	-0.61	-0.17	-0.50
2	2	3	600.	170.	130.	20159.	0.83	0.18	1.06
3	3	4	600.	1000.	130.	20083.	0.82	1.05	1.05
4	4	5	600.	190.	130.	17972.	0.74	0.16	0.85
5	5	6	350.	440.	120.	3546.	0.43	0.30	0.68
6	5	9	500.	290.	120.	12829.	0.76	0.37	1.29
7	6	7	200.	320.	110.	1582.	0.58	0.87	2.72
8	6	8	200.	750.	110.	982.	0.36	0.84	1.13
9	6	24	250.	550.	120.	982.	0.23	0.18	0.32
10	9	10	450.	300.	120.	10887.	0.79	0.48	1.59
11	10	11	400.	360.	120.	6980.	0.64	0.45	1.24
12	10	16	300.	440.	110.	2572.	0.44	0.44	1.00
13	11	12	350.	400.	120.	4643.	0.56	0.45	1.11
14	12	13	200.	290.	110.	186.	0.07	0.02	0.05
15	12	17	300.	1320.	120.	3089.	0.51	1.46	1.11
16	13	14	100.	290.	110.	97.	0.14	0.13	0.45
17	14	15	200.	420.	110.	-1005.	-0.37	-0.49	-1.18
18	15	16	300.	420.	120.	-1372.	-0.22	-0.10	-0.25
19	17	18	300.	1070.	120.	2300.	0.38	0.69	0.64
20	18	29	300.	400.	120.	2111.	0.35	0.22	0.55

ALTERNATIVE D-A (Recommended Plan, Single Pipeline Alignment)
Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	30.00	0.00	30.00	0.00	0.00
2	1.37	0.00	29.15	27.78	28.63
3	1.22	1633.00	28.43	27.21	28.78
4	1.50	4172.00	24.50	23.00	28.50
5	1.50	1681.00	23.88	22.38	28.50
6	1.62	0.00	21.76	20.14	28.38
7	1.59	2469.00	19.78	18.19	28.41
8	1.50	2469.00	17.11	15.61	28.50
9	2.79	3671.00	22.60	19.81	27.21
10	2.41	3241.00	20.96	18.55	27.59
11	2.24	2470.00	19.56	17.32	27.76
12	3.21	1547.00	18.40	15.19	26.79
13	2.76	1235.00	17.96	15.20	27.24
14	2.45	1555.00	18.05	15.60	27.55
15	2.74	1472.00	19.26	16.52	27.26
16	2.71	1980.00	19.73	17.02	27.29
17	3.69	1067.00	14.70	11.01	26.31
18	3.57	1067.00	12.76	9.19	26.43
19	1.80	2378.00	12.09	10.29	28.20
20	3.08	1067.00	10.15	7.07	26.92
21	3.08	1067.00	14.45	11.37	26.92
22	3.10	473.00	15.56	12.46	26.90
23	3.10	755.00	19.01	15.91	26.90
24	1.87	2470.00	17.72	15.85	28.13
25	1.79	755.00	15.33	13.54	28.21
26	1.60	774.00	20.69	19.09	28.40
27	1.94	2291.00	12.54	10.60	28.06
28	1.69	700.00	11.22	9.53	28.31
29	4.00	4790.00	11.76	7.76	26.00

Iteration Times : 6

ALTERNATIVE D-A (Recommended Plan, Single Pipeline Alignment)
Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	700.	350.	130.	-47529.	-1.43	-0.85	-2.44
2	2	3	600.	170.	130.	42649.	1.75	0.72	4.23
3	2	23	250.	1610.	120.	4882.	1.15	10.13	6.29
4	3	4	600.	1000.	130.	41018.	1.68	3.93	3.93
5	4	5	600.	190.	130.	36852.	1.51	0.61	3.22
6	5	6	350.	440.	120.	10242.	1.23	2.12	4.82
7	5	9	500.	290.	120.	24938.	1.47	1.28	4.41
8	6	7	200.	320.	110.	2469.	0.91	1.99	6.20
9	6	8	200.	750.	110.	2469.	0.91	4.65	6.20
10	6	24	250.	550.	120.	5305.	1.25	4.04	7.34
11	9	10	450.	300.	120.	21270.	1.55	1.65	5.49
12	10	11	400.	360.	120.	12948.	1.19	1.40	3.88
13	10	16	300.	440.	120.	5084.	0.83	1.23	2.79
14	11	12	350.	400.	120.	7793.	0.94	1.16	2.91
15	11	19	200.	1030.	110.	2687.	0.99	7.47	7.26
16	12	13	200.	290.	110.	1156.	0.43	0.44	1.52
17	12	17	300.	1320.	120.	5091.	0.83	3.70	2.80
18	13	14	100.	290.	110.	-79.	-0.12	-0.09	-0.31
19	14	15	200.	420.	110.	-1534.	-0.60	-1.21	-2.89
20	15	16	300.	420.	120.	-3104.	-0.51	-0.47	-1.12
21	17	18	300.	1070.	120.	4025.	0.66	1.94	1.81
22	18	21	250.	1650.	120.	-1830.	-0.43	-1.69	-1.02
23	18	29	300.	400.	120.	4790.	0.78	1.00	2.50
24	19	20	100.	500.	110.	309.	0.46	1.93	3.87
25	20	21	150.	1520.	110.	-758.	-0.50	-4.30	-2.83
26	21	22	250.	300.	120.	-3654.	-0.86	-1.10	-3.68
27	22	23	250.	750.	120.	-4126.	-0.97	-3.46	-4.61
28	24	25	250.	1040.	120.	2835.	0.67	2.39	2.30
29	25	26	150.	1350.	110.	-911.	-0.60	-5.36	-3.97
30	25	27	250.	1100.	120.	2991.	0.71	2.79	2.54
31	26	1	150.	750.	110.	-1685.	-1.10	-9.31	-12.41
32	27	28	150.	540.	110.	700.	0.46	1.32	2.44

ALTERNATIVE D-A (Recommended Plan, Single Pipeline Alignment)
Year 2010, Fire at LUCAO

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	30.00	0.00	30.00	0.00	0.00
2	1.37	0.00	29.56	28.19	28.63
3	1.22	1014.00	29.20	27.98	28.78
4	1.50	2591.00	27.24	25.74	28.50
5	1.50	1044.00	26.93	25.43	28.50
6	1.62	0.00	26.06	24.44	28.38
7	1.59	1534.00	25.24	23.65	28.41
8	1.50	1534.00	24.13	22.63	28.50
9	2.79	2280.00	26.21	23.42	27.21
10	2.41	2013.00	25.25	22.84	27.59
11	2.24	1534.00	24.28	22.04	27.76
12	3.21	961.00	23.27	20.06	26.79
13	2.76	767.00	23.17	20.41	27.24
14	2.45	966.00	23.78	21.33	27.55
15	2.74	914.00	24.46	21.72	27.26
16	2.71	1230.00	24.68	21.97	27.29
17	3.69	663.00	18.71	15.02	26.31
18	3.57	663.00	15.76	12.19	26.43
19	1.80	1477.00	20.54	18.74	28.20
20	3.08	563.00	17.80	14.72	26.92
21	3.08	662.00	18.53	15.45	26.92
22	3.10	294.00	19.47	16.37	26.90
23	3.10	469.00	22.20	19.10	26.90
24	1.87	1533.00	24.42	22.55	28.13
25	1.79	469.00	23.46	21.67	28.21
26	1.60	481.00	25.92	24.32	28.40
27	1.94	1423.00	22.30	20.35	28.06
28	1.69	435.00	21.76	20.07	28.31
29	4.05	6775.00	13.86	9.81	25.95

Iteration Times : 6

ALTERNATIVE D-A (Recommended Plan, Single Pipeline Alignment)
Year 2010, Fire at LUCAO

<< PIPELINE >>

PIPE No.	NODE No. from	NODE No. to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	HEADLOSS (0/00)
1	2	1	700.	350.	130.	-33303.	-1.00	-0.44	-1.26
2	2	3	600.	170.	130.	29197.	1.20	0.36	2.10
3	2	23	250.	1610.	120.	4106.	0.97	7.36	4.57
4	3	4	600.	1000.	130.	28184.	1.15	1.96	1.96
5	4	5	600.	190.	130.	25593.	1.05	0.31	1.64
6	5	6	350.	440.	120.	6330.	0.76	0.87	1.98
7	5	9	500.	290.	120.	18222.	1.07	0.72	2.47
8	6	7	200.	320.	110.	1534.	0.57	0.82	2.57
9	6	8	200.	750.	110.	1534.	0.57	1.93	2.57
10	6	24	250.	550.	120.	3262.	0.77	1.64	2.98
11	9	10	450.	300.	120.	15942.	1.16	0.97	3.22
12	10	11	400.	360.	120.	10597.	0.98	0.95	2.68
13	10	16	300.	440.	120.	3333.	0.55	0.56	1.28
14	11	12	350.	400.	120.	7213.	0.87	1.01	2.52
15	11	19	200.	1030.	110.	1850.	0.68	3.74	3.63
16	12	13	200.	290.	110.	543.	0.20	0.11	0.38
17	12	17	300.	1320.	120.	5709.	0.93	4.57	3.46
18	13	14	100.	290.	110.	-224.	-0.33	-0.62	-2.13
19	14	15	200.	420.	110.	-1190.	-0.44	-0.67	-1.60
20	15	16	300.	420.	120.	-2103.	-0.34	-0.23	-0.54
21	17	18	300.	1070.	120.	5046.	0.83	2.95	2.75
22	18	21	250.	1650.	120.	-2391.	-0.56	-2.77	-1.68
23	18	29	300.	400.	120.	6775.	1.11	1.90	4.75
24	19	20	100.	500.	110.	373.	0.55	2.74	5.47
25	20	21	150.	1520.	110.	-290.	-0.19	-0.73	-0.48
26	21	22	250.	300.	120.	-3343.	-0.79	-0.94	-3.12
27	22	23	250.	750.	120.	-3637.	-0.86	-2.74	-3.65
28	24	25	250.	1040.	120.	1729.	0.41	0.96	0.92
29	25	26	150.	1350.	110.	-598.	-0.39	-2.46	-1.82
30	25	27	250.	1100.	120.	1858.	0.44	1.16	1.05
31	26	1	150.	750.	110.	-1079.	-0.71	-4.08	-5.44
32	27	28	150.	540.	110.	435.	0.28	0.55	1.01

ALTERNATIV D-B (Parallel Pipeline Alignment of Recommended Plan)
Year 1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	30.00	0.00	30.00	0.00	0.00
2	1.37	0.00	28.26	26.89	28.63
3	1.22	76.00	27.42	26.20	28.78
4	1.50	2111.00	22.49	20.99	28.50
5	1.50	1597.00	21.73	20.23	28.50
6	1.62	0.00	16.39	14.77	28.38
7	1.59	1582.00	12.86	11.27	28.41
8	1.50	982.00	12.97	11.47	28.50
9	2.79	1942.00	20.62	17.83	27.21
10	2.41	1235.00	19.01	16.60	27.59
11	2.24	2337.00	17.99	15.75	27.76
12	3.21	1367.00	16.76	13.55	26.79
13	2.76	90.00	15.64	12.88	27.24
14	2.45	1102.00	9.03	6.58	27.55
15	2.74	367.00	10.53	7.79	27.26
16	2.71	1300.00	17.22	14.51	27.29
17	3.69	789.00	13.20	9.51	26.31
18	3.57	189.00	11.53	7.96	26.43
19	1.80	0.00	21.80	20.00	28.20
20	3.08	0.00	23.08	20.00	26.92
21	3.08	0.00	23.08	20.00	26.92
22	3.10	0.00	23.10	20.00	26.90
23	3.10	0.00	23.10	20.00	26.90
24	1.87	982.00	13.88	12.01	28.13
25	1.79	0.00	21.79	20.00	28.21
26	1.60	0.00	21.60	20.00	28.40
27	1.94	0.00	21.94	20.00	28.06
28	1.69	0.00	21.69	20.00	28.31
29	4.00	2111.00	11.00	7.00	26.00

Iteration Times : 6

ALTERNATIV D-B (Parallel Pipeline Alignment of Recommended Plan)
Year 1995

<< PIPELINE >>

PIPE No.	NODE No. from	to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu. m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	450.	350.	120.	-20144.	-1.47	-1.74	-4.96
2	2	3	450.	170.	120.	20146.	1.47	0.84	4.96
3	3	4	450.	1000.	120.	20070.	1.46	4.93	4.93
4	4	5	450.	190.	120.	17961.	1.31	0.76	4.01
5	5	6	200.	440.	110.	3546.	1.31	5.34	12.13
6	5	9	400.	290.	120.	12823.	1.18	1.11	3.81
7	6	7	150.	320.	110.	1582.	1.04	3.53	11.04
8	6	8	150.	750.	110.	982.	0.64	3.43	4.57
9	6	24	150.	550.	110.	982.	0.64	2.51	4.57
10	9	10	350.	300.	120.	10882.	1.31	1.62	5.39
11	10	11	350.	360.	120.	7685.	0.92	1.02	2.83
12	10	16	200.	440.	110.	1963.	0.72	1.79	4.06
13	11	12	300.	400.	120.	5349.	0.88	1.23	3.07
14	12	13	150.	290.	110.	895.	0.59	1.12	3.85
15	12	17	250.	1320.	120.	3087.	0.73	3.55	2.69
16	13	14	100.	290.	110.	805.	1.19	6.61	22.80
17	14	15	100.	420.	110.	-296.	-0.44	-1.50	-3.58
18	15	16	100.	420.	110.	-663.	-0.98	-6.69	-15.92
19	17	18	250.	1070.	120.	2299.	0.54	1.67	1.56
20	18	29	250.	400.	120.	2111.	0.50	0.53	1.33

ALTERNATIVE D-B (Parallel Pipeline Alignment of Recommended Plan)
Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	30.00	0.00	30.00	0.00	0.00
2	1.37	0.00	28.21	26.84	28.63
3	1.22	1633.00	27.27	26.05	28.78
4	1.50	4172.00	22.13	20.63	28.50
5	1.50	1681.00	21.33	19.83	28.50
6	1.62	0.00	18.66	17.04	28.38
7	1.59	2469.00	16.43	14.84	28.41
8	1.50	2469.00	13.43	11.93	28.50
9	2.79	3671.00	20.27	17.48	27.21
10	2.41	3241.00	19.17	16.76	27.59
11	2.24	2470.00	18.39	16.15	27.76
12	3.21	1547.00	17.29	14.08	26.79
13	2.76	1235.00	15.72	12.96	27.24
14	2.45	1555.00	15.14	12.69	27.55
15	2.74	1472.00	17.11	14.37	27.26
16	2.71	1980.00	17.93	15.22	27.29
17	3.69	1067.00	14.76	11.07	26.31
18	3.57	1067.00	12.51	8.94	26.43
19	1.80	2378.00	10.66	8.86	28.20
20	3.08	1067.00	10.31	7.23	26.92
21	3.08	1067.00	14.11	11.03	26.92
22	3.10	473.00	15.15	12.05	26.90
23	3.10	755.00	18.46	15.36	26.90
24	1.87	2470.00	16.02	14.15	28.13
25	1.79	755.00	13.74	11.95	28.21
26	1.60	774.00	19.93	18.33	28.40
27	1.94	2291.00	10.94	9.00	28.06
28	1.69	700.00	9.63	7.94	28.31
29	4.00	4790.00	11.37	7.37	26.00

Iteration Times : 7

ALTERNATIVE D-B (Parallel Pipeline Alignment of Recommended Plan)
Year 2010

<< PIPELINE >>

PIPE No.	NODE No. from	--to	DIA. (mm)	LENGTH (m)	H-W C	FLOW (cu.m/day)	VEL. (m/sec)	HEADLOSS (m)	(0/00)
1	2	1	450.	350.	120.	-20459.	-1.49	-1.79	-5.11
2	2	1	500.	350.	120.	-27005.	-1.59	-1.79	-5.11
3	2	3	450.	170.	120.	21347.	1.55	0.94	5.52
4	2	3	450.	170.	120.	21347.	1.55	0.94	5.52
5	2	23	250.	1610.	120.	4782.	1.13	9.75	6.06
6	3	4	450.	1000.	120.	20531.	1.49	5.14	5.14
7	3	4	450.	1000.	120.	20531.	1.49	5.14	5.14
8	4	5	450.	190.	120.	18447.	1.34	0.80	4.22
9	4	5	450.	190.	120.	18447.	1.34	0.80	4.22
10	5	6	200.	440.	110.	2439.	0.90	2.67	6.07
11	5	6	300.	440.	120.	7730.	1.27	2.67	6.07
12	5	9	400.	290.	120.	12523.	1.15	1.06	3.65
13	5	9	400.	290.	120.	12523.	1.15	1.06	3.65
14	6	7	150.	320.	110.	1235.	0.81	2.23	6.98
15	6	7	150.	320.	110.	1235.	0.81	2.23	6.98
16	6	8	150.	750.	110.	1234.	0.81	5.23	6.98
17	6	8	150.	750.	110.	1234.	0.81	5.23	6.98
18	6	24	150.	550.	110.	1010.	0.66	2.65	4.81
19	6	24	250.	550.	120.	4222.	1.00	2.65	4.81
20	9	10	350.	300.	120.	8831.	1.06	1.10	3.66
21	9	10	400.	300.	120.	12546.	1.16	1.10	3.65
22	10	11	350.	360.	120.	6674.	0.80	0.79	2.18
23	10	11	350.	360.	120.	6674.	0.80	0.79	2.18
24	10	16	200.	440.	110.	1617.	0.60	1.25	2.83
25	10	16	250.	440.	120.	3173.	0.75	1.25	2.83
26	11	12	300.	400.	120.	5029.	0.82	1.09	2.74
27	11	12	250.	400.	120.	3114.	0.73	1.09	2.74
28	11	19	200.	1030.	110.	2736.	1.01	7.73	7.50
29	12	13	150.	290.	110.	1080.	0.71	1.58	5.44
30	12	13	100.	290.	110.	372.	0.55	1.58	5.44
31	12	17	250.	1320.	120.	2573.	0.61	2.54	1.92
32	12	17	250.	1320.	120.	2573.	0.61	2.54	1.92
33	13	14	100.	290.	110.	216.	0.32	0.58	2.00
34	14	15	100.	420.	110.	-343.	-0.51	-1.97	-4.69
35	14	15	150.	420.	110.	-995.	-0.65	-1.97	-4.69
36	15	16	100.	420.	110.	-214.	-0.32	-0.82	-1.96
37	15	16	250.	420.	120.	-2597.	-0.61	-0.82	-1.96
38	17	18	250.	1070.	120.	2701.	0.64	2.25	2.10
39	17	18	200.	1070.	110.	1377.	0.51	2.25	2.10
40	18	21	250.	1650.	120.	-1778.	-0.42	-1.60	-0.97
41	18	29	250.	400.	120.	3173.	0.75	1.13	2.83
42	18	29	200.	400.	110.	1617.	0.60	1.13	2.83
43	19	20	150.	500.	110.	358.	0.23	0.35	0.70
44	20	21	150.	1520.	110.	-709.	-0.46	-3.80	-2.50
45	21	22	250.	300.	120.	-3554.	-0.84	-1.05	-3.50
46	22	23	250.	750.	120.	-4027.	-0.95	-3.30	-4.41
47	24	25	250.	1040.	120.	2762.	0.65	2.28	2.19
48	25	26	150.	1350.	110.	-984.	-0.64	-6.19	-4.59
49	25	27	250.	1100.	120.	2991.	0.71	2.79	2.54
50	26	1	150.	750.	110.	-1758.	-1.15	-10.07	-13.43
51	27	28	150.	540.	110.	700.	0.46	1.32	2.44

APPENDIX 8.2.1.A BREAKDOWN OF COST ESTIMATES.

(Unit: thousand Pesos)

Dagupan ITEM	UNIT COST	Phase I (Stage 1) NUMBER	Phase I (Stage 1) COST	Phase I (Stage 2) NUMBER	Phase I (Stage 2) COST	Phase I Total NUMBER	Phase I Total COST	Phase II Cost NUMBER	Phase II Cost COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	640000	8	5120	7	4480	15	9600	0	0
(2)DEEP WELL PUMP w/HOUSE	450000	8	3600	7	3150	15	6750	0	0
Flow Meter D=100	25000	8	200	7	175	15	375	0	0
(3)DEEP WELL PUMP REPAIR	252000	10	2520	0	0	10	2520	0	0
Flow Meter D=100	25000	10	250	0	0	10	250	0	0
(4)RADIAL WELL	1760000	0	0	0	0	0	0	4	7040
WELL PUMP	403000	0	0	0	0	0	0	9	3627
RADIAL WELL PUMP HOUSE	634000	0	0	0	0	0	0	4	2536
SUB-TOTAL			11690		7805		19495		13203
2 TRANSMISSION FACILITIES									
(1)Main Pipe D=600(Steel)	1600	0	0	0	0	0	0	26000	41600
(2)Main Pipe									
D=150 (PVC Pipe)	410	5400	2214	3850	1579	9250	3793		0
D=200 (Steel Pipe)	520	1500	780	1050	546	2550	1326		0
D=250 (Steel Pipe)	630	1000	630	1050	662	2050	1292		0
D=300 (Steel Pipe)	760	750	570	550	418	1300	988	2400	1824
D=350 (Steel Pipe)	900	4000	3600	700	630	4700	4230		0
SUB-TOTAL			7794		3835		11629		43424
3 Slow Sand Filtration Plant		0	0	0	0	0	0	1	9544
4 DISTRIBUTION FACILITIES							0		
(1)Reservoir		(2400)	2898	0	0	(2400)	2898	(4550)	4362
(2)Pump Facility (Equip.)			1784		800		2584		3394
-do- (Civil)			1331		0		1331		1748
(3)Chlorination Facility	98100	11	1079	0	0	11	1079	45kg/dx1	119
(4)Electric Sub-station		200KVA	2620			200KVA	2620	400KVA	1020
(5)Distribution pipes									
1)Main Pipes									
D=150 (PVC Pipe)	410	0	0	0	0	0	0	4160	1706
D=200 (Steel Pipe)	520	0	0	1780	926	1780	926	1030	536
D=250 (Steel Pipe)	630	0	0	550	347	550	347	6150	3875
D=300 (Steel Pipe)	760	440	334	3210	2440	3650	2774	0	0
D=350 (Steel Pipe)	900	440	396	400	360	840	756	0	0
D=400 (Steel Pipe)	970	300	291	0	0	300	291	0	0
D=450 (Steel Pipe)	1160	240	278	0	0	240	278	0	0
D=500 (Steel Pipe)	1330	290	386	0	0	290	386	0	0
D=600 (Steel Pipe)	1600	1360	2176	0	0	1360	2176	0	0
D=700 (Steel Pipe)	1910	350	669	0	0	350	669	0	0
RIVER CROSSING CD=1.5m	1658	120	199	0	0	120	199	300	497
D=450 Materials	626	120	75	0	0	120	75		0
D=250 Materials	340	0	0	0	0	0	0	300	102
2)Valves									
D=150 (Gate Valve)	5300	0	0	6	32	6	32	14	74
D=200 (Gate Valve)	6700	0	0	6	40	6	40	3	20
D=250 (Gate Valve)	11200	0	0	2	22	2	22	22	246
D=300 (Butterfly Valve)	34800	2	70	10	348	12	418	0	0
D=350 (Butterfly Valve)	74400	2	149	1	74	3	223	0	0
D=400 (Butterfly Valve)	95200	1	95	0	0	1	95	0	0
D=450 (Butterfly Valve)	125900	1	126	0	0	1	126	0	0
D=500 (Butterfly Valve)	174000	1	174	0	0	1	174	0	0
D=600 (Butterfly Valve)	243600	5	1218	0	0	5	1218	0	0
D=700 (Butterfly Valve)	313200	1	313	0	0	1	313	0	0
3)Internal Network									6081
UPTO 1990			5049		0		5049		.
UPTO 1995			0		898		898		
4)Service Conections									
D=1/2	810	2279	1846	3811	3086	6090	4932	8940	7241
D=3/4	1280	17	22	7	9	24	31	16	20
5)Rehabilitation									
Water Meter 1/2''	400	1392	557	0	0	1392	557		
Water Meter 3/4''	880	16	14	0	0	16	14		
Old Laterals			571	0	0	0	571		
Service Connect.wo/Metr	480	724	348	0	0	724	348		
Service Connect.w/Meter	880	1401	1233	0	0	1401	1233		
6)Flow Meter									
D=600	215000	0	0	0	0	0	0	1	215
7)Fire Protection									
D=150	16800	0	0	0	0	0	0	62	1042
D=100	9400	0	0	0	0	0	0	281	2641
SUB-TOTAL			26301	0	9382	0	35683		34939
5 1)Administration Bldg								1	1610
2)Operation Center		1	1380			1	1380	0	0
SUB-TOTAL			1380		0		1380		1610
6 Land Acquisition	60	2200	132	0	0	2200	132	22000	1320
Vehicle	300000	2	600	1	300	3	900	3	900
Stored Material & Equip.		0	503	0	247	0	750		898
SUB-TOTAL			1235		547		1782		3118
7 Replacement of Equipment			0		0		0		14562
TOTAL			48400		21569		69969		120400
8 Leakage Detection	240	4250	1020	0	0	4250	1020		0
GRAND TOTAL			49420		21569		70989		120400

(Unit: thousand Pesos)

Daxupan ITEM	UNIT COST	1988 NO	1988 COST	1989 NO	1989 COST	1990 NO	1990 COST	1991 NO	1991 COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	640000		0	4	2560	4	2560	2	1280
(2)DEEP WELL PUMP w/HOUSE	450000		0	4	1800	4	1800	2	900
Flow Meter D=100	25000		0	4	100	4	100	2	50
(3)DEEP WELL PUMP REPAIR	252000		0	10	2520		0		0
Flow Meter D=100	25000		0	10	250		0		0
(4)RADIAL WELL	1760000		0		0		0		0
WELL PUMP	403000		0		0		0		0
RADIAL WELL PUMP HOUSE	634000		0		0		0		0
SUB-TOTAL			0		7230		4460		2230
2 TRANSMISSION FACILITIES									
(1)Main Pipe D=600(Steel)	1600		0		0		0		0
(2)Main Pipe					0		0		0
D=150 (PVC Pipe)	410		0	2900	1189	2500	1025	1050	431
D=200 (Steel Pipe)	520		0	1500	780	0	0	0	0
D=250 (Steel Pipe)	630		0	1000	630	0	0	0	0
D=300 (Steel Pipe)	760		0	750	570	0	0	550	418
D=350 (Steel Pipe)	900		0	2500	2250	1500	1350	700	630
SUB-TOTAL			0		5419		2375		1479
3 Slow Sand Filtration Plant									
4 DISTRIBUTION FACILITIES									
(1)Reservoir				(2400)	2898				
(2)Pump Facility (Equip.)					1784				800
-do- (Civil)					1331				
(3)Chlorination Facility	98100			11	1079				
(4)Electric Sub-station				1	2620				
(5)Distribution pipes		1988		1989		1990		1991	
1)Main Pipes									
D=150 (PVC Pipe)	410		0		0		0		0
D=200 (Steel Pipe)	520		0		0		0	1780	926
D=250 (Steel Pipe)	630		0		0		0	550	347
D=300 (Steel Pipe)	760		0		0	440	334	3210	2440
D=350 (Steel Pipe)	900		0		0	440	396	400	360
D=400 (Steel Pipe)	970		0		0	300	291		0
D=450 (Steel Pipe)	1160		0		0	240	278		0
D=500 (Steel Pipe)	1330		0		0	290	386		0
D=600 (Steel Pipe)	1600		0	1360	2176		0		0
D=700 (Steel Pipe)	1910		0	350	669		0		0
RIVER CROSSING CD=1.5m	1658		0		0	120	199		0
D=450 Materials	626		0		0	120	75		0
D=250 Materials	340		0		0		0		0
2)Valves									
D=150 (Gate Valve)	5300		0		0		0	6	32
D=200 (Gate Valve)	6700		0		0		0	6	40
D=250 (Gate Valve)	11200		0		0		0	2	22
D=300 (Butterfly Valve)	34800		0		0	2	70	10	348
D=350 (Butterfly Valve)	74400		0		0	2	149	1	74
D=400 (Butterfly Valve)	95200		0		0	1	95		0
D=450 (Butterfly Valve)	125900		0		0	1	126		0
D=500 (Butterfly Valve)	174000		0		0	1	174		0
D=600 (Butterfly Valve)	243600		0	5	1218		0		0
D=700 (Butterfly Valve)	313200		0	1	313		0		0
3)Internal Network									
UPTO 1990					2525		2524		
UPTO 1995									180
4)Service Conections									
D=1/2	810		0	1139	923	1140	923	763	618
D=3/4	1280		0	8	10	9	12	1	1
5)Rehabilitation									
Water Meter 1/2''	400	1392	557	0	0	0	0		
Water Meter 3/4''	880	16	14	0	0	0	0		
Old Laterals					286		285		
Service Connect.wo/Metr	480	242	116	241	116	241	116		
Service Connect.w/Meter	880	467	411	467	411	467	411		
6)Flow Meter									
D=600	215000		0		0		0		0
7)Fire Protection									
D=150	16800								
D=100	9400								
SUB-TOTAL			1098		18359		6844		6188
5 1)Administration Bldg									
2)Operation Center				1	1380				
SUB-TOTAL			0	1	1380		0		0
6 Land Acquisition	60	2200	132		0		0		0
Vehicle	300000	1	300	1	300		0	1	300
Stored Material & Equip.			20		334		149		118
SUB-TOTAL			452		634		149		418
7 Replacement of Equipment			0		0		0		0
TOTAL			1550		33022		13828		10315
8 Leakage Detection	240	1420	341	1420	341	1410	338		0
GRAND TOTAL			1891		33363		14166		10315

(Unit: thousand Pesos)

Dagupan ITEM	UNIT COST	1992 NO	1992 COST	1992 NO	1992 COST	1994 NO	1994 COST	1995 NO	1995 COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	640000	1	640	1	640	2	1280	1	640
(2)DEEP WELL PUMP w/HOUSE	450000	1	450	1	450	2	900	1	450
Flow Meter D=100	25000	1	25	1	25	2	50	1	25
(3)DEEP WELL PUMP REPAIR	252000		0		0		0		0
Flow Meter D=100	25000		0		0		0		0
(4)RADIAL WELL	1760000		0		0		0		0
WELL PUMP	403000		0		0		0		0
RADIAL WELL PUMP HOUSE	634000		0		0		0		0
SUB-TOTAL			1115		1115		2230		1115
2 TRANSMISSION FACILITIES									
(1)Main Pipe D=600(Steel)	1600		0		0		0		0
(2)Main Pipe			0		0		0		0
D=150 (PVC Pipe)	410	1100	451	400	164	900	369	400	164
D=200 (Steel Pipe)	520	0	0	0	0	450	234	600	312
D=250 (Steel Pipe)	630	0	0	550	347	500	315	0	0
D=300 (Steel Pipe)	760	0	0	0	0	0	0	0	0
D=350 (Steel Pipe)	900	0	0	0	0	0	0	0	0
SUB-TOTAL			451		511		918		476
3 Slow Sand Filtration Plant									
4 DISTRIBUTION FACILITIES									
(1)Reservoir									
(2)Pump Facility (Equip.)									
-do- (Civil)									
(3)Chlorination Facility	98100								
(4)Electric Sub-station									
(5)Distribution pipes		1992		1993		1994		1995	
1)Main Pipes									
D=150 (PVC Pipe)	410		0		0		0		0
D=200 (Steel Pipe)	520		0		0		0		0
D=250 (Steel Pipe)	630		0		0		0		0
D=300 (Steel Pipe)	760		0		0		0		0
D=350 (Steel Pipe)	900		0		0		0		0
D=400 (Steel Pipe)	970		0		0		0		0
D=450 (Steel Pipe)	1160		0		0		0		0
D=500 (Steel Pipe)	1330		0		0		0		0
D=600 (Steel Pipe)	1600		0		0		0		0
D=700 (Steel Pipe)	1910		0		0		0		0
RIVER CROSSING CD=1.5m	1658		0		0		0		0
D=450 Materials	626		0		0		0		0
D=250 Materials	340		0		0		0		0
2)Valves									
D=150 (Gate Valve)	5300		0		0		0		0
D=200 (Gate Valve)	6700		0		0		0		0
D=250 (Gate Valve)	11200		0		0		0		0
D=300 (Butterfly Valve)	34800		0		0		0		0
D=350 (Butterfly Valve)	74400		0		0		0		0
D=400 (Butterfly Valve)	95200		0		0		0		0
D=450 (Butterfly Valve)	125900		0		0		0		0
D=500 (Butterfly Valve)	174000		0		0		0		0
D=600 (Butterfly Valve)	243600		0		0		0		0
D=700 (Butterfly Valve)	313200		0		0		0		0
3)Internal Network									
UPTO 1990									
UPTO 1995			180		180		179		179
4)Service Conections									
D=1/2	810	762	617	762	617	762	617	762	617
D=3/4	1280	2	3	1	1	2	3	1	1
5)Rehabilitation									
Water Meter 1/2''	400								
Water Meter 3/4''	880								
Old Laterals									
Service Connect.wo/Metr	480								
Service Connect.w/Meter	880								
6)Flow Meter									
D=600	215000		0		0		0		0
7)Fire Protection									
D=150	16800								
D=100	9400								
SUB-TOTAL			800		798		799		797
5 1)Administration Bldg									
2)Operation Center									
SUB-TOTAL			0		0		0		0
6 Land Acquisition	60		0		0		0		0
Vehicle	300000		0		0		0		0
Stored Material & Equip.			28		29		44		28
SUB-TOTAL			28		29		44		28
7 Replacement of Equipment			0		0		0		0
TOTAL			2394		2453		3991		2416
8 Leakage Detection	240		0		0		0		0
GRAND TOTAL			2394		2453		3991		2416

APPENDIX 8.2.1.B PROJECT COST WITH FOREIGN AND LOCAL CURRENCY BREAKDOWN (1986 Price Level, Dagupan City)

SUMMARY

Phase I, Stage 1

(Unit: thousand ₱)

	Local	F.E.C	Total
Direct Construction Cost	21,868	26,532	48,400
Physical Cont. (8% of D.C.C.)	1,749	2,123	3,872
Sub Total	23,617	28,655	52,272
Leakage Detection	1,020	-	1,020
Detailed Design (10% of S.T. in Stage 1 & Stage 2)	3,778	3,779	7,557
Construction Supervision (4% of S.T.)	1,045	1,046	2,091
Total	29,460	33,480	62,940

Phase I, Stage 2

(Unit: thousand ₱)

	Local	F.E.C	Total
Direct Construction Cost	9,604	11,965	21,569
Physical Cont. (8% of D.C.C.)	769	957	1,726
Sub Total	10,373	12,922	23,295
Construction Supervision (4% of S.T.)	609	223	932
Total	10,982	13,145	24,227

Phase II

(Unit: thousand ₱)

	Local	F.E.C	Total
Direct Construction Cost	53,133	67,267	120,400
Physical Cont. (8% of D.C.C.)	4,251	5,381	9,632
Sub Total	57,384	72,648	130,032
Detailed Design (10% of S.T.)	6,501	6,502	13,003
Construction Supervision (4% of S.T.)	5,201	-	5,201
Total	69,086	79,150	148,236

The following tables show the breakdown of the project cost in each design year. The unit of all figures is thousand pesos. Project cost is further broken down into the Foreign Exchange Compornent and the Local Currency Compornent. Abbreviations in the tables are as follows:

COST	---	Construction Cost
C.FEC	---	Cost for Civil Work in the Foreign Exchange Compornent
C.DOM	---	Cost for Civil Work in the Local Currency Compornent
C.D.UNSKL	---	Cost for Unskilled Laborer of Civil Works in the Local Currency Compornent.
E.FEC	---	Cost for Equipments in the Foreign Exchange Compornent
E.DOM	---	Cost for Equipments in the Local Currency Compornent

COST = C.FEC + C.DOM + E.FEC + E.DOM

The exchange rates used in the cost estimates are as follows:

₱20 = $1

$1 = ¥155

DAGUPAN	1988						1989						1990					
ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)DEEP WELL	0.0	0.0	0.0	0.0	0.0	0.0	2560.0	435.2	1177.0	128.0	512.0	435.2	2560.0	435.2	1177.0	128.0	512.0	435.2
(2)PUMPING FACILITY																		
1)Pumping Station	0.0	0.0	0.0	0.0	0.0	0.0	1800.0	162.0	630.0	90.0	846.0	162.0	1800.0	162.0	630.0	90.0	846.0	162.0
2)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	350.0	0.0	0.0	0.0	350.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)REPAIR & IMPROVEMENT	0.0	0.0	0.0	0.0	0.0	0.0	2520.0	0.0	0.0	0.0	2116.8	403.2	100.0	0.0	0.0	0.0	84.0	16.0
(4)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	7230.0	597.2	1807.6	218.0	3821.8	1000.4	4460.0	597.2	1807.6	218.0	1442.0	613.2
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	0.0	0.0	0.0	0.0	0.0	0.0	5419.0	975.4	1517.3	216.8	1679.9	1246.4	2375.0	427.5	665.0	95.0	736.2	546.3
(2)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	5419.0	975.4	1517.3	216.8	1679.9	1246.4	2375.0	427.5	665.0	95.0	736.2	546.3
3.0 WATER PURIFICATION PLANT																		
(1)Slow Sand Filtration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	2898.0	753.5	1883.7	202.9	141.9	115.9		0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	0.0	0.0	0.0	0.0	0.0	0.0	3115.0	93.5	1246.0	219.2	1464.0	311.5		0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	0.0	0.0	0.0	0.0	0.0	0.0	1079.0	54.0	366.9	32.4	496.2	161.9		0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2620.0	406.1	576.4	52.4	1375.5	262.0		0.0	0.0	0.0	0.0	0.0
(5)Distribution pipes																		
1)Main Pipes	0.0	0.0	0.0	0.0	0.0	0.0	2845.0	512.1	796.6	113.8	881.9	654.4	1685.0	303.3	471.8	67.4	522.3	387.6
2)River Crossing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	199.0	85.6	113.4	15.9	0.0	0.0
3)River Crossing Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0	42.7	32.3
4)Valves	0.0	0.0	0.0	0.0	0.0	0.0	1531.0	30.6	321.5	91.9	1041.1	137.8	614.0	12.3	128.9	36.8	417.5	55.3
5)Internal Network	0.0	0.0	0.0	0.0	0.0	0.0	2525.0	404.0	707.0	101.0	858.5	555.5	2524.0	403.8	706.7	101.0	858.2	555.3
6)Service Connections	0.0	0.0	0.0	0.0	0.0	0.0	933.0	9.3	93.3	28.0	793.1	37.3	935.0	9.4	93.5	28.1	794.7	37.4
7)Water Meter	571.0	0.0	0.0	0.0	571.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Cnnctn Rhbltn wo/M	116.0	2.9	30.2	7.0	72.5	10.4	116.0	2.9	30.2	7.0	72.5	10.4	116.0	2.9	30.2	7.0	72.5	10.4
9)Srvc Cnnctn Rhbltn w/Mr	411.0	4.1	41.1	12.3	349.4	16.4	411.0	4.1	41.1	12.3	349.4	16.4	411.0	4.1	41.1	12.3	349.4	16.4
10)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	286.0	45.8	80.1	11.4	97.2	62.9	285.0	51.3	79.8	11.4	88.3	65.6
11)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0						0.0					
12)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1098.0	7.0	71.3	19.3	992.9	26.8	18359.0	2315.9	6142.8	902.3	7574.3	2326.0	6841.0	872.7	1605.4	279.9	3145.6	1169.3
5.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	1380.0	124.2	565.8	69.0	496.8	193.2		0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	1380.0	124.2	565.8	69.0	496.8	193.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1098.0	7.0	71.3	19.3	992.9	26.8	32388.0	4012.7	10033.5	1406.1	13575.8	4766.0	13679.0	1897.4	4138.0	592.9	5323.8	2319.8
6.0 Land Acquisition	132.0		132.0				0.0		0.0				0.0		0.0			
Vehicle	300.0				150.0	150.0	300.0				150.0	150.0	0.0				0.0	0.0
Stored Material & Equip.	20.0				16.8	3.2	334.0				280.6	53.4	149.0				125.2	23.8
SUB-TOTAL	452.0	0.0	132.0		166.8	153.2	634.0	0.0	0.0		430.6	203.4	149.0	0.0	0.0		125.2	23.8
7.0 Replacement of Equip.																		
1)WELL PUMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.0 Leakage Detection	341.0		341.0				341.0		341.0				338.0		338.0			
GRAND TOTAL	1801.0	7.0	544.3	19.3	1159.7	180.0	33363.0	4012.7	10374.5	1406.1	14006.4	4969.4	14166.0	1897.4	4476.0	592.9	5449.3	2343.6

DAGUPAN		1988						1989						1990					
No.	ITEM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM	COST	C.FEC	C.DOM	C.D.UNSKL	E.FEC	E.DOM
1	Deep Well Facilities	0.0	0.0	0.0	0.0	0.0	0.0	7230.0	597.2	1807.6	218.0	3824.8	1000.4	4460.0	597.2	1807.6	218.0	1442.0	613.2
2	Transmission Facilities	0.0	0.0	0.0	0.0	0.0	0.0	5419.0	975.4	1517.3	216.8	1679.9	1246.4	2375.0	427.5	665.0	95.0	736.2	546.3
3	Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	2898.0	753.5	1883.7	202.9	141.9	115.9	0.0	0.0	0.0	0.0	0.0	0.0
5	Disinfection Facilities	0.0	0.0	0.0	0.0	0.0	0.0	1079.0	54.0	366.9	32.4	496.2	161.9	0.0	0.0	0.0	0.0	0.0	0.0
6	Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2620.0	406.1	576.4	52.4	1375.5	262.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Distribution Facilities	0.0	0.0	0.0	0.0	0.0	0.0	10302.0	1086.0	3151.2	567.3	4342.7	1722.1	5382.0	856.3	1500.6	232.5	1929.0	1096.1
8	Service Connection	1098.0	7.0	71.3	19.3	992.9	26.8	1460.0	16.3	164.6	47.3	1215.0	64.1	1462.0	16.4	164.8	47.4	1216.6	64.2
9	Admini. Bldg. & Ope. Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	1380.0	124.2	565.8	69.0	496.8	193.2	0.0	0.0	0.0	0.0	0.0	0.0
10	Land Acquisition	132.0	0.0	132.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Vehicle & Stored Material	320.0	0.0	0.0	0.0	166.8	153.2	634.0	0.0	0.0	0.0	430.6	203.4	149.0	0.0	0.0	0.0	125.2	23.8
12	Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SUB TOTAL	1550.0	7.0	203.3	19.3	1159.7	180.0	33022.0	4012.7	10033.5	1406.1	14006.4	1969.4	13828.0	1897.4	4138.0	592.9	5449.0	2343.6
13	Leakage Detection	341.0	0.0	341.0	0.0	0.0	0.0	341.0	0.0	341.0	0.0	0.0	0.0	338.0	0.0	338.0	0.0	0.0	0.0
	TOTAL	1801.0	7.0	544.3	19.3	1159.7	180.0	33363.0	4012.7	10374.5	1406.1	14006.4	4969.4	14166.0	1897.4	4476.0	592.9	5449.0	2343.6

DAGUPAN ITEM	Phase I (Stage I) COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	1991 COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	1992 COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)DEEP WELL	5120.0	870.4	2355.2	256.0	1024.0	870.4	1280.0	217.6	588.8	64.0	256.0	217.6	640.0	108.8	294.4	32.0	128.0	108.8
(2)PUMPING FACILITY	0.0	0.0	0.0	0.0	0.0	0.0												
1)Pumping Station	3600.0	324.0	1260.0	180.0	1692.0	324.0	900.0	81.0	315.0	45.0	423.0	81.0	450.0	40.5	157.5	22.5	211.5	40.5
2)Flow Meter	350.0	0.0	0.0	0.0	350.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0	25.0	0.0	0.0	0.0	25.0	0.0
(3)REPAIR & IMPRUVEMENT	2620.0	0.0	0.0	0.0	2200.8	419.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	11690.0	1194.4	3615.2	436.0	5266.8	1613.6	2230.0	298.6	903.8	109.0	729.0	298.6	1115.0	149.3	451.9	54.5	364.5	149.3
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	7794.0	1402.9	2182.3	311.8	2416.1	1792.7	1479.0	266.2	414.1	59.2	458.5	340.2	451.0	81.2	126.3	18.0	139.8	103.7
(2)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	7794.0	1402.9	2182.3	311.8	2416.1	1792.7	1479.0	266.2	414.1	59.2	458.5	340.2	451.0	81.2	126.3	18.0	139.8	103.7
3.0 WATER PURIFICTION PLANT																		
(1)Slow Sand Filtration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	2808.0	753.5	1883.7	202.9	144.9	115.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	3115.0	93.5	1246.0	219.2	1464.0	311.5	800.0	0.0	0.0	0.0	661.0	136.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	1079.0	54.0	366.9	32.4	496.2	161.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	2620.0	406.1	576.4	52.4	1375.5	262.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)Distribution pipes																		
1)Main Pipes	4530.0	815.4	1268.4	181.2	1401.2	1042.0	4073.0	733.1	1140.4	162.9	1262.7	936.8	0.0	0.0	0.0	0.0	0.0	0.0
2)River Crossing	199.0	85.6	113.4	15.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)River Crossing Material	75.0	0.0	0.0	0.0	42.7	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Valves	2145.0	42.9	450.4	128.7	1458.6	193.1	516.0	10.3	108.4	31.0	350.9	46.4	0.0	0.0	0.0	0.0	0.0	0.0
5)Internal Network	5049.0	807.8	1413.7	202.0	1716.7	1110.8	180.0	28.8	50.4	7.2	61.2	39.6	180.0	28.8	50.4	7.2	61.2	39.6
6)Service Connections	1868.0	18.7	186.8	56.1	1587.8	74.7	619.0	6.2	61.9	18.6	526.1	24.8	620.0	6.2	62.0	18.6	527.0	24.8
7)Water Meter	571.0	0.0	0.0	0.0	571.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Cnnctn Rhblln wo/M	348.0	8.7	90.6	21.0	217.5	31.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9)Srvc Cnnctn Rhbltn w/Mr	1233.0	12.3	123.3	36.9	1018.2	49.2												
10)Lateral Rehabilitation	571.0	97.1	159.9	22.8	185.5	128.5	0.0						0.0					
11)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0						0.0					
12)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	26301.0	3195.6	7879.5	1201.5	11712.8	3513.1	6188.0	778.4	1361.1	219.7	2864.9	1183.6	800.0	35.0	112.4	25.8	588.2	64.4
5.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Operation Center	1380.0	124.2	565.8	69.0	496.8	193.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1380.0	124.2	565.8	69.0	496.8	193.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	47165.0	5917.1	14242.8	2018.3	19892.5	7112.6	9897.0	1343.2	2679.0	387.9	4052.4	1822.4	2366.0	265.5	690.6	98.3	1092.5	317.4
6.0 Land Acquisition	132.0	0.0	132.0	0.0	0.0	0.0	0.0		0.0				0.0		0.0			
Vehicle	600.0	0.0	0.0	0.0	300.0	300.0	300.0				150.0	150.0	0.0				0.0	0.0
Stored Material & Equip.	503.0	0.0	0.0	0.0	422.6	80.4	118.0				99.1	18.9	28.0				23.5	4.5
SUB-TOTAL	1235.0	0.0	132.0	0.0	722.6	380.4	418.0	0.0	0.0		249.1	168.9	28.0	0.0	0.0		23.5	4.5
7.0 Replacement of Equip.																		
1)WELL PUMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.0 Leakage Detection	1020.0	0.0	1020.0	0.0	0.0	0.0		0.0	0.0				0	0.0	0.0			
GRAND TOTAL	49420.0	5917.1	15394.8	2018.3	20615.1	7493.0	10315.0	1343.2	2679.0	387.9	4301.5	1991.3	2394.0	265.5	690.6	98.3	1116.0	321.9

No.	DAGUPAN ITEM	Phase I (Stage I) COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	1991 COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	1992 COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM
1	Deep Well Facilities	11690.0	1194.4	3615.2	436.0	5266.8	1613.6	2230.0	298.6	903.8	109.0	729.0	298.6	1115.0	149.3	451.9	51.5	364.5	149.3
2	Transmission Facilities	7794.0	1402.9	2182.3	311.8	2416.1	1792.7	1479.0	266.2	414.1	59.2	458.5	340.2	451.0	81.2	126.3	18.0	139.8	103.7
3	Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Reservoir	2808.0	753.5	1883.7	202.9	144.9	115.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Disinfection Facilities	1079.0	54.0	366.9	32.4	496.2	161.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	Electric Sub-station	2620.0	406.1	576.4	52.4	1375.5	262.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Distribution Facilities	15684.0	1942.3	4651.8	799.8	6271.7	2818.2	5569.0	772.2	1299.2	201.1	2338.8	1158.8	180.0	28.8	50.4	7.2	61.2	39.6
8	Service Connection	4020.0	39.7	400.7	114.0	3424.5	155.1	619.0	6.2	61.9	18.6	526.1	24.8	620.0	6.2	62.0	18.6	527.0	24.8
9	Admini. Bldg. & Ope. Ctr.	1380.0	124.2	565.8	69.0	496.8	193.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Land Acquisition	132.0	0.0	132.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Vehicle & Stored Material	1103.0	0.0	0.0	0.0	722.6	380.4	418.0	0.0	0.0	0.0	249.1	168.9	28.0	0.0	0.0	0.0	23.5	4.5
12	Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SUB TOTAL	48400.0	5917.1	14374.8	2018.3	20615.1	7493.0	10315.0	1343.2	2679.0	387.9	4301.5	1991.3	2394.0	265.5	690.6	98.3	1116.0	321.9
13	Leakage Detection	1020.0	0.0	1020.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	49420.0	5917.1	15391.8	2018.3	20615.1	7493.0	10315.0	1343.2	2679.0	387.9	4301.5	1991.3	2394.0	265.5	690.6	98.3	1116.0	321.9

DAGUPAN ITEM	1993 COST	1993 C.FEC	1993 C.DOM	1993 C.D.UNSKL	1993 E.FEC	1993 E.DOM	1994 COST	1994 C.FEC	1994 C.DOM	1994 C.D.UNSKL	1994 E.FEC	1994 E.DOM	1995 COST	1995 C.FEC	1995 C.DOM	1995 C.D.UNSKL	1995 E.FEC	1995 E.DOM
1.0 SOURCE FACILITY																		
(1)DEEP WELL	640.0	108.8	294.4	32.0	128.0	108.8	1280.0	217.6	588.8	64.0	256.0	217.6	640.0	108.8	294.4	32.0	128.0	108.8
(2)PUMPING FACILITY																		
1)Pumping Station	450.0	40.5	157.5	22.5	211.5	40.5	900.0	81.0	315.0	45.0	423.0	81.0	450.0	40.5	157.5	22.5	211.5	40.5
2)Flow Meter	25.0	0.0	0.0	0.0	25.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0	25.0	0.0	0.0	0.0	25.0	0.0
(3)REPAIR & IMPROVEMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1115.0	149.3	451.9	54.5	364.5	149.3	2230.0	298.6	903.8	109.0	729.0	298.6	1115.0	149.3	451.9	54.5	364.5	149.3
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	511.0	92.0	143.1	20.4	158.4	117.5	918.0	165.2	257.0	36.7	284.7	211.1	476.0	85.7	133.3	19.0	147.5	109.5
(2)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	511.0	92.0	143.1	20.4	158.4	117.5	918.0	165.2	257.0	36.7	284.7	211.1	476.0	85.7	133.3	19.0	147.5	109.5
3.0 WATER PURIFICATION PLANT																		
(1)Slow Sand Filtration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)Pump Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)Chlorination Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5)Distribution pipes																		
1)Main Pipes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)River Crossing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)River Crossing Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Valves	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Internal Network	180.0	28.8	50.4	7.2	61.2	39.6	179.0	28.6	50.1	7.2	60.9	39.4	179.0	28.6	50.1	7.2	60.9	39.4
6)Service Connections	618.0	6.2	61.8	18.5	525.3	24.7	620.0	6.2	62.0	18.6	527.0	24.8	618.0	6.2	61.8	18.5	525.3	24.7
7)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Cnnctn Rhblln wo/M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9)Srvc Cnnctn Rhbltn w/Mr																		
10)Lateral Rehabilitation	0.0						0.0						0.0					
11)Flow Meter	0.0						0.0						0.0					
12)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	798.0	35.0	112.2	25.7	586.5	64.3	799.0	34.8	112.1	25.8	587.9	64.2	797.0	34.8	111.9	25.7	586.2	64.1
5.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2424.0	276.3	707.2	100.6	1109.4	331.1	3947.0	498.6	1272.9	171.5	1601.6	573.9	2388.0	269.8	697.1	99.2	1098.2	322.9
6.0 Land Acquisition	0.0		0.0				0.0		0.0				0.0		0.0			
Vehicle	0.0				0.0	0.0	0.0				0.0	0.0	0.0				0.0	0.0
Stored Material & Equip.	29.0				24.4	4.6	44.0				37.0	7.0	28.0				23.5	4.5
SUB-TOTAL	29.0	0.0	0.0		24.4	4.6	44.0	0.0	0.0		37.0	7.0	28.0	0.0	0.0		23.5	4.5
7.0 Replacement of Equip.																		
1)WELL PUMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.0 Leakage Detection	0	0.0	0.0				0	0.0	0.0				0	0.0	0.0			
GRAND TOTAL	2453.0	276.3	707.2	100.6	1133.8	335.7	3991.0	498.6	1272.9	171.5	1638.6	580.9	2416.0	269.8	697.1	99.2	1121.7	327.4

DAGUPAN No. ITEM	1993 COST	1993 C.FEC	1993 C.DOM	1993 C.D.UNSKL	1993 E.FEC	1993 E.DOM	1994 COST	1994 C.FEC	1994 C.DOM	1994 C.D.UNSKL	1994 E.FEC	1994 E.DOM	1995 COST	1995 C.FEC	1995 C.DOM	1995 C.D.UNSKL	1995 E.FEC	1995 E.DOM
1 Deep Well Facilities	1115.0	149.3	451.9	54.5	364.5	149.3	2230.0	298.6	903.8	109.0	729.0	298.6	1115.0	149.3	451.9	54.5	364.5	149.3
2 Transmission Facilities	511.0	92.0	143.1	20.4	158.4	117.5	918.0	165.2	257.0	36.7	284.7	211.1	476.0	85.7	133.3	19.0	147.5	109.5
3 Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Disinfection Facilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 Distribution Facilities	180.0	28.8	50.4	7.2	61.2	39.6	179.0	28.6	50.1	7.2	60.9	39.4	179.0	28.6	50.1	7.2	60.9	39.4
8 Service Connection	618.0	6.2	61.8	18.5	525.3	24.7	620.0	6.2	62.0	18.6	527.0	24.8	618.0	6.2	61.8	18.5	525.3	24.7
9 Admini. Bldg. & Ope. Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Land Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 Vehicle & Stored Material	29.0	0.0	0.0	0.0	24.4	4.6	44.0	0.0	0.0	0.0	37.0	7.0	28.0	0.0	0.0	0.0	23.5	4.5
12 Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB TOTAL	2453.0	276.3	707.2	100.6	1133.8	335.7	3991.0	498.6	1272.9	171.5	1638.6	580.9	2416.0	269.8	697.1	99.2	1121.7	327.4
13 Leakage Detection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2453.0	276.3	707.2	100.6	1133.8	335.7	3991.0	498.6	1272.9	171.5	1638.6	580.9	2416.0	269.8	697.1	99.2	1121.7	327.4

DAGUPAN ITEM	Phase I (Stage 2) COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	Phase I Total COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	Phase II COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM
1.0 SOURCE FACILITY																		
(1)DEEP WELL	4480.0	761.6	2000.8	224.0	896.0	761.6	9600.0	1632.0	4416.0	480.0	1920.0	1632.0	0.0	0.0	0.0	0.0	0.0	0.0
(2)PUMPING FACILITY																		
1)Pumping Station	3150.0	283.5	1102.5	157.5	1480.5	283.5	6750.0	607.5	2362.5	337.5	3172.5	607.5	0.0	0.0	0.0	0.0	0.0	0.0
2)Flow Meter	175.0	0.0	0.0	0.0	175.0	0.0	525.0	0.0	0.0	0.0	525.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(3)REPAIR & IMPROVEMENT	0.0	0.0	0.0	0.0	0.0	0.0	2620.0	0.0	0.0	0.0	2200.8	419.2	3627.0	0.0	0.0	0.0	3046.7	580.3
(4)RADIAL WELL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7040.0	3590.4	2041.6	140.8	1337.6	70.4
(5)PUMP HOUSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2536.0	152.2	2383.8	456.5	0.0	0.0
SUB-TOTAL	7805.0	1045.1	3163.3	381.5	2551.5	1045.1	19495.0	2239.5	6778.5	817.5	7818.3	2658.7	13203.0	3742.6	4425.4	597.3	4384.3	650.7
2.0 TRANSMISSION FACILITIES																		
(1)Pipelines	3835.0	690.3	1073.8	153.3	1188.9	882.0	11629.0	2093.2	3256.1	465.1	3605.0	2674.7	43424.0	7816.3	12158.7	1737.0	13461.5	9987.5
(2)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	3835.0	690.3	1073.8	153.3	1188.9	882.0	11629.0	2093.2	3256.1	465.1	3605.0	2674.7	43424.0	7816.3	12158.7	1737.0	13461.5	9987.5
3.0 WATER PURIFICATION PLANT																		
(1)Slow Sand Filtration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9544.0	3531.3	5535.5	572.6	381.8	95.4
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9544.0	3531.3	5535.5	572.6	381.8	95.4
4.0 DISTRIBUTION FACILITIES																		
(1)Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	2898.0	753.5	1883.7	202.9	144.9	115.9	4362.0	1134.1	2835.3	305.3	218.1	174.5
(2)Pump Facility	800.0	0.0	0.0	0.0	664.0	136.0	3915.0	93.5	1216.0	249.2	2128.0	447.5	5142.0	102.8	1645.4	308.5	2828.2	565.6
(3)Chlorination Facility	0.0	0.0	0.0	0.0	0.0	0.0	1079.0	54.0	366.9	32.4	496.2	161.9	119.0	6.0	40.5	3.6	54.6	17.9
(4)Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2620.0	406.1	576.4	52.4	1375.5	262.0	1020.0	158.1	224.4	20.4	535.5	102.0
(5)Distribution pipes																		
1)Main Pipes	4073.0	733.1	1140.4	162.9	1262.7	936.8	8603.0	1548.5	2408.8	344.1	2006.9	1978.8	6117.0	1101.1	1712.8	244.7	1896.2	1406.9
2)River Crossing	0.0	0.0	0.0	0.0	0.0	0.0	199.0	85.6	113.4	15.9	0.0	0.0	497.0	213.7	283.3	39.8	0.0	0.0
3)River Crossing Material	0.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0	42.7	32.3	102.0	0.0	0.0	0.0	58.1	43.9
4)Valves	516.0	10.3	108.4	31.0	350.9	46.4	2661.0	53.2	558.8	159.7	1809.5	239.5	340.0	6.8	71.4	20.4	231.2	30.6
5)Internal Network	898.0	143.6	251.4	36.0	305.4	197.6	5947.0	951.4	1665.1	238.0	2022.1	1308.4	6081.0	973.0	1702.7	243.2	2067.5	1337.8
6)Service Connections	3095.0	31.0	309.5	92.8	2630.7	123.8	4963.0	49.7	496.3	148.9	4218.5	198.5	7261.0	72.6	726.1	217.8	6171.9	290.4
7)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	571.0	0.0	0.0	0.0	571.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8)Srvc Cnnctn Rhbltn wo/M	0.0	0.0	0.0	0.0	0.0	0.0	348.0	8.7	90.6	21.0	217.5	31.2	0.0	0.0	0.0	0.0	0.0	0.0
9)Srvc Cnnctn Rhbltn w/Mr	0.0	0.0	0.0	0.0	0.0	0.0	1233.0	12.3	123.3	36.9	1048.2	49.2	0.0					
10)Lateral Rehabilitation	0.0	0.0	0.0	0.0	0.0	0.0	571.0	97.1	159.9	22.8	185.5	128.5	0.0					
11)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	215.0	0.0	0.0	0.0	215.0	0.0
12)Fire Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3683.0	73.7	1031.2	368.3	2283.5	294.6
SUB-TOTAL	9382.0	918.0	1809.7	322.7	5213.7	1440.6	35683.0	4113.6	9689.2	1521.2	16926.5	4953.7	34939.0	3841.9	10273.1	1772.0	16559.8	4264.2
5.0 1)Administration Bldg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1610.0	161.0	869.4	80.5	257.6	322.0
2)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	1380.0	124.2	565.8	69.0	496.8	193.2	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	1380.0	124.2	565.8	69.0	496.8	193.2	1610.0	161.0	869.4	80.5	257.6	322.0
TOTAL	21022.0	2653.4	6046.8	857.5	8954.1	3367.7	68187.0	8570.5	20289.6	2875.8	28846.6	10480.3	102720.0	19093.1	33262.1	4759.4	35045.0	15319.8
6.0 Land Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	132.0	0.0	132.0	0.0	0.0	0.0	1320.0		1320.0			
Vehicle	300.0	0.0	0.0	0.0	150.0	150.0	900.0	0.0	0.0	0.0	450.0	450.0	900.0				450.0	450.0
Stored Material & Equip.	247.0	0.0	0.0	0.0	207.5	39.5	750.0	0.0	0.0	0.0	630.1	119.9	898.0				754.3	143.7
SUB-TOTAL	547.0	0.0	0.0	0.0	357.5	189.5	1782.0	0.0	132.0	0.0	1080.1	569.9	3118.0	0.0	1320.0		1204.3	593.7
7.0 Replacement of Equip.																		
1)WELL PUMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3780.0	0.0	0.0	0.0	3175.2	604.8
2)Chlorinator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0	45.0	15.0
3)Flow Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	375.0	0.0	0.0	0.0	375.0	0.0
4)Water Meter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4154.0	0.0	0.0	0.0	4154.0	0.0
5)Booster Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2584.0	0.0	0.0	0.0	2144.7	439.3
6)Operation Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	690.0	0.0	0.0	0.0	496.8	193.2
7)Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2700.0	0.0	0.0	0.0	1350.0	1350.0
8)Stored Material & Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	219.0	0.0	0.0	0.0	181.0	35.0
SUB-TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14562.0	0.0	0.0	0.0	11924.7	2637.3
8.0 Leakage Detection	0.0	0.0	0.0	0.0	0.0	0.0	1020.0	0.0	1020.0	0.0	0.0	0.0	0.0	0.0	0.0			
GRAND TOTAL	21569.0	2653.4	6046.8	857.5	9311.6	3557.2	70989.0	8570.5	21441.6	2875.8	29926.7	11050.2	120400.0	19093.1	34582.1	4759.4	48174.0	18550.8

DAGUPAN No. ITEM	Phase I (Stage 2) COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	Phase I Total COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM	Phase II COST	C.FEC	C.DOM	C.D.UNSKI	E.FEC	E.DOM
1 Deep Well Facilities	7805.0	1015.1	3163.3	381.5	2551.5	1045.1	19495.0	2239.5	6778.5	817.5	7818.3	2658.7	13203.0	3742.6	4425.4	597.3	4384.3	650.7
2 Transmission Facilities	3835.0	690.3	1073.8	153.3	1188.9	882.0	11629.0	2093.2	3256.1	465.1	3605.0	2674.7	43424.0	7816.3	12158.7	1737.0	13461.5	9987.5
3 Purification Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9544.0	3531.3	5535.5	572.6	381.8	95.4
4 Reservoir	0.0	0.0	0.0	0.0	0.0	0.0	2898.0	753.5	1883.7	202.9	144.9	115.9	4362.0	1134.1	2835.3	305.3	218.1	174.5
5 Disinfection Facilities	0.0	0.0	0.0	0.0	0.0	0.0	1079.0	54.0	366.9	32.4	496.2	161.9	119.0	6.0	40.5	3.6	54.6	17.9
6 Electric Sub-station	0.0	0.0	0.0	0.0	0.0	0.0	2620.0	406.1	576.4	52.4	1375.5	262.0	1020.0	158.1	224.4	20.4	535.5	102.0
7 Distribution Facilities	6287.0	887.0	1500.2	229.9	2583.0	1316.8	21971.0	2829.3	6152.0	1029.7	8854.7	4135.0	22177.0	2471.1	6446.8	1224.3	9579.7	3078.4
8 Service Connection	3095.0	31.0	309.5	92.8	2630.7	123.8	7115.0	70.7	710.2	206.8	6055.2	278.9	7261.0	72.6	726.1	217.8	6171.9	290.4
9 Admini. Bldg. & Ope. Ctr.	0.0	0.0	0.0	0.0	0.0	0.0	1380.0	124.2	565.8	69.0	496.8	193.2	1610.0	161.0	869.4	80.5	257.6	322.0
10 Land Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	132.0	0.0	132.0	0.0	0.0	0.0	1320.0	0.0	1320.0	0.0	0.0	0.0
11 Vehicle & Stored Material	547.0	0.0	0.0	0.0	357.5	189.5	1650.0	0.0	0.0	0.0	1080.1	569.9	1798.0	0.0	0.0	0.0	1204.3	593.7
12 Replacement of Equip.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14562.0	0.0	0.0	0.0	11924.7	2637.3
SUB TOTAL	21569.0	2653.4	6046.8	857.5	9311.6	3557.2	69969.0	8570.5	20421.6	2875.8	29926.7	11050.2	120400.0	19093.1	34582.1	4759.4	48174.0	18550.8
13 Leakage Detection	0.0	0.0	0.0	0.0	0.0	0.0	1020.0	0.0	1020.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	21569.0	2653.4	6046.8	857.5	9311.6	3557.2	70989.0	8570.5	21441.6	2875.8	29926.7	11050.2	120400.0	19093.1	34582.1	4759.4	48174.0	18550.8

APPENDIX 8.2.1.C OPERATION AND MAINTENANCE COST (Dagupan City)

(cost; thousand peso)

Item			Stage 1	Stage 2	Phase II
			Cost	Cost	Cost
Operation & Maintenance Cost					
Salary	1,730	₱/M.M	1,080	1,495	1,806
Power	0.50	₱/kwH	484	746	1597
Chemical	27	₱/kg	90	122	241
Miscellaneous			690	1,051	1,902
Maintenance			511	800	1,482
Total			2,855	4,214	7,028

APPENDIX 9.3.1 MARKET SURVEY

The market survey was conducted by interviews to the residents in the study area using the LWUA's interview sheet as per attached in the end of this section.

The total number of respondents and its estimated coverage ratio to the total number of households in the study area are as follows:

Total Number of Respondents	Estimated Total Household	Coverage Ratio to Total Household
4,050	11,616	35%

The results of the market survey are obtained as shown in TABLE 9.3.1.1.

From the market survey, the income distribution of the respondents are shown as follows:

Income Bracket[1/]	Ave.Pesos	Number
₱900 and below	650	1,027
₱901 to ₱1500	1,224	1,227
₱1,501 to ₱2,500	2,121	674
₱2,501 to ₱4,500	3,501	458
₱4,501 and above	8,406	314

1/ Residential, excluding no-income and no-answer

TABLE 9.3.1.1 MARKET SURVEY SUMMARY

Total Number of Respondents: 4050

1. Distribution According to Building Type

		No.	%
a.	Residential	: 3727	92.02
b.	Commercial	: 269	6.64
c.	Industrial	: 54	1.33

2. Distribution According to Source of Water

		No.	%
a.	Connected to System	: 1310	32.35
b.	Neighbor's Connection	: 567	14.00
c.	Public Faucet	: 1467	36.22
d.	Private System	: 665	16.42
e.	Water Vendor	: 26	0.64
f.	Others	: 15	0.37

3. Average Persons Per Household

a.	Residential / Number of Sample	: 6.69 /	3711
b.	Commercial / Number of Sample	: 6.78 /	267
c.	Industrial / Number of Sample	: 8.76 /	54

4. Willingness To Connect (%)

		Residential	Commercial	Industrial	Total
a.	Yes :	31.26	21.56	20.37	30.47
b.	No :	36.84	29.00	44.44	36.42
c.	Undecided :	0.78	0.74	0.00	0.77
d.	W/ Own Conn.:	31.12	48.70	35.19	32.35

5. Average Monthly Water Needs

	Type / Number of Sample :	Residential	Commercial	Industrial
a.	Kerosene Can / 1006 :	10.23	8.71	5.50
b.	Drum / 1705 :	2.33	3.98	5.02
c.	Gallon / 194 :	62.65	10.71	10.00
d.	Others / 1122 :	55.52	60.20	118.19

6. Ave. Monthly Electric Bills for Residential Users (PESO):121.20
Number of Effective Respondents : 3122

7. Income Distribution
(Residential, Excluding No-Income and No-Answer)

		AVE.PESO	NUMBER
a.	P900 and Below :	650	1027
b.	P901 to P1500 :	1224	1227
c.	P1501 to P2500 :	2121	674
d.	P2501 to P4500 :	3501	458
e.	P4501 and Above :	8406	314

Existing major sources of water for the respondents and willingness to connect by each source of water are :

Sources of Water	Distribution	Willingness to Connect	
		Yes	No
Connected to System	32%	- %	- %
Neighbor's Connection	14	64	34
Public Faucet	36	41	58
Private System	16	37	62

Public faucet and connections to the system are the major sources of water for the respondents. The rest draw their water needs from private systems and neighbor's connections. In addition, only 1% of the respondents depends on water vendors and others for its water sources. From the above table, the majority of the respondents using neighbor's connections are willing to connect to the waterworks system, while the majority of respondents using public faucet and private system are unwilling to connect to the waterworks system.

The following results on the distribution of water sources and willingness to connect according to income bracket of the respondents are also obtained from the market survey.

TABLE 9.3.1.2 DISTRIBUTION OF WILLINGNESS TO CONNECT BY INCOME BRACKET

Sources of Water	Income Bracket				
	₱900 & below	₱901- ₱1,500	₱1,501- ₱2,500	₱2,501- ₱4,500	₱4,501- & above
Connected to System	13 %	27 %	45 %	49 %	61 %
Neighbor's Connection	19	15	13	11	4
Public Faucet	53	42	27	18	10
Private System	14	15	15	21	25
Willingness to Connect					
Yes	33	33	29	29	20
No	54	39	26	21	19
Undecided	1	1	1	1	1
With Own Connection	12	27	44	49	60

As shown above, around 50% of the respondents belonging to the high income group is already connected to the existing waterworks system. However, the extention of waterworks is rather limited in the low income group, being dependent mainly on public faucet for their water sources.

As the result of market survey, the respondents' willingness to connect and the user's types are shown as follows :

Answer	Residential	Commercial	Industrial	Total
Yes :	31.3 %	21.6 %	20.4 %	30.5 %
No :	36.8	29.0	44.4	36.4
Undecided :	0.8	0.7	0.0	0.8
With Own Conn. :	31.1	48.7	35.2	32.3

Residential users account for 92% of the total respondents and willingness to connect on the part of the respondents is only 30% of the total, while unwillingness to connect is 36%. It is observed from the result of the market survey that one third of respondents, especially in the low income group, are not willing to connect to the waterworks system in Dagupan city.

INTERVIEW SHEET FORMAT USED IN THE MARKET SURVEY

BLOCK NO. ________ CITY/MUNICIPALITY ____________ BARANGAY ________ ZONE ______ STREET ________

Stop No.	Building Type			User Code 1/	PPH	Willing to Connect		Ave. Water Needs 2/	Ave. Electric Bill	Average Monthly Family Income					Bldg. Cond. Code 3/	Respondent
	Res	Com	Ind			YES	NO			P900 and Below	P901 to P1,500	P1,501 to P2,500	P2,501 to P4,500	P4,501 and Above		

1/ USER CODE
C - Connected to System
NC - Neighbor's Connection
PF - Public Faucet
PS - Private System (Elec./Hand Pump)
V - Water Vendor
O - Others, specify

2/ Consumption Code
KC - Kero-Can or Gray Container
D - Drum
G - Gallon
O - Others

3/ Building Condition Code
A - Very Good
B - Good
C - Fair
D - Poor

I certify that the above information are true and correct.

____
Interviewer

APPENDIX 9.7.1 FINANCIAL INTERNAL RATE OF RETURN (FIRR)

In the calculation of Financial Internal Rate of Return (FIRR), the following two indicators are normally used to evaluate financial profitability of a project.

(1) Internal Rate of Return on Investment (IRROI)

The term IRROI indicates the internal rate of return on total capital investment, and assesses the profitability of the Project as a whole and the ability to recover funds invested in the Project.

The IRROI is calculated based on the assumption that the total capital investment is covered by its own capital. Therefore, the financial conditions such as the loan conditions on borrowed capital, changes on the ratio of equity to total capital requirement and others have no effect on the IRROI. Accordingly, the IRROI indicates the profitability of the Project itself.

(2) Internal Rate of Return on Equity (IRROE)

The term IRROE indicates the internal rate of return on equity, and assesses the profitability only with respect to equity and the ability to recover funds invested in the Project as equity. Here, the IRROE is calculated on the basis of such financial conditions proper to the Project as the loan conditions on borrowed capital and amount of capital owned.

In this study, the FIRR was calculated using the same method applied in the study report of the BACOLOD CITY WATER DISTRICT PHASE II WATER SUPPLY FEASIBILITY STUDY, DRAFT REPORT VOLUME 3 by LWUA.

APPENDIX 9.8.1 PROPOSED WATER RATE

The proposed water rates for 1/2 inch connections of commercial users, and 3/4 inch connections of domestic and commercial users to achieve financial self-sufficiency are as follows :

(1) Water rate for 1/2 inch connections of commercial users

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱ 50.0	₱ 6.8	₱ 9.2	₱13.0
1989	1.5	75.0	10.2	13.8	19.6
1990	1.5	75.0	10.2	13.8	19.6
1991	2.0	100.0	13.6	18.6	26.0
1992	2.6	130.0	17.6	24.0	33.8
1993	3.0	150.0	20.2	27.8	39.0
1994	3.2	160.0	21.6	29.6	41.6
1995	3.2	160.0	21.6	29.6	41.6
1996	3.9	195.0	26.4	36.0	50.8
1997	4.5	225.0	30.4	41.6	58.6

(2) Water rate for 3/4 inch connection of domestic users

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱ 40.0	₱ 5.4	₱ 7.4	₱10.4
1989	1.5	60.0	8.2	11.0	15.7
1990	1.5	60.0	8.2	11.0	15.7
1991	2.0	80.0	10.9	14.9	20.8
1992	2.6	104.0	14.1	19.2	27.0
1993	3.0	120.0	16.2	22.2	31.2
1994	3.2	128.0	17.3	23.7	33.3
1995	3.2	128.0	17.3	23.7	33.3
1996	3.9	156.0	21.1	28.8	40.6
1997	4.5	180.0	24.3	33.3	46.9

(3) Water rate for 3/4 inch connection of commercial users

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱80.0	₱10.8	₱14.8	₱20.8
1989	1.5	120.0	16.4	22.0	31.4
1990	1.5	120.0	16.4	22.0	31.4
1991	2.0	160.0	21.8	29.8	41.6
1992	2.6	208.0	28.2	38.4	54.0
1993	3.0	240.0	32.4	44.4	62.4
1994	3.2	256.0	34.6	47.4	66.6
1995	3.2	256.0	34.6	47.4	66.6
1996	3.9	312.0	42.2	57.6	81.2
1997	4.5	360.0	48.6	66.6	93.8

LIST OF PERSONS CONCERNED

LIST OF PERSONS CONCERNED

ADVISORY COMMITTEE MEMBERS

Dr. Kiyoshi Yamada	-	Chairman of Committee, Professor, Ritsumeikan University
Mr. Hisashi Watanabe	-	Member, for Water Supply System Planning, Nagoya City
Mr. Masahiro Takai	-	Member, for Water Source Planning, Kobe City
Mr. Tsutomu Sakagawa (Predecessor: Mr. Yoshiro Kaburagi)	-	Member, for Water Supply System Planning, Ministry of Health and Welfare
Mr. Shozo Matsuura (Predecessor: Mr. Yoichi Seki)	-	Coordinator, Japan International Cooperation Agency (JICA)

LWUA OFFICIALS

Mr. Porthos P. Alma Jose	-	Administrator
Col. Carlos C. Leaño, Jr.	-	Ex-General Manager
Mr. Salvador J. Rivera	-	Sr. Deputy Administrator
Mr. Ibarra J. Olgado	-	Deputy Administrator for Regulatory
Mr. Daniel I. Castillo	-	Deputy Administrator for Finance
Mr. Vitaliano J. dela Vega	-	Deputy Administrator for Engineering
Mr. Alfredo B. Espino	-	Manager, Planning Department
Mr. Isidoro A. Yee	-	Asst. Manager, Planning Department
Mr. Roberto B. Binag	-	Manager, Water Systems Development Division
Mr. Eriberto R. Calubaquib	-	Manager, Water Resources Division
Mr. Antonio R. de Vera	-	Project Manager IV
Mr. Armando T. Fernandes	-	Manager, Construction Department
Mr. Arador R. Sambo	-	Manager, Water District Formation/ Review Department
Mr. Francis C. Joven	-	Manager, Formation of Water District Division

LWUA OFFICIALS (CONT'D)

Mr. Hector A. Dayrit	-	Manager, Rates Division
Mr. Teofilo R. Palaganas	-	Area Manager, Advisory Services Div.
Mr. Henry I. Pacis	-	Water District Development Officer
Mrs. Jean C. Leoncio	-	Manager, Loan Evaluation Division

OTHER AGENCIES

NIA CONSULTANTS INC.

Mr. Isidro Digal	-	Manager, Planning Division
Mr. Lorenzo N. Macaspac	-	Professional Mechanical Engineer

NWRC

Atty. Elena Luz J. Alojipan	-	Hearing Officer, IV

MWSS

Mr. Antonio E. Kaimo	-	Acting Department Manager, Planning and Design Department

ANGELES CITY

Mr. Francisco G. Nepomuceno	-	City Mayor
Atty. Filomeno Espiritu	-	City Treasurer
Mr. Filomeno M. Bonifacio, Jr.	-	City Engineer
Mr. Romeo P. Calara	-	Sr. Mechancial Engineer

DAGUPAN CITY

Mr. Liberato L. Reyna, Sr.	-	City Mayor
Mr. Cipriano M. Manaois	-	Ex-Mayor
Mr. Juanito A. Pajaro	-	City Treasurer
Mr. Silverio C. Coquia	-	Waterworks Superintendent
Mr. Manuel B. Ravanzo	-	City Development Coordinator

CABUYAO, STA. ROSA AND BIÑAN

Atty. Felicismo T. San Luis	-	Governor, Province of Laguna
Mr. Romeo G. Ballesteros	-	Provincial Civil Security Officer
Mr. Dante T. Reyes	-	Executive Assistant/Development Coordinator
Mr. Catalino Caparas	-	Waterworks Supervisor, Province of Laguna
Mr. Isidro T. Hildawa	-	Mayor, Municipality of Cabuyao
Mr. Cesar E. Nepomuceno	-	Mayor, Municipality of Sts. Rosa
Mr. Noe C. Zarate	-	Mayor, Municipality of Biñan
Mrs. Josefa L. Pradel	-	Municipal Development Coordinator, Cabuyao
Mr. Felizardo P. Manto	-	Municipal Planning and Development Coordinator, Sta. Rosa
Mr. Carito P. Torres	-	Municipal Census Officer, Sta. Rosa

BAYOMBONG AND SOLANO

Mrs. Belen F. Calderon	-	Governor, Province of Nueva Vizcaya
Mrs. Natalia F. Dumlao	-	Ex-Governor
Mr. Clamente G. Bacani	-	Provincial Secretary
Mr. Artemio P. Bahia	-	Provincial Attorney
Mr. Jesus M. Calata	-	Provincial Engineer
Mr. Tomas C. Garra	-	Supervising Project Analyst Provincial Planning & Develop't Office
Mr. Geoffrey B. Magday	-	Concurrent Provincial Waterworks Officer
Capt. Federico M. Bolusan	-	Provincial Waterworks Supervisor
Mr. John Bagasao	-	Mayor, Municipality of Bayombong
Mr. Lunbert Galima	-	Mayor, Municipality of Solano

STUDY TEAM MEMBERS

Mr. Toru Hayashi	–	Team Leader Legistration/Organization Nippon Jogesuido Sekkei Co., Ltd. (NJS)
Mr. Masatoshi Momose	–	Water Supply System Planning, NJS
Mr. Chikara Amitani	–	Water Supply System Planning, NJS
Mr. Masuomi Hiroyama	–	Transmission/Distribution System Planning, NJS
Mr. Hideaki Fukui	–	Transmission/Distribution System Planning, NJS
Mr. Takafumi Kiguchi	–	Facility Design, NJS
Mr. Yukio Maejima	–	Water Source Planning, NJS
Mr. Fumiaki Ichino	–	Water Source Planning, Richo Soil Investigation Co., Ltd.
Mr. Mitsuo Tsutsumi	–	Well Development, NJS
Mr. Masaaki Awamoto	–	Financial and Economic Analysis, Techno Consultants, Inc.

MINUTES OF THE MEETINGS

MINUTES OF THE MEETING
MUNICIPAL WATER SUPPLY
PROJECT STUDY

Manila, March 25, 1986

Toru Hayashi
Study Team Leader
Japan International
Cooperation Agency

Atty. Ibarra Olgado
Officer in charge
LWUA

MINUTES OF THE MEETING

A series of meetings between JICA survey team and LWUA personnel regarding the Inception Report were held during March 18 to March 24, 1986 to confirm the objectives, scope of work and schedule for implementation of the study. Also discussed during the meetings were undertakings by both parties and approaches to the project.

The following are the items agreed upon:

1. Objective of the Study

The objective of the study is to prepare Basic Development Plan and Short Term Development Plan for the water supply projects in the following four project areas.

1. Angeles City, Pampanga
2. Dagupan City, Pangasinan
3. Cabuyao, Sta. Rosa and Binan, Laguna
4. Bayombong and Solano, Nueva Vizcaya

2. Scope of the Study

The study will be conducted in four (4) phases including works both in the Philippines and in Japan. The following are the outline of each phase:

2.1 Phase I: Formulation of Basic Development Plan

a) Collection and review of data and information available
b) Implementation of field survey
c) Outline of Basic Development Plan
d) Preparation of framework for the Feasibility Study
e) Preparatory work for implementation of Phase II study

2.2 Phase II: Field Investigation for Preparation of Feasibility Study

a) Field Investigation

- o Geoelectric prospecting
- o Test well drilling and pumping test
- o Inventory of wells and pumping tests of selected existing wells
- o Measurement of yield at springs

J.H.,

- o Testing of existing pumps
- o Measurement of unaccounted-for-water and hydraulic survey
- o Investigation of existing water supply facilities

b) Study of availability of materials and equipment for construction and improvement of water supply facilities and capability of local contractors

c) Review of design criteria for design of proposed water supply facilities

d) Study of the alternative water supply schemes

2.3 Phase III: Preparation of Feasibility Study (Draft Final Report)

a) Preliminary design of the recommended water supply systems among alternatives

b) Recommendation on organization/management of the system and establishment of water districts

c) Implementation schedule

d) Cost estimation for construction, operation, and maintenance of the system

e) Financial study

2.4 Phase IV: Preparation of Final Report

3. Approach to the Project

3.1 Development of Master Plan

a) Study Area

Study of fundamentals for the development of Master Plan will be made covering the entire city/municipality. However, the plan for the water supply system should be limited to those areas to be covered by level II/III systems.

b) Target Year

The base year for planning is 1986 in principle and target year is 2010. In addition, the years, 1990, 1995 and 2000 shall be considered although detailed study, such as breakdown of population by sub-area shall be only made for the present, 1990 and 2010.

c) Plan of Water Supply System

Layout of the existing and proposed pipelines and other major facilities will be shown on the map

d) Rough Cost Estimates

Rough cost estimates will be made using cost data prepared by the LWUA for feasibility studies.

e) Water Sources

Based on the data on water resources collected during Phase I, applicable water sources will be recommended to meet the water demands and other conditions including socio-economic needs.

f) Establishment of the Water District

Information on the willingness by the cities and municipalities as well as present problem areas in management of the existing water supply systems will be collected and evaluated to make recommendations for implementation of the water supply project.

3.2 Preparation of Framework for the Short Term Development Plan

a) Previous reports, if any, prepared by the city/municipality will be reviewed. The subject area will be recommended in consideration of existing service area, potential water resources, needs and willingness of the inhabitants, and financial viability. Marketing surveys will be conducted by the LWUA financial specialists to support the study.

b) Target Year

The base year is 1986 in principle and target year is 1990 for the four project areas.

c) Water Sources

Existing water sources including springs and deep wells will be evaluated to their maximum safe capacities. Improvement of existing source facilities and new development requirements will also be studied.

T.K.,

d) Preparatory work for the field survey during Phase II.

Most of the measurements in the field will be conducted during the Phase II. Since the work for test well drilling is critical, timely arrangement/procurement of equipment and material at the initial stage of the Phase II is indispensable. Detailed discussion to reach an agreement for the purpose between two parties will be made during the last two weeks of Phase I period reflecting the result of field survey and collected information. Responsibilities by each party for implementation of the field examination will be accomplished in accordance with the minutes exchanged on October 23, 1985.

4. Schedule for Implementation of the Study

4.1 Phase I

JICA team started field work from March 17 and is scheduled to finish its Phase I work on April 27. Discussions on the methodologies and required arrangements as well as collection and review of data will be conducted in Manila during first half of the study period. Field trip to the subject cities/municipalities will be done within two weeks during latter half of the study period. The outline of the basic development plan and framework of the short term plan will be prepared by the end of this Phase. Detailed schedule is attached herewith.

4.2 Phase II to Phase IV

Phase II field work is tentatively scheduled to start from the beginning of June 1986 and Final Report will be submitted at the end of February 1987 in Phase IV period.

5. Undertakings by JICA and LWUA

In accordance with the agreement between JICA and LWUA signed on October 23, 1985, each party will accomplish its responsibilities.

SCHEDULE FOR IMPLEMENTATION OF THE STUDY

Date		Activities		
March 17	Mon	1st Group: Tokyo-Manila, visit to Japan Embassy & JICA.		
18	Tue	A.M.: Courtesy call on LWUA, P.M.: Explanation of and discussions on Inception Report.		
19	Wed	Discussions on Inception Report, data collection and required arrangements.		
20	Thur	Preparation of minutes and data collection.		
21	Fri	Exchange of minutes.		
22	Sat	Inner meeting of Survey Team.		
(23)	Sun	- do -		
24	Mon	Collection and review of data and information.		
25	Tue	2nd Group: Tokyo-Manila, review of data and information.		
26	Wed	. Analysis of data and information collected. . Preparatory work for the field survey		
△27	Thur	) Analysis of data and information collected.		
△28	Fri	)		
△29	Sat	)		
(30)	Sun	)	B Group: Manila-Dagupan/	C Group: Manila-Dagupan
31	Mon	A Group: Cabuyao, etc /	Dagupan City	Dagupan City
April 1	Tue	. Data collection	. Data collection	
2	Wed	. Field Survey	. Field Survey	
		. Discussions with officers	. Discussions with officers	
3	Thur			Bayombong, Solano
4	Fri			
5	Sat	Preparation of Field/ Report	Preparation of Field Report	C Group: Dagupan
(6)	Sun	- do -	- do -	Dagupan-Manila
7	Mon	A Group: Angeles City/	B Group: Bayombong & Solano	Cabuyao, etc.
8	Tue	. Data collection	. Data collection	
9	Wed	. Field Survey	. Field Survey	Angeles City
	Thu	. Discussions with officers	. Discussions with officers	
11	Fri			

April	12	Sat	Preparation of Field Report	Preparation of Field Report
	(13)	Sun	- do -	B Group: Dagupan-Manila
	14	Mon	Review of data and information	
	15	Tue	Preparation of Basic Development Plan and Framework of short term plan	
	16	Wed	- do -	
	17	Thur	- do -	
	18	Fri	- do -	
	19	Sat	- do -	
	(20)	Sun	Preparation of Report	
	21	Mon	Preparation of Report	
	22	Tue	- do -	
	23	Wed	- do -	
	24	Thur	Meeting with LWUA	
	25	Fri	Meeting with LWUA and visit to JICA and Embassy	
	26	Sat	Inner meeting	
	(27)	Sun	Manila - Tokyo	

MINUTES OF MEETING

MUNICIPAL WATER SUPPLY PROJECT STUDY

Manila, June 18, 1986

Toru Hayashi
Study Team Leader
Japan International
Cooperation Agency

Porthos P. Alma Jose
Administrator
Local Water Utilities
Administration

MINUTES OF THE MEETING

A series of meeting between the JICA study team and LWUA officials regarding the Phase II Study Program for the Municipal Water Supply Project were held from June 9 to June 18, 1986 to confirm the placement of the Progress Report, scope of work and schedule of implementation of the study. Also discussed during the meeting were undertakings by both parties and approaches to the Phase II Study.

The following are the items agreed upon:

1. Progress Report

The study team submitted ten (10) copies of the Progress Report to LWUA on June 8, 1986.

2. Contents of the Phase II Study

2.1 Plan of Water Supply System

A plan of water supply system for the years 2010 and 1995 shall be prepared showing relationship of the major facilities and shall be incorporated in the Final Reports.

2.2 Basic Development Plan

The Basic Development Plan (2010) is recommended in the Progress Report as a result of the alternative study including potential water sources and required facilities. Supplemental description and schematic drawings will be prepared. Cost comparison between alternatives will be made based on the present cost.

2.3 Short Term Development Plan

The water supply system for the immediate improvement (1995) should be planned considering the relation to the Basic Development Plan.

2.4 Hydraulic Calculation

Hydraulic calculation on the recommended water supply system should be carried out.

2.5 Target Year

The target year for the immediate improvement is 1995. Required study for the fundamentals will be made for the year 1986 (base year), 1995 (immediate improvement) and 2010 (long term development), respectively. Implementation schedule for the year 1990 may also be included as the stage 1 of the immediate improvement program.

2.6 Design Criteria

Design criteria for feasibility study should follow the LWUA guidelines. To some extent, however, alternatives may be accepted if reasons are justifiable.

2.7 Composition of Reports

Composition of Interim Report and Draft Final Report will be finalized through the discussion between the Study Team and LWUA during the Phase II Study period.

3. Arrangement for Phase II Study

3.1 Land acquisition for Test Well Sites

LWUA shall at its own expense, be responsible for the land acquisition for test wells prior to the scheduled test well drilling.

3.2 Preparation for Drilling Equipment

In accordance with the Minutes of Meeting between JICA and LWUA dated October 23, 1985, LWUA shall at its own expense, be responsible for the provision of equipment for test well drilling.

One drilling rig shall be provided within the month of June, and another one beginning July.

Test well drilling in the three study areas shall be completed within the Phase II Study period.

3.3 Safekeeping of Materials for Test Wells

LWUA shall be responsible for safekeeping of materials for test wells which are supplied by JICA.

3.4 Field Survey

1. Schedule of the LWUA Engineers

Required arrangements be made by the LWUA according to the following schedule:

Rodolfo Oamil	:	6/16 - 7/15 (Angeles City)
Allen Lowe	:	7/16 - 8/15 (Cabuyao, Sta. Rosa, Biñan)
Abelardo Buencamino	:	6/16 - 7/13 (Dagupan)
Melchor Casil	:	7/13 - 8/16 (Bayombong & Solano)

Schedule for the two hydrogeologists will be decided after making arrangement of drilling machine.

2. Living allowance and travel cost for LWUA Engineers

   LWUA is responsible for LWUA Engineer and well drillers.

   In accordance with the schedule, they may work on Saturday/Sunday, if necessary.

3. Vehicle arrangement

   Land Cruiser : LWUA will provide a vehicle (Land Cruiser) for the survey in Dagupan and Bayombong and Solano from June 16 (Mon) to August 15, 1986.

4. Preparation of road map for Cabuyao, Sta. Rosa and Biñan.

   LWUA (Allen) will prepare and confirm (in the area) the road network for the subject area planned in the progress report. Aerial photograph be utilized for this purpose. This work should be completed by the beginning of July.

3.5 Market Survey

LWUA shall conduct the Market Survey for Angeles City on the third week of June.

3.6 Water Quality Analysis

Necessary arrangements for water quality analysis will be made at the LWUA laboratory or other institutions.

3.7 Electric Logging Equipment

LWUA will provide the study team with a set of electric logging equipment.

3.8 Data on Unit Cost

LWUA shall assist the study team in the collection of necessary data for unit cost.

22 September 1986

MINUTES OF AGREEMENT BETWEEN LWUA AND JICA

Discussions on the Interim Report and the requirement for completion of the Draft Final Report were made between the two parties (JICA and LWUA) from September 18 to 22, 1986. Fundamentals for planning water supply system for the four study areas and basic approach/figures which were incorporated in the Interim Report were agreed upon discussions. In addition, the following major subjects were confirmed by the two parties:

(1) Completion of Test Well Construction

The scheduled test well construction at the three sites, Dagupan, Angeles, and Sta. Rosa is behind schedule due to the delay of procurement of well drilling equipment, repair of broken equipment, land acquisition for test well sites as well as unfavorable weather.

Under these circumstances, the parties agreed that LWUA will make all efforts to catch up with the delay of construction.

(2) Draft Final Report

The major items to be included in the report are as follows:

Chapter 1 Summary and Recommendations
Chapter 2 General Background
Chapter 3 Description of the Study Area
Chapter 4 Existing System
Chapter 5 Population and Water Demand Projections
Chapter 6 Water Resources
Chapter 7 Analysis and Evaluation of Alternatives
Chapter 8 Recommended Plan
Chapter 9 Financial Feasibility Analysis
Chapter 10 Economic Feasibility Analysis
Chapter 11 Organization and Management Study

Drawings to be prepared comprise general plan and standard drawings for major facilities.

Noted:

ALFREDO B. ESPINO
Planning Manager

TORU HAYASHI
Team Leader - JICA

MINUTES OF MEETING

MUNICIPAL WATER SUPPLY PROJECT STUDY

Manila, December 8,1986

Toru Hayashi Study Team Leader Japan International Cooperation Agency	Porthos P. Alma Jose Administrator Local Water Utilities Administration

MINUTES OF THE MEETING

A series of meeting between JICA survey team and LWUA personnel regarding the Draft Final Report on Municipal Water Supply Project were held during the period December 2 to December 8, 1986 to present the report on the study and confirm its contents.

From Chapter 2 to Chapter 5, i.e., General Background, Description of the Study Area, Existing Water Supply and Sanitation Conditions, and Population and Water Demand Projections, no problem was noted since the contents of these chapters have already been discussed and concurred by both parties at the time the Progress Report and Interim Report were submitted.

The major items to be revised/supplemented are as follows:

Technical Aspect

1. Alternative study of transmission/distribution pipeline system

   - Staged construction of pipeline:

     An economic evaluation of staging construction of transmission and distribution mains will be studied and presented in the report. Two phases of construction should at least be considered taking into consideration the following recommended construction Phases:

     Phase I - (1989-1995)
     Phase II - (1996-2010)

   - Alternative of pipeline routes: If there are available roads, 2 alternatives will be studied for major main routes. Others will be discussed and cancelled.

   - Economic cost comparison

     As per request of LWUA, economic evaluation will be made for the discount rate of 12 percent. The estimation using the rates of 10% and 15% will also be made for reference purpose.

2. Hydraulic calculation for the distribution network. The computation results of alternative and recommended distribution system will be incorporated in the Appendix.

3. Review and revise/supplement the alternative study, Chapter 7 with reference to the presentation.

4. Preparation of implementation schedule using bar-chart. Based on the implementation program shown in the Draft Final Report, bar-chart showing construction period by phase will be prepared for major facilities. That for Phase II is roughly prepared.

5. Preparation of a plan of water supply facilities showing the differences of construction phases. The scale of the plan may be approximately from 1/20,000 to 1/25,000.

6. Cost estimates

Required cost for the services of leakage detection and for repair/replacement of existing pipes and accessories will be added under the following conditions:

a) Old laterals: The subject length of the pipeline is 10-30% of the total length of existing laterals. Unit cost is that for new construction.

b) Service Connections: Required cost is estimated based on the unit cost given below

{₱850 (material) + labor cost} x No. of existing connections

c) Cost for leak detection: ₱240/connect x No. of existing connections

7. Study of economical sizing of pump transmission mains.

Financial Aspect

1. Financial scheme should not include government grant since the policy of the LWUA changed two months ago. The soft loan may be utilized to supplement regular loan. LWUA can extend soft loans up to a maximum of 50% of the total project cost.

A certain percent of Water District equity to the total construction cost may be considered depending on the ability-to-pay of the W.D.

2. Per latest policy Engineering cost is computed as a fixed percentage of estimated construction cost (ECC). ECC is equal to the summation of basic construction cost, physical contingencies and price contingencies. The percentages are:

ECC $\leq$ ₱20M = Engineering cost is 13% of ECC
ECC $>$ ₱20M = Engineering cost is 10% of ECC

Construction supervision is 4% of ECC

3. Debt service table

a) Standard procedure = Regular loan can finance disbursements for the first four (4) years and soft loan for the next 4 years. However, the combination of the two types may be adopted.

b) Preparation of separate debt service tables for regular loan and for soft loan.

4. Preparation of a table for unescalated O & M costs

5. Equivalent volume of water sold

   - Water consumption for the first 10 cu.m will be calculated using the total number of domestic connections and 10 cu.m/connection

   - Range of water consumption maybe as follows:

     1) First 10 cu.m.
     2) 11-20
     3) 21-35
     4) over 35

   The present percentages for the ranges from 11 cu.m to over 35 cu.m will be used for the calculation of the total equivalent volume.

6. Financial Internal Rate of Return (FIRR) computation

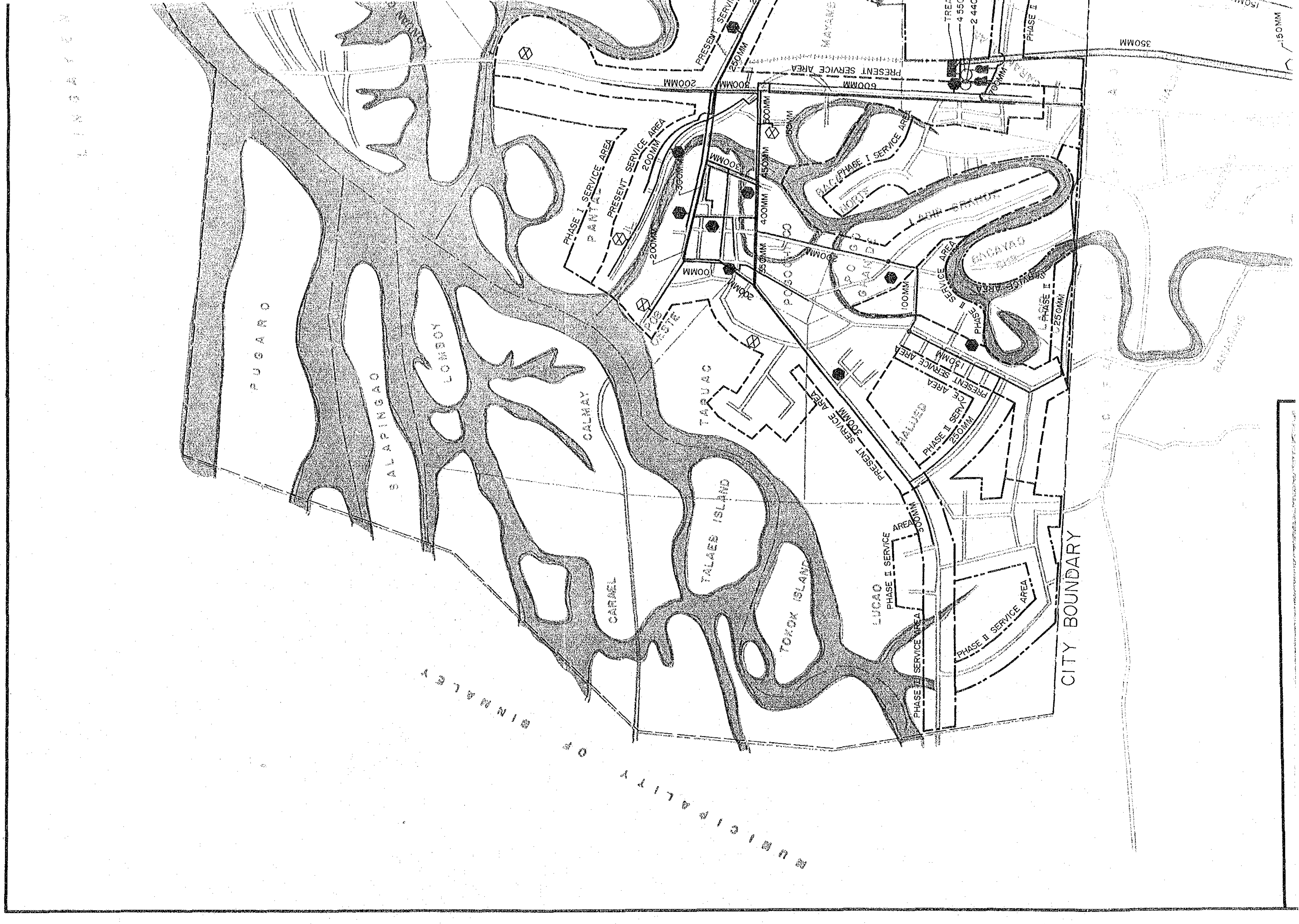
   In conformance with LWUA procedure FIRR will be computed based on the total investment not just the portion funded by WD equity to measure the efficiency of the project as a whole.

   The FIRR may at least be equal to the weighted average of the interest rates of the loans (regular and soft loans). The period for this analysis can be extended (20 to 40 years).

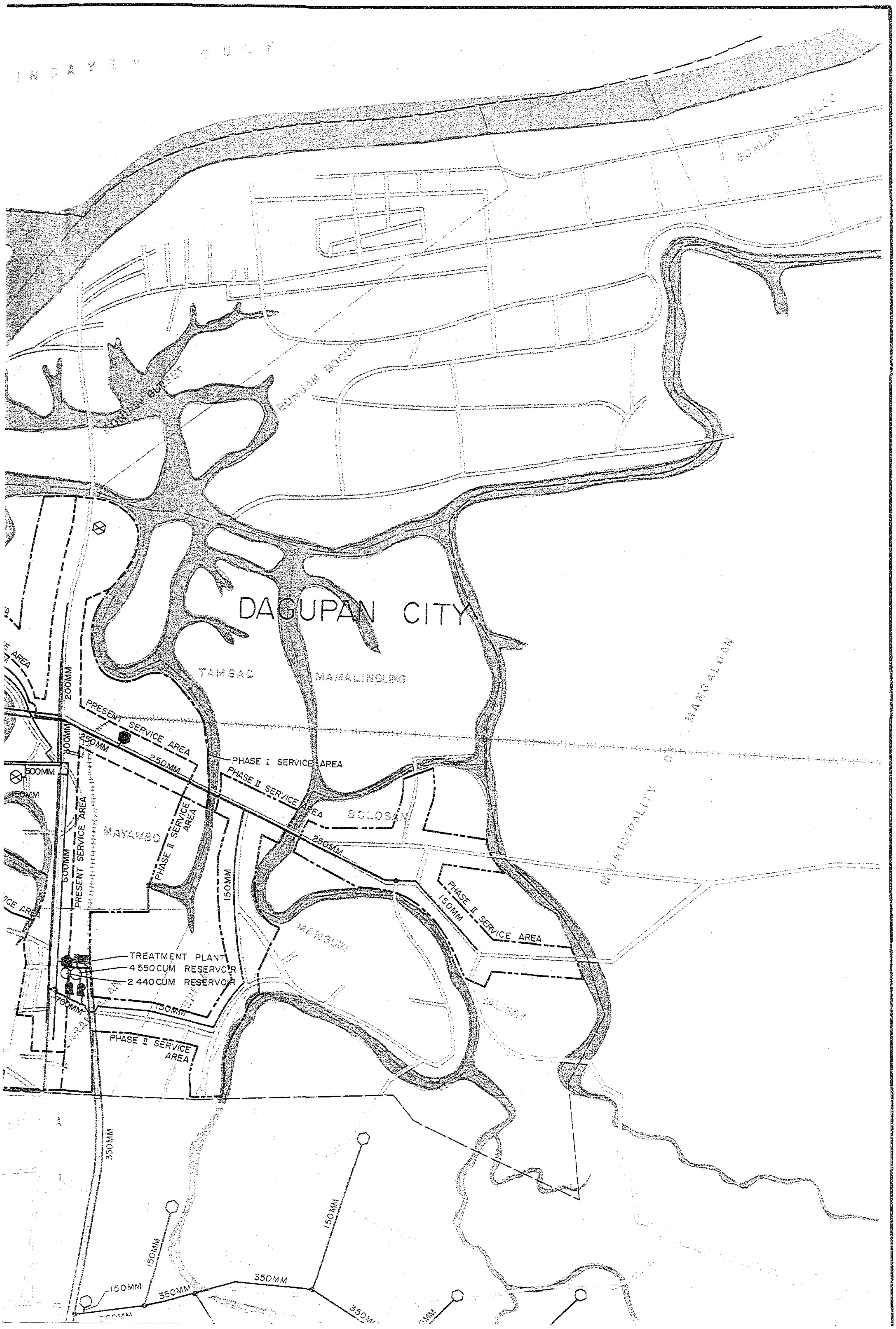
7. As per LWUA standards, fifteen (15%)percent inflation rate is used.

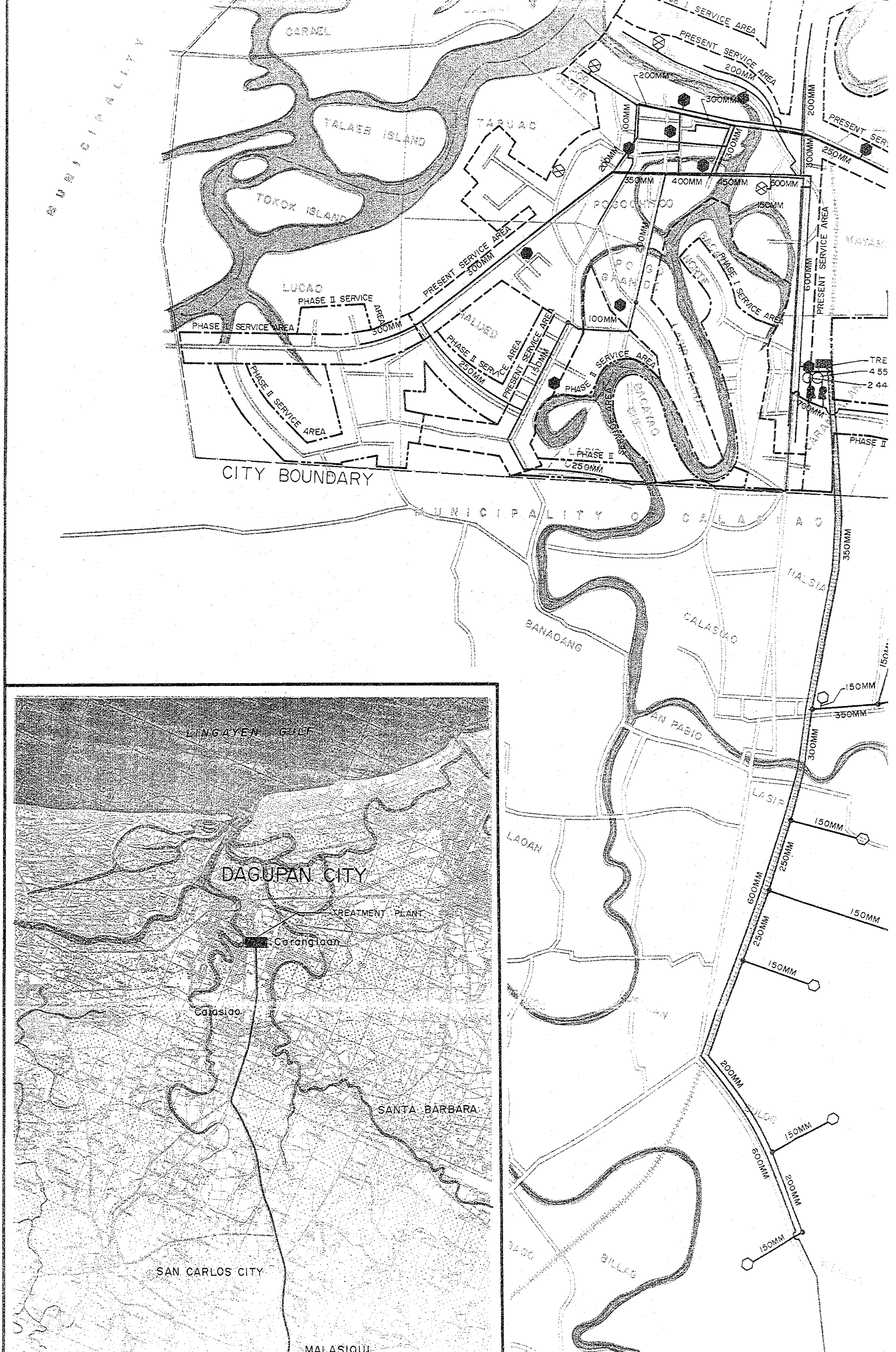
8. Economic Analysis

   In consideration of the characteristics of the project, IERR may be lower than the desired level.

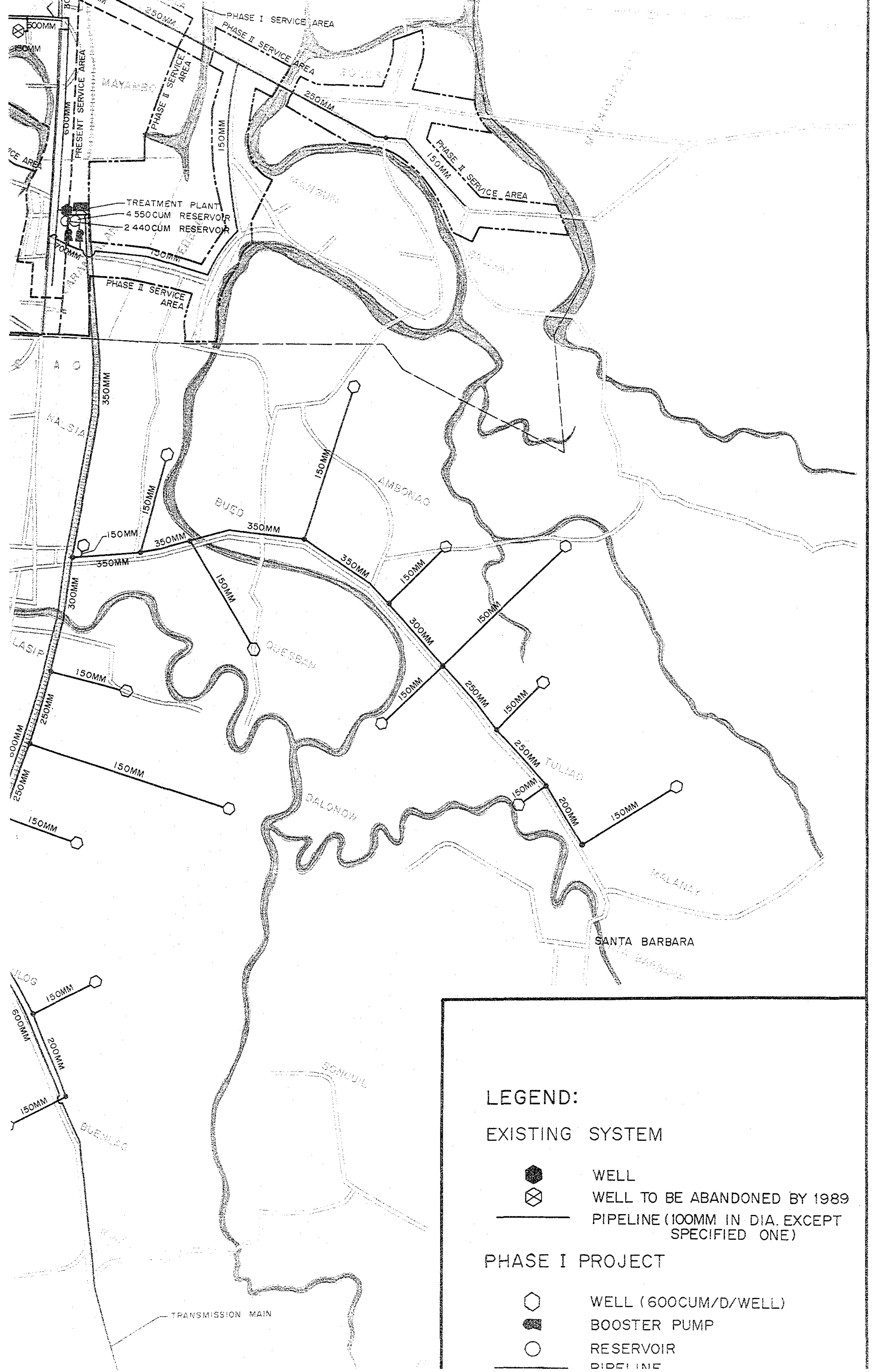


PUGARO
SALAPINGAO
LOMBOY
CALMAY
CARAEL
TALAES ISLAND
TOKOK ISLAND
TAPUAC
LUCAO
PANTAL
CITY BOUNDARY
MUNICIPALITY OF BINMALEY
PHASE I SERVICE AREA
PRESENT SERVICE AREA
PHASE II SERVICE AREA
350MM
600MM
300MM
250MM
200MM
400MM
150MM
100MM

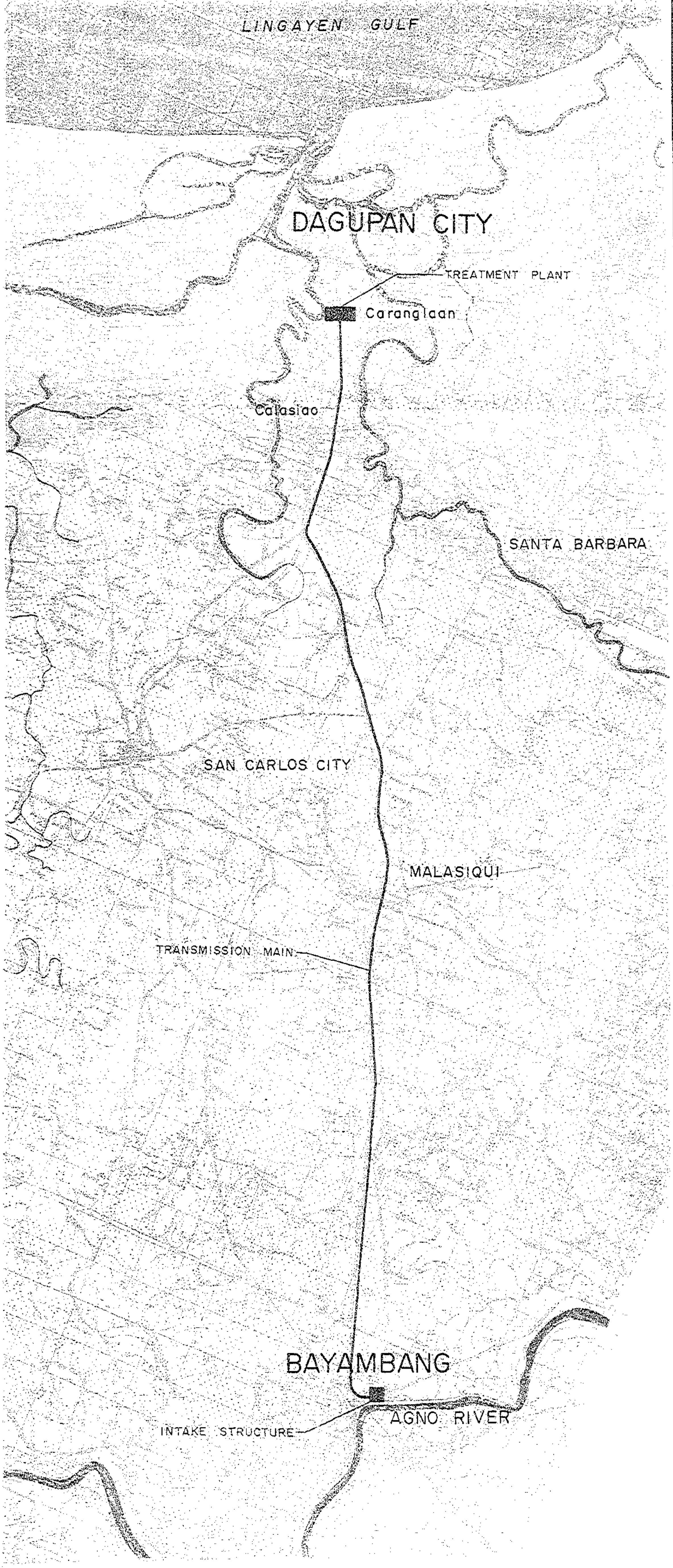

DAGUPAN CITY
TAMBAC
MAMALINGLING
BOLOSAN
MAYAMBO
MANGIN
MUNICIPALITY OF MANGALDAN
PRESENT SERVICE AREA
PHASE I SERVICE AREA
PHASE II SERVICE AREA
TREATMENT PLANT
4 550 CUM RESERVOIR
2 440 CUM RESERVOIR
200MM
250MM
150MM
350MM
600MM
500MM



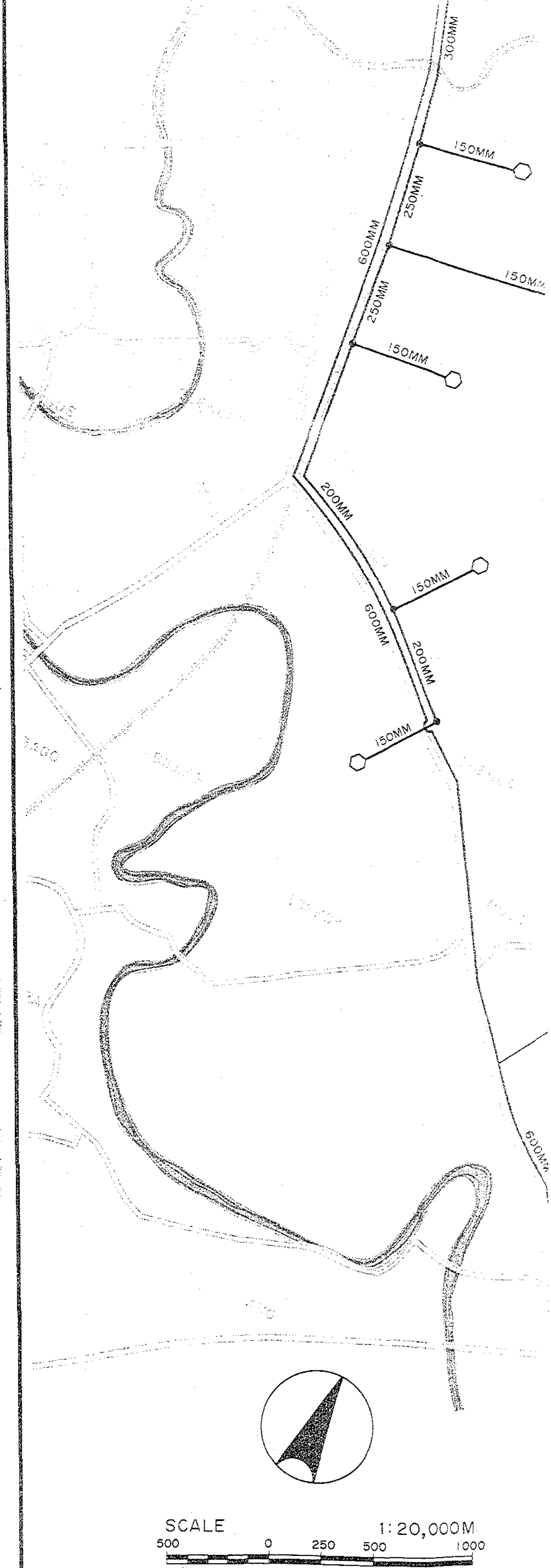
PRESENT SERVICE AREA
PHASE I SERVICE AREA
PHASE II SERVICE AREA
CITY BOUNDARY
MUNICIPALITY OF CALASIAO
CALASIAO
BANAOANG
LAOAN
SAN PABLO
LASIP
MALSIA
BILLAG
TAPUAC
TALAEB ISLAND
TOKOK ISLAND
LUCAO
MALUED
CARAEL
POGO GRANDE
NORTE
DAGUPAN CITY
TREATMENT PLANT
Caranglaan
Calasiao
LINGAYEN GULF
SANTA BARBARA
SAN CARLOS CITY
MALASIQUI
350MM
300MM
250MM
200MM
150MM
600MM
500MM
450MM
400MM
100MM



PHASE I SERVICE AREA
PHASE II SERVICE AREA
PRESENT SERVICE AREA
MAYAMBO
TREATMENT PLANT
4 550CUM RESERVOIR
2 440CUM RESERVOIR
700MM
600MM
350MM
300MM
250MM
200MM
150MM
MALSIA
BUED
AMBONAO
QUESBAN
LASIP
DALONGUE
TULIAO
MALANAY
SANTA BARBARA
SONQUIL
BUENLAG
TRANSMISSION MAIN
LEGEND:
EXISTING SYSTEM
WELL
WELL TO BE ABANDONED BY 1989
PIPELINE (100MM IN DIA. EXCEPT SPECIFIED ONE)
PHASE I PROJECT
WELL (600CUM/D/WELL)
BOOSTER PUMP
RESERVOIR



NOTE: THE SYSTEM SHOWN ABOVE IS FOR PHASE II



GENERAL LAYOU

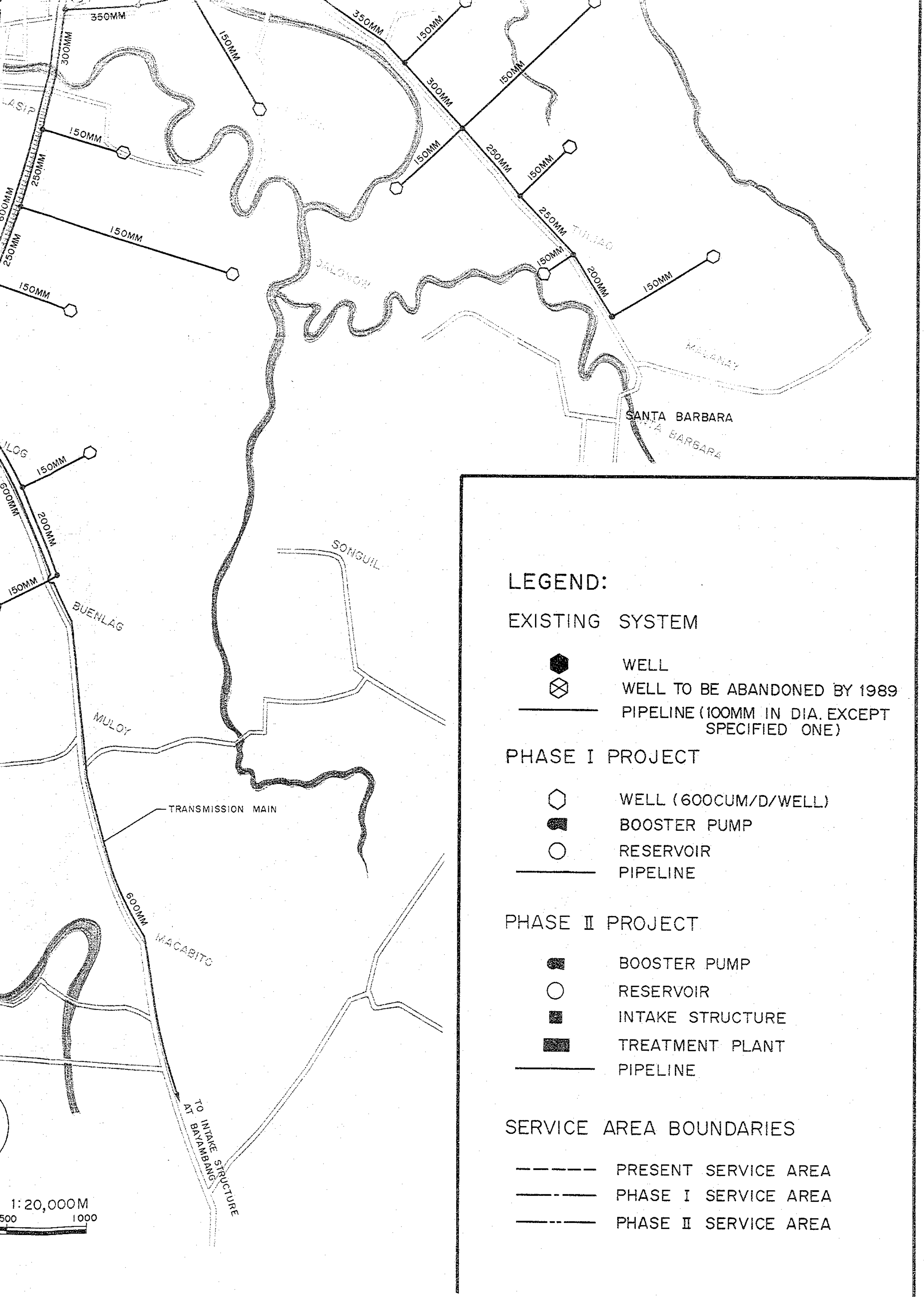


FIGURE 8.2.1
RAL LAYOUT OF THE RECOMMENDED WATER SUPPLY SYSTEM
DAGPAN CITY, PANGASINAN
MARCH 1987

JICA