APPENDICES

APPENDIX 3.4.1 ELECTRIC CHARGES ADOPTED BY THE MERALCO

Residential

First 14 kwh	₱2.00 (Minimum Charge)
Next 36 kwh	0.125 per kwh
Next 50 kwh	0.15 per kwh
Next 100 kwh	0.20 per kwh
Excess kwh	0.365 per kwh

General Service

Classification

X-1 (Conn. Load : 1-500c Natis)

First 14 kwh	₱3.00 (Minimum Charge)
Next 76 kwh	0.21 per kwh
Excess kwh	0.365 per kwh

X-MD (Conn. Load : over 5,000 Natis)

Demand Charge	₱12.60 per kw
Plus Energy Charge	
First 100 hrs.	₱ 0.33 per kwh
Next 100 hrs.	0.28 per kwh
Next 100 hrs.	0.25 per kwh
Excess kwh	0.23 per kwh

APPENDIX 4.1.1 POPULATION AND NUMBER OF HOUSEHOLDS BY WATER SERVICE

MUNICIPALITY OF CABUYAO (1980)

Barangay	Population No. of HH	Level III System	Level I System (Point Source) Well	Spring	Others	Total
	2298	1638	660	-	-	660
1. Bgy.I	383	273	110	-	-	110
	1590	1308	282	-	-	282
2. Bgy. II	265	218	47	-	-	47
	1698	1014	684	-	-	684
3. Bgy. III	283	169	114	-	-	114
	1320		1320			1320
4. Baclaran	220	-	220	-	-	220
5. Banay-	2946		2946			2946
banay	491	-	491	-	-	491
	3246		3222	36	-	3246
6. Banlic	541	-	537	6	-	541
	3954	972	2982			2982
7. Bigaa	659	162	497	-	-	497
	1632	-	1626	6	-	1632
8. Butong	272	-	271	1	-	272
	648		252	144	252	648
9. Casile	108	-	42	24	42	108
	588	-	576	12		588
10. Diezmo	98	-	96	2	-	98
	5112		5112		-	5112
11. Gulod	852	-	852	-	-	852
	4794		4794			4794
12. Mamatid	799	-	799	-	-	799
	5376		5376			5376
13. Marinig	896	-	896	-	-	896
	3588		3588			3588
14. Niugan	598	-	598	-	-	598
	450		390		60	450
15. Pittland	75	-	65	-	10	75
	2892		2892			2892
16. Pulo	482	-	482	-	-	482
	3042	582	2424	36		2460
17. Sala	507	97	404	6	-	410
	1998		1998			1998
18. San Isidro	333	-	333	-	-	333
Total	47172	5514	41112	234	312	41658
	7862	919	6852	39	52	6943

Note: Above : Population
Below : No. of Households

Source: Comprehensive Development Plan

APPENDIX 4.1.2 POPULATION AND NUMBER OF HOUSEHOLDS SERVED BY WATER SOURCE MUNICIPALITY OF STA. ROSA (1980)

Barangay	Population No. of HH	Level III System	Level I System(Point Source) Well/Spring	Others	Total
1. Kan-	4794	1038	1722	2034	3756
luran	799	173	287	339	626
	3198	942	606	1650	2256
2. Malusok	533	157	101	275	376
	2142	228	1404	510	1914
3. Market -	357	38	234	85	319
Area	7134	246	6444	444	6888
4. Aplaya	1189	41	1074	74	1148
	5736	1350	1788	2598	4386
5. Balibago	956	225	298	433	731
	4716		4716		4716
6. Caingin	786	-	786	-	786
	2376	132	1146	1098	2244
7. Dila	396	22	191	183	374
	5172	546	3558	1068	4626
8. Dita	862	91	593	178	771
	1416		1416		1416
9. Don Jose	236	-	236	-	236
	1626	366	492	768	1260
10. Ibaba	271	61	82	128	210
	3120	288	2310	522	2832
11. Labas	520	48	385	87	472
12. Maka-	3312		3108	204	3312
biling	552	-	518	34	552
13. Malit-	2964		2898	66	2964
lit	494	-	483	11	494
	4836		4824	16	4836
14. Pook	806	-	804	2	806
15. Pulong	3156		2634	522	3156
Sta.Cruz	526	-	439	87	526
16. Sto,	714		714		714
Domingo	119	-	119	-	119
	6588		6372	216	6588
17.Sinalahan	1098	-	1062	36	1098
	6900	840	4386	1674	6060
18. Tagapo	1150	140	731	279	1010
TOTAL	69900	5976	50502	13422	63924
	11650	996	8417	2237	10654

Note: Above : Population
Below : No. of Households

Source: Comprehensive Development Plan

APPENDIX 4.1.3 POPULATION AND NUMBER OF HOUSEHOLDS SERVED BY WATER SOURCE MUNICIPALITY OF BINAN (1980)

Barangay	Population No. of HH	Level III	Point Source with Pitcher Pump			Point Source
			Public Well	Private Well	Total	
	8238	150	156	3216	3372	4716
1. Caulalay	1373	25	26	536	562	786
	600		24	264	288	312
2. Casile	100	-	4	44	48	52
	14766	276	282	5736	6018	8472
3. dela Paz	2461	46	47	956	1003	1412
	15174	264	264	5388	5652	9258
4. Malaban	2529	44	44	898	942	1543
	4044	858	66	1350	1416	1770
5. Poblacion	674	143	11	225	236	295
6. San	14100	2088	282	5682	5964	6048
Antonio	2350	348	47	947	994	1008
	4062	366	78	1602	1680	2016
7. San Jose	677	61	13	267	280	336
8. San	7650	222	144	2970	3114	4314
Vicente	1275	37	24	495	519	719
9. Sto.	2856	138	60	1230	1290	1428
Domingo	476	23	10	205	215	238
	228	60	12		72	156
10. Biñan	38	10	2		12	26
	222		12	48	60	162
11. Bungahan	37		2	8	10	27
	1320		36	408	456	864
12. Calabuso	220	-	6	68	76	144
	366		12	36	48	318
13. Ganado	61	-	2	6	8	53
	1608		36	456	492	1116
14. Halang	268	-	6	76	82	186
	828		24		144	660
15. Langkiwa	138	-	4	24	28	110
	762		24	180	204	558
16. Loma	127	-	4	30	34	93
	90		6	12	18	72
17. Malamig	15	-	1	2	3	12
18. Mampl-	1056		30	306	336	720
lasan	176	-	5	51	56	120
	4026	216	72	1476	1548	2262
19. Platero	671	36	12	246	258	377
	1086		36	138	174	912
20. San Anton	181	-	6	23	29	152
21. Soro-	996	-	36	168	204	792
Soro	166	-	6	28	34	132
	624		18	126	144	480
22. Timbao	104	-	3	21	24	80
	2292		60	168	228	2064
23. Tubigan	382	-	10	28	38	344
	276		12	60	72	204
24. Zapote	46	-	2	10	12	34
	87270	4578	1782	31236	33018	49674
TOTAL	14545	763	297	5206	5503	8279

Note: Above : Population
Below : No. of Households
Source: Municipal Development Plan

APPENDIX 4.2.1 SURVEY FOR ESTIMATION OF C-VALUE

A section of the transmission pipeline was selected for the purpose of this survey. Measurements of water pressure and flow rate were conducted at the two points throughout the day. The selection criteria for the section of the pipeline are:

1) There is no distribution of water in the section.
2) There is easy access to the points. Also electricity is available.
3) Water pressure can be measured using existing devices.

The section between the reservoir area to Cabuyao (diameter of pipes, 250 mm; length, approximately 7 km) was selected in the light of the above conditions.

The test at the selected points was implemented during the unaccounted-for-water/not utilized water survey. Although the two points were measured on different dates, both points were measured for about 7 hours. The flow rates in the selected section fluctuated at a certain range daily, but it was expected that the range would be negligible during week days. However, the supplementary measurements mentioned above were still taken into account. FIGURE 4.2.1.1 shows the location of measuring points.

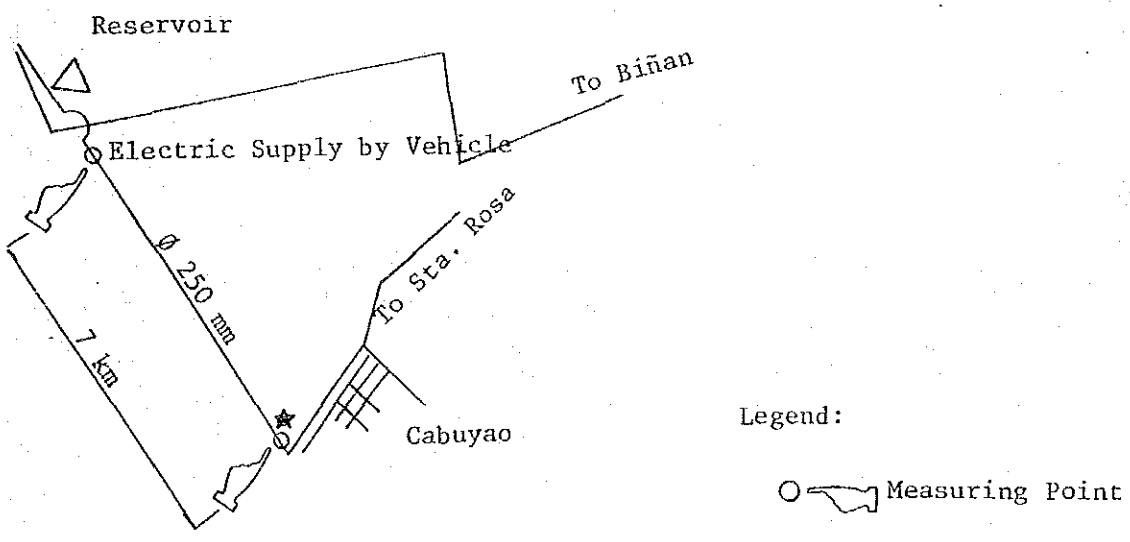


FIGURE 4.2.1.1 LOCATION OF MEASURING POINTS

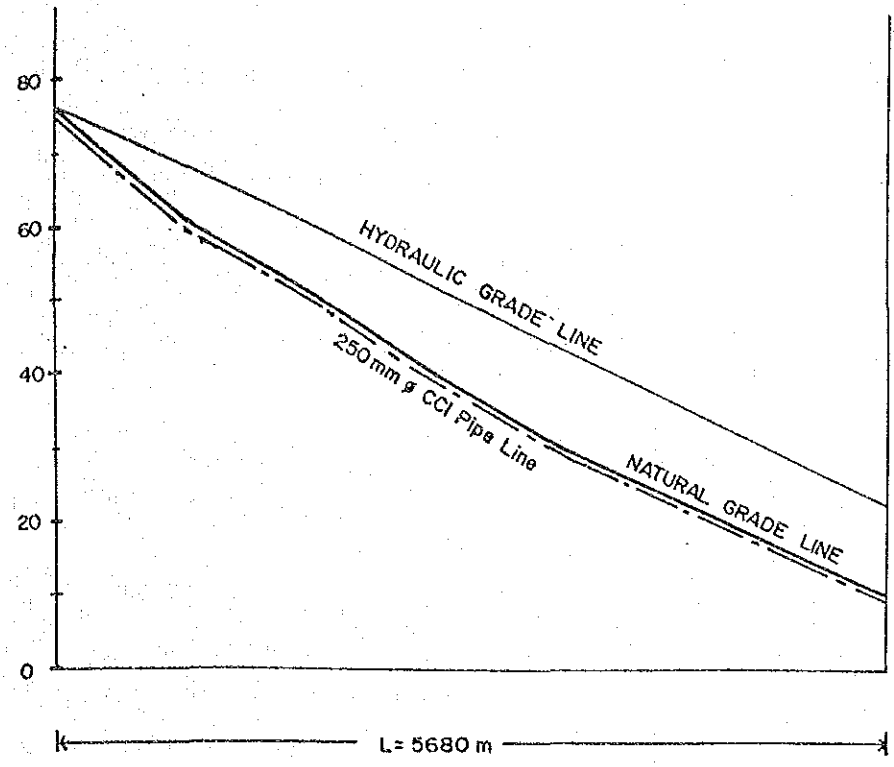
The flow rate in the Cabuyao-Sta. Rosa line is directly affected by the operation of the value at the reservoir. The time period for analysis was determined to be for four hours, from 1:00 P.M. to 5:00 P.M. thus avoiding the value operation time.

The average flow velocity is about 1.4 m/s, thus the time log is estimated at one hour between the two points. TABLE 4.2.1.2 shows the measurement result on the requirements.

TABLE 4.2.1.2 MEASUREMENT RESULTS

Item	Reservoir			Cabuyao Inlet		
Time	Flow Rate cu.m/hr.	Velocity m/s	Pressure (m)	Flow Rate cu.m/hr.	Velocity m/s	Pressure (m)
13:00	270	1.33	0.4	-	-	-
14:00	274	1.35	0.4	274	1.35	13.3
15:00	289	1.42	0.4	281	1.38	16.9
16:00	293	1.44	0.4	289	1.42	19.0
17:00	-	-	-	295	1.45	19.8
Average	282	1.39	0.4	285	1.40	17.3

FIGURE 4.2.1.2 - presents the profiles of hydraulic grade-line and computation result of "C" value.



UPSTREAM (Reservoir area)

Q= 282 m^3/hr = 0.0783 m^3/sec

ELEVATION= 76.2 m

PRESSURE HEAD = 0.4 m

PIPE DIAMETER= 250 mm

COMPUTATION ;

$C = 3.59028 \cdot Q\,ave \cdot D^{-2.63} \cdot H^{-0.54} \cdot L^{0.54}$

Thus;

$C = 3.5902 \times 0.0787 \times (0.25)^{-2.63} \times (49.2)^{-0.54} \times (5680)^{0.54} = 141$

DOWNSTREAM (Entrance of Cabuyao)

Q= 285 m^3/hr = 0.0792 m^3/sec

ELEVATION = 10.1 m

PRESSURE HEAD = 17.3

PIPE DIAMETER = 250 mm

Where ;

Qave. = 1/2 (0.078 + 0.0792) = 0.0787

D = 0.250 m

L = 5.680 m

H= (76.2 + 0.4) - (10.1 + 17.3) = 49.2

FIGURE 4.2.1.2 PROFILE OF HYDRAULIC GRADE LINE

APPENDIX 4.2.2 WATER PRESSURE IN THE SERVICE AREA

The preliminary survey revealed that many of the houses possess additional faucets. The water pressure measurements were done outside the houses covering 36 points; 7 in Cabuyao, 17 in Sta. Rosa and 12 in Biñan. (10 points: Automatic Pressure Recorder). The survey was conducted for three days to cover the three areas, one day for each area. Two shifts had been adopted due to the measuring requirement throughout the day.

TABLE 4.2.2.1 and FIGURE 4.2.2.1. show the selected points for this test. FIGURE 4.2.2.2 shows contour line covering the 3 municipalities.

The measurement records for every hour at the 36 points throughout the day are shown in TABLE 4.2.2.2. The contour lines are prepared for the total water head and water pressure based on the records at 7:00 A.M. and 1:00 P.M. which may represent the hours in maximum and minimum water consumption throughout the day, respectively. FIGURE 4.2.2.3.A to FIGURE 4.2.2.3.L present the contour lines by municipality. The total water head at the measurement point is calculated using the topographical contour prepared by each municipality.

TABLE 4.2.2.1 LOCATION OF SELECTED POINTS FOR PRESSURE TEST

No.	Elevation (GL m)	Address of the Selected Point	R.M.
1	13	Sala, Cabuyao	APR
2	11	144, Sala, Cabuyao	
3	8	8, P. Burgos St. Cabuyao	
4	7	156, Bigaa, Cabuyao	
5	9	M.H. Del Pilar St., Cabuyao	
6	10	59, AM. Roxas St., Cabuyao	
7	9	176, Malvar St., Cabuyao	
8	9	Max. Pueblo, Sta. Rosa	APR
9	16	1816, Dita, Sta. Rosa	
10	13	1586, Dila, Sta. Rosa	
11	12	1211, Balibago, Sta. Rosa	
12	13	13th, F. Reyes St. Balibago, Sta. Rosa	
13	9	890, Rizal St. Labas, Sta. Rosa	
14	7	1176, Lucero St. Malusok, Sta. Rosa	
15	8	J.P. Riza, Sta. Rosa	APR
16	6	180, Ibaba, Sta. Rosa	
17	4	Aplaya, Sta. Rosa	APR
18	9	1072, Lucero St., Sta. Rosa	
19	9	686, P. Gomez St., Sta. Rosa	
20	7	Tatlong Hari, Sta. Rosa	APR
21	7	Tatlong Hari, Sta. Rosa	APR
22	9	7, Tagapo, Sta. Rosa	
23	9	Hi-way, Tagapo, Sta. Rosa	
24	13	Balibago, Hi-way, Sta. Rosa	
25	9	Platero, Biñan	
26	8	Monalat, Biñan	
27	8	780, Balintawak St., Biñan	
28	7	Manabat, Biñan	APR
29	4	497, Dalampasigan St., Malabon, Biñan	
30	6	828, Dela Paz, Biñan	
31	8	Capinpin St., Biñan	APR
32	8	55, Dr. A. Gonzales St., San Jose, Biñan	
33	9	67, A. Bonifacio St. Canlacay, Biñan	
34	9	San Vicente, Biñan	
35	9	San Vicente, Biñan	APR
36	8	Bonifacio St., Biñan	APR

Note: APR ---- Automatic Pressure Recorder

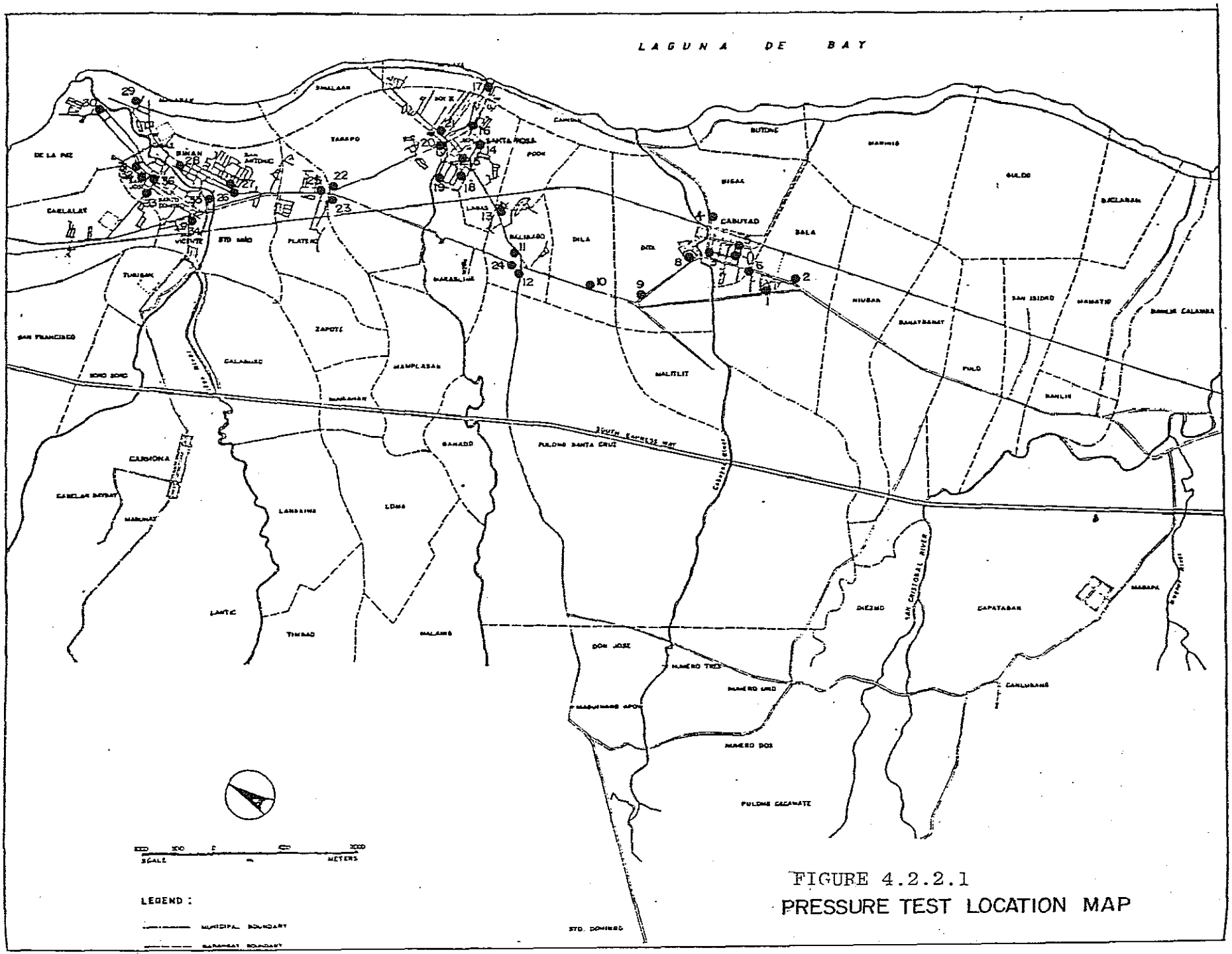


FIGURE 4.2.2.1
PRESSURE TEST LOCATION MAP

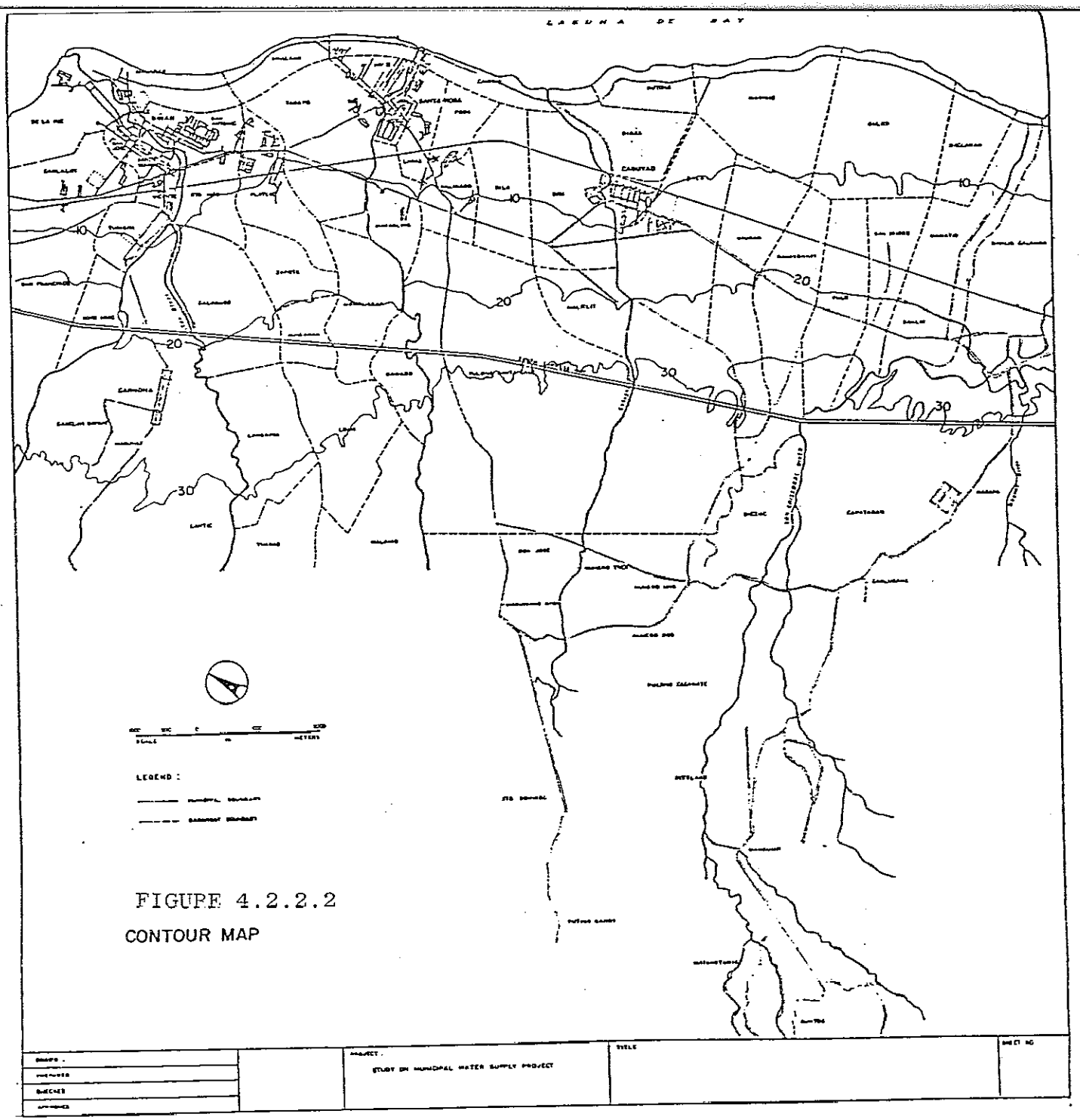


FIGURE 4.2.2.2

CONTOUR MAP

TABLE - 4.2.2.2 PRESSURE TEST (Unit: kg/cm^2)

Hour No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1.3	1.3	1.7	1.7	1.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.2	1.3	1.3	1.3
2	1.7	1.7	1.7	1.5	1.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.7	0.7	0.8	0.8	0.5	0.7	1.0	1.3	1.6	1.7
3	1.9	1.9	1.8	1.8	0.9	0.4	0.3	0.3	0.5	0.4	0.1	0.5	0.5	0.7	0.4	0.4	0.4	0.4	0.4	0.4	1.4	1.7	1.9	1.9
4	2.0	2.0	2.0	2.0	1.5	0.9	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.4	1.8	2.0	2.0
5	1.7	1.7	1.7	1.2	1.0	0.3	0.1	0.3	0.2	0.2	0.2	0.1	0.3	0.5	0.7	0.7	0.7	0.7	0.5	0.6	1.1	1.2	1.5	1.6
6	1.9	1.9	1.9	1.9	1.6	0.7	0.5	0.5	0.6	0.5	0.5	0.6	0.6	0.7	0.8	0.9	0.9	0.8	0.9	0.9	1.2	1.5	1.9	1.9
7	2.0	2.2	2.5	2.5	2.4	0.5	0.5	0.6	0.6	0.5	0.6	0.6	0.8	0.8	0.8	0.8	0.9	0.9	0.8	0.8	1.2	1.5	1.6	1.8
8	1.7	1.7	1.7	1.7	1.3	0.6	0.4	0.5	0.6	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	1.1	1.3	1.5	1.6
9	1.0	1.0	1.0	1.0	0.4	0	0	0	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.5	0.9	1.0
10	1.0	1.0	1.1	1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.7	0.9	1.0
11	0.8	0.8	0.8	0.7	0.4	0	0	0	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	0.7	0.8
12	0.6	0.6	0.7	0.6	0.5	0.3	0.2	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.5	0.5
13	0.9	1.0	1.0	1.0	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.4	0.7	0.8	0.9
14	0.6	0.6	0.6	0.5	0.3	0.1	0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.5	0.5	0.5	0.5
15	1.2	1.2	1.2	1.1	0.9	0.5	0.4	0.4	0.3	0.3	0.3	0.5	0.4	0.5	0.6	0.6	0.7	0.7	0.7	0.5	0.7	1.0	1.0	1.1
16	1.1	1.1	1.1	1.1	1.0	0.1	<0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.3	03	0.3	0.2	0.3	0.3	0.3	0.4	1.0	1.0
17	1.1	1.1	1.1	1.1	1.9	0.5	0.3	0.3	0.2	0.2	0.2	0.3	0.4	0.6	0.6	0.5	0.4	0.4	0.5	0.5	0.7	1.0	1.0	1.1
18	1.1	1.1	1.1	1.1	1.9	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.7	0.9	1.0	1.1
19	1.0	1.1	1.1	1.0	0.9	0.3	<0.1	<0.1	0.2	0.1	0.1	0.1	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.3	0.6	0.9	1.0	1.0
20	1.3	1.3	1.3	1.2	1.1	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.6	0.8	1.1	1.2	1.2
21	0.8	0.8	0.8	0.8	0.7	0.4	0.3	0.3	0.2	0.3	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.6	0.7	0.8	0.8
22	0.8	0.8	0.8	0.8	0.8	0.5	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.3	0.1	0.3	0.3	0.5	0.2	0.4	0.7	0.7	0.6
23	0.9	1.1	0.9	0.8	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	0.3	0.3	0.1	0.2	0.2	0.3	0.3	1.1	1.2	0.8	1.2
24	1.3	1.4	1.3	1.3	1.1	0.4	0.2	0.2	0.5	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.5	0.9	0.7	0.9	1.0	1.3	1.3
25	1.7	1.7	1.7	1.9	1.5	0.8	0.5	0.3	0.3	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.9	1.0	1.3	1.5	1.5
26	0.9	0.8	0.8	0.8	0.7	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.3	0.5	0.7	0.8	0.8
27	0.4	0.4	0.4	0.3	<0.1	<0.1	<0.1	<0.1	0	0	0	0	<0.1	0	0	0	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.3
28	0.4	0.4	0.4	0.4	0.3	0.1	0.5	0.5	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.3	0.3	0.4	0.4
29	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
30	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
31	0	0	0	0	0	0.3	0.4	0.4	0.3	0.3	0.2	0.4	0.2	0.3	0.4	0.2	0.1	0.3	0.3	0.3	0.2	0.1	0	0
32	<0.1	<0.1	<0.1	<0.1	0	0	<0.1	<0.1	<0.1	0	<0.1	0	0	0	<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
33	0.5	0.5	0.5	0.3	0.2	<0.1	0.7	0.7	0.5	<0.1	0.7	<0.1	0	<0.1	<0.1	0	0	<0.1	<0.1	<0.1	0.3	0.4	0.5	0.5
34	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0	0	0	0	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
35	0.5	0.5	0.5	0.5	0.4	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.5
36	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	0	0	0	0	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1

Note: <0.1 : less than 0.1 kg/cm^2

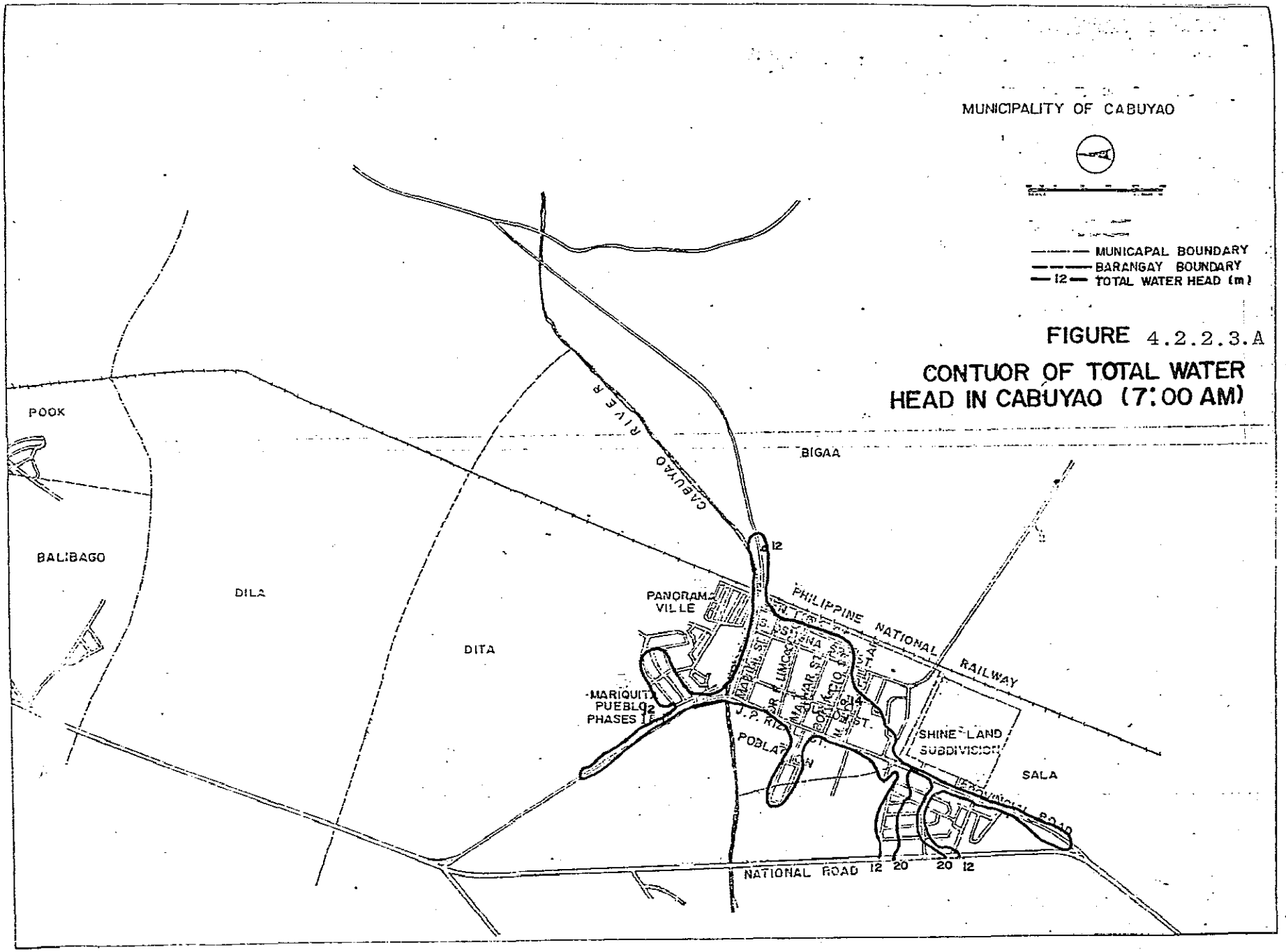
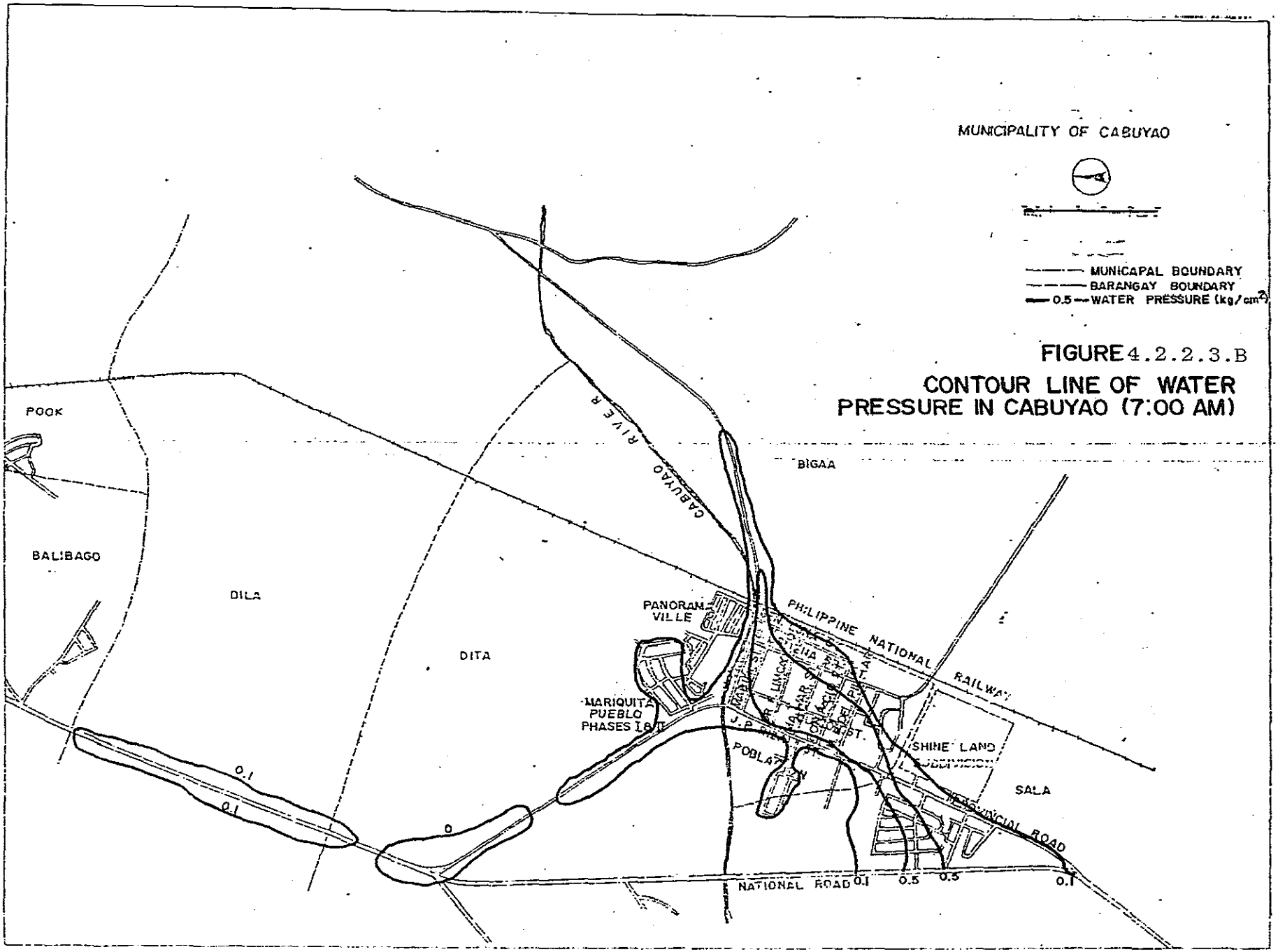


FIGURE 4.2.2.3.A

CONTUOR OF TOTAL WATER HEAD IN CABUYAO (7:00 AM)


MUNICIPALITY OF CABUYAO
MUNICIPAL BOUNDARY
BARANGAY BOUNDARY
0.5 WATER PRESSURE (kg/cm²)
FIGURE 4.2.2.3.B
CONTOUR LINE OF WATER PRESSURE IN CABUYAO (7:00 AM)
POOK
BALIBAGO
DILA
DITA
BIGAA
CABUYAO RIVER
PANORAMA VILLE
MARIQUITA PUEBLO PHASES I & II
PHILIPPINE NATIONAL RAILWAY
SHINE LAND
SALA
POBLACION
PROVINCIAL ROAD
NATIONAL ROAD
0.1
0.5
0

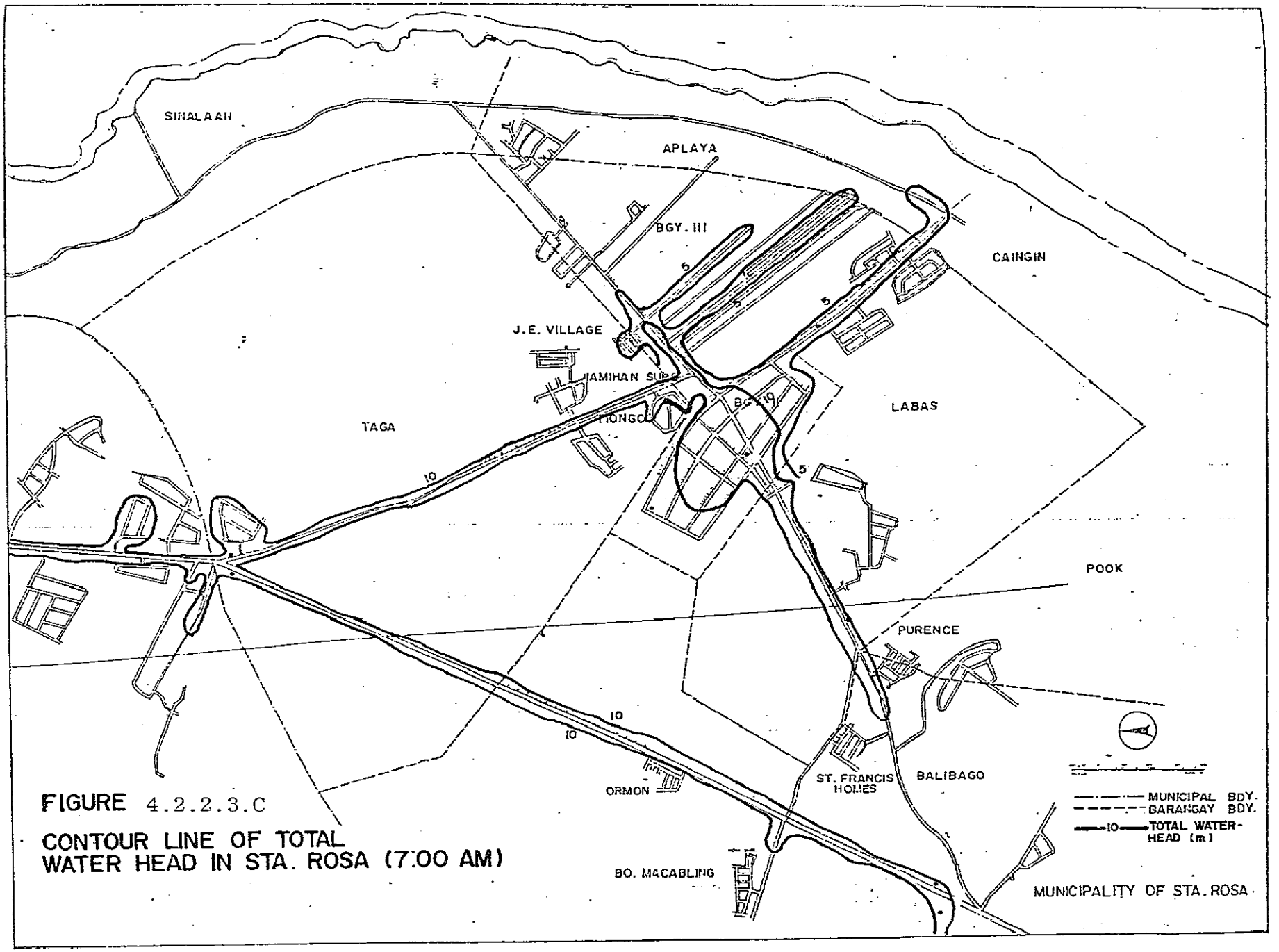


FIGURE 4.2.2.3.C

CONTOUR LINE OF TOTAL WATER HEAD IN STA. ROSA (7:00 AM)

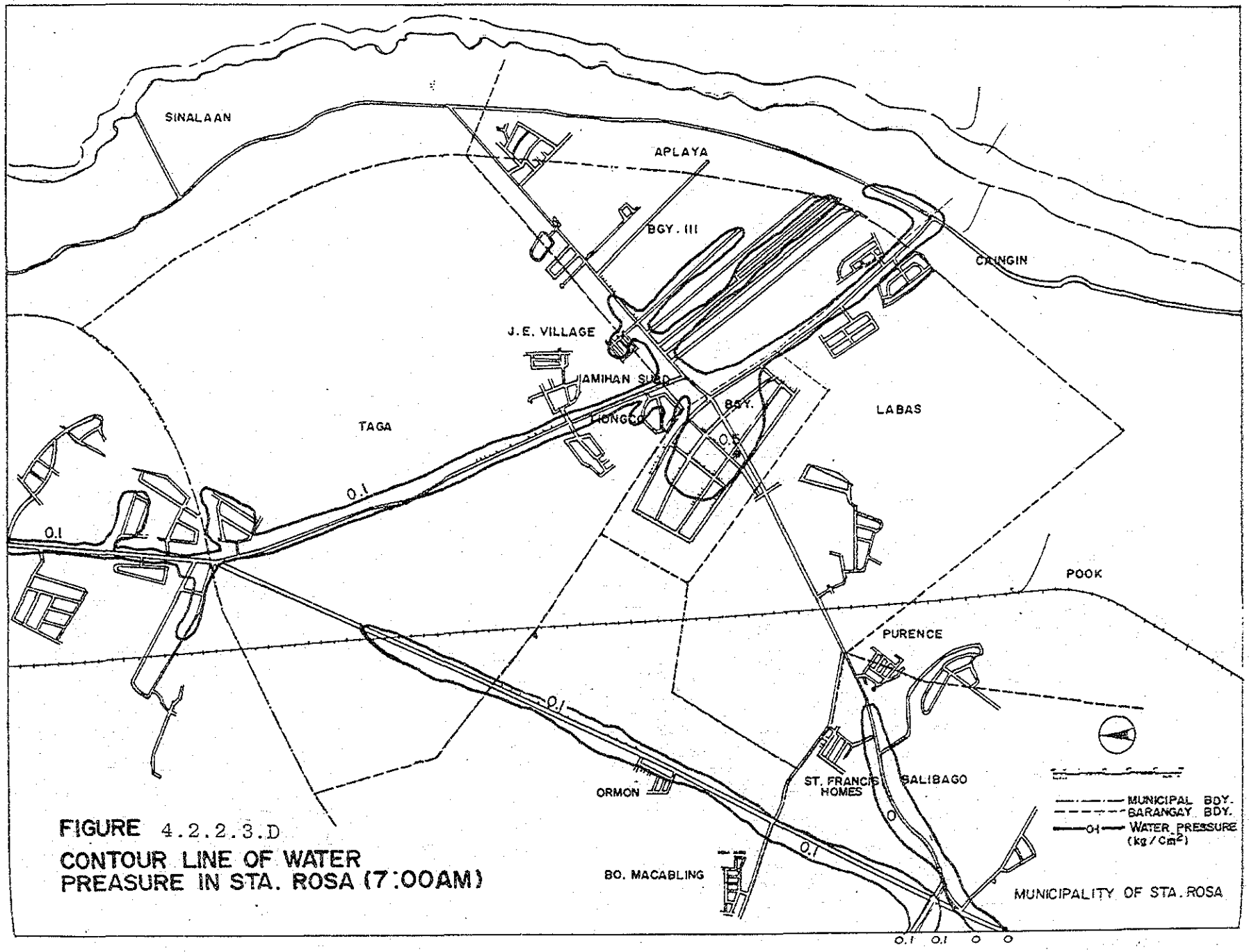


FIGURE 4.2.2.3.D
CONTOUR LINE OF WATER PREASURE IN STA. ROSA (7:00AM)

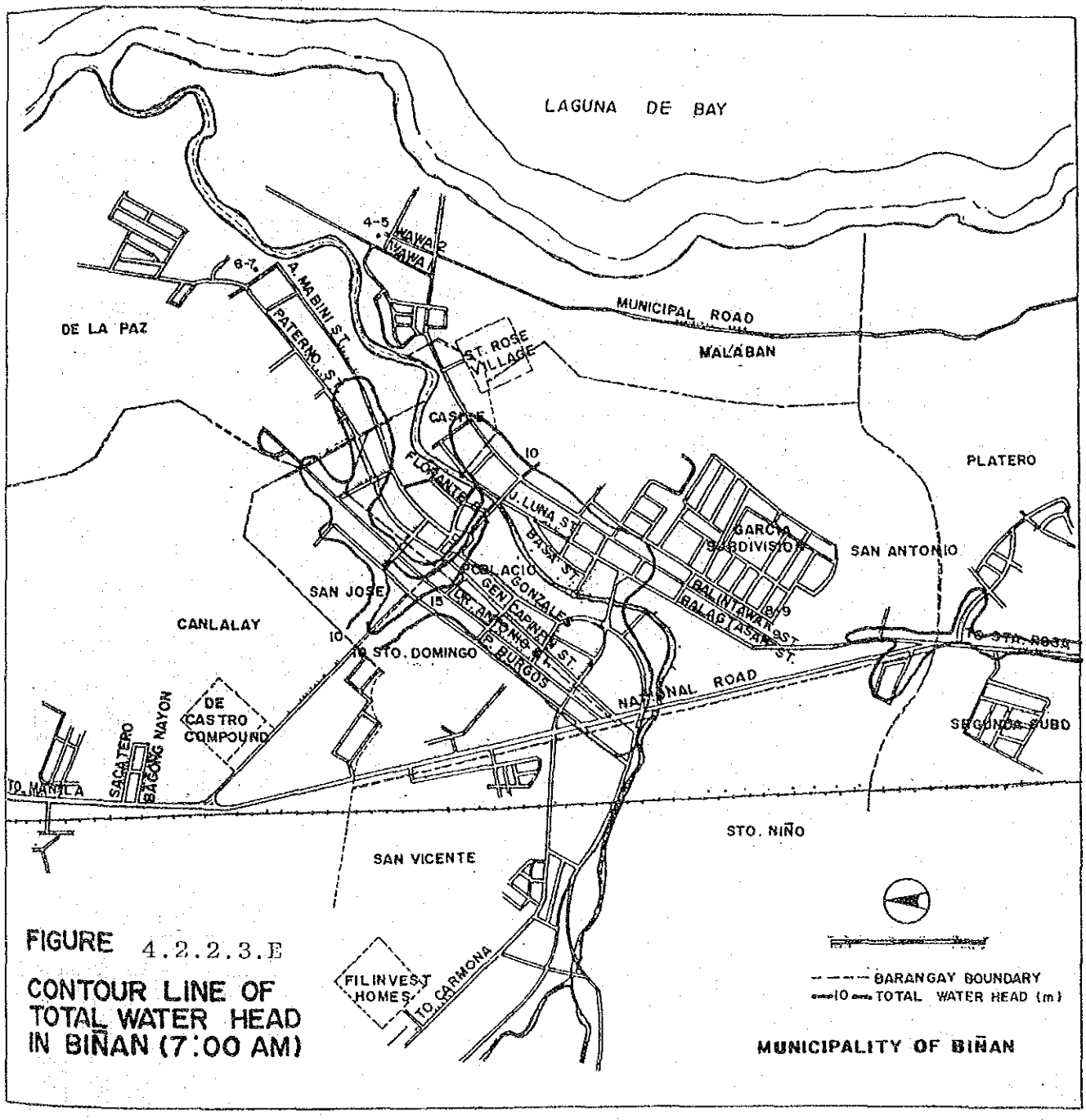


FIGURE 4.2.2.3.E

CONTOUR LINE OF TOTAL WATER HEAD IN BIÑAN (7:00 AM)

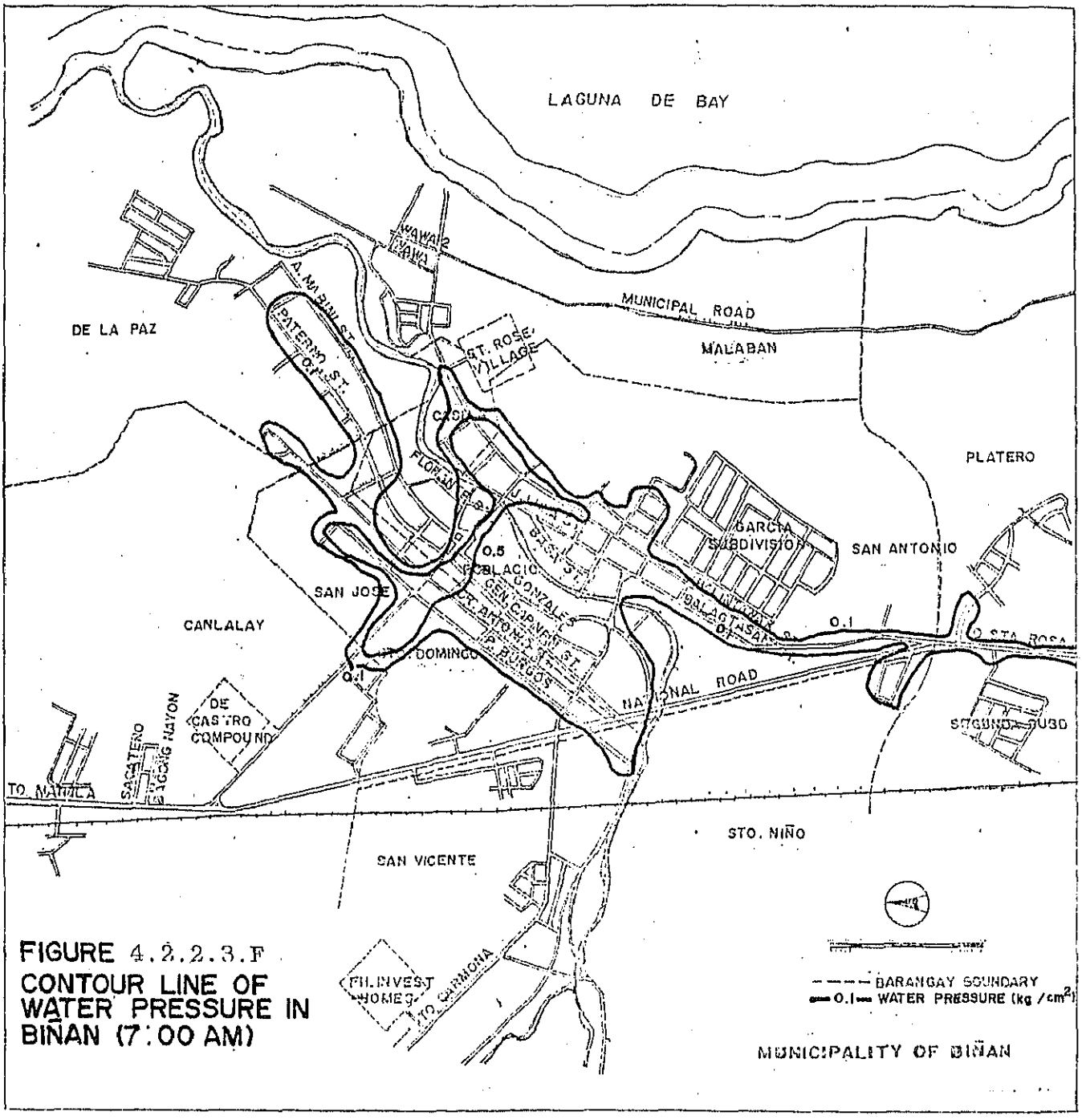


FIGURE 4.2.2.3.F
CONTOUR LINE OF WATER PRESSURE IN BIÑAN (7:00 AM)

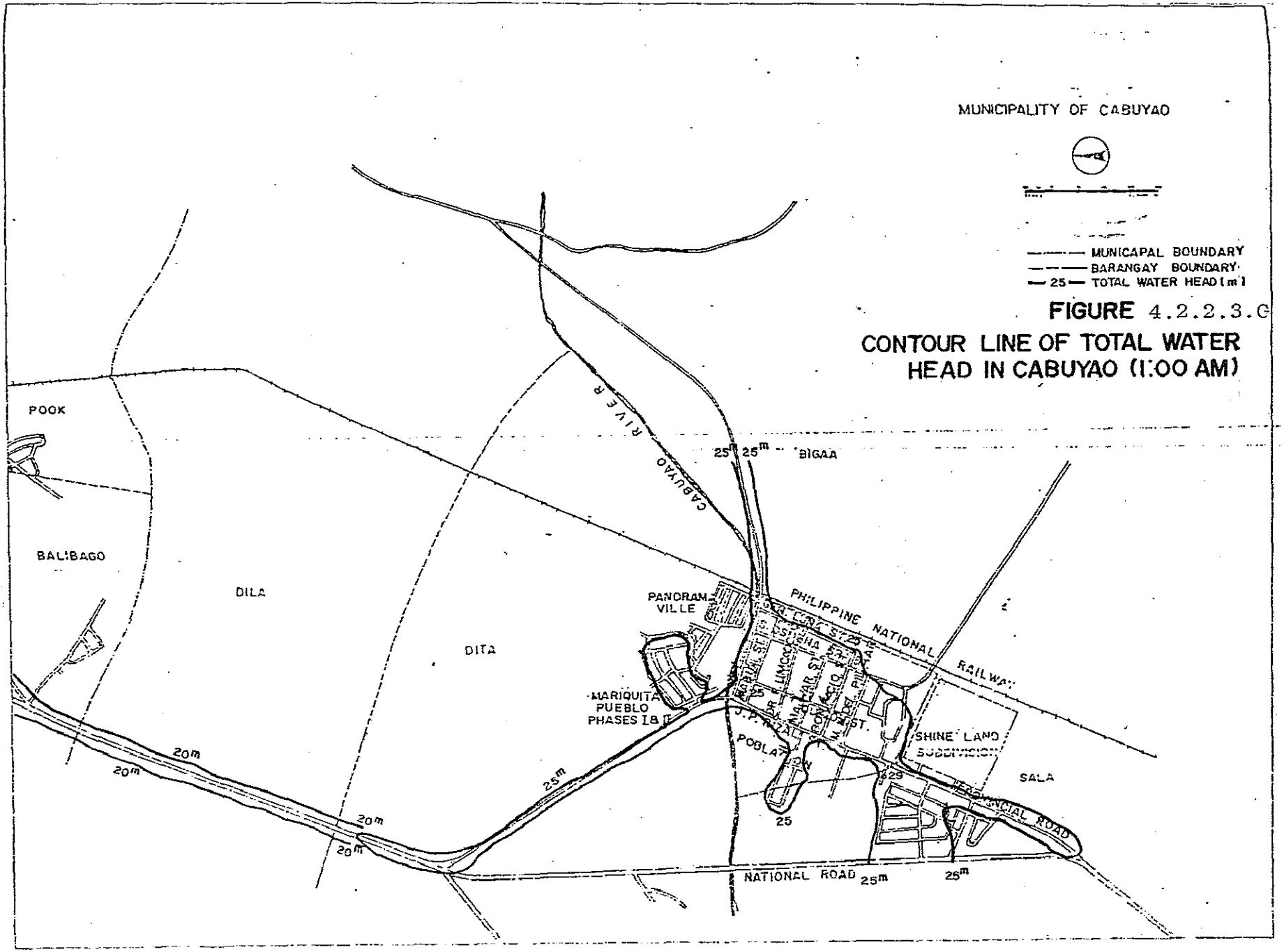


FIGURE 4.2.2.3.C

CONTOUR LINE OF TOTAL WATER HEAD IN CABUYAO (1:00 AM)

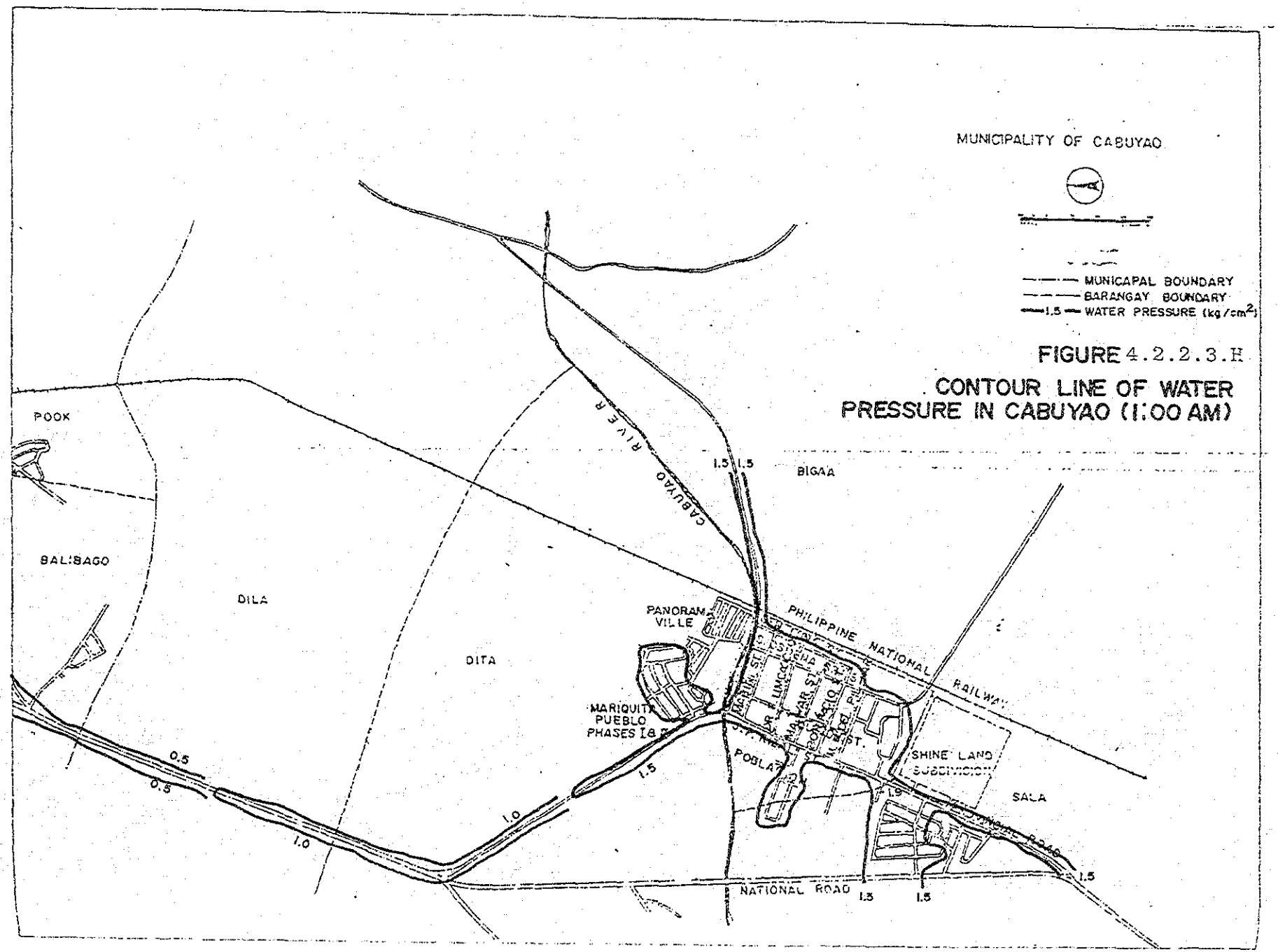


FIGURE 4.2.2.3.H
CONTOUR LINE OF WATER PRESSURE IN CABUYAO (1:00 AM)

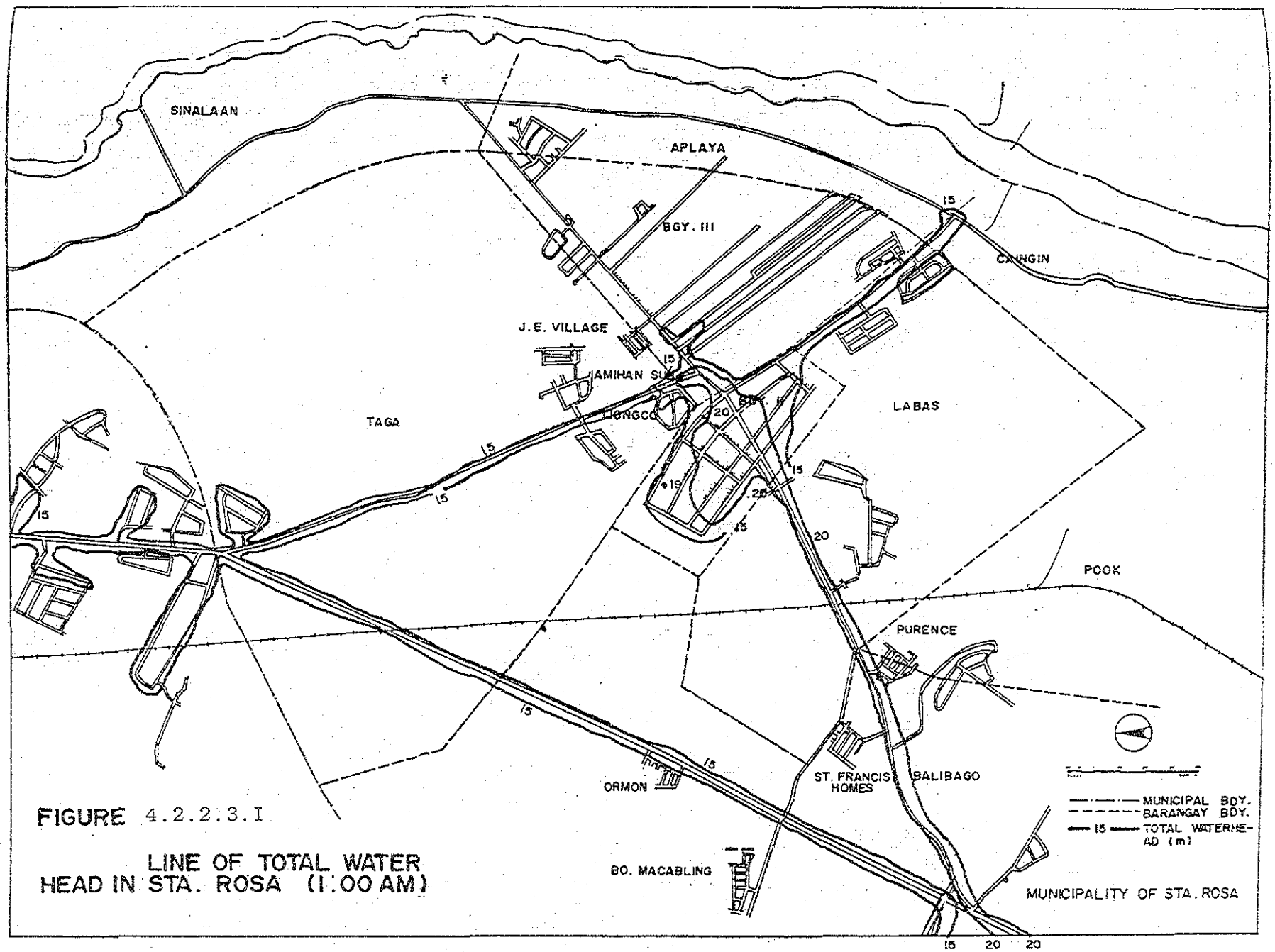


FIGURE 4.2.2.3.I

LINE OF TOTAL WATER HEAD IN STA. ROSA (1:00 AM)

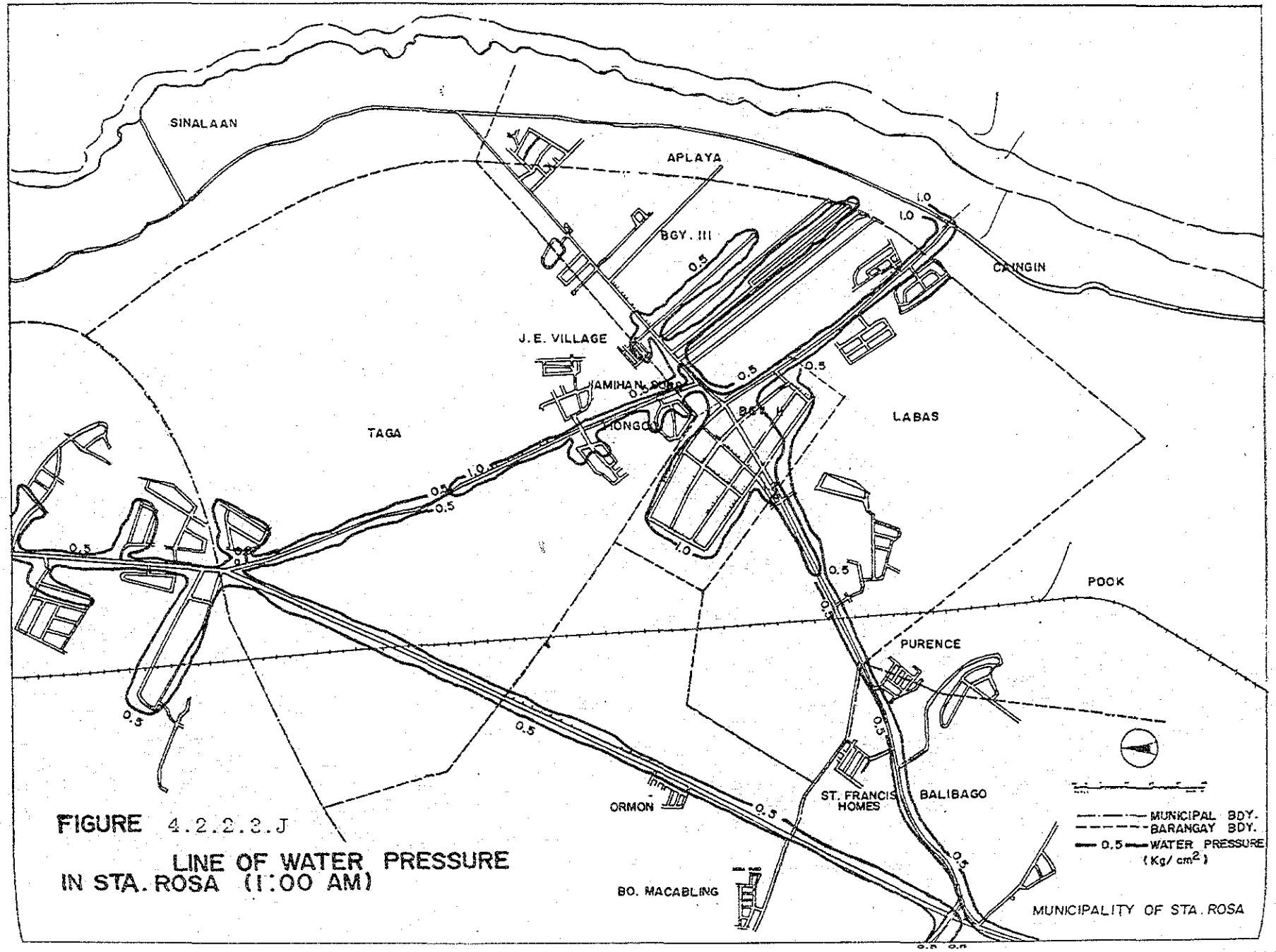
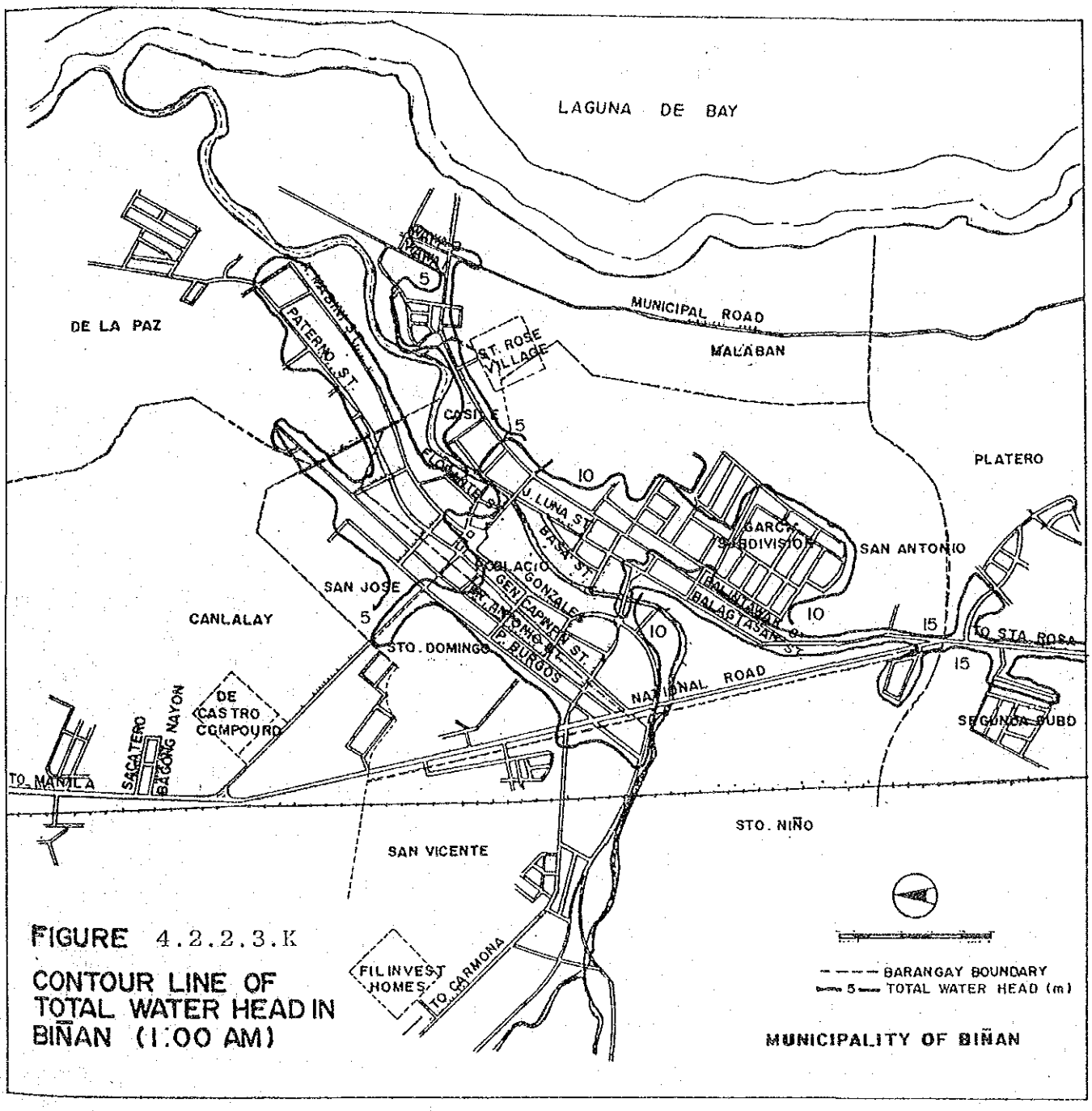


FIGURE 4.2.2.3.J

LINE OF WATER PRESSURE IN STA. ROSA (1:00 AM)


LAGUNA DE BAY
DE LA PAZ
PATERNO ST.
MUNICIPAL ROAD
MALABAN
ST. ROSE VILLAGE
PLATERO
J. LUNA ST.
BASA ST.
SAN ANTONIO
SAN JOSE
CANLALAY
STO. DOMINGO
GEN. CAPINPIN ST.
P. BURGOS
NATIONAL ROAD
TO STA. ROSA
SEGUNDA SUBD
DE CASTRO COMPOUND
SAGATERO
BAGONG NAYON
TO MANILA
STO. NIÑO
SAN VICENTE
FILINVEST HOMES
TO CARMONA
FIGURE 4.2.2.3.K
CONTOUR LINE OF TOTAL WATER HEAD IN BIÑAN (1:00 AM)
BARANGAY BOUNDARY
5 TOTAL WATER HEAD (m)
MUNICIPALITY OF BIÑAN

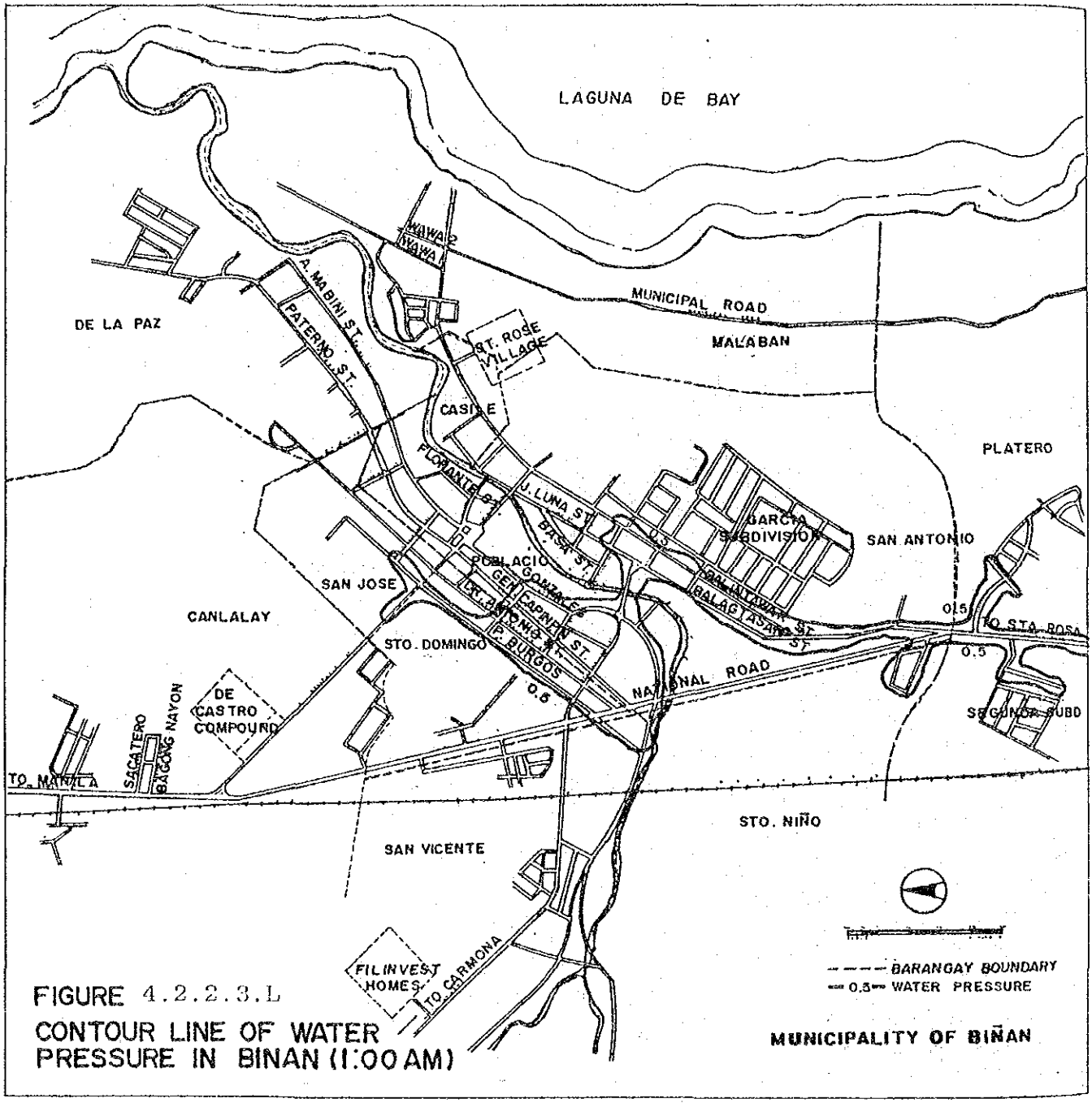


FIGURE 4.2.2.3.L
CONTOUR LINE OF WATER PRESSURE IN BINAN (1:00 AM)

APPENDIX 4.2.3 COLLECTED CHARGES FOR THE MONTH OF JUNE, 1986 BY CONSUMER TYPE

Unit:Peso

Municipality	Barangay	Metered					Flat Rate								Total
							Nonfunctioning Meter				Without Meter				
		Domestic	Commercial	Institutional	Industrial	Sub-Total	Domestic	Commerc.	Insti.	Sub-Total	Domestic	Commer.	Insti.	Sub-Total	
Cabuyao	1 Barangay I	6295.75	-	-	-	6295.75	750.00	10.00	30.00	790.00	44.00	14.00	30.00	88.00	7173.75
	2 " II	5565.00	68.50	36.75	-	5 .70.25	402.00	-	-	402.00	-	-	-	-	6072.25
	3 " III	3900.25	-	-	-	3960.25	287.75	-	-	287.75	-	-	-	- .	4248.00
	4 Bigaa	2937.75	-	-	-	2937.75	312.75	-	-	312.75	-	-	-	-	3250.50
	5 Sala	3095.25	10.00	50.00	-	3155.25	137.75	-	10.00	147.75	14.00	-	-	14.00	3317.00
	Sub-Total	21854.00	78.50	86.75	-	22019.25	1890.25	10.00	40.00	1940.25	58.00	14.00	30.00	102.00	24061.50
Sta.Rosa	1 Aplaya	887.75	-	-	-	887.75	127.75	-	-	127.75	-	-	-	-	1015.50
	2 Balibago	10155.00	14.50	-	4219.-	14388.50	897.25	66.25	-	963.50	14.00	-	-	14.00	15366.00
	3 Barangay I	3523.00	10.00	-	-	3533.00	354.50	-	-	354.50	57.20	-	-	57.20	3944.70
	4 " II	5874.25	10.00	-	-	5884.25	359.00	-	-	359.00	43.80	-	-	43.80	6287.05
	5 " III	1009.00	-	-	-	1009.00	116.50	-	-	116.50	-	15.20	-	15.20	1140.70
	6 Dila	416.75	-	-	1109.00	1525.75	30.00	-	-	30.00	-	-	-	-	1555.75
	7 Dita	5990.50	2203.00	-	260.50	8454.00	260.25	-	13.00	273.25	14.00	-	-	14.00	8741.25
	8 Ibaba	1812.75	-	-	-	1812.75	10.00	-	-	10.00	14.00	-	-	14.00	1836.75
	9 Labas	1900.00	-	-	-	1900.00	139.50	-	-	139.50	-	-	-	-	2039.50
	10 Macabling	347.50	-	-	147.00	494.50	42.00	-	-	42.00	-	-	-	-	536.50
	11 Tagapo	4955.00	-	160.00	-	5115.00	69.25	-	-	69.25	28.60	-	-	28.60	5212.85
	Sub-Total	36871.50	2237.50	160.00	5735.50	45004.50	2406.00	66.25	13.00	2485.75	171.60	15.20	-	186.80	47676.55
Biñan	1 Dela Paz	313.25	-	-	-	313.25	20.00	-	-	20.00	143.60	-	-	143.60	476.85
	2 Malaban	176.50	-	-	-	176.50	34.00	-	-	34.00	340.80	-	15.20	356.00	566.50
	3 Platero	1691.00	-	-	-	1691.00	219.75	-	-	219.75	-	-	-	-	1910.75
	4 Poblacion	1472.25	189.50	-	-	1661.75	133.00	-	45.00	178.00	925.40	58.40	14.60	998.40	2838.15
	5 San Antonio	7342.50	34.25	-	-	7376.75	716.25	-	-	716.25	1008.20	-	-	1008.20	9101.20
	6 San Jose	607.50	-	-	-	607.50	22.00	-	-	22.00	403.40	-	-	403.40	1032.90
	7 San Vicente	803.50	-	-	-	803.50	-	-	-	-	57.20	-	-	57.20	860.70
	8 Sto. Domingo	175.25	-	-	-	175.25	-	-	-	-	199.60	-	-	199.60	374.85
	Sub-Total	12581.75	223.75	-	-	12805.50	1145.00	-	45.00	1190.00	3078.20	58.40	29.80	3166.70	17161.90
	T o t a l	71307.25	2539.75	246.75	5735.50	79829.25	5441.25	76.25	98.00	5675.50	3307.80	87.60	59.80	3455.20	88899.95

APPENDIX 4.3.1 SPRING DISCHARGE RATE

The discharge rate from the existing spring is 115.8 l/s or 10,008 cu.m/day. The total discharge volume from the four springs in the vicinity of the existing spring box, which may be tapped as additional sources of water, is approximately 40 l/s.

TABLE 4.3.1.1 DISCHARGE RATE FROM SPRINGS

Existing/ Potential	Point	l/s	Measurement Records
Existing spring box	ϕ 300	82.5	AM. 298 cu.m/hr. Ave. 297 cu.m/hr. PM. 295
	ϕ 200	33.3	AM. 120 Ave. 120 PM. 120
	Sub-Total	115.8	AM. 418 AVE. 417 PM. 415
Potential Source	No. 1	5.6	Required time to fill a drum-can 245 l : 43.8 sec
	No. 2	21.5	245 l : 11.4 sec
	No. 3	9.6	245 l : 25.4 sec
	No. 4	1.6	18 l : 11.0 sec
	Sub-Total	38.3	
	TOTAL	154.1	

The discharge amount from the existing spring box is almost constant through the year (approximately 8 percent increase in rainy season compared to the amount during dry season). The amount from the four potential water sources (springs) is also constant through the year. TABLE 4.3.1.2 shows the figures measured in dry and rainy season.

TABLE 4.3.1.2 SPRING WATER MEASUREMENT RECORDS

Kind	Detail	Daily Discharge Rate Dry	Rainy	R. M.
Existing spring box	ϕ 300	6,826 cu.m/d.	7,128	Difference between two seasons is less than 8%
	ϕ 200	2,462	2,880	
	Sub-Total		9,288	10,008
Potential sources	4 springs	3,283	3,309	

APPENDIX 4.4.1 WATER CONSUMPTION (METERED CONNECTIONS)BY CONSUMER TYPE

Unit: cu.m/month or cu.m/day

Municipality	Barangay	Domestic		Commercial		Institutional		Industrial		Total	
		Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily
Cabuyao	1 Barangay I	7,573	252.4	-	-	-	-	-	-	7,573	252.4
	2 Barangay II	6,643	221.4	99	3.3	45	1.5	-	-	6,787	226.2
	3 Barangay III	4,960	165.3	-		-		-		4,960	165.3
	4 Bigaa	3,742	124.7	-		-		-		3,742	124.7
	5 Sala	4,049	135.0	1	0.0	65	2.2	-		4,115	137.2
	Sub-Total	26,967	898.8	100	3.3	110	3.7	-	-	27,177	905.8
Sta. Rosa	1 Aplaya	1,155	38.5	-		-		-		1,155	38.5
	2 Balibago	11,760	392.0	19	0.6	-		2,851	95.0	14,630	487.6
	3 Barangay I	4,474	149.1	10	0.3	-		-		4,484	149.4
	4 Barangay II	7,290	243.0	-		4	0.1	-		7,294	243.1
	5 " III	1,212	40.4	-		-		-		1,212	40.4
	6 Dila	536	17.9	-		-		816	27.2	1,352	45.1
	7 Dita	7,611	253.7	1,507	50.2	-		212	7.1	9,330	311.0
	8 Ibaba	2,283	76.1	-		-		-		2,283	76.1
	9 Labas	2,249	75.0	-		-		-		2,249	75.0
	10 Macabling	401	13.4	-		-		147	4.9	548	18.3
	11 Tagapo	6,437	214.6	-		171	5.7	-		6,608	220.3
	Sub-Total	45,408	1,513.7	1,536	51.1	175	5.8	4,026	134.2	51,145	1,704.8
Biñan	1 Dela Paz	397	13.2	-		-		-		397	13.2
	2 Malaban	236	7.9	-		-		-		236	7.9
	3 Platero	2,100	70.0	-		-		-		2,100	70.0
	4 Poblacion	1,870	62.3	260	8.7	-		-		2,130	71.0
	5 San Antonio	9,283	309.4	49	1.6	-		-		9,332	311.0
	6 San Jose	761	25.4	-		-		-		761	25.4
	7 San Vicente	997	33.2	-		-		-		997	33.2
	8 Sto. Domingo	234	7.8	-		-		-		234	7.8
	Sub-Total	15,878	529.2	309	10.3	-	-	-	-	16,187	539.5
	Total	88,253	2,941.7	1,945	64.7	285	9.5	4,026	134.2	94,509	3,150.1

APPENDIX 4.5.1 UNACCOUNTED-FOR WATER/NOT-UTILIZED WATER

This survey comprises two major elements; one for the transmission lines and another for distribution networks in the selected model areas. The two study section of the transmission lines and the four areas are shown in FIGURE 4.5.1.1 and given below.

- Transmission Line : Cabuyao - Sta. Rosa Line ; one from the spring to reservoir area and another from the reservoir area to the entrance of Cabuyao

- Distribution network :
  a) The core area of Cabuyao.
  b) The Sta. Rosa area including the core area of the municipality and the area along Cabuyao - Sta. Rosa line in Sta. Rosa.
  c) The area along Biñan line in Sta. Rosa.
  d) The Biñan area.

A flow chart for this investigation and analysis is given in FIGURE 4.5.1.2.

(1) Background Information on the Study Sections of the Transmission Pipeline and the Study Areas

There are no residents along the transmission line from the spring to the entrance of Cabuyao. However, there are large houses approximately 300 m from the transmission pipeline upstream of the reservoir as shown in FIGURE 4.5.1.1. The aforementioned four areas are high population density areas. The following are some information on the study areas based on the field survey.

1) The core area of Cabuyao

The area consists of barangays Bigaa, Sala and Poblacion. The area is predominantly a residential area except for the area along J.P. Rizal St. near the public market which is used both for commercial and institutional purposes in barangay Sala.

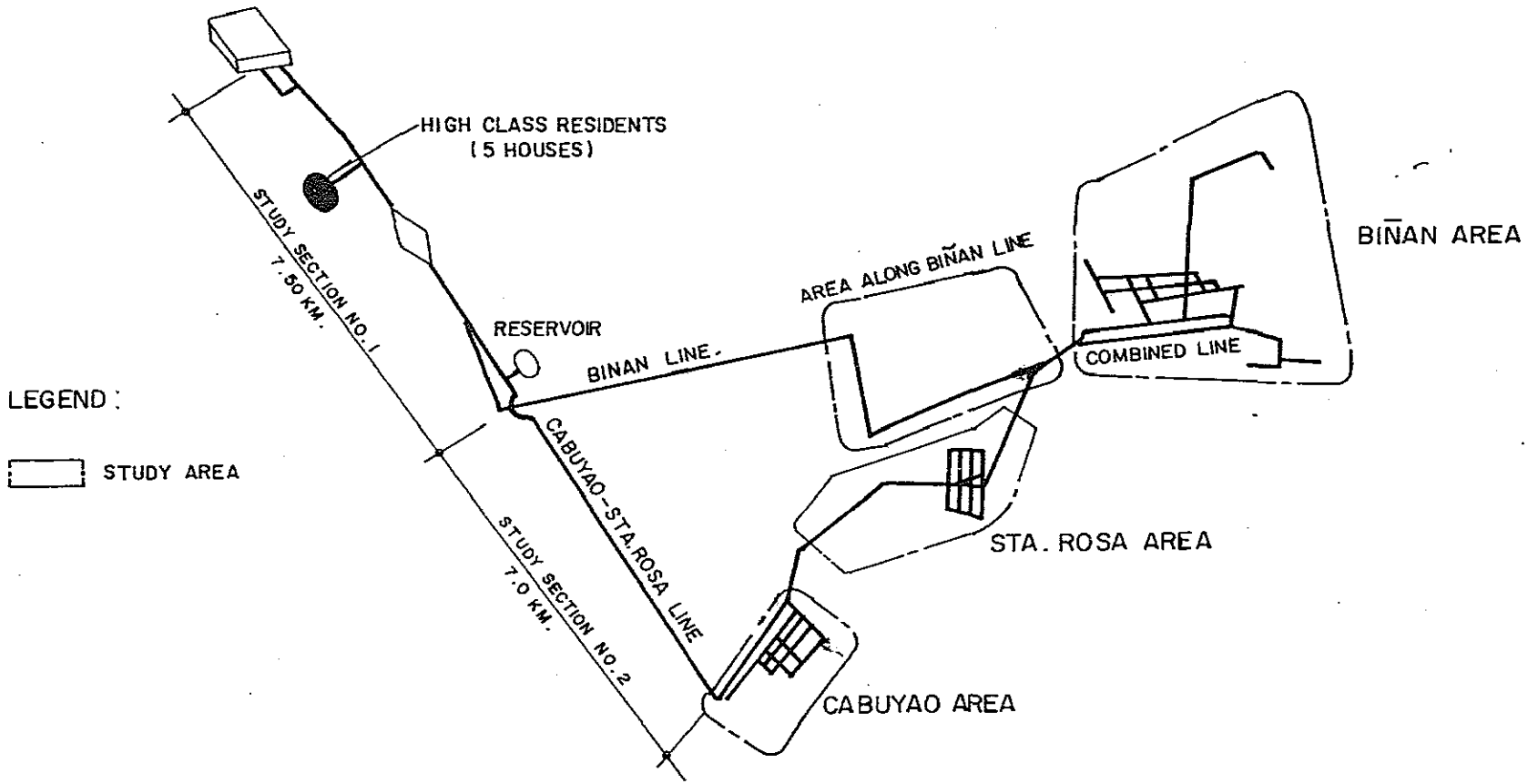
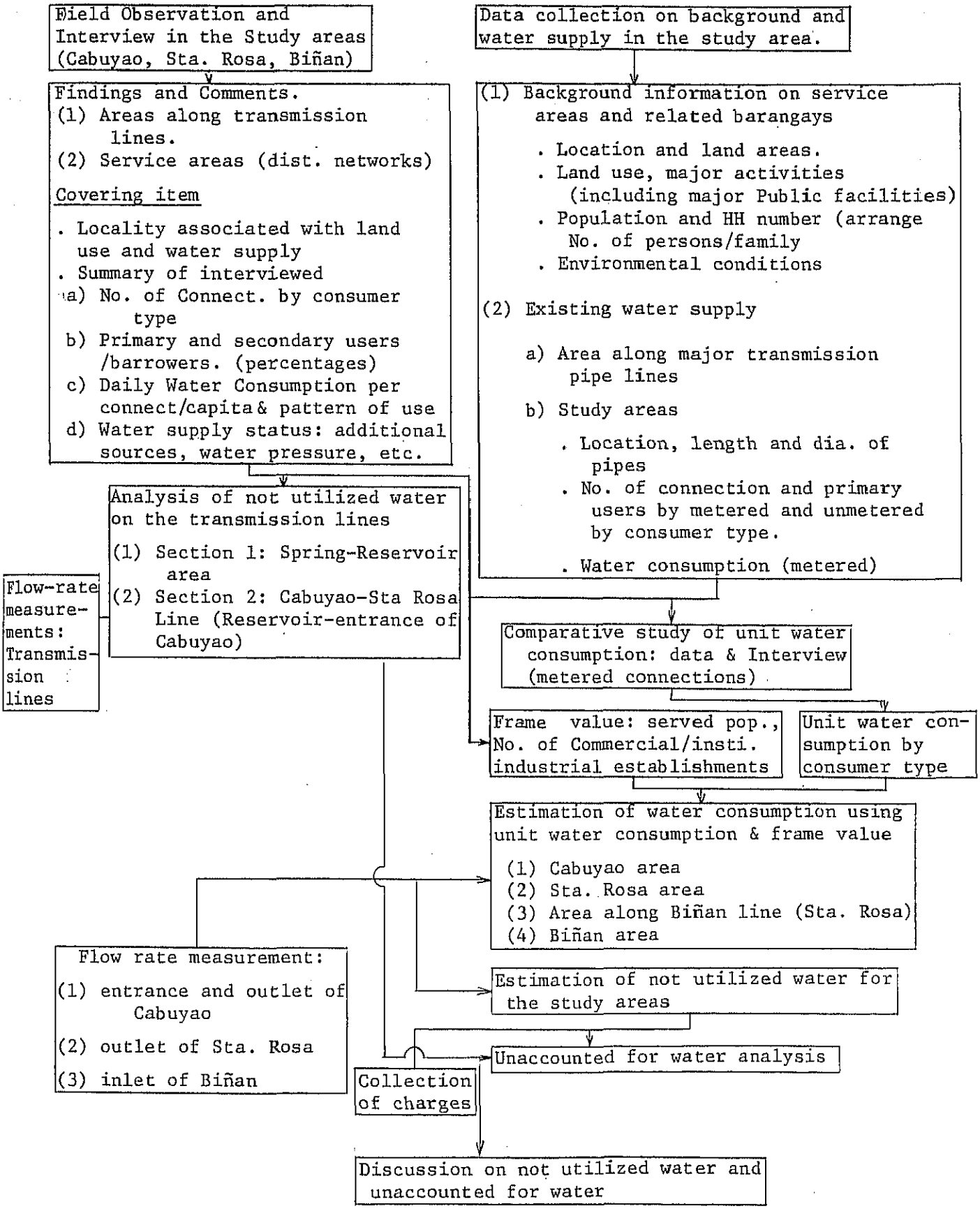


FIGURE 4.5.1.1

STUDY AREA AND PIPELINE SECTION

FIGURE 4.5.1.2 Flow Chart for estimation of unaccounted for water/ not utilized water



Commercial establishments are mainly eateries, grocery stores and a wet market that caters to the local constituents of the municipality.

2) The Sta. Rosa area; the core area of Sta. Rosa and the area along Cabuyao - Sta. Rosa line.

The subject area comprises barangays Aplaya, Balibago, Barangay I, II & III, Pila, Pita, Ibaba, Labas and Tagapo. Although there are many industrial establishments in Sta. Rosa, the area served by the water system is predominantly a residential area except for the municipal building, market and the school areas at the poblacion. Commercial establishments in the poblacion mainly caters to the local constituents.

3) The area along Biñan line in Sta. Rosa

The study area comprises barangays Balibago and Macabling in Sta. Rosa, and Platero in Biñan. The area is also residential.

4) Biñan area

The area includes barangays Dela Paz, Malaban, Platero, Poblacion, San Antonio, San Jose, San Vicente and Sto. Domingo. The area is predominantly a residential area. Commercial establishments include supermarkets, groceries, theaters and the supermarket where food products from other municipalities are regularly delivered.

Existing Water Supply

There are 726 metered domestic connections in Cabuyao, 719 of which are domestic, 4 commercial and 3 institutional connections.

A total of 49 domestic concessionaires or about 7% of the total number of concessionaires was interviewed.

Based on the 49 concessionaires interviewed, except for those at the fringes at barangays Bigaa and Sala, water supply including water pressure was said to be relatively adequate in the service area.

About 316 persons are served by the 49 interviewed domestic connections; 272 persons are primary users while 44 or about 16% of the primary users are secondary users or borrowers. The 49 connections registered a combined consumption of 61.257 cu.m for one day, or an average per capita consumption for the 316 served population of about 194 liters/day.

As of June 1986, there are 1,188 domestic connections, 3 commercial, 4 institutional and 5 industrial connections or a total of 1,200 service connections in the Sta. Rosa service area. One of these connections is the Nissin Monde Biscuits factory which draws about 2,850 cu.m of water monthly. Based on the 37 interviewed domestic concessionaires in the core area of Sta. Rosa, water supply and pressure are relatively adequate in the distribution system except for the area near the Balibago market which draws water from the Cabuyao - Sta. Rosa line. According to the 66 domestic concessionaires interviewed along the transmission lines, the same situation as in the market area is also experienced during the day, especially in the morning, along the Biñan transmission line in barangay Pulong St. Cruz, and the Cabuyao - Sta. Rosa transmission line along barangays Dita, Dila and Balibago. These areas get only enough water and pressure during the nighttime. Concessionaires often resort to storing water during the night for use the next day.

Along the distribution line, about 276 persons are served by the 37 interviewed domestic concessionaires; 197 persons are primary users while 79 or about 40% of the primary users are secondary users or borrowers. The 37 connections registered a combined consumption of 48.265 cu.m for one day, or an average per capita consumption for the 276 served population of about 175 liters/day.

Along the transmission line, about 572 persons are served by the 66 interviewed domestic concessionaires; 376 persons are primary users while 196 or about 52% of the primary users are secondary users or borrowers. The 37 connections registered a combined consumption of 80.100 cu.m for one day, or an average per capita consumption for the 572 served population of about 140 liters/day.

As of June 1986, there are 483 domestic and 7 commercial connections, or a total of 490 service connections in the Biñan service area.

According to the interviewed 37 domestic connections, the Biñan area has a scheduled supply of water; corresponding to the operation of the pump at the public market and at the subdivision in barangay Platero. The only area wherein water supply is available anytime is at barangays San Antonio and Platero which draw water from the Cabuyao-Sta. Rosa line. Water supply and pressure are so inadequate in the area that affluent concessionaires often install individual booster pumps. Especially in the poblacion area, interviewed concessionaires contend that they could not draw water anytime without a booster pump.

About 298 persons are served by the 35 domestic connections: 197 are primary users while 101 or 51% of the primary users are secondary users. The 35 domestic connections registered a combined consumption of 55.248 or an average per capita consumption of about 185 liters/day.

TABLE 4.5.1.1 summarizes the results of the interviews on the served population and daily consumption.

TABLE 4.5.1.1 SUMMARY OF INTERVIEWED DOMESTIC CONCESSIONAIRES

Area	Primary User H.H.	Primary User Pop.	Secondary User H.H.	Secondary User Pop.	Secondary Primary %	Total User H.H.	Total User Pop.	Daily Consumpt.	Per Capita Consumption liters/day
Cabuyao	49	272	7	44	16%	56	316	61.257	194
Sta. Rosa	37	197	20	79	40%	57	276	48.265	175
Biñan	35	197	23	101	51%	58	298	55.248	185
Area along Biñan line (Sta. Rosa)	66	376	49	196	52%	115	572	80.100	140

(2) Unit Water Consumption and Total Water Consumption

Unit water consumption by consumer type was estimated using reported water consumption (metered) for the month of June, 1986 including the secondary users/borrowers as based on the interview results. A summary of average unit water consumption by municipality both from recorded data for the month of June and results of meter reading during the interview is given in TABLE 4.5.1.2.

TABLE 4.5.1.2 UNIT WATER CONSUMPTION BY WATER CONSUMER TYPE (METERED)

Municipality	Domestic Data in June l/cap.d	Domestic Data in June cu.m/con.d	Domestic Interview l/cap.d	Commercial cu.m/con.d	Institutional cu.m/con.d	Industrial cu.m/con.d
Cabuyao	173.6	1.250	194	1.100	1.223	-
Sta.Rosa	151.7	1.274	*175 140	17.033	1.450	26.840
Biñan	121.7	1.096	185	1.471	-	-
Total	150.8	1.231	174	4.621	1.357	26.840

Note: * Average in the core area. Average in the area along Biñan line.

With regard to the unit domestic consumption, the figures from meter reading are larger than those from the data for the month of June. The figures from the meter readings seem to correspond to the daily maximum as was gathered from the concessionaires during the interview. The average consumption figure by municipality corresponds to the water supply status in relation to the location of the spring water source with service

area. However the figures are comparatively larger than those of similar municipalities. It was concluded through interview with concessionaires and officials concerned that the figures may include the water caused by wastage and leakage in the section of service connection between the water meter and faucets.

The number of metered connections for commercial, institutional and industrial use is limited in the subject area. Therefore estimated average unit water consumption for these uses is not a reliable bases for future demand projection. The average figure by consumer type may however be used to estimate present water consumption by unmetered connections.

The total water consumption by study area as estimated is shown in TABLE 4.5.1.3. The following are the bases of calculation:

Metered connections:	Reported figures for the month of June by consumer type
Unmetered connections:	Estimated figures using municipal average per connection consumption and number of connections (Data on June 1986)

TABLE 4.5.1.4 summarizes the total water consumption in round figures by study area.

TABLE 4.5.1.3

NO. OF CONNECTIONS AND CONSUMPTION BY MAIN PIPE LINE

MAIN PIPELINE	MUNICIPALITY/ BARANGAY	DOMESTIC						COMMERCIAL					
		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL	
		CONNECTIONS	M3/d	CONNECTIONS	M3/d	CONNECTIONS	M3/d	CONNECTIONS	M3/d	CONNECTIONS	M3/d	CONN.	M3/d
CABUYAO STA. ROSA LINE	CABUYAO												
	1. BARANGAY I	203	252	31	39	234	291	-	-	2	2	2	2
	2. BARANGAY II	178	221	28	35	206	256	3	3	-	-	3	3
	3. BARANGAY III	130	165	14	18	144	183	-	-	-	-	-	-
	4. BIGAA	99	125	8	10	107	135	-	-	-	-	-	-
	5. SALA	109	135	8	10	117	145	1	0	-	-	1	0
	SUB-TOTAL	719	898	89	112	808	1010	4	3	2	2	6	5
	STA. ROSA												
	1. APLAYA	32	39	5	6	37	45	-	-	-	-	-	-
	2. BALIBAGO	59	83	3	4	62	87	-	-	-	-	-	-
	3. BARANGAY I	126	149	19	24	145	173	1	1	-	-	1	1
	4. BARANGAY II	191	243	16	20	207	263	-	-	-	-	-	-
	5. BARANGAY III	32	40	4	5	36	45	-	-	1	1	1	1
	6. DILA	19	18	3	4	22	22	-	-	-	-	-	-
	7. DITA	202	254	12	15	214	269	1	50	-	-	-	-
	8. IBABA	64	76	2	3	66	79	-	-	-	-	-	-
	9. LABAS	52	75	5	6	57	81	-	-	-	-	-	-
	10. TAGAPO	179	215	6	8	185	223	-	-	-	-	-	-
	SUB-TOTAL	956	1192	75	95	1031	1287	2	51	1	1	2	2
	TOTAL	1675	2092	164	207	1839	2297	6	54	3	3	8	7
BIÑAN LINE	STA. ROSA												
	1. BALIBAGO	219	309	22	28	241	337	1	1	1	1	2	2
	2. MACABLING	13	13	1	1	14	14	-	-	-	-	-	-
	SUB-TOTAL	232	322	23	29	255	351	1	1	1	1	2	2
	BIÑAN												
	1. PLATERO	28	32	2	2	30	34	-	-	-	-	-	-
	TOTAL	260	354	25	31	285	385	1	1	1	1	2	2

TABLE 4.5.1.3 (cont'd)

MAIN PIPELINE	MUNICIPALITY/ BARANGAY	INSTITUTIONAL						INDUSTRIAL					
		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL	
		CONNECTIONS	M3/d	CONNECTION	M3/d	CONN.	M3/d	CONNECTIONS	M3/d	CONNECTIONS	M3/d	CONN.	M3/d
	CABUYAO												
	1. BARANGAY I	-	-	3	4	3	4	-	-	-	-	-	-
	2. BARANGAY II	2	2	-	-	2	2	-	-	-	-	-	-
	3. BARANGAY III	-	-	-	-	-	-	-	-	-	-	-	-
	4. BIGAA	-	-	-	-	-	-	-	-	-	-	-	-
	5. SALA	1	2	1	41*	2	4	-	-	-	-	-	-
	SUB-TOTAL	3	4	4	45	7	4	-	-	-	-	-	-
CABUYAO STA. ROSA LINE	STA. ROSA												
	1. APLAYA	-	-	-	-	-	-	-	-	-	-	-	-
	2. BALIBAGO	-	-	-	-	-	-	-	-	-	-	-	-
	3. BARANGAY I	-	-	-	-	-	-	-	-	-	-	-	-
	4. BARANGAY II	1	0	-	-	1	0	-	-	-	-	-	-
	5. BARANGAY III	-	-	-	-	-	-	-	-	-	-	-	-
	6. DILA	-	-	-	-	-	-	2	22	-	-	2	27
	7. DITA	-	-	1	2	1	2	1	7	-	-	1	7
	8. IBABA	-	-	-	-	-	-	-	-	-	-	-	-
	9. LABAS	-	-	-	-	-	-	-	-	-	-	-	-
	10. TAGAPO	3	6	-	-	3	6	-	-	-	-	-	-
	SUB-TOTAL	7	6	1	2	5	8	3	34	-	-	3	34
	TOTAL	7	10	5	47	12	57	3	34	-	-	3	34
BIÑAN LINE	STA. ROSA												
	1. BALIBAGO	-	-	-	-	-	-	1	95	-	-	1	95
	2. MACABLING	-	-	-	-	-	-	1	5	-	-	1	5
	SUB-TOTAL	-	-	-	-	-	-	2	100	-	-	2	100
	BIÑAN												
	1. PLATERO	-	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	-	-	-	-	-	-	2	100	-	-	2	100

TABLE 4.5.1.3 (cont'd)

MAIN PIPELINE	MUNICIPALITY/ BARANGAY	GRAND TOTAL						REMARKS
		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL		
		CONNECTIONS	M 3/d	CONNECTIONS	M 3/d	CONNECTIONS	M 3/d	
	CABUYAO							
	1. BARANGAY I	203	252	36	45	239	297	
	2. BARANGAY II	183	226	28	35	211	261	
	3. BARANGAY III	130	165	14	18	144	183	
	4. BIGAA	99	125	8	10	107	135	
	5. SALA	111	137	9	51	120	188	*Municipal building consumption = 40 m³/day
CABUYAO STA. ROSA LINE	SUB-TOTAL	726	905	95	159	821	1064	
	STA. ROSA							
	1. APLAYA	32	39	5	6	37	45	
	2. BALIBAGO	59	83	3	4	62	87	
	3. BARANGAY I	127	150	19	24	146	174	
	4. BARANGAY II	191	243	16	20	207	263	
	5. BARANGAY III	32	40	5	6	37	46	
	6. DILA	21	45	3	4	24	49	
	7. DITA	203	341	13	17	216	328	
	8. IBABA	64	76	2	3	66	79	
	9. LABAS	52	75	5	6	57	81	
	10. TAGAPO	182	221	6	8	188	229	
	SUB-TOTAL	963	1283	77	98	1040	1381	
	TOTAL	1689	2188	172	257	1861	2445	
BIÑAN LINE	STA. ROSA							
	1. BALIBAGO	221	405	23	29	244	434	
	2. MACABLING	14	18	1	1	15	19	
	SUB-TOTAL	235	423	24	30	259	453	
	BIÑAN							
	PLATERO	28	32	2	2	30	34	
	TOTAL	263	455	26	32	289	487	

TABLE 4.5.1.3 (cont'd)

MAIN PIPELINE	BARANGAY	DOMESTIC						COMMERCIAL					
		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL	
		CONNECTIONS	M 3/d	CONNECTIONS	M 3/d	CONN.	M 3/d	CONNECTIONS	M 3/d	CONNECTIONS	M 3/d	CONN.	M 3/d
	BIÑAN												
COMBINED CABUYAO AND BIÑAN LINE	1.DE LA PAZ	14	13	12	13	23	26	-	-	-	-	-	-
	2.MALABAN	8	8	27	30	35	38	-	-	-	-	-	-
	3.PLATERO	29	38	5	6	34	44	-	-	-	-	-	-
	4.POBLACION	64	62	72	79	136	141	6	9	5	7	11	16
	5.SAN ANTONIO	263	309	120	132	383	441	1	2	-	-	1	2
	6.SAN JOSE	31	25	30	33	61	58	-	-	-	-	-	-
	7.SAN VICENTE	38	33	4	5	42	38	-	-	-	-	-	-
	8.STO. DOMINGO	8	8	14	15	22	23	-	-	-	-	-	-
	SUB-TOTAL	455	496	284	313	739	809	7	11	5	7	12	18

WATER SOURCE	BARANGAY	INSTITUTIONAL						INDUSTRIAL					
		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL		FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL	
		CONNECTIONS	M 3/d	CONNECTIONS	M 3/d	CONN.	M 3/d	CONNECTIONS	M3/d	CONNECTIONS	M3/d	CONN.	M 3/d
	BIÑAN												
COMBINED CABUYAO AND BIÑAN LINE	1. DE LA PAZ	-	-	-	-	-	-	-	-	-	-	-	-
	2. MALABAN	-	-	1	2	1	2	-	-	-	-	-	-
	3. PLATERO	-	-	-	-	-	-	-	-	-	-	-	-
	4. POBLACION	-	-	3	4	3	4	-	-	-	-	-	-
	5. SAN ANTONIO	-	-	-	-	-	-	-	-	-	-	-	-
	6. SAN JOSE	-	-	-	-	-	-	-	-	-	-	-	-
	7. SAN VICENTE	-	-	-	-	-	-	-	-	-	-	-	-
	8. STO. DOMINGO	-	-	-	-	-	-	-	-	-	-	-	-
	SUB-TOTAL	-	-	4	6	4	6	-	-	-	-	-	-

TOTAL

WATER SOURCE	BARANGAY	FUNCTIONAL METERED		NON-FUNCTIONAL METERED w/out METER		TOTAL		REMARKS
		CONNECTIONS	M 3/d	CONNECTIONS	M 3/d	CONNECTIONS	M3/d	
	BIÑAN							
COMBINED CABUYAO AND BIÑAN LINE	1. DE LA PAZ	14	13	12	13	26	26	
	2. MALABAN	8	8	28	32	36	40	
	3. PLATERO	29	38	5	6	34	44	
	4. POBLACION	70	141	80	90	150	231	
	5. SAN ANTONIO	264	311	120	132	384	443	
	6. SAN JOSE	31	25	30	33	61	58	
	7. SAN VICENTE	38	33	4	5	42	38	
	8. STO. DOMINGO	8	8	14	15	22	23	
	SUB-TOTAL	462	577	293	326	755	903	

TABLE 4.5.1.4 SUMMARY OF WATER CONSUMPTION BY STUDY AREA

Unit: cu.m/day

Study Area	Water Consumption	Percentage
a. Core area of Cabuyao	1,050	27.6
b. Core area and area along Cabuyao-Sta. Rosa line in Sta. Rosa	1,350	48.7
c. Area along Biñan line in Sta. Rosa	500	
d. Biñan area	900	23.7
T o t a l	3,800	100

(3) Flow Rate Measurement Results

The measurement results are summarized (rounded off) by section of pipeline in TABLE 4.5.1.5. Continuous measurement for one day was conducted at 6 points and a short time measurement at the spring and another point. Detailed records are given in TABLE 4.5.1.6.

TABLE 4.5.1.5 MEASUREMENT RESULTS

Section of Pipe Line	Measuring Point	Daily flow	R. M.
Transmission line: Spring - Reservoir area	Total of 2 outlets from existing spring	10,000	Details are given in "Discharge rate of Spring"
	Approx. 3 km from spring	11,000	reference point
Cabuyao-Sta. Rosa Line:	Manhole in the premise of Reservoir	5,600	24 hours
Reservoir - exit of Sta. Rosa	Entrance of core area of Cabuyao	5,600	"
	Outlet of Cabuyao	3,400	"
	Outlet of Sta. Rosa	50	" 53 cu.m/day = flow into Biñan line
Biñan Line:	Reservoir premise	4,050	24 hours
Reservoir area - Biñan area	Entrance of Biñan	1,550	"

TABLE 4.5.1.6 FLOW RATE MESUREMENT (24 HOURS)

TIME	CABUYAO STA. ROSA LINE 1	BIÑAN LINE 2	RESERVOIR 3 WATER LEVEL	RESERVOIR 3 STORAGE VOLUME	CABUYAO STA. ROSA LINE 4	C. S. ROSA LINE 5	SUPPLIED AMOUNT TO CABUYAO	OUTLET OF S. R. Inflow	OUTLET OF S. R. Outflow 6	SUPPLIED AMOUNT TO STA. ROSA	ENTRANCE OF BIÑAN 7
0 - 1	135	167	1.42	994	191	133	58	0	5	128	88
1 - 2	100	166	1.57	1,112	197	137	60	0	6	131	88
2 - 3	122	166	1.76	1,266	201	141	60	0	6	135	88
3 - 4	100	166	1.92	1,398	206	143	63	0	5	138	88
4 - 5	244	162	2.10	1,552	211	140	71	0	2	138	85
5 - 6	234	169	2.06	1,500	219	129	90	8	0	137	78
6 - 7	272	173	1.94	1,415	223	113	110	31	0	144	56
7 - 8	282	174	1.83	1,323	219	108	111	49	0	157	37
8 - 9	293	174	1.77	1,274	219	111	108	55	0	166	32
9 - 10	299	170	1.61	1,144	222	111	111	49	0	160	41
10 - 11	302	166	1.49	1,049	218	108	110	43	0	151	45
11 - 12	293	169	1.40	978	236	128	108	48	0	176	38
12 - 13	273	173	1.31	909	267	155	112	42	0	197	46
13 - 14	262	165	1.10	750	274	168	106	28	0	196	64
14 - 15	263	(168)	1.08	736	281	175	106	25	0	200	67
15 - 16	275	(168)	1.05	714	289	182	107	20	0	202	71
16 - 17	290	(168)	0.98	662	295	186	109	32	0	218	57
17 - 18	296	(168)	0.90	604	298	183	115	39	0	222	48
18 - 19	316	(168)	0.85	569	293	182	111	39	0	221	47
19 - 20	300	(168)	0.85	569	297	182	115	20	0	202	36
20 - 21	187	161	0.85	569	224	141	83	17	0	158	74
21 - 22	135	169	0.95	641	169	112	57	6	0	118	82
22 - 23	140	168	1.11	758	176	120	56	1	0	121	88
23 - 24	131	167	1.26	870	185	129	56	0	5	124	89
TOTAL	5,566	4,033	-	983	5,610	3,417	2,193	552	29	3,940	1,533

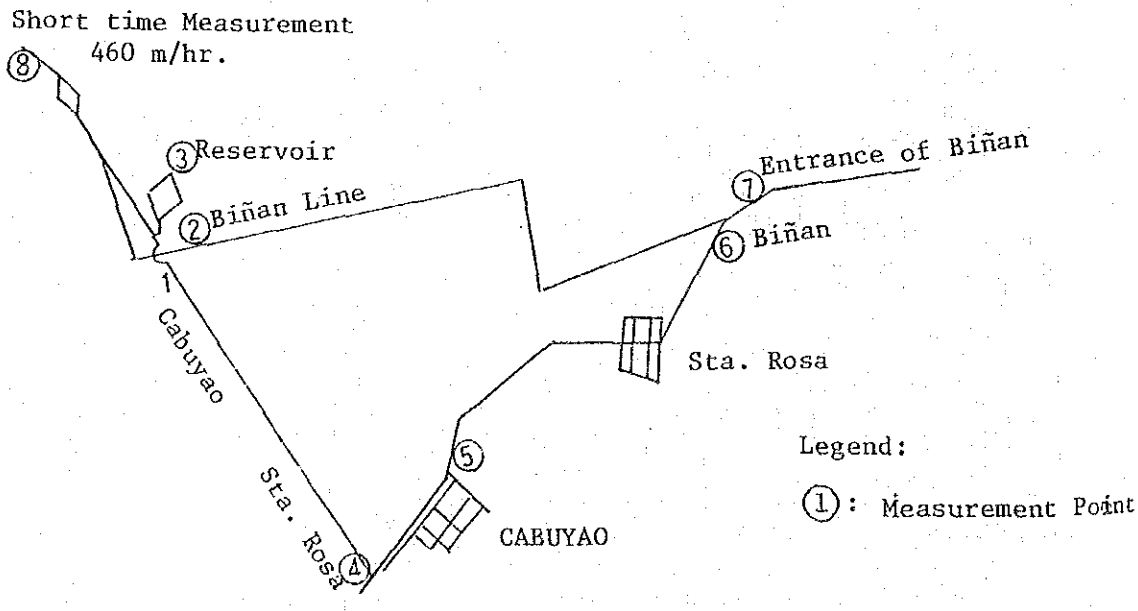


FIGURE 4.5.1.3 LOCATION OF MEASUREMENT POINT

FIGURE 4.5.1.4 shows the flow rates along the main pipeline from the spring to the service areas together with the amount of water calculated to be to major service areas.

Because of no flow/quite low pressure at the junction area of Biñan and Cabuyao-Sta. Rosa lines, approximately 550 cu.m/day is transmitted by the Biñan line to supply part of Sta. Rosa through the Cabuyao-Sta. Rosa line. Approximately 1,000 cu.m/day is discharged from the reservoir into Cabuyao - Sta. Rosa line between 4:00 A.M. and 6:00 P.M.

(4) Discussions and Conclusions on not utilized water/unaccounted-for water

1) Transmission lines

The two sections of the transmission line from the spring to the entrance of Cabuyao area were studied using flow rate measurement results.

a) Transmission line from the spring to the reservoir area

Discharge rate from the spring box : 10,000 cu.m/day
Transmitted amount at the reservoir area :
9,650 cu.m/day
Supply to the high class residents, leakage and other losses : 350 cu.m/day

Although approximately 3,000 cu.m/day were suspected to be leaked in the study section during the Phase I survey, the measurement result revealed that the amount of water transmitted from the intake of the spring box was substantial. The "C" value may be more than the expected figure taking into consideration the existing pipe alignment and the year of its construction. It is concluded that the pipeline installed is in straight alignment with the field and that the water does not contain unfavorable materials associated with "C" value and the joint portions are not damaged.

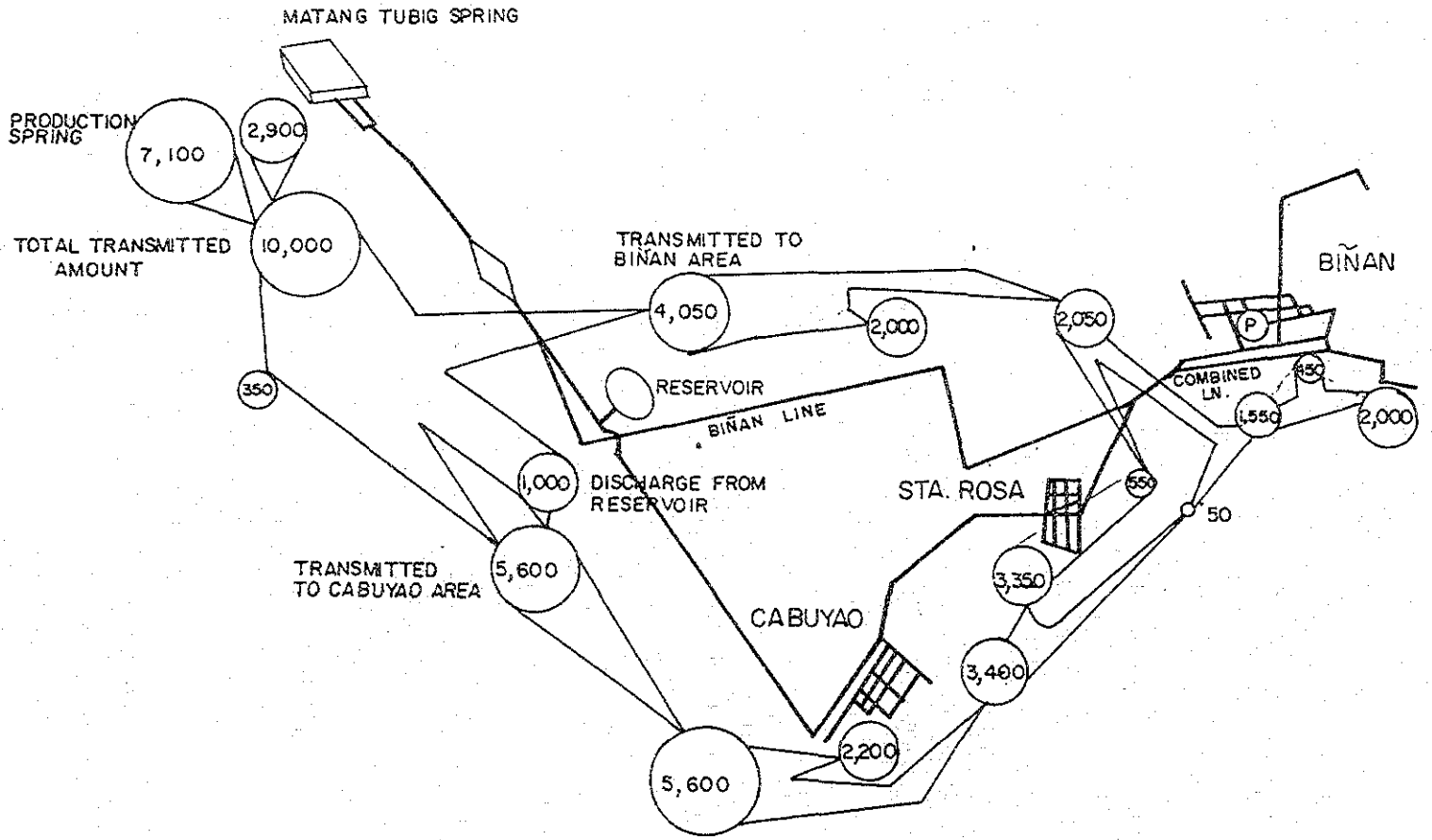


FIGURE 4.5.1.4

FLOW RATE ALONG MAIN PIPE LINES

b) Transmission line from the reservoir area to the entrance of Cabuyao.

Transmitted rate at the reservoir area : 5,600 cu.m/day
(Cabuyao - Sta. Rosa line)
Transmitted rate at the entrance of
Cabuyao : 5,600 cu.m/day

There is no difference between the above measurement results in rounded off figures. Additional flow rate measurement between the two points were conducted thereby confirming that the figure is almost the same as the one mentioned.

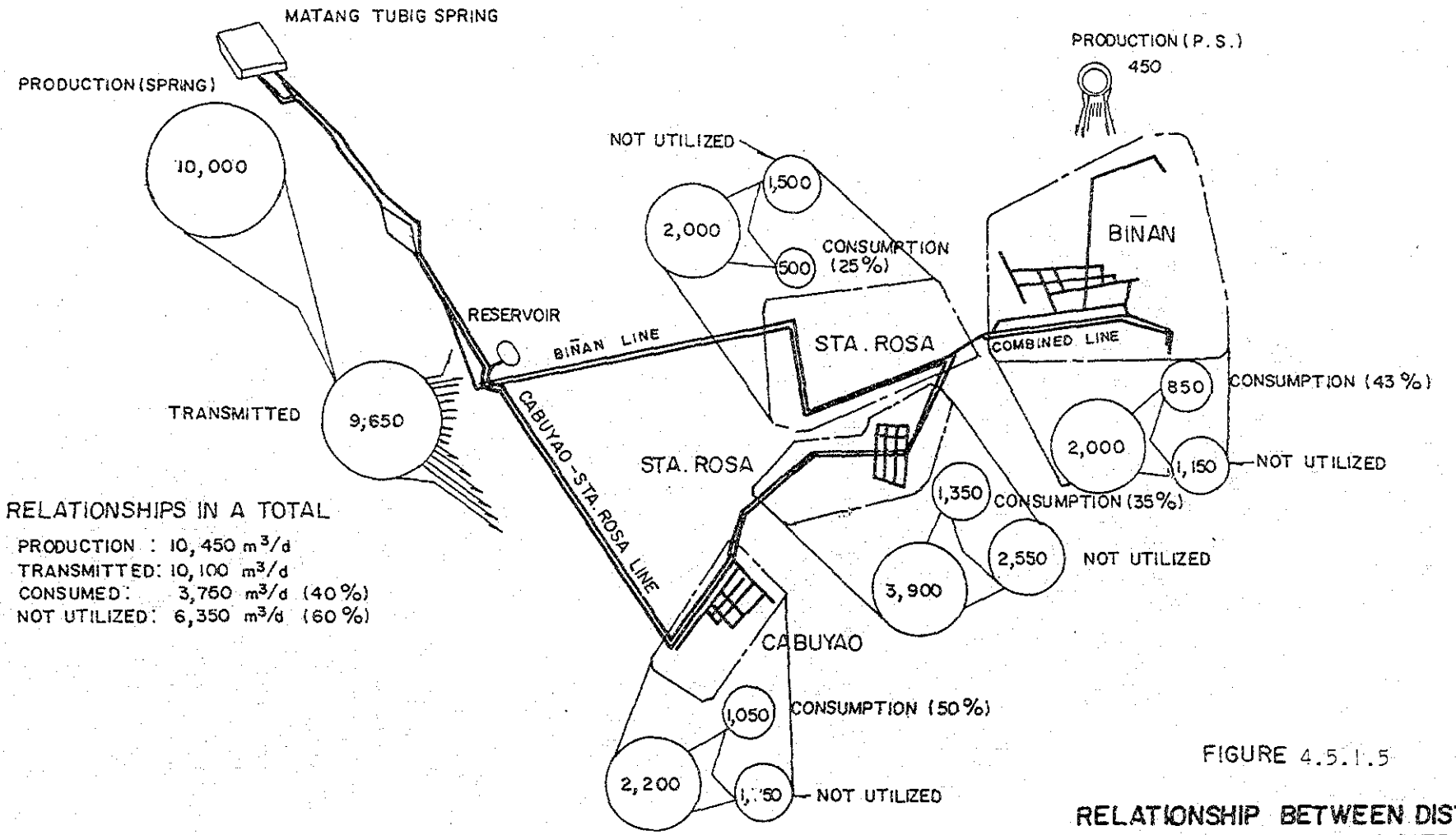
2) Distribution networks

The relationship between distributed water amount and water consumption is summarized in TABLE 4.5.1.7 and FIGURE 4.5.1.5 by study area.

TABLE 4.5.1.7 RELATIONSHIP BETWEEN DISTRIBUTED AND CONSUMED WATER

	Study Area	Distributed Water (cu.m/d.)	Water Consumption (cu.m/d.)	Percentage of utilized water	R.M.
a.	Core area of Cabuyao	2,200	1,050	48%	
b.	Core area and area along Cabuyao - Sta. Rosa line	3,900	1,350	35	
c.	Area along Biñan line in Sta. Rosa	2,000	500	25	
d.	Biñan area	*2,000	900	45	
	T o t a l	10,100 (8,100)	3,800 (3,300)	38 (41)	( ) means excluding C. area

Note : * Distributed amount includes that from the existing pumping station (reported supply amount)



RELATIONSHIPS IN A TOTAL

PRODUCTION : 10,450 m^3/d
TRANSMITTED: 10,100 m^3/d
CONSUMED: 3,750 m^3/d (40%)
NOT UTILIZED: 6,350 m^3/d (60%)

FIGURE 4.5.1.5

RELATIONSHIP BETWEEN DISTRIBUTED CONSUMED AND NOT UTILIZED WATER IN THE FOUR (4) AREAS

The percentage of utilized water for the four service areas shows low levels with a maximum of less than 50 percent. The water consumption is estimated using the monthly average figure (June, 1986), however, the result of the meter reading for the domestic consumption as revealed during interview was higher than the average (10% to 50%). Assuming that about 20% is added to the average water consumption, the average percentage of utilized water in the system excluding the area along Biñan line is calculated at approximately 50 percent. Accordingly almost half of distributed water is counted as unutilized water.

As to the causes of not utilized water, further detailed investigations will be required with a special emphasis on service connections with leakage, and non-metered and illegal connections as the culprits.

Unaccounted-for water

An accounted-for water was estimated by municipality based on the following:

a) Metered connections : water consumption reported for the month of June

b) Non-metered connections : 18 cu.m/connection-month for the concessionaires with one faucet. (₱14/connect.) and 1 cu.m/additional faucet-month (₱0.6/connect.)

c) Metered but not functioning : Average charges per connection are calculated and water consumption per connection is estimated according to the metered rate.

TABLE 4.5.1.8 shows the accounted-for water by municipality.

TABLE 4.5.1.8 ACCOUNTED-FOR WATER

MUNICIPALITY	METERED			NON-METERED				NOT FUNCTIONING METERED			TOTAL CONSUMPTION	
	NO. OF CONNECT	CHARGE ₱	CONSUMPTION m 3/m	NO. OF CONNECT One f /	Addition	CHARGE ₱	CONSUMP. m 3/m	NO. OF CONNECT	CHARGE ₱	CONSUMP. m 3/m	MONTHLY m 3/m	DAILY m 3/d
CABUYAO	726	₱ 22,019.25	27,177	5	53	₱ 102.00	143	90	₱ 1,940.25	2,880	30,200	1,007
STA. ROSA	1,200	45,004.50	51,145	13	7	186.80	241	88	2,485.75	3,608	54,994	1,833
BIÑAN	490	12,805.50	16,187	221	154	3,166.40	4,132	74	1,190.00	1,628	21,947	732
TOTAL	2,416	₱79,829.25	94,509	239	214	₱3,455.20	4,516	252	₱ 5,615.50	8,116	107,141	3,572

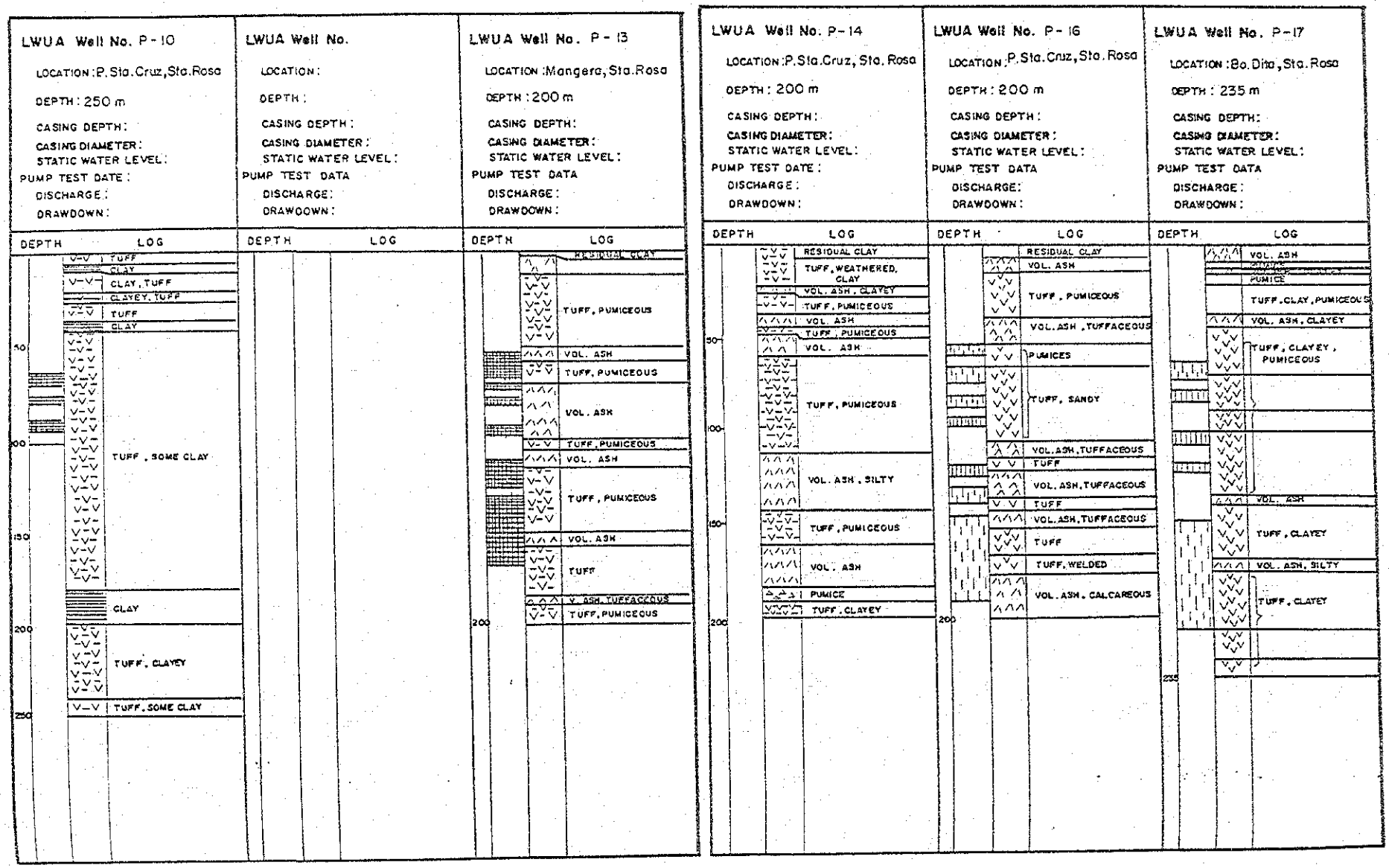
Approximately 3,600 cu.m/day corresponds to the accounted-for-water, while 6,500 cu.m/day or about 65 percent of production amount is unaccounted-for water.

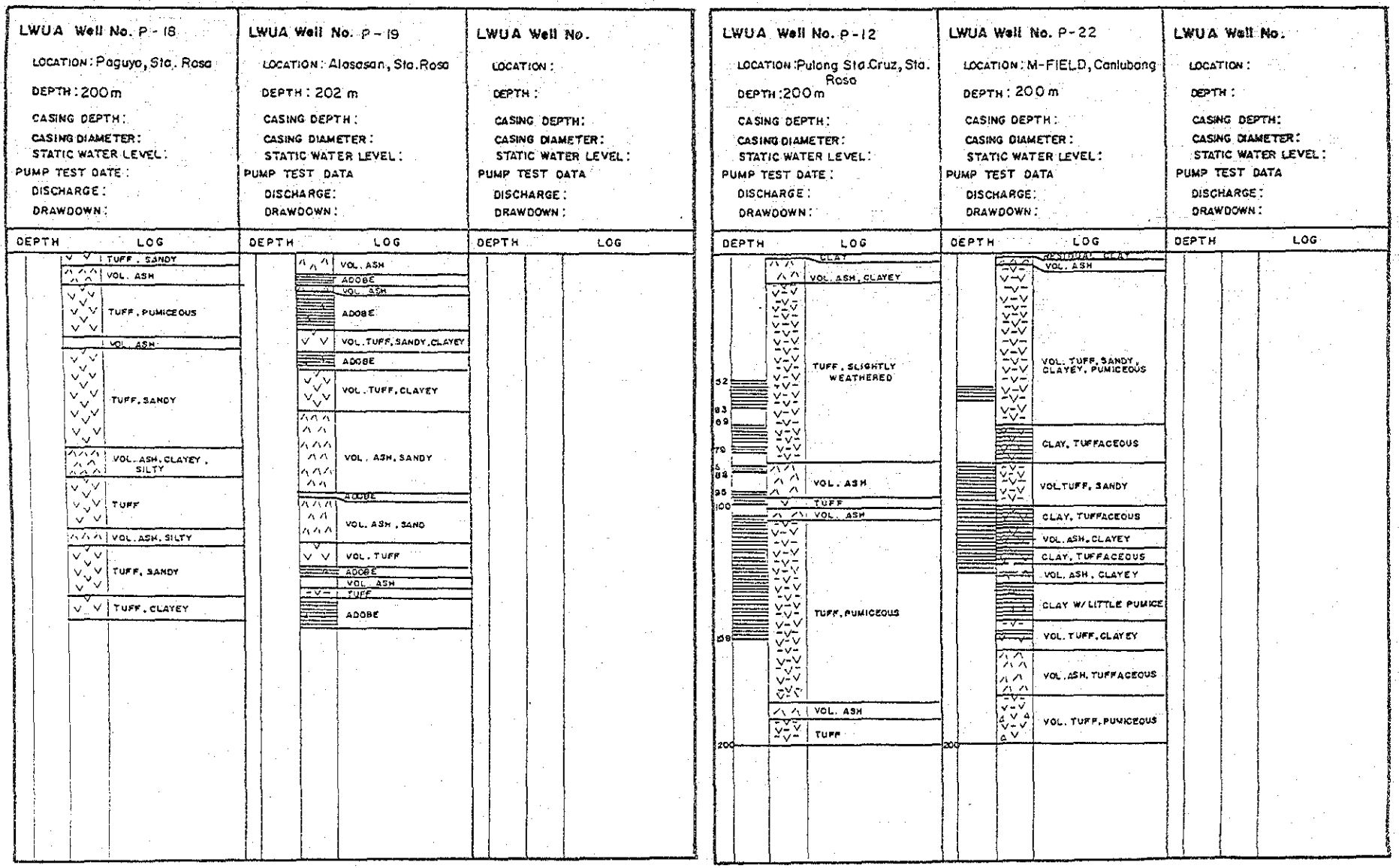
It may be worthwhile to notice that there are a number of additional faucets in the category of non-metered connections. The water consumption in the whole system was estimated at 3,800 cu.m/day without considering the consumption at the additional faucets because there was no data available on the per faucet consumption. Additional faucets are for the primary consumer or for other families (secondary users/borrowers). Depending on who uses the faucets, per faucet consumption could differ.

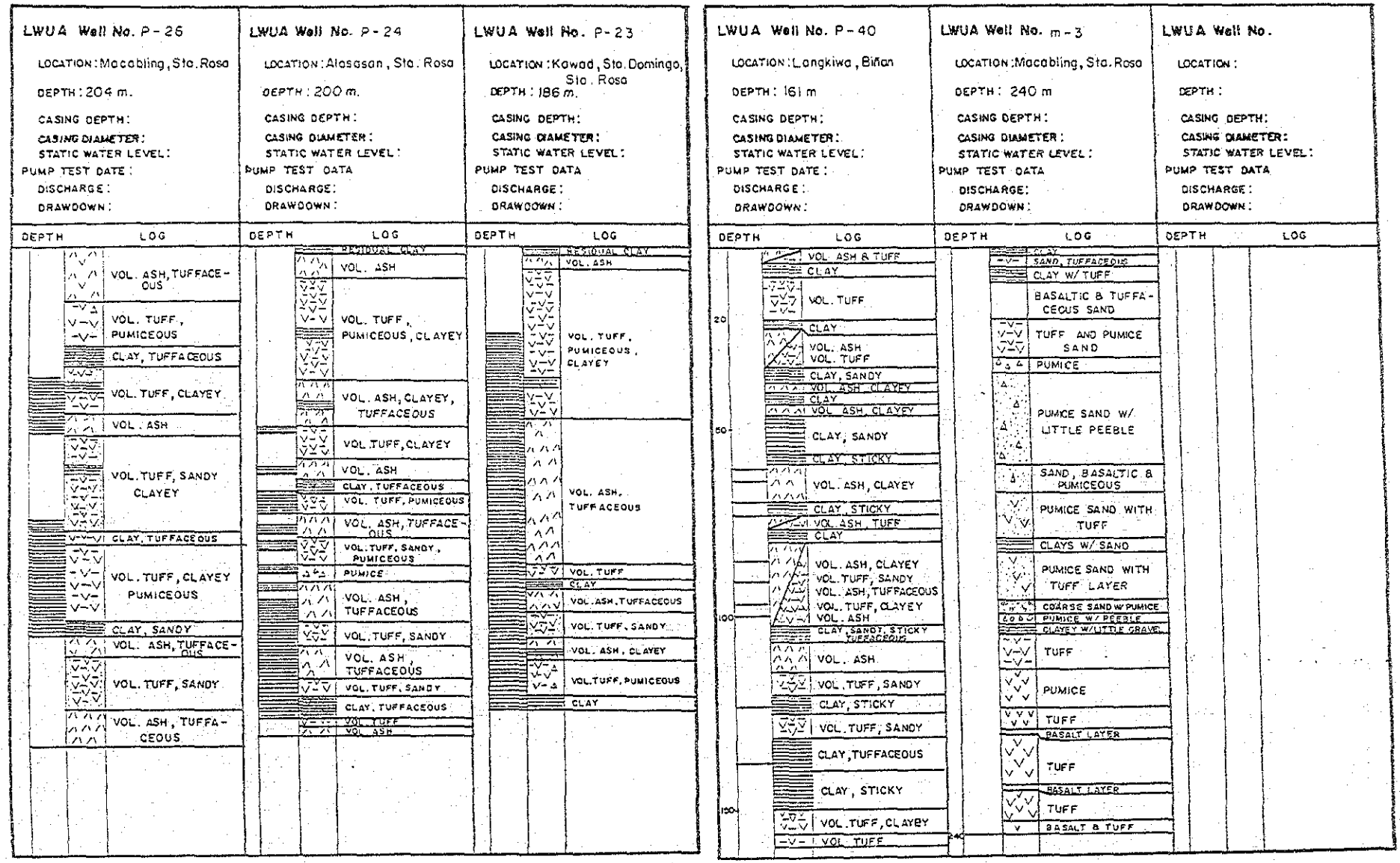
If the average per faucet consumption is assumed to be 1.231 cu.m/day which is the overall average of the domestic metered connection, about 260 cu.m/day would be the additional consumption. The following is the percentage of utilized water in the total system, except the area along Biñan line, using the above assumption.

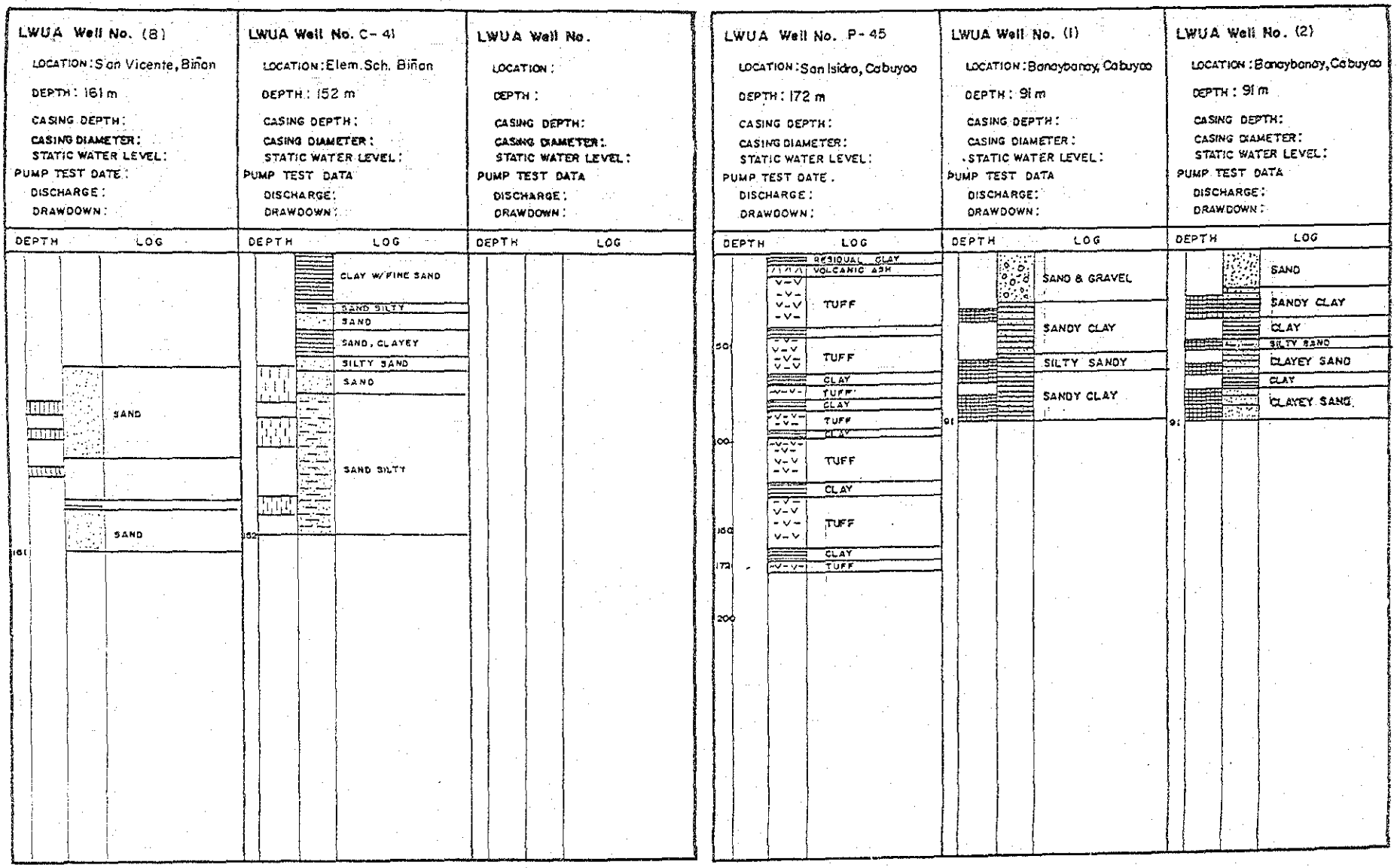
Distributed water	:	8,100 cu.m/day
Water consumption (1)	:	3,600 (= 3,300 + 300)
Water consumption (2) (20% additional)	:	4,300
Percentage of utilized water	:	55%

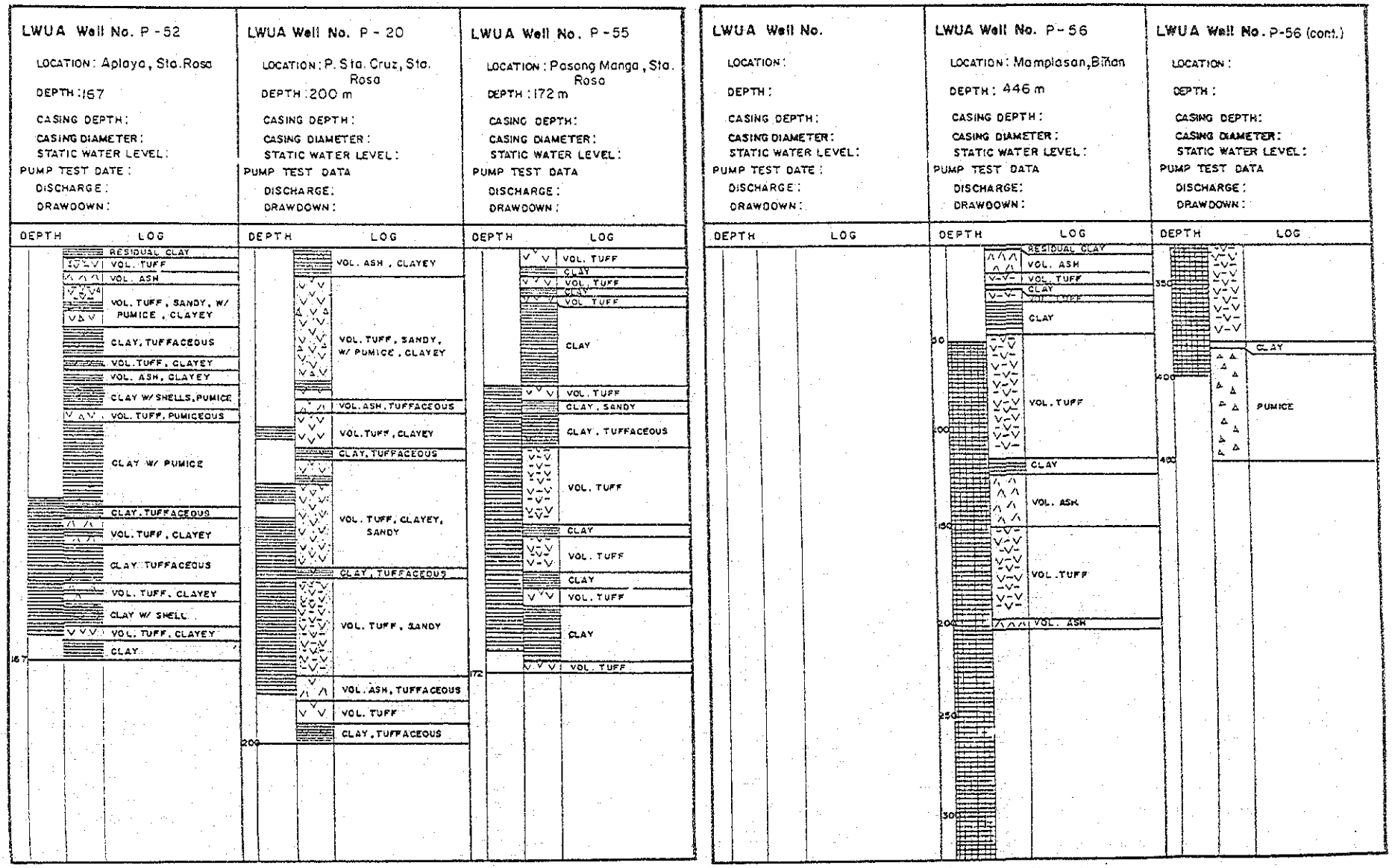
APPENDIX 6.7.1 WELL LITHOLOGIC LOGS

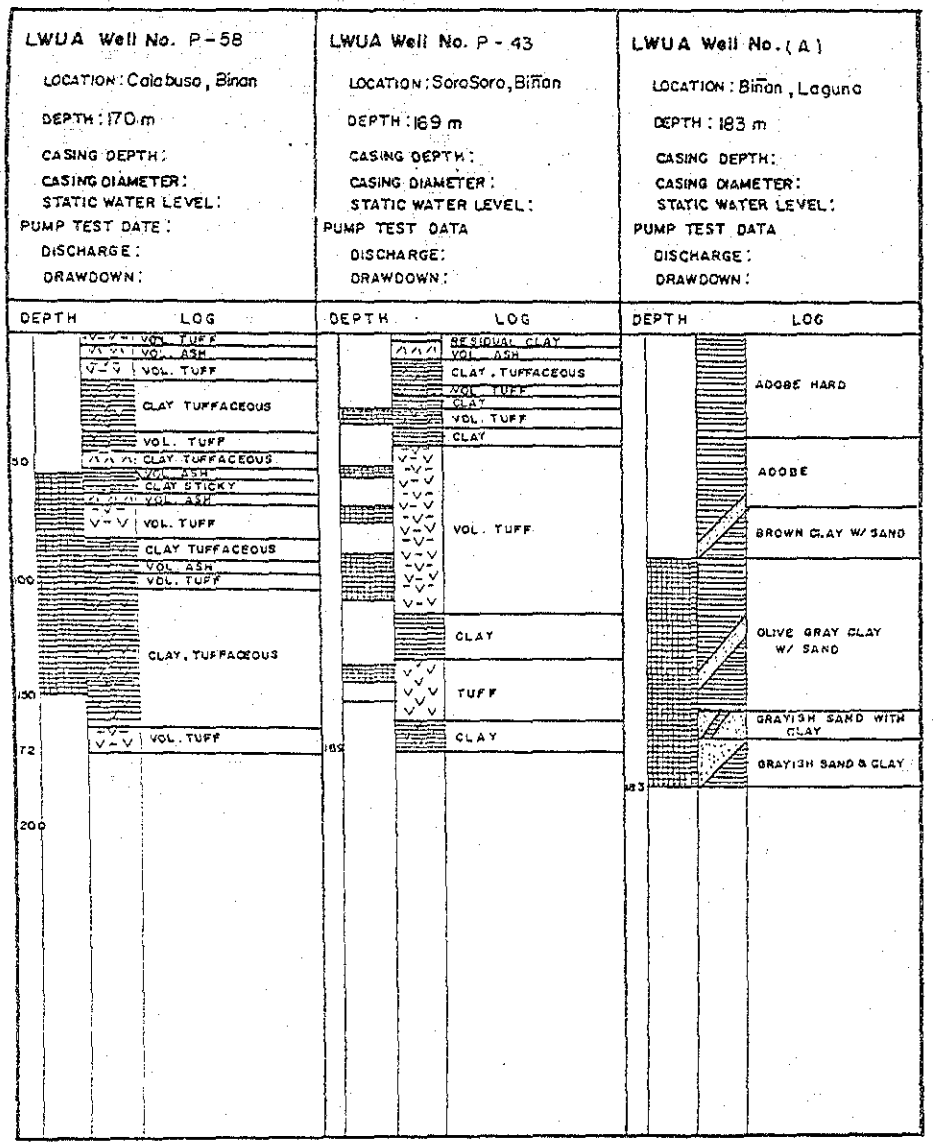



LWUA Well No. P-18
LOCATION: Paguyo, Sta. Rosa
DEPTH: 200m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
TUFF, SANDY
VOL. ASH
TUFF, PUMICEOUS
VOL. ASH
TUFF, SANDY
VOL. ASH, CLAYEY, SILTY
TUFF
VOL. ASH, SILTY
TUFF, SANDY
TUFF, CLAYEY
LWUA Well No. P-19
LOCATION: Alasasan, Sta. Rosa
DEPTH: 202 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
VOL. ASH
ADOBE
VOL. ASH
ADOBE
VOL. TUFF, SANDY, CLAYEY
ADOBE
VOL. TUFF, CLAYEY
VOL. ASH, SANDY
ADOBE
VOL. ASH, SAND
VOL. TUFF
ADOBE
VOL. ASH
TUFF
ADOBE
LWUA Well No.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
LWUA Well No. P-12
LOCATION: Pulong Sta. Cruz, Sta. Rosa
DEPTH: 200m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
CLAY
VOL. ASH, CLAYEY
TUFF, SLIGHTLY WEATHERED
52
63
69
79
82
95
100
VOL. ASH
TUFF
VOL. ASH
TUFF, PUMICEOUS
158
VOL. ASH
TUFF
200
LWUA Well No. P-22
LOCATION: M-FIELD, Canlubang
DEPTH: 200 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
RESIDUAL CLAY
VOL. ASH
VOL. TUFF, SANDY, CLAYEY, PUMICEOUS
CLAY, TUFFACEOUS
VOL. TUFF, SANDY
CLAY, TUFFACEOUS
VOL. ASH, CLAYEY
CLAY, TUFFACEOUS
VOL. ASH, CLAYEY
CLAY W/ LITTLE PUMICE
VOL. TUFF, CLAYEY
VOL. ASH, TUFFACEOUS
VOL. TUFF, PUMICEOUS
200
LWUA Well No.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG


LWUA Well No. P-26
LOCATION: Macabling, Sta. Rosa
DEPTH: 204 m.
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
VOL. ASH, TUFFACEOUS
VOL. TUFF, PUMICEOUS
CLAY, TUFFACEOUS
VOL. TUFF, CLAYEY
VOL. ASH
VOL. TUFF, SANDY CLAYEY
CLAY, TUFFACEOUS
VOL. TUFF, CLAYEY PUMICEOUS
CLAY, SANDY
VOL. ASH, TUFFACEOUS
VOL. TUFF, SANDY
VOL. ASH, TUFFACEOUS
LWUA Well No. P-24
LOCATION: Alasasan, Sta. Rosa
DEPTH: 200 m.
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
RESIDUAL CLAY
VOL. ASH
VOL. TUFF, PUMICEOUS, CLAYEY
VOL. ASH, CLAYEY, TUFFACEOUS
VOL. TUFF, CLAYEY
VOL. ASH
CLAY, TUFFACEOUS
VOL. TUFF, PUMICEOUS
VOL. ASH, TUFFACEOUS
VOL. TUFF, SANDY, PUMICEOUS
PUMICE
VOL. ASH, TUFFACEOUS
VOL. TUFF, SANDY
VOL. ASH, TUFFACEOUS
VOL. TUFF, SANDY
CLAY, TUFFACEOUS
VOL. TUFF
VOL. ASH
LWUA Well No. P-23
LOCATION: Kawad, Sto. Domingo, Sta. Rosa
DEPTH: 186 m.
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
RESIDUAL CLAY
VOL. ASH
VOL. TUFF, PUMICEOUS, CLAYEY
VOL. ASH, TUFFACEOUS
VOL. TUFF
CLAY
VOL. ASH, TUFFACEOUS
VOL. TUFF, SANDY
VOL. ASH, CLAYEY
VOL. TUFF, PUMICEOUS
CLAY
LWUA Well No. P-40
LOCATION: Langkiwa, Biñan
DEPTH: 161 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
VOL. ASH & TUFF
CLAY
VOL. TUFF
CLAY
VOL. ASH VOL. TUFF
CLAY, SANDY
VOL. ASH, CLAYEY
CLAY
VOL. ASH, CLAYEY
CLAY, SANDY
CLAY, STICKY
VOL. ASH, CLAYEY
CLAY, STICKY
VOL. ASH, TUFF
CLAY
VOL. ASH, CLAYEY
VOL. TUFF, SANDY
VOL. ASH, TUFFACEOUS
VOL. TUFF, CLAYEY
VOL. ASH
CLAY, SANDY, STICKY TUFFACEOUS
VOL. ASH
VOL. TUFF, SANDY
CLAY, STICKY
VOL. TUFF, SANDY
CLAY, TUFFACEOUS
CLAY, STICKY
VOL. TUFF, CLAYEY
VOL. TUFF
LWUA Well No. m-3
LOCATION: Macabling, Sta. Rosa
DEPTH: 240 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
CLAY
SAND, TUFFACEOUS
CLAY W/ TUFF
BASALTIC & TUFFACEOUS SAND
TUFF AND PUMICE SAND
PUMICE
PUMICE SAND W/ LITTLE PEEBLE
SAND, BASALTIC & PUMICEOUS
PUMICE SAND WITH TUFF
CLAYS W/ SAND
PUMICE SAND WITH TUFF LAYER
COARSE SAND W PUMICE
PUMICE W/ PEEBLE
CLAYEY W/LITTLE GRAVEL
TUFF
PUMICE
TUFF
BASALT LAYER
TUFF
BASALT LAYER
TUFF
BASALT & TUFF
LWUA Well No.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG


LWUA Well No. (8)
LOCATION: San Vicente, Biñan
DEPTH: 161 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
SAND
SAND
161
LWUA Well No. C-41
LOCATION: Elem. Sch. Biñan
DEPTH: 152 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
CLAY W/FINE SAND
SAND SILTY
SAND
SAND, CLAYEY
SILTY SAND
SAND
SAND SILTY
152
LWUA Well No.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
LWUA Well No. P-45
LOCATION: San Isidro, Cabuyao
DEPTH: 172 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE.
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
RESIDUAL CLAY
VOLCANIC ASH
TUFF
TUFF
CLAY
TUFF
CLAY
TUFF
CLAY
TUFF
CLAY
TUFF
CLAY
TUFF
50
100
150
172
200
LWUA Well No. (1)
LOCATION: Banaybanay, Cabuyao
DEPTH: 91 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
SAND & GRAVEL
SANDY CLAY
SILTY SANDY
SANDY CLAY
91
LWUA Well No. (2)
LOCATION: Banaybanay, Cabuyao
DEPTH: 91 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
SAND
SANDY CLAY
CLAY
SILTY SAND
CLAYEY SAND
CLAY
CLAYEY SAND
91


LWUA Well No. P-52
LOCATION: Aplaya, Sta. Rosa
DEPTH: 167
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
RESIDUAL CLAY
VOL. TUFF
VOL. ASH
VOL. TUFF, SANDY, W/ PUMICE, CLAYEY
CLAY, TUFFACEOUS
VOL. TUFF, CLAYEY
VOL. ASH, CLAYEY
CLAY W/ SHELLS, PUMICE
VOL. TUFF, PUMICEOUS
CLAY W/ PUMICE
CLAY, TUFFACEOUS
VOL. TUFF, CLAYEY
CLAY, TUFFACEOUS
VOL. TUFF, CLAYEY
CLAY W/ SHELL
VOL. TUFF, CLAYEY
CLAY
167
LWUA Well No. P-20
LOCATION: P. Sta. Cruz, Sta. Rosa
DEPTH: 200 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
VOL. ASH, CLAYEY
VOL. TUFF, SANDY, W/ PUMICE, CLAYEY
VOL. ASH, TUFFACEOUS
VOL. TUFF, CLAYEY
CLAY, TUFFACEOUS
VOL. TUFF, CLAYEY, SANDY
CLAY, TUFFACEOUS
VOL. TUFF, SANDY
VOL. ASH, TUFFACEOUS
VOL. TUFF
CLAY, TUFFACEOUS
200
LWUA Well No. P-55
LOCATION: Pasong Manga, Sta. Rosa
DEPTH: 172 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. TUFF
CLAY, SANDY
CLAY, TUFFACEOUS
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. TUFF
172
LWUA Well No.
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATE:
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
LWUA Well No. P-56
LOCATION: Mamplasan, Biñan
DEPTH: 446 m
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
RESIDUAL CLAY
VOL. ASH
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. ASH
VOL. TUFF
CLAY
VOL. ASH
50
100
150
200
250
300
LWUA Well No. P-56 (cont.)
LOCATION:
DEPTH:
CASING DEPTH:
CASING DIAMETER:
STATIC WATER LEVEL:
PUMP TEST DATA
DISCHARGE:
DRAWDOWN:
DEPTH
LOG
CLAY
PUMICE
350
400
400


LWUA Well No. P-58
LOCATION : Calabuso, Binan
DEPTH : 170 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATE :
DISCHARGE :
DRAWDOWN :
DEPTH
LOG
VOL. TUFF
VOL. ASH
VOL. TUFF
CLAY TUFFACEOUS
VOL. TUFF
CLAY TUFFACEOUS
50
VOL. ASH
CLAY STICKY
VOL. ASH
VOL. TUFF
CLAY TUFFACEOUS
VOL. ASH
VOL. TUFF
100
CLAY, TUFFACEOUS
150
72
VOL. TUFF
200
LWUA Well No. P - 43
LOCATION : SoroSoro, Binan
DEPTH : 169 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :
DEPTH
LOG
RESIDUAL CLAY
VOL. ASH
CLAY, TUFFACEOUS
VOL. TUFF
CLAY
VOL. TUFF
CLAY
VOL. TUFF
CLAY
TUFF
CLAY
152
LWUA Well No. (A)
LOCATION : Binan, Laguna
DEPTH : 183 m
CASING DEPTH :
CASING DIAMETER :
STATIC WATER LEVEL :
PUMP TEST DATA
DISCHARGE :
DRAWDOWN :
DEPTH
LOG
ADOBE HARD
ADOBE
BROWN CLAY W/ SAND
OLIVE GRAY CLAY W/ SAND
GRAYISH SAND WITH CLAY
GRAYISH SAND & CLAY
183

APPENDIX 6.8.1 SELECTION OF SAMPLING POINT

Sampling points in the project area took into account the following:

- Existing sources, i.e., spring and deep well, to evaluate the qualitative characteristics of the present water system;
- The other deep well sources at representative locations, thus, a general impression on the areas overall water quality could be established;
- Important well sources, e.g. the free-flowing wells in Sta. Rosa. By comparing test results of each, relative analysis on the continuity of the aquifer i.e. similar valves would probably describe some water source, could be done; and
- Large well source (NIA wells) and the Laguna de Bay as they pose to be alternative sources for the system.

To summarize:

- Two (2) existing deep wells in the city water supply system
- One (1) existing spring in the city water supply system
- Seven (7) deep wells
- Four (4) shallow wells
- One (1) potential spring
- One (1) surface water source (Laguna de Bay)
- Three (3) faucets and one (1) shallow well for bacteriological analysis

FIGURE 6.8.1.1 shows location of the selected points.

FIGURE 6.8.1.1 LOCATION OF SUMPLING POINTS

APPENDIX 6.8.2 WATER QUALITY ANALYSIS - CABUYAO-STA. ROSA-BIÑAN

Sample No.	Well No.	Location	* Group	Turb. (FTU)	TDS (mg/l)	pH (-)	EC (μS/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)	Fe (mg/l)	Mn (mg/l)	E.Coli. (MPN)	NO_3-N (mg/l)	NH_4-N (mg/l)
1	NIA P-58	Calaboso, Biñan	C	0.67	320	7.43	470	233	146	22	49	9.7	31.6	16.3	0	284.3	13.9	5	0.15	0.2	-	1.24	0.01
2	WW-1	Biñan Market, Biñan	A	0.61	384	7.21	580	285	199	12	59	9.4	42.0	22.8	0	344.7	18.6	7.5	0.13	nil	-	0.78	0.02
3	Faucet	San Antonio, Biñan	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(+)	-	-
4	B-2	Malaban, Biñan	D	1.25	640	7.63	800	328	356	9	80	15	76.5	40.1	0	400.2	83.6	90	0.10	nil	-	9.67	0.06
5	B-1	San Antonio, Biñan	D	1.31	352	7.56	560	256	172	28	50	8.7	32.8	21.9	0	312.3	18.6	5	0.15	0.10	-	0.87	0.04
6	B-1	San Antonio, Biñan	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(+)	-	-
7	WW-2	Tulay Bato, Biñan	A	-	-	6.96	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	NIA M-3	Macabling, Sta. Rosa	C	1.45	314	7.41	456	237	176	32	39.5	7.4	32.8	22.8	0	289.1	13.9	3.5	0.13	nil	-	1.09	0.01
9	NIA P-56	Mamplasan, Biñan	C	0.45	288	6.92	415	218	176	36	33	6.4	32.8	22.8	0	266	11.6	3	0.06	nil	-	1.45	nil
10	NIA P-18	Paguyo, Sta. Rosa	C	0.58	314	7.26	470	228	191	14	30	7.2	40.4	21.9	0	278.2	11.6	3.5	0.06	0.10	-	1.58	0.01
11	SR-1	Labas, Sta. Rosa	D	2.45	374	7.73	520	275	206	9	47	6.7	36	28.2	0	335.5	18.6	2	0.10	0.05	-	0.87	0.01
12	Faucet	Aplayo, Sta. Rosa	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(+)	-	-
13	NIA P-57	Aplayo, Sta. Rosa	C	0.43	355	7.84	595	256	139	6	72.5	8.5	26.8	17.5	0	312.3	18.6	10.0	0.20	nil	-	0.44	0.01
14		Laguna de Bay, Sta. Rosa	F	25.8	576	7.47	910	142	184	12	120	7.1	44.8	17.5	0	173.2	190.4	34.5	0.20	0.20	-	5.04	0.03
15	Faucet	Waterworks Office, Cabuyao	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(-)	-	-
16	C-1	Waterworks Office, Cabuyao	D	2.75	526	7.73	495	247	191	14	36	7.5	38.8	22.8	0	301.3	13.9	3	0.06	0.05	-	0.50	0.02
17	AFP-MBA1	Cabuyao	C	0.75	352	7.73	515	266	221	16	27.5	6.8	43.6	27.2	0	324.5	11.6	3	0.10	nil	-	0.39	0.01
18	NIA P-45	San Isidoro, Cabuyao	C	-	-	6.87	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Spring 1	Matan Tubig	B	0.41	250	7.01	330	176	157	33	17.5	5	38.8	14.6	0	214.7	11.6	5	0.13	nil	-	4.50	0.01
20	Spring 2	Matan Tubig	E	0.43	237	6.96	340	171	165	28	15	4.8	36.0	18.2	0	208.6	9.3	4	0.13	nil	-	4.48	nil

*: Category; A - Deep wells in the city water supply system
B - Spring in the city water supply system
C - Deep well
D - Shallow well
E - Potential spring for the city water supply system
F - Surface water source
G - For bacteriological analysis

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/1
	Gross Beta	30pCi/1
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 7.2.1 WATER RIGHT IN THE SPRING AREA

	User Name	Water Volume 1/sec	Water Volume cu.m/day	Purpose	Remarks
1)	Canlubang Sugar Estate	461	39,830	industry	the water after power plant
2)	Yulo	96	8,294	irrigation	
3)	Canlubang Pulp Manufacturing	457	39,485	electric power	
	Total	1,014	87,609		

Source; NWRC

The total of 48,124 cu.m/day comprising item 1) and 2) in the above table may be water amount available including river water and spring water. The amount was also field confirmed as follows:

a) Existing spring for the CSBWS waterworks and potential springs
: 12,600 cu.m/day

b) Transmitted amount to Canlubang Sugar estate
: 15,000 cu.m/day

c) Flow rate at the upstream of nearby river
: 15,500 cu.m/day

Total : 43,100 cu.m/day

The water utilized for the Canlubang Sugar Estate at present might be used for the CSBWS waterworks in the future when its business activities would be discontinued as related to the survey term. It is advantageous to consider spring water sources for the water supply, however, a total of 12,600 cu.m/day may be the maximum available volume at this stage. Negotiations with the private sector to acquire additional spring water should be done in the future.

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

(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		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	11	-	-	53	2	66
Civil Works	17	9	6	-	2	34
Total	28	9	6	53	4	100

(4) 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	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.

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 Depart

BREAKDOWN OF COSTS IN %

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

(5) 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 Depart

BREAKDOWN OF COSTS IN %

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

(6) Internal Network

Population Density (Person/ha)	Total Length of Pipeline (m/ha)	Unit Cost (₱/ha) Diameter (100/150)	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		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	22	-	-	7	27	56
Civil Works	17	7	4	-	16	44
Total	39	7	4	7	43	100

(7) 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		
	Material	Labor		Direct	Indirect	Total
		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		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	4	-	-	83	2	89
Civil Works	6	1	3	-	1	11
Total	10	1	3	83	3	100

(8) 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		
	Material	Labor		Direct	Indirect	Total
		Skilled	Unskilled			
Equipment	8	-	-	57	5	70
Civil Works	10	8	10	-	2	30
Total	18	8	10	57	7	100

(9) 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

(10) 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

(11) 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

(12) Energy Cost

$$C = N_p (h)(Pu)(Em)^{-1}$$

where,

C = cost (thousand peso)

N_p = pump power demand (kw)

h = hours of operation

P_u = unit power cost (₱/kwH)

E_m = motor efficiency (0.85)

(13) 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)

(14) 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 (1/sec)

C = "C" value (Hazen William Formula)

Ec = energy cost (₱/kwh)

Oe = overall efficiency

APPENDIX 7.3.1 ALTERNATIVE STUDY OF WATER SOURCE AND TRANSMISSION

(1) Cost Estimates of Water Source and Transmission Alternatives

Required Facilities	Unit Cost (₱)	Alternative S-1 Q'ty	Alternative S-1 Cost (₱1,000 peso)	Alternative S-2 Q'ty	Alternative S-2 Cost (₱1,000 peso)
Construction Cost					
1. Water Sources					
Deep Well	1,160,000	16 units	18,560	4 units	4,640
Deep Well Pump	790,000	16 units	12,640	4 units	3,160
Intake Pump Station	8,366,000	-	-	1 unit	8,366
Sub Total			31,200		16,166
2. Transmission Line					
ϕ 250 mm	630 /m	10,000 m	6,300	2,400 m	1,512
ϕ 350 mm	900 /m	700 m	630	-	-
ϕ 400 mm	970 /m	1,800 m	1,746	1,100 m	1,067
ϕ 450 mm	1,160 /m	-	-	1,300 m	1,508
ϕ 500 mm	1,330 /m	500 m	665	-	-
ϕ 700 mm	1,910 /m	4,400 m	8,404	1,000 m	1,910
Sub Total			17,745		5,997
3. Water Treatment					
Rapid Sand Filter	61,204,000	-	-	1 unit	61,204
TOTAL			48,945		83,367
Operation & Maintenance Cost (15 years)					
1. Energy	₱ 0.3 /KWH	77,790	23,337	48,360 MWH	14,508
2. Laborer	₱ 1,200 /MM	16 persons	3,456	5 persons	1,080
3. Maintenance	(10% of Construction Cost)	-	4,895	-	8,337
TOTAL			31,688		23,925
GRAND TOTAL			80,633		107,292

(2) Cost Estimates of Transmission Alternatives

Pipe Size	Pipe Length (m)			Unit Cost	Cost (₱ x 1,000)		
	Phase I	Phase II	Total	(₱/m)	Phase I	Phase II	Total
Alternative T-1							
ϕ 250 mm	1,400	4,800	6,200	630	882	3,024	3,906
ϕ 350 mm	-	700	700	900	-	630	630
ϕ 400 mm	-	1,800	1,800	970	-	1,746	1,746
ϕ 500 mm	-	500	500	1,330	-	665	665
ϕ 700 mm	3,200	1,200	4,400	1,910	6,112	2,292	8,404
TOTAL	4,600	9,000	13,600		6,994	8,357	15,351
Alternative T-2							
ϕ 250 mm	2,200	4,800	7,000	630	1,386	3,024	4,410
ϕ 350 mm	-	700	700	900	-	630	630
ϕ 400 mm	1,100	1,800	2,900	970	1,067	1,746	2,813
ϕ 450 mm	1,300	-	1,300	1,160	1,508	-	1,508
ϕ 500 mm	-	500	500	1,330	-	665	665
ϕ 600 mm	-	3,200	3,200	1,600	-	5,120	5,120
ϕ 700 mm	-	1,200	1,200	1,910	-	2,292	2,292
TOTAL	4,600	12,200	16,800		3,961	13,477	17,438

APPENDIX 7.3.2 COST COMPARISON OF THE TWO CASES

Case 1 Construction of transmission line from the spring to the existing reservoir area, enabling use of the additional springs.

Case 2 Development of an additional well in Biñan with a production of approx. 5,200 cu.m/day, as an alternative, to utilize new spring water sources.

A new well site for Case 2 is tentatively scheduled for development in Sta. Rosa, with a minimum transmission pipeline length of 1 km. The cost requirement for Case 1 is bigger than that of Case 2.

Case 1

Item	Unit	Quantity	Unit Cost	Cost	R.M.
Pipeline ϕ350	m	4,100	970	3,977,000	
Total				3,977,000	3,300cu.m/day

Case 2

Item	Unit	Quantity	Unit Cost	Cost	R.M.
Well Construction ϕ250 x 200m	unit	1	940,000	940,000	Q=5,200 cu.m/d
Pipe line ϕ200	m	1,000	410	410,000	
Pump Station	unit	1		790,000	3.7 cu.m/min x 40m x 37kw
Sub-Total				2,140,000	
Operation & Maintenance Cost					15 years
Electricity	kwh	5,208,000	0.3₱/kwh	1,562,400	
Labor	unit	1		216,000	
Maintenance				214,000	Const. Cost x 0.1
Sub-Total				1,992,400	
Total				4,132,400	for 5,200 cmd
				(2,622,500	for 3,300 cmd)

FIGURE 7.3.2.1 SCHEMATIC LAYOUT OF CABUYAO

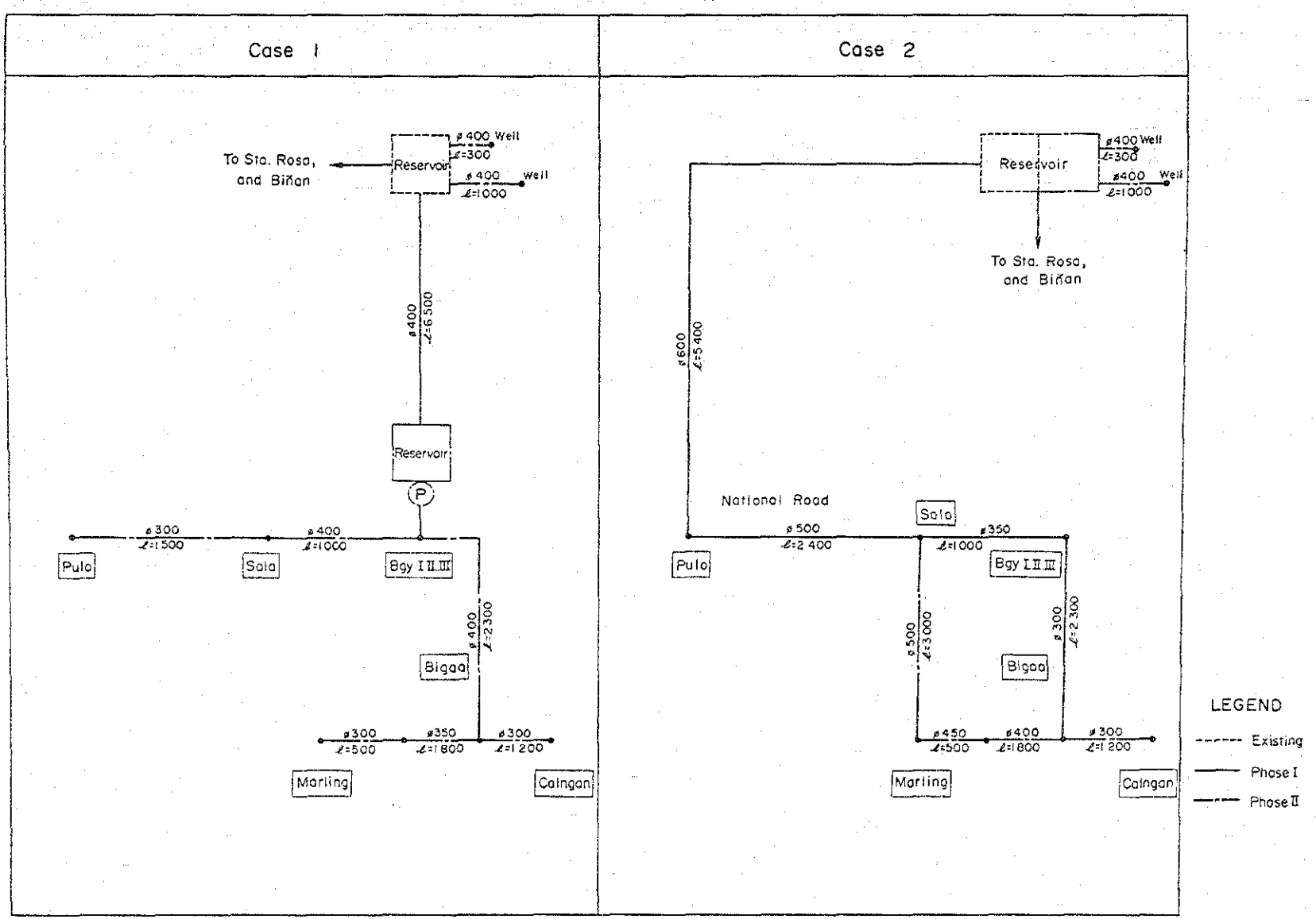


TABLE 7.3.2.1 COST CONPARISON ON CABUYAO SYSTEM

Case 1

Phase	Item	Unit	Unit Cost	Cost	Remarks
I	Transmission Lain				
	ϕ400	6,500 m	970 ₱/m	6,305,000	
	Sub Total			6,305,000	
	Distribution Lain				
	ϕ400	3,300	970 ₱/m	3,201,000	
	ϕ350	1,800	900 ₱/m	1,620,000	
	ϕ300	3,200	760 ₱/m	2,432,000	
	Reservoir V = 1,800 cu.m	1 unit		2,411,000	
II	Pump Station	1 unit		20,449,000	ϕ250x7.0 cu.m/min x 35m x 59kw x 4sets
	Sub Total			30,113,000	
	Operation & Maintenance				
	Electricity	69,532,000 kwh	0.3 ₱/kwh	20,859,600	
I & II	Labor	1 unit		1,944,000	Mechanical Engineer 1 Pump Operator 4 Labor 4
	Maintenance			3,641,800	Construction Cost x 0.1
	Sub Total			26,445,400	
II	Land Acquisition	900 sq.m	120 ₱/m	108,000	
	Total			62,971,400	

TABLE 7.3.2.1 COST COMPARISON ON CABUYAO SYSTEM (CONT'D)

Case 2

Phase	Item	Unit	Unit Cost	Cost	Remarks
	Pipe Line				
	ϕ600	5,400m	1,600 ₱/m	8,640,000	
I	ϕ500	2,400m	1,330 ₱/m	3,192,000	
	ϕ350	1,000m	900 ₱/m	900,000	
	ϕ300	2,300m	760 ₱/m	1,748,000	
	Sub Total			14,480,000	
	Distribution Pipe Line				
	ϕ500	3,000m	1,330 ₱/m	3,990,000	
	ϕ450	500m	1,160 ₱/m	580,000	
	ϕ400	1,800m	970 ₱/m	1,746,000	
II	ϕ300	1,200m	760 ₱/m	912,000	
	Reservoir V = 1,800 cu.m	1 unit		2,411,000	
	Sub Total			9,639,000	
I & II	Operation & Maintenance Maintenance			2,412,000	Construction Cost x 0.1
II	Land Acquisition	900 sq.m	120 ₱/m	108,000	
	Ground Total			26,639,000	

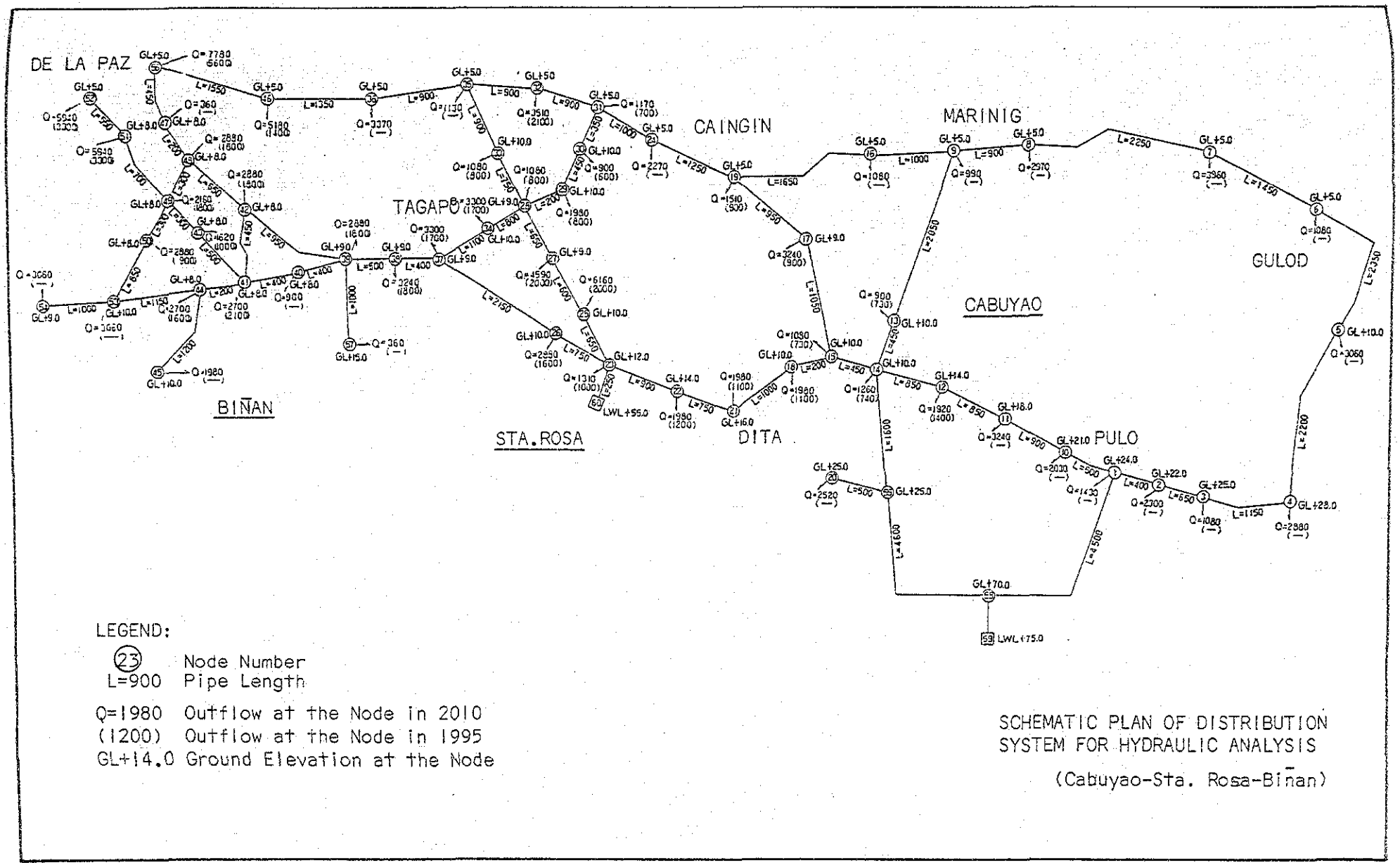
APPENDIX 7.3.3 COMPUTER-AIDED HYDRAULIC ANALYSIS OF DISTRIBUTION SYSTEM (Cabuyao-Sta. Rosa-Biñan)

o List of Computed Cases

Alternative	D-1-A	(1995, 2010)
	D-1-B	(1995, 2010)
	D-2	(2010)

o Note

This appendix show 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.



SCHEMATIC PLAN OF DISTRIBUTION SYSTEM FOR HYDRAULIC ANALYSIS

(Cabuyao-Sta. Rosa-Biñan)

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, Year 1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	24.00	0.00	44.00	20.00	51.00
2	22.00	0.00	42.00	20.00	53.00
3	25.00	0.00	45.00	20.00	50.00
4	28.00	0.00	48.00	20.00	47.00
5	10.00	0.00	30.00	20.00	65.00
6	5.00	0.00	25.00	20.00	70.00
7	5.00	0.00	25.00	20.00	70.00
8	5.00	0.00	25.00	20.00	70.00
9	5.00	0.00	25.00	20.00	70.00
10	21.00	0.00	41.00	20.00	54.00
11	18.00	0.00	38.00	20.00	57.00
12	14.00	1400.00	24.46	10.46	61.00
13	10.00	730.00	24.65	14.65	65.00
14	10.00	740.00	24.68	14.68	65.00
15	10.00	730.00	23.72	13.72	65.00
16	5.00	0.00	25.00	20.00	70.00
17	9.00	900.00	23.43	14.43	66.00
18	10.00	1100.00	23.64	13.64	65.00
19	5.00	900.00	25.00	20.00	70.00
20	25.00	0.00	45.00	20.00	50.00
21	16.00	1100.00	52.75	36.75	59.00
22	14.00	1200.00	53.05	39.05	61.00
23	12.00	1000.00	54.46	42.46	63.00
24	5.00	0.00	25.00	20.00	70.00
25	10.00	2000.00	46.40	36.40	65.00
26	10.00	1600.00	52.50	42.50	65.00
27	9.00	1200.00	42.39	33.39	66.00
28	9.00	1600.00	39.77	30.77	66.00
29	10.00	800.00	39.28	29.28	65.00
30	10.00	600.00	37.83	27.83	65.00
31	5.00	700.00	37.05	32.05	70.00
32	5.00	2100.00	32.91	27.91	70.00
33	10.00	800.00	39.74	29.74	65.00
34	10.00	1700.00	41.52	31.52	65.00
35	5.00	0.00	25.00	20.00	70.00
36	5.00	0.00	25.00	20.00	70.00
37	9.00	1700.00	47.38	38.38	66.00
38	9.00	1800.00	46.74	37.74	66.00
39	9.00	1800.00	46.03	37.03	66.00
40	8.00	0.00	46.03	38.03	67.00
41	8.00	2100.00	38.21	30.21	67.00
42	8.00	1800.00	42.91	34.91	67.00
43	8.00	1000.00	38.24	30.24	67.00
44	8.00	1600.00	28.00	20.00	67.00
45	10.00	0.00	30.00	20.00	65.00
46	5.00	1400.00	20.99	15.99	70.00
47	8.00	0.00	36.91	28.91	67.00
48	8.00	1800.00	39.37	31.37	67.00
49	8.00	1800.00	38.29	30.29	67.00
50	8.00	900.00	38.28	30.28	67.00
51	8.00	3300.00	36.79	28.79	67.00
52	5.00	3300.00	36.47	31.47	70.00
53	10.00	0.00	30.00	20.00	65.00
54	9.00	0.00	29.00	20.00	66.00
55	25.00	0.00	37.67	12.67	50.00

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, Year 1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
56	5.00	5600.00	34.64	29.64	70.00
57	15.00	0.00	35.00	20.00	60.00
58	70.00	0.00	75.00	5.00	5.00
59	75.00	0.00	75.00	0.00	0.00
60	55.00	0.00	55.00	0.00	20.00

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, 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	12	14	300.	850.	120.	-1400.	-0.23	-0.22	-0.26
2	13	14	300.	450.	120.	-730.	-0.12	-0.03	-0.08
3	14	15	250.	450.	120.	2730.	0.64	0.97	2.15
4	14	55	250.	1600.	120.	-5600.	-1.32	-12.99	-8.12
5	15	17	250.	1050.	120.	900.	0.21	0.29	0.27
6	15	18	250.	200.	120.	1100.	0.26	0.08	0.40
7	21	22	250.	750.	120.	-1100.	-0.26	-0.30	-0.40
8	22	23	250.	900.	120.	-2300.	-0.54	-1.41	-1.56
9	23	60	700.	250.	130.	-44700.	-1.34	-0.54	-2.18
10	23	25	250.	650.	120.	7039.	1.66	8.06	12.40
11	23	26	600.	750.	130.	32817.	1.34	1.95	2.60
12	23	26	200.	750.	110.	1544.	0.57	1.95	2.60
13	25	27	250.	600.	120.	5039.	1.19	4.00	6.67
14	26	37	600.	2150.	130.	31289.	1.28	5.12	2.38
15	26	37	200.	2150.	110.	1472.	0.54	5.12	2.38
16	27	28	250.	650.	120.	3839.	0.91	2.62	4.03
17	28	29	300.	250.	120.	4200.	0.69	0.49	1.96
18	28	34	250.	800.	120.	-2761.	-0.65	-1.75	-2.19
19	28	33	350.	750.	120.	800.	0.10	0.03	0.04
20	29	30	250.	450.	120.	3400.	0.80	1.45	3.22
21	30	31	250.	350.	120.	2800.	0.66	0.79	2.25
22	31	32	200.	900.	110.	2100.	0.77	4.14	4.60
23	34	37	250.	1100.	120.	-4461.	-1.05	-5.86	-5.33
24	37	38	600.	400.	130.	25405.	1.04	0.65	1.62
25	37	38	200.	400.	110.	1195.	0.44	0.65	1.62
26	38	39	600.	500.	130.	23685.	0.97	0.71	1.42
27	38	39	200.	500.	110.	1115.	0.41	0.71	1.42
28	39	40	500.	400.	120.	-8.	0.00	0.00	0.00
29	39	42	500.	950.	120.	21250.	1.25	3.12	3.28
30	39	42	200.	950.	110.	1750.	0.64	3.12	3.28
31	41	43	450.	500.	120.	-2100.	-0.15	-0.04	-0.08
32	42	48	450.	650.	120.	21200.	1.54	3.55	5.45
33	43	49	450.	300.	120.	-3100.	-0.23	-0.05	-0.16
34	46	56	150.	1550.	110.	-1400.	-0.92	-13.65	-8.81
35	47	48	250.	200.	120.	-7000.	-1.65	-2.45	-12.27
36	47	56	300.	450.	120.	7000.	1.15	2.27	5.05
37	48	49	400.	300.	120.	12400.	1.14	1.08	3.59
38	49	50	400.	300.	120.	900.	0.08	0.01	0.03
39	49	51	350.	700.	120.	6600.	0.79	1.50	2.14
40	51	52	350.	550.	120.	3300.	0.40	0.33	0.59
41	55	58	250.	4600.	120.	-5600.	-1.32	-37.33	-8.12
42	58	59	600.	10.	130.	-5600.	-0.23	0.00	-0.10

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	24.00	1430.00	64.60	40.60	51.00
2	22.00	2300.00	61.47	39.47	53.00
3	25.00	1080.00	57.88	32.88	50.00
4	28.00	2880.00	46.79	18.79	47.00
5	10.00	3060.00	35.52	25.52	65.00
6	5.00	1080.00	25.33	20.33	70.00
7	5.00	3960.00	13.12	8.12	70.00
8	5.00	2970.00	15.97	10.97	70.00
9	5.00	990.00	19.92	14.92	70.00
10	21.00	2030.00	61.73	40.73	54.00
11	18.00	3240.00	45.42	27.42	57.00
12	14.00	1920.00	35.98	21.98	61.00
13	10.00	900.00	27.31	17.31	65.00
14	10.00	1260.00	29.43	19.43	65.00
15	10.00	1080.00	27.34	17.34	65.00
16	5.00	1080.00	16.58	11.58	70.00
17	9.00	3240.00	20.39	11.39	66.00
18	10.00	1980.00	27.58	17.58	65.00
19	5.00	1510.00	17.18	12.18	70.00
20	25.00	2520.00	33.48	8.48	50.00
21	16.00	1980.00	31.81	15.81	59.00
22	14.00	1980.00	38.56	24.56	61.00
23	12.00	1310.00	52.38	40.38	63.00
24	5.00	2270.00	17.18	12.18	70.00
25	10.00	6160.00	42.95	32.95	65.00
26	10.00	2880.00	46.71	36.71	65.00
27	9.00	4590.00	36.93	27.93	66.00
28	9.00	1080.00	32.26	23.26	66.00
29	10.00	1980.00	30.40	20.40	65.00
30	10.00	900.00	25.39	15.39	65.00
31	5.00	1170.00	22.41	17.41	70.00
32	5.00	3510.00	17.41	12.41	70.00
33	10.00	1080.00	27.74	17.74	65.00
34	10.00	3300.00	31.26	21.26	65.00
35	5.00	1130.00	23.22	18.22	70.00
36	5.00	3370.00	17.19	12.19	70.00
37	9.00	3300.00	31.83	22.83	66.00
38	9.00	3240.00	29.45	20.45	66.00
39	9.00	2880.00	26.80	17.80	66.00
40	8.00	900.00	24.98	16.98	67.00
41	8.00	2700.00	23.27	15.27	67.00
42	8.00	2880.00	23.96	15.96	67.00
43	8.00	1620.00	22.05	14.05	67.00
44	8.00	2700.00	22.06	14.06	67.00
45	10.00	1980.00	20.39	10.39	65.00
46	5.00	5180.00	13.82	8.82	70.00
47	8.00	360.00	18.15	10.15	67.00
48	8.00	2880.00	21.69	13.69	67.00
49	8.00	2160.00	21.46	13.46	67.00
50	8.00	2880.00	21.37	13.37	67.00
51	8.00	5940.00	17.02	9.02	67.00
52	5.00	5940.00	16.06	11.06	70.00
53	10.00	3060.00	20.23	10.23	65.00
54	9.00	3060.00	17.58	8.58	66.00
55	25.00	0.00	34.41	9.41	50.00

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
56	5.00	7780.00	15.12	10.12	70.00
57	15.00	360.00	26.09	11.09	60.00
58	70.00	0.00	74.97	4.97	5.00
59	75.00	0.00	75.00	0.00	0.00
60	55.00	0.00	55.00	0.00	20.00

Iteration Times : 42

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, 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	1	58	600.	4500.	130.	-30730.	-1.26	-10.37	-2.30
2	1	2	350.	400.	120.	13312.	1.60	3.13	7.84
3	1	10	400.	500.	120.	15987.	1.47	2.87	5.74
4	2	3	350.	650.	120.	11012.	1.32	3.58	5.51
5	3	4	300.	1150.	120.	9932.	1.63	11.10	9.65
6	4	5	300.	2200.	120.	7052.	1.15	11.26	5.12
7	5	6	250.	2350.	120.	3992.	0.94	10.19	4.34
8	6	7	200.	1450.	110.	2912.	1.07	12.21	8.42
9	7	8	200.	2250.	110.	-1048.	-0.39	-2.85	-1.27
10	8	9	250.	900.	120.	-4018.	-0.95	-3.95	-4.39
11	9	13	300.	2050.	120.	-5837.	-0.96	-7.39	-3.61
12	9	16	150.	1000.	110.	830.	0.54	3.34	3.34
13	10	11	300.	900.	120.	13957.	2.29	16.31	18.12
14	11	12	300.	850.	120.	10717.	1.75	9.44	11.11
15	12	14	300.	850.	120.	8797.	1.44	6.55	7.71
16	13	14	300.	450.	120.	-5737.	-1.10	-2.12	-4.70
17	14	55	250.	1600.	120.	-3337.	-0.79	-4.98	-3.11
18	14	15	250.	450.	120.	4137.	0.98	2.08	4.63
19	15	17	250.	1050.	120.	5019.	1.18	6.96	6.63
20	15	18	250.	200.	120.	-1962.	-0.46	-0.23	-1.16
21	16	19	150.	1650.	110.	-250.	-0.16	-0.60	-0.36
22	17	19	200.	950.	110.	1779.	0.66	3.21	3.38
23	18	21	250.	1000.	120.	-3942.	-0.93	-4.24	-4.24
24	19	24	200.	1250.	110.	17.	0.01	0.00	0.00
25	20	55	250.	500.	120.	-2520.	-0.59	-0.92	-1.85
26	21	22	250.	750.	120.	-5922.	-1.40	-6.75	-9.00
27	22	23	250.	900.	120.	-7902.	-1.86	-13.82	-15.36
28	23	60	700.	250.	130.	-104413.	-3.14	-2.62	-10.47
29	23	25	400.	650.	120.	26382.	2.43	9.43	14.51
30	23	25	250.	650.	120.	7664.	1.81	9.43	14.51
31	23	26	600.	750.	130.	58407.	2.39	5.67	7.57
32	23	26	200.	750.	110.	2748.	1.01	5.67	7.57
33	24	31	200.	1000.	110.	-2252.	-0.83	-5.23	-5.23
34	25	27	400.	600.	120.	21608.	1.99	6.02	10.03
35	25	27	250.	600.	120.	6278.	1.48	6.02	10.03
36	26	37	600.	2150.	130.	55657.	2.26	14.88	6.92
37	26	37	200.	2150.	110.	2619.	0.96	14.88	6.92
38	27	28	250.	650.	120.	5244.	1.24	4.67	7.19
39	27	28	400.	650.	120.	18052.	1.66	4.67	7.19
40	28	29	300.	250.	120.	8627.	1.41	1.86	7.43
41	28	34	250.	800.	120.	2037.	0.48	1.00	1.25
42	28	33	350.	750.	120.	11551.	1.39	4.52	6.02
43	29	30	250.	450.	120.	6647.	1.57	5.02	11.15
44	30	31	250.	350.	120.	5747.	1.36	2.98	8.52
45	31	32	200.	900.	110.	2326.	0.86	5.00	5.55
46	32	35	150.	900.	110.	-1184.	-0.78	-5.81	-6.46
47	33	35	350.	900.	120.	10471.	1.26	4.52	5.02
48	34	37	250.	1100.	120.	-1263.	-0.30	-0.57	-0.51
49	35	36	300.	900.	120.	8157.	1.34	6.03	6.70
50	36	46	300.	1350.	120.	4787.	0.78	3.37	2.50
51	37	38	600.	400.	130.	51299.	2.10	2.38	5.95
52	37	38	200.	400.	110.	2414.	0.89	2.38	5.95
53	38	39	600.	500.	130.	48205.	1.97	2.65	5.30
54	38	39	200.	500.	110.	2268.	0.84	2.65	5.30
55	39	40	500.	400.	120.	25377.	1.50	1.82	4.55

ALTERNATIVE D-1-A (Recommended Plan, Single Pipeline Alignment)
2 Reservoir System, 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)
56	39	42	500.	950.	120.	20194.	1.19	2.83	2.98
57	39	42	200.	950.	110.	1663.	0.61	2.83	2.98
58	39	57	150.	1000.	110.	360.	0.24	0.71	0.71
59	40	41	500.	400.	120.	24477.	1.44	1.70	4.25
60	41	42	250.	450.	120.	-2280.	-0.54	-0.69	-1.54
61	41	43	450.	500.	120.	13762.	1.00	1.23	2.45
62	41	44	350.	250.	120.	10295.	1.24	1.22	4.87
63	42	48	450.	650.	120.	16596.	1.22	2.28	3.50
64	43	49	450.	300.	120.	12142.	0.88	0.58	1.94
65	44	45	250.	1200.	110.	1980.	0.47	1.67	1.39
66	44	53	350.	1150.	120.	5615.	0.68	1.82	1.58
67	46	56	150.	1550.	110.	-393.	-0.26	-1.30	-0.84
68	47	48	250.	200.	120.	-8533.	-2.01	-3.54	-17.70
69	47	56	300.	450.	120.	8173.	1.34	3.03	6.73
70	48	49	400.	300.	120.	5283.	0.49	0.22	0.74
71	49	50	400.	300.	120.	3385.	0.31	0.10	0.32
72	49	51	350.	700.	120.	11880.	1.43	4.44	6.35
73	50	53	150.	850.	110.	505.	0.33	1.13	1.33
74	51	52	350.	550.	120.	5940.	0.71	0.97	1.76
75	53	54	250.	1000.	120.	3060.	0.72	2.65	2.65
76	55	58	250.	4600.	120.	-5857.	-1.38	-40.56	-8.82
77	58	59	600.	10.	130.	-36587.	-1.50	-0.03	-3.18

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recommended Plan)
2 Reservoir System, Year 1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	24.00	0.00	44.00	20.00	51.00
2	22.00	0.00	42.00	20.00	53.00
3	25.00	0.00	45.00	20.00	50.00
4	28.00	0.00	48.00	20.00	47.00
5	10.00	0.00	30.00	20.00	65.00
6	5.00	0.00	25.00	20.00	70.00
7	5.00	0.00	25.00	20.00	70.00
8	5.00	0.00	25.00	20.00	70.00
9	5.00	0.00	25.00	20.00	70.00
10	21.00	0.00	41.00	20.00	54.00
11	18.00	0.00	38.00	20.00	57.00
12	14.00	1400.00	44.43	30.43	61.00
13	10.00	730.00	43.77	33.77	65.00
14	10.00	740.00	44.96	34.96	65.00
15	10.00	730.00	44.69	34.69	65.00
16	5.00	0.00	25.00	20.00	70.00
17	9.00	900.00	29.96	20.96	66.00
18	10.00	1100.00	44.78	34.78	65.00
19	5.00	900.00	26.27	21.27	70.00
20	25.00	0.00	45.00	20.00	50.00
21	16.00	1100.00	46.29	30.29	59.00
22	14.00	1200.00	48.66	34.66	61.00
23	12.00	1000.00	53.66	41.66	63.00
24	5.00	0.00	25.00	20.00	70.00
25	10.00	2000.00	42.36	32.36	65.00
26	10.00	1600.00	48.43	38.43	65.00
27	9.00	1200.00	36.03	27.03	66.00
28	9.00	1600.00	31.35	22.35	66.00
29	10.00	800.00	27.20	17.20	65.00
30	10.00	600.00	22.15	12.15	65.00
31	5.00	700.00	19.41	14.41	70.00
32	5.00	2100.00	15.27	10.27	70.00
33	10.00	800.00	29.01	19.01	65.00
34	10.00	1700.00	31.81	21.81	65.00
35	5.00	0.00	25.00	20.00	70.00
36	5.00	0.00	25.00	20.00	70.00
37	9.00	1700.00	34.71	25.71	66.00
38	9.00	1800.00	32.80	23.80	66.00
39	9.00	1800.00	30.68	21.68	66.00
40	8.00	0.00	27.85	19.85	67.00
41	8.00	2100.00	25.01	17.01	67.00
42	8.00	1800.00	26.38	18.38	67.00
43	8.00	1000.00	21.06	13.06	67.00
44	8.00	1600.00	22.19	14.19	67.00
45	10.00	0.00	30.00	20.00	65.00
46	5.00	1400.00	13.16	8.16	70.00
47	8.00	0.00	18.79	10.79	67.00
48	8.00	1800.00	19.80	11.80	67.00
49	8.00	1800.00	19.16	11.16	67.00
50	8.00	900.00	19.08	11.08	67.00
51	8.00	3300.00	15.99	7.99	67.00
52	5.00	3300.00	14.32	9.32	70.00
53	10.00	0.00	30.00	20.00	65.00
54	9.00	0.00	29.00	20.00	65.00
55	25.00	0.00	52.71	27.71	50.00

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recommended Plan)
2 Reservoir System, Year 1995

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
56	5.00	5600.00	16.52	11.52	70.00
57	15.00	0.00	35.00	20.00	60.00
58	70.00	0.00	74.99	4.99	5.00
59	75.00	0.00	75.00	0.00	0.00
60	55.00	0.00	55.00	0.00	20.00

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recommended Plan)
2 Reservoir System, 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	12	14	250.	850.	120.	-1400.	-0.33	-0.53	-0.62
2	13	14	150.	450.	110.	-730.	-0.48	-1.19	-2.64
3	14	55	250.	1600.	120.	-4238.	-1.00	-7.75	-4.84
4	14	15	250.	450.	120.	1358.	0.32	0.27	0.60
5	15	17	150.	1050.	110.	1800.	1.18	14.73	14.03
6	15	18	250.	200.	120.	-1162.	-0.27	-0.09	-0.44
7	17	19	150.	950.	110.	900.	0.59	3.69	3.89
8	18	21	250.	1000.	120.	-2262.	-0.53	-1.51	-1.51
9	21	22	250.	750.	120.	-3362.	-0.79	-2.37	-3.15
10	22	23	250.	900.	120.	-4562.	-1.08	-5.00	-5.55
11	23	60	600.	250.	130.	-48562.	-1.99	-1.34	-5.38
12	23	25	250.	650.	120.	8450.	1.99	11.30	17.39
13	23	26	200.	750.	110.	2629.	0.97	5.22	6.97
14	23	26	500.	750.	120.	31922.	1.88	5.22	6.97
15	25	27	250.	600.	120.	6450.	1.52	6.33	10.54
16	26	37	200.	2150.	110.	2507.	0.92	13.72	6.38
17	26	37	500.	2150.	120.	30443.	1.79	13.72	6.38
18	27	28	250.	650.	120.	5250.	1.24	4.68	7.20
19	28	29	200.	250.	110.	4200.	1.55	4.15	16.59
20	28	34	250.	800.	120.	-1350.	-0.32	-0.47	-0.58
21	28	33	150.	750.	110.	800.	0.52	2.34	3.12
22	29	30	200.	450.	110.	3400.	1.25	5.05	11.22
23	30	31	200.	350.	110.	2800.	1.03	2.74	7.83
24	31	32	200.	900.	110.	2100.	0.77	4.14	4.60
25	34	37	250.	1100.	120.	-3050.	-0.72	-2.90	-2.63
26	37	38	200.	400.	110.	2145.	0.79	1.91	4.78
27	37	38	500.	400.	120.	26055.	1.54	1.91	4.78
28	38	39	200.	500.	110.	2008.	0.74	2.12	4.23
29	38	39	500.	500.	120.	24392.	1.44	2.12	4.23
30	39	40	350.	400.	120.	12612.	1.52	2.84	7.09
31	39	42	350.	950.	120.	9904.	1.19	4.30	4.53
32	39	42	200.	950.	110.	2084.	0.77	4.30	4.53
33	40	41	350.	400.	120.	12612.	1.52	2.84	7.09
34	41	43	300.	500.	120.	8912.	1.46	3.95	7.90
35	41	44	150.	250.	110.	1600.	1.05	2.82	11.28
36	42	48	300.	650.	120.	10188.	1.67	6.57	10.11
37	43	49	300.	300.	120.	7912.	1.30	1.90	6.33
38	46	56	200.	1550.	110.	-1400.	-0.52	-3.36	-2.17
39	47	48	300.	200.	120.	-7000.	-1.15	-1.01	-5.05
40	47	56	300.	450.	120.	7000.	1.15	2.27	5.05
41	48	49	200.	300.	110.	1388.	0.51	0.64	2.13
42	49	50	250.	300.	120.	900.	0.21	0.08	0.27
43	49	51	300.	700.	120.	6500.	1.08	3.17	4.53
44	51	52	250.	550.	120.	3300.	0.78	1.68	3.05
45	55	58	250.	4600.	120.	-4238.	-1.00	-22.28	-4.84
46	58	59	350.	10.	120.	-4237.	-0.51	-0.01	-0.94

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recpommended Plan)
2 Reservoir System, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	24.00	1430.00	64.33	40.33	51.00
2	22.00	2300.00	61.19	39.19	53.00
3	25.00	1080.00	57.60	32.60	50.00
4	28.00	2880.00	46.50	18.50	47.00
5	10.00	3060.00	35.22	25.22	65.00
6	5.00	1080.00	25.01	20.01	70.00
7	5.00	3960.00	12.76	7.76	70.00
8	5.00	2970.00	15.59	10.59	70.00
9	5.00	990.00	19.53	14.53	70.00
10	21.00	2030.00	61.30	40.30	54.00
11	18.00	3240.00	53.14	35.14	57.00
12	14.00	1920.00	42.95	28.95	61.00
13	10.00	900.00	27.51	17.51	65.00
14	10.00	1260.00	31.21	21.21	65.00
15	10.00	1080.00	29.04	19.04	65.00
16	5.00	1080.00	14.09	9.09	70.00
17	9.00	3240.00	18.73	9.73	66.00
18	10.00	1980.00	29.18	19.18	65.00
19	5.00	1510.00	16.38	11.38	70.00
20	25.00	2520.00	34.95	9.95	50.00
21	16.00	1980.00	32.55	16.55	59.00
22	14.00	1980.00	38.37	24.37	61.00
23	12.00	1310.00	50.74	38.74	63.00
24	5.00	2270.00	16.46	11.46	70.00
25	10.00	6160.00	42.13	32.13	65.00
26	10.00	2880.00	46.02	36.02	65.00
27	9.00	4590.00	36.74	27.74	66.00
28	9.00	1080.00	32.66	23.66	66.00
29	10.00	1980.00	30.45	20.45	65.00
30	10.00	900.00	25.30	15.30	65.00
31	5.00	1170.00	22.21	17.21	70.00
32	5.00	3510.00	16.78	11.78	70.00
33	10.00	1080.00	29.50	19.50	65.00
34	10.00	3300.00	32.25	22.25	65.00
35	5.00	1130.00	21.67	16.67	70.00
36	5.00	3370.00	16.90	11.90	70.00
37	9.00	3300.00	33.62	24.62	66.00
38	9.00	3240.00	31.18	22.18	66.00
39	9.00	2880.00	28.46	19.46	66.00
40	8.00	900.00	26.92	18.92	67.00
41	8.00	2700.00	24.86	16.86	67.00
42	8.00	2880.00	25.41	17.41	67.00
43	8.00	1620.00	23.64	15.64	67.00
44	8.00	2700.00	22.91	14.91	67.00
45	10.00	1980.00	21.49	11.49	65.00
46	5.00	5180.00	14.69	9.69	70.00
47	8.00	360.00	21.64	13.64	67.00
48	8.00	2880.00	23.42	15.42	67.00
49	8.00	2160.00	23.04	15.04	67.00
50	8.00	2880.00	22.87	14.87	67.00
51	8.00	5940.00	19.19	11.19	67.00
52	5.00	5940.00	17.81	12.81	70.00
53	10.00	3060.00	21.16	11.16	65.00
54	9.00	3060.00	18.51	9.51	66.00
55	25.00	0.00	35.87	10.87	50.00

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recpommended Plan)
2 Reservoir System, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu.m/day)	H.G.L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
56	5.00	7780.00	17.91	12.91	70.00
57	15.00	360.00	27.74	12.74	60.00
58	70.00	0.00	74.98	4.98	5.00
59	75.00	0.00	75.00	0.00	0.00
60	55.00	0.00	55.00	0.00	20.00

Iteration Times : 32

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recommended Plan)
2 Reservoir System, 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	1	58	600.	4500.	130.	-31184.	-1.28	-10.65	-2.37
2	1	2	350.	400.	120.	13317.	1.60	3.14	7.84
3	1	10	400.	500.	120.	16438.	1.51	3.02	6.04
4	2	3	350.	650.	120.	11017.	1.33	3.59	5.52
5	3	4	300.	1150.	120.	9937.	1.63	11.11	9.66
6	4	5	300.	2200.	120.	7057.	1.16	11.27	5.12
7	5	6	250.	2350.	120.	3997.	0.94	10.21	4.35
8	6	7	200.	1450.	110.	2917.	1.07	12.25	8.45
9	7	8	200.	2250.	110.	-1043.	-0.38	-2.83	-1.26
10	8	9	250.	900.	120.	-4013.	-0.95	-3.94	-4.38
11	9	16	150.	1000.	110.	1080.	0.71	5.45	5.45
12	9	13	300.	2050.	120.	-6083.	-1.00	-7.98	-3.89
13	10	11	350.	900.	120.	14408.	1.73	8.16	9.07
14	11	12	300.	850.	120.	11168.	1.83	10.19	11.99
15	12	14	150.	850.	110.	1785.	1.17	11.74	13.81
16	12	14	250.	850.	120.	7463.	1.76	11.74	13.81
17	13	14	250.	450.	120.	-5635.	-1.33	-3.69	-8.21
18	13	14	150.	450.	110.	-1348.	-0.88	-3.69	-8.21
19	14	55	250.	1600.	120.	-3222.	-0.76	-4.67	-2.92
20	14	15	250.	450.	120.	4226.	1.00	2.17	4.82
21	15	17	200.	1050.	110.	3165.	1.17	10.32	9.82
22	15	17	150.	1050.	110.	1485.	0.97	10.32	9.82
23	15	18	250.	200.	120.	-1503.	-0.35	-0.14	-0.71
24	17	19	150.	950.	110.	705.	0.46	2.35	2.47
25	17	19	150.	950.	110.	705.	0.46	2.35	2.47
26	18	21	250.	1000.	120.	-3483.	-0.82	-3.37	-3.37
27	19	24	150.	1250.	110.	-100.	-0.07	-0.08	-0.07
28	20	55	250.	500.	120.	-2520.	-0.59	-0.92	-1.85
29	21	22	250.	750.	120.	-5463.	-1.29	-5.81	-7.75
30	22	23	250.	900.	120.	-7443.	-1.76	-12.37	-13.75
31	23	60	300.	250.	120.	-13505.	-2.21	-4.26	-17.05
32	23	25	400.	650.	120.	25118.	2.31	8.61	13.25
33	23	26	500.	750.	120.	30209.	1.78	4.72	6.29
34	23	60	600.	250.	130.	-90568.	-3.71	-4.26	-17.05
35	23	25	250.	650.	120.	7297.	1.72	8.61	13.25
36	23	26	200.	750.	110.	2487.	0.92	4.72	6.29
37	23	26	500.	750.	120.	30209.	1.78	4.72	6.29
38	24	31	200.	1000.	110.	-2370.	-0.87	-5.75	-5.75
39	25	27	400.	600.	120.	20345.	1.87	5.38	8.97
40	25	27	250.	600.	120.	5910.	1.39	5.38	8.97
41	26	37	500.	2150.	120.	28826.	1.70	12.40	5.77
42	26	37	200.	2150.	110.	2374.	0.87	12.40	5.77
43	26	37	500.	2150.	120.	28826.	1.70	12.40	5.77
44	27	28	400.	650.	120.	16788.	1.55	4.08	6.28
45	27	28	250.	650.	120.	4877.	1.15	4.08	6.28
46	28	29	250.	250.	120.	5864.	1.38	2.21	8.84
47	28	33	350.	750.	120.	9529.	1.15	3.16	4.22
48	28	29	200.	250.	110.	2989.	1.10	2.21	8.84
49	28	34	250.	800.	120.	1263.	0.30	0.41	0.51
50	28	33	150.	750.	110.	941.	0.62	3.16	4.22
51	29	30	200.	450.	110.	3436.	1.27	5.15	11.44
52	29	30	200.	450.	110.	3436.	1.27	5.15	11.44
53	30	31	200.	350.	110.	2986.	1.10	3.09	8.82
54	30	31	200.	350.	110.	2986.	1.10	3.09	8.82
55	31	32	200.	900.	110.	2432.	0.90	5.43	6.03

ALTERNATIVE D-1-B (Parallel Pipeline Alignment of Recommended Plan)
2 Reservoir System, 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)
56	32	35	150.	900.	110.	-1078.	-0.71	-4.88	-5.43
57	33	35	300.	900.	120.	9390.	1.54	7.83	8.70
58	34	37	250.	1100.	120.	-2037.	-0.48	-1.37	-1.25
59	35	36	300.	900.	120.	7182.	1.18	4.77	5.29
60	36	46	300.	1350.	120.	3812.	0.62	2.21	1.64
61	37	38	500.	400.	120.	29716.	1.75	2.44	6.10
62	37	38	200.	400.	110.	2447.	0.90	2.44	6.10
63	37	38	450.	400.	120.	22524.	1.64	2.44	6.10
64	38	39	500.	500.	120.	27956.	1.65	2.72	5.45
65	38	39	200.	500.	110.	2302.	0.85	2.72	5.45
66	38	39	450.	500.	120.	21190.	1.54	2.72	5.45
67	39	57	150.	1000.	110.	360.	0.24	0.71	0.71
68	39	40	450.	400.	120.	17534.	1.28	1.53	3.84
69	39	42	400.	950.	120.	11674.	1.08	3.05	3.21
70	39	40	350.	400.	120.	9054.	1.09	1.53	3.84
71	39	42	350.	950.	120.	8217.	0.99	3.05	3.21
72	39	42	200.	950.	110.	1729.	0.64	3.05	3.21
73	40	41	400.	400.	120.	15076.	1.39	2.06	5.15
74	40	41	350.	400.	120.	10612.	1.28	2.06	5.15
75	41	42	250.	450.	120.	-2011.	-0.47	-0.55	-1.22
76	41	43	400.	500.	120.	10093.	0.93	1.22	2.45
77	41	44	300.	250.	120.	8858.	1.45	1.95	7.81
78	41	43	300.	500.	120.	4736.	0.78	1.22	2.45
79	41	44	150.	250.	110.	1312.	0.85	1.95	7.81
80	42	48	400.	650.	120.	11386.	1.05	1.99	3.06
81	42	48	300.	650.	120.	5343.	0.87	1.99	3.06
82	43	49	400.	300.	120.	8991.	0.83	0.59	1.98
83	43	49	300.	300.	120.	4219.	0.69	0.59	1.98
84	44	45	250.	1200.	120.	1980.	0.47	1.42	1.18
85	44	53	350.	1150.	120.	5490.	0.66	1.75	1.52
86	45	56	200.	1550.	110.	-1368.	-0.50	-3.22	-2.08
87	47	48	300.	200.	120.	-9508.	-1.56	-1.78	-8.90
88	47	56	300.	450.	120.	9148.	1.50	3.73	8.29
89	48	49	300.	300.	120.	3299.	0.54	0.38	1.25
90	48	49	200.	300.	110.	1041.	0.38	0.38	1.25
91	49	50	300.	300.	120.	2168.	0.36	0.17	0.58
92	49	51	250.	700.	120.	4543.	1.07	3.86	5.51
93	49	50	250.	300.	120.	1342.	0.32	0.17	0.58
94	49	51	300.	700.	120.	7337.	1.20	3.86	5.51
95	50	53	150.	850.	110.	630.	0.41	1.71	2.01
96	51	52	250.	550.	120.	2970.	0.70	1.38	2.51
97	51	52	250.	550.	120.	2970.	0.70	1.38	2.51
98	53	54	250.	1000.	120.	3060.	0.72	2.65	2.65
99	55	58	250.	4600.	120.	-5742.	-1.35	-39.10	-8.50
100	58	59	600.	10.	130.	-30174.	-1.24	-0.02	-2.23
101	58	59	350.	10.	120.	-6749.	-0.81	-0.02	-2.23

ALTERNATIVE D-2
3 Reservoir System, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
1	24.00	1430.00	63.45	39.45	51.00
2	22.00	2300.00	61.81	39.81	53.00
3	25.00	1080.00	58.19	33.19	50.00
4	28.00	2880.00	46.98	18.98	47.00
5	10.00	3060.00	35.57	25.57	65.00
6	5.00	1080.00	25.12	20.12	70.00
7	5.00	3960.00	12.50	7.50	70.00
8	5.00	2970.00	15.09	10.09	70.00
9	5.00	990.00	18.94	13.94	70.00
10	21.00	2030.00	59.98	38.98	54.00
11	18.00	3240.00	50.42	32.42	57.00
12	14.00	1920.00	37.95	23.95	61.00
13	10.00	900.00	26.62	16.62	65.00
14	10.00	1260.00	28.81	18.81	65.00
15	10.00	1080.00	24.92	14.92	65.00
16	5.00	1080.00	14.20	9.20	70.00
17	9.00	3240.00	17.75	8.75	66.00
18	10.00	1980.00	24.93	14.93	65.00
19	5.00	1510.00	14.27	9.27	70.00
20	25.00	2520.00	32.97	7.97	50.00
21	15.00	1980.00	26.58	10.58	59.00
22	14.00	1980.00	30.39	16.39	61.00
23	12.00	1310.00	39.54	27.54	63.00
24	5.00	2270.00	14.14	9.14	70.00
25	10.00	6160.00	32.42	22.42	65.00
26	10.00	2880.00	29.53	19.53	65.00
27	9.00	4590.00	28.18	19.18	66.00
28	9.00	1080.00	25.13	16.13	66.00
29	10.00	1980.00	23.30	13.30	65.00
30	10.00	900.00	21.26	11.26	65.00
31	5.00	1170.00	18.33	13.33	70.00
32	5.00	3510.00	16.66	11.66	70.00
33	10.00	1080.00	22.62	12.62	65.00
34	10.00	3300.00	25.08	15.08	65.00
35	5.00	1130.00	17.68	12.68	70.00
36	5.00	3370.00	15.05	10.05	70.00
37	9.00	3300.00	27.65	18.65	66.00
38	9.00	3240.00	37.89	28.89	66.00
39	9.00	2880.00	34.94	25.94	66.00
40	8.00	900.00	31.12	23.12	67.00
41	8.00	2700.00	27.51	19.51	67.00
42	8.00	2880.00	27.67	19.67	67.00
43	8.00	1620.00	24.41	16.41	67.00
44	8.00	2700.00	25.50	17.50	67.00
45	10.00	1980.00	20.55	10.55	65.00
46	5.00	5180.00	14.47	9.47	70.00
47	8.00	360.00	21.80	13.80	67.00
48	8.00	2880.00	22.99	14.99	67.00
49	8.00	2160.00	22.88	14.88	67.00
50	8.00	2880.00	22.70	14.70	67.00
51	8.00	5940.00	18.44	10.44	67.00
52	5.00	5940.00	16.39	11.39	70.00
53	10.00	3060.00	19.74	9.74	65.00
54	9.00	3060.00	17.09	8.09	66.00
55	25.00	0.00	33.89	8.89	50.00

ALTERNATIVE D-2
3 Reservoir System, Year 2010

<< NODES >>

NODE No.	GROUND ELEV. (m)	FLOW (cu. m/day)	H. G. L. ELEV. (m)	DYNAMIC HEAD (m)	STATIC HEAD (m)
56	5.00	7780.00	16.45	11.45	70.00
57	15.00	360.00	29.81	14.81	60.00
58	70.00	0.00	74.97	4.97	5.00
59	75.00	0.00	75.00	0.00	0.00
60	40.00	0.00	40.00	0.00	35.00
61	40.00	0.00	40.00	0.00	35.00

Iteration Times : 29

ALTERNATIVE D-2
3 Reservoir System, 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	1	58	600.	4500.	130.	-32518.	-1.33	-11.51	-2.56
2	1	2	400.	400.	120.	13365.	1.23	1.65	4.12
3	1	10	400.	500.	120.	17723.	1.63	3.47	6.95
4	2	3	350.	650.	120.	11065.	1.33	3.62	5.56
5	3	4	300.	1150.	120.	9985.	1.63	11.21	9.75
6	4	5	300.	2200.	120.	7105.	1.16	11.42	5.19
7	5	6	250.	2350.	120.	4045.	0.95	10.44	4.44
8	6	7	200.	1450.	110.	2965.	1.09	12.63	8.71
9	7	8	200.	2250.	110.	-995.	-0.37	-2.59	-1.15
10	8	9	250.	900.	120.	-3965.	-0.93	-3.85	-4.28
11	9	13	300.	2050.	120.	-5957.	-0.98	-7.68	-3.74
12	9	16	150.	1000.	110.	1002.	0.66	4.74	4.74
13	10	11	350.	900.	120.	15593.	1.89	9.56	10.63
14	11	12	300.	850.	120.	12453.	2.04	12.47	14.67
15	12	14	300.	850.	120.	10533.	1.72	9.14	10.76
16	13	14	300.	450.	120.	-6857.	-1.12	-2.19	-4.86
17	14	55	250.	1600.	120.	-3376.	-0.80	-5.09	-3.18
18	14	15	250.	450.	120.	5792.	1.37	3.89	8.64
19	15	17	250.	1050.	120.	5099.	1.20	7.16	6.82
20	15	18	250.	200.	120.	-387.	-0.09	-0.01	-0.06
21	15	19	150.	1650.	110.	-78.	-0.05	-0.07	-0.04
22	17	19	200.	950.	110.	1859.	0.68	3.49	3.67
23	18	21	250.	1000.	120.	-2367.	-0.56	-1.65	-1.65
24	19	24	200.	1250.	110.	271.	0.10	0.13	0.10
25	20	55	250.	500.	120.	-2520.	-0.59	-0.92	-1.85
26	21	22	250.	750.	120.	-4347.	-1.03	-3.81	-5.08
27	22	23	250.	900.	120.	-6327.	-1.49	-9.16	-10.18
28	23	60	700.	250.	130.	-40623.	-1.22	-0.46	-1.82
29	23	25	400.	650.	120.	22665.	2.09	7.12	10.95
30	23	25	250.	650.	120.	6585.	1.55	7.12	10.95
31	23	26	200.	750.	110.	3736.	1.38	10.02	13.36
32	24	31	200.	1000.	110.	-1999.	-0.74	-4.19	-4.19
33	25	27	400.	600.	120.	17892.	1.65	4.24	7.07
34	25	27	250.	600.	120.	5198.	1.23	4.24	7.07
35	26	37	200.	2150.	110.	856.	0.32	1.87	0.87
36	27	28	250.	650.	120.	4165.	0.98	3.05	4.69
37	27	28	400.	650.	120.	14335.	1.32	3.05	4.69
38	28	29	300.	250.	120.	8574.	1.40	1.84	7.35
39	28	34	250.	800.	120.	437.	0.10	0.06	0.07
40	28	33	350.	750.	120.	8408.	1.01	2.51	3.35
41	29	30	300.	450.	120.	6594.	1.08	2.03	4.52
42	30	31	250.	350.	120.	5694.	1.34	2.93	8.37
43	31	32	250.	900.	120.	2526.	0.60	1.67	1.86
44	32	35	200.	900.	110.	-984.	-0.36	-1.02	-1.13
45	33	35	300.	900.	120.	7328.	1.20	4.95	5.50
46	34	37	250.	1100.	120.	-2863.	-0.67	-2.58	-2.34
47	35	36	300.	900.	120.	5214.	0.85	2.63	2.93
48	36	46	300.	1350.	120.	1844.	0.30	0.58	0.43
49	37	38	200.	400.	110.	-5307.	-1.96	-10.24	-25.59
50	38	39	600.	500.	130.	51016.	2.09	2.94	5.89
51	38	39	200.	500.	110.	2401.	0.88	2.94	5.89
52	38	61	600.	250.	130.	-61963.	-2.54	-2.11	-8.44
53	39	40	450.	400.	120.	28721.	2.09	3.83	9.57
54	39	42	400.	950.	120.	18688.	1.72	7.28	7.66
55	39	42	200.	950.	110.	2767.	1.02	7.28	7.66

ALTERNATIVE D-2
3 Reservoir System, 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)
56	39	57	100.	1000.	110.	360.	0.53	5.13	5.13
57	40	41	450.	400.	120.	27821.	2.02	3.61	9.02
58	41	42	200.	450.	110.	-522.	-0.19	-0.16	-0.35
59	41	43	400.	500.	120.	16650.	1.53	3.09	6.19
60	41	44	300.	250.	120.	8994.	1.47	2.01	8.03
61	42	48	400.	650.	120.	18053.	1.66	4.67	7.19
62	43	49	400.	300.	120.	15030.	1.38	1.54	5.12
63	44	45	200.	1200.	110.	1980.	0.73	4.95	4.12
64	44	53	250.	1150.	120.	4314.	1.02	5.76	5.01
65	45	56	300.	1550.	120.	-3336.	-0.55	-1.98	-1.28
66	47	48	350.	200.	120.	-11476.	-1.38	-1.19	-5.95
67	47	56	300.	450.	120.	11116.	1.82	5.35	11.89
68	48	49	400.	300.	120.	3697.	0.34	0.11	0.38
69	49	50	400.	300.	120.	4686.	0.43	0.18	0.59
70	49	51	350.	700.	120.	11880.	1.43	4.44	6.35
71	50	53	200.	850.	110.	1806.	0.67	2.96	3.48
72	51	52	300.	550.	120.	5940.	0.97	2.05	3.72
73	53	54	250.	1000.	120.	3060.	0.72	2.65	2.65
74	55	58	250.	4600.	120.	-5896.	-1.39	-41.07	-8.93
75	58	59	600.	10.	130.	-38414.	-1.57	-0.03	-3.48

APPENDIX 7.3.4 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 8.2.1.A BREAKDOWN OF COST ESTIMATES

(Unit: thousand Pesos)

Cabuyao-Sta.Rosa-Binan 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 NUMBER	Phase II Cost COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	1160000	0	0	4	4640	4	4640	11	12760
(2)DEEP WELL PUMP w/HOUSE	790000	1	790	4	3160	5	3950	11	8690
Flow Meter D=150	62000	1	62	4	248	5	310	11	682
SUB-TOTAL			852		8048		8900		22132
2 TRANSMISSION FACILITIES									
(1)Pipe Protection									
D=200	251	400	100	0	0	400	100		0
D=300	337	400	135	0	0	400	135		0
(2)Main Pipes									
D=250 (Steel Pipe)	630	1100	693	1300	819	2400	1512	4800	3024
D=350 (Steel Pipe)	900	0	0	0	0	0	0	700	630
D=400 (Steel Pipe)	970	1100	1067	0	0	1100	1067	1800	1746
D=450 (Steel Pipe)	1160	1300	1508	0	0	1300	1508	0	0
D=500 (Steel Pipe)	1330	0	0	0	0	0	0	500	665
D=600 (Steel Pipe)	1600	0	0	0	0	0	0	3200	5120
D=700 (Steel Pipe)	1910	0	0	0	0	0	0	1200	2292
SUB-TOTAL			3503		819		4322		13477
3 DISTRIBUTION FACILITIES							0		
(1)Reservoir			3417	0	0		3417		11291
(2)Pump Facility (Equip.)			2090		3084		5174		6437
-do- (Civil)			2666		0		2666		3316
(3)Chlrntn Facility 22kg/d	98100	2	196	1	98	3	294	1	98
- do - 45kg/d	119000	0	0	0	0	0	0	1	119
(4)Electric Sub-station		1	3643					1	4858
(5)Distribution pipes									
1)Main Pipes									
D=150 (PVC Pipe)	410	0	0	2950	1210	2950	1210	4000	1640
D=200 (Steel Pipe)	520	0	0	1850	962	1850	962	5950	3094
D=250 (Steel Pipe)	630	2050	1292	0	0	2050	1292	8000	5040
D=300 (Steel Pipe)	760	2000	1520	2300	1748	4300	3268	7100	5396
D=350 (Steel Pipe)	900	1450	1305	1400	1260	2850	2565	2500	2250
D=400 (Steel Pipe)	970	600	582	0	0	600	582	2400	2328
D=450 (Steel Pipe)	1160	1450	1682	0	0	1450	1682	0	0
D=500 (Steel Pipe)	1330	950	1264	800	1064	1750	2328	0	0
D=600 (Steel Pipe)	1600	3800	6080	0	0	3800	6080	4500	7200
D=700 (Steel Pipe)	1910	250	478	0	0	250	478	0	0
2)Valves									
D=150 (Gate Valve)	5300	0	0	15	80	15	80	18	95
D=200 (Gate Valve)	6700	0	0	6	40	6	40	20	134
D=250 (Gate Valve)	11200	7	79	0	0	7	79	27	302
D=300 (Butterfly Valve)	34800	7	243	8	278	15	521	24	835
D=350 (Butterfly Valve)	74400	5	372	5	372	10	744	8	595
D=400 (Butterfly Valve)	95200	2	190	3	286	5	476	0	0
D=450 (Butterfly Valve)	125900	5	630	0	0	5	630	0	0
D=500 (Butterfly Valve)	174000	3	522	3	522	6	1044	0	0
D=600 (Butterfly Valve)	243600	13	3167	0	0	13	3167	15	3654
D=700 (Butterfly Valve)	313200	1	313	0	0	1	313	0	0
3)Internal Network									
Commercial 150poo/ha	25700	0	0	18	463	18	463	0	0
Commercial 250poo/ha	30400	0	0	0	0	0	0	62	1885
Residential 100poo/ha	18700	52	972	0	0	52	972	0	0
Residential 150poo/ha	21000	0	0	394	8274	394	8274	0	0
Residential 250poo/ha	30400	0	0	0	0	0	0	561	17054
4)Service Conections									
D=1/2	810	4901	3970	15464	12525	20365	16495	42879	34732
D=3/4	1280	66	84	12	17	78	101	74	95
5)Rehabilitation									
Water Meter 1/2''	400	491	196	0	0	491	196	0	0
Water Meter 3/4''	880	0	0	0	0	0	0	0	0
Old Laterals			860	0	0		860	0	0
Service Cnnctn.wo/Meter	480	246	117	0	0	246	117	0	0
Service Cnnctn.w/Meter	880	1208	1064	0	0	1208	1064	0	0
6)Flow Meter D=150	62000	1	62	0	0	1	62	0	0
-do- D=350	164000	1	164	0	0	1	164	2	328
7)Fire Protection							0		
D=150	16800	0	0	0	0	0	0	75	1260
D=100	9400	0	0	0	0	0	0	335	3149
SUB-TOTAL			39220		32283		71503		117185
4 1)Administration Bldg.								1	1820
2)Operation Center		1	1583			1	1583		
SUB-TOTAL			1583		0		1583		1820
5 Land Acquisition	100	1800	180	2000	200	3800	380	14100	1410
Vehicle	300000	2	600	4	1200	6	1800	13	3900
Stored Material & Equip.			501		561		1062		1811
SUB-TOTAL			1281		1961		3242		7151
6 Replacement of Equipment			0		0		0		20848
T O T A L			46439		43111		89550		182613
7 Leak Detection	240	2907	699	0	0	2907	699	0	0
GRAND TOTAL			47138		43111		90249		182613

(Unit: thousand Pesos)

Cabuyao-Sta.Rosa-Binan	UNIT COST	1988		1989		1990		1991	
ITEM		NO	COST	NO	COST	NO	COST	NO	COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	1160000	0	0	0	0	0	0	1	1160
(2)DEEP WELL PUMP w/HOUSE	790000	0	0	1	790	0	0	1	790
Flow Meter D=150	62000	0	0	1	62	0	0	1	62
SUB-TOTAL			0	2	852		0		2012
2 TRANSMISSION FACILITIES									
(1)Pipe Protection									
D=200	251		0	400	100		0		0
D=300	337		0	400	135		0		0
(2)Main Pipes									
D=250 (Steel Pipe)	630		0	1100	693		0	800	504
D=350 (Steel Pipe)	900		0	0	0		0		0
D=400 (Steel Pipe)	970		0	1100	1067		0		0
D=450 (Steel Pipe)	1160		0	1300	1508		0		0
D=500 (Steel Pipe)	1330		0	0	0		0		0
D=600 (Steel Pipe)	1600		0	0	0		0		0
D=700 (Steel Pipe)	1910		0	0	0		0		0
SUB-TOTAL			0		3503		0		504
3 DISTRIBUTION FACILITIES									
(1)Reservoir				1	3417				
(2)Pump Facility (Equip.)					2090				3084
-do- (Civil)					2666				
(3)Chlrnte Facility 22kg/d	98100			2	196	0	0	1	98
- do - 45kg/d	119000				0	0	0	0	0
(4)Electric Sub-station				1	3643				
(5)Distribution pipes		1988		1989		1990		1991	
1)Main Pipes									
D=150 (PVC Pipe)	410		0		0		0	2950	1210
D=200 (Steel Pipe)	520		0		0		0	1850	962
D=250 (Steel Pipe)	630		0	1050	662	1000	630	0	0
D=300 (Steel Pipe)	760		0	700	532	1300	988	2300	1748
D=350 (Steel Pipe)	900		0	750	675	700	630	1400	1260
D=400 (Steel Pipe)	970		0	300	291	300	291	0	0
D=450 (Steel Pipe)	1160		0	650	754	800	928	0	0
D=500 (Steel Pipe)	1330		0	950	1264		0	800	1064
D=600 (Steel Pipe)	1600		0	3800	6080		0		0
D=700 (Steel Pipe)	1910		0	250	478		0		0
2)Valves									
D=150 (Gate Valve)	5300		0		0		0	15	80
D=200 (Gate Valve)	6700		0		0		0	6	40
D=250 (Gate Valve)	11200		0	4	45	3	34	0	0
D=300 (Butterfly Valve)	34800		0	3	104	4	139	8	278
D=350 (Butterfly Valve)	74400		0	3	223	2	149	5	372
D=400 (Butterfly Valve)	95200		0	1	95	1	95	3	286
D=450 (Butterfly Valve)	125900		0	2	252	3	378	0	0
D=500 (Butterfly Valve)	174000		0	3	522		0	3	522
D=600 (Butterfly Valve)	243600		0	13	3167		0	0	0
D=700 (Butterfly Valve)	313200		0	1	313		0	0	0
3)Internal Network									
Commercial 150pop/ha	25700		0		0		0	4	103
Commercial 250pop/ha	30400		0		0		0		0
Residential 100pop/ha	18700		0	26	486	26	486		0
Residential 150pop/ha	21000		0		0		0	79	1659
Residential 250pop/ha	30400		0		0		0		0
4)Service Conections									
D=1/2	810		0	2451	1985	2450	1985	3093	2505
D=3/4	1280		0	33	42	33	42	3	4
5)Renabilitation									
Water Meter 1/2''	400	491	196	0	0	0	0		0
Water Meter 3/4''	880	0	0	0	0	0	0		0
-Old Laterals			0		430		430		0
Service Cnnctn.wo/Meter	480	82	39	82	39	82	39		0
Service Cnnctn.w/Meter	880	403	355	403	355	402	354		0
6)Flow Meter D=150	62000		0	1	62		0		0
-do- D=350	164000		0	1	164		0		0
7)Fire Protection									
D=150	16800		0		0		0		0
D=100	9400		0		0		0		0
SUB-TOTAL			590		31032		7598		15275
4 1)Administration Bldg.									
2)Operation Center				1	1583				
SUB-TOTAL			0	1	1583		0		0
5 Land Acquisition	100	1800	180		0		0	2000	200
Vehicle	300000	2	600		0		0	1	300
Stored Material & Equip.			11		387		103		243
SUB-TOTAL			791		387		103		743
6 Replacement of Equipment			0		0		0		0
T O T A L			1381		37257		7701		18531
7 Leak Detection	240	969	233	969	233	969	233		0
GRAND TOTAL			1611		37490		7934		18531

(Unit: thousand Pesos)

Cabuyao-Sta.Rosa-Binan	UNIT COST	1992		1993		1994		1995	
ITEM		NO	COST	NO	COST	NO	COST	NO	COST
1 SOURCE FACILITY									
(1)DEEP WELL CONSTRUCTION	1160000	1	1160	1	1160	1	1160	0	0
(2)DEEP WELL PUMP w/HOUSE	790000	1	790	1	790	1	790	0	0
Flow Meter D=150	62000	1	62	1	62	1	62	0	0
SUB-TOTAL		3	2012	3	2012	3	2012	0	0
2 TRANSMISSION FACILITIES									
(1)Pipe Protection									
D=200	251	0	0	0	0	0	0	0	0
D=300	337	0	0	0	0	0	0	0	0
(2)Main Pipes									
D=250 (Steel Pipe)	630	200	126	200	126	100	63		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
SUB-TOTAL			126		126		63		0
3 DISTRIBUTION FACILITIES									
(1)Reservoir									
(2)Pump Facility (Equip.)									
-do- (Civil)									
(3)Chlrntn Facility 22kg/d	98100	0	0	0	0	0	0	0	0
- do - 45kg/d	119000	0	0	0	0	0	0	0	0
(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
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									
Commercial 150pop/ha	25700	4	103	4	103	3	77	3	77
Commercial 250pop/ha	30400		0		0		0		0
Residential 100pop/ha	18700		0		0		0		0
Residential 150pop/ha	21000	79	1659	79	1659	79	1659	78	1638
Residential 250pop/ha	30400		0		0		0		0
4)Service Connections									
D=1/2	810	3092	2505	3092	2505	3092	2505	3092	2505
D=3/4	1280	3	4	3	3	2	3	3	3
5)Rehabilitation									
Water Meter 1/2''	400		0		0		0		0
Water Meter 3/4''	880		0		0		0		0
-Old Laterals			0		0		0		0
Service Connctn.wo/Meter	480		0		0		0		0
Service Connctn.w/Meter	880		0		0		0		0
6)Flow Meter D=150	62000		0		0		0		0
-do- D=350	164000		0		0		0		0
7)Fire Protection									
D=150	16800		0		0		0		0
D=100	9400		0		0		0		0
SUB-TOTAL			1271		1270		1211		1223
4 1)Administration Bldg.									
2)Operation Center									
SUB-TOTAL			0		0		0		0
5 Land Acquisition	100		0		0		0		0
Vehicle	300000	1	300	1	300	1	300		0
Stored Material & Equip.			85		85		84		64
SUB-TOTAL			385		385		384		64
6 Replacement of Equipment			0		0		0		0
T O T A L			6791		6793		6703		4287
7 Leak Detection	240		0		0		0		0
GRAND TOTAL			6791		6793		6703		4287