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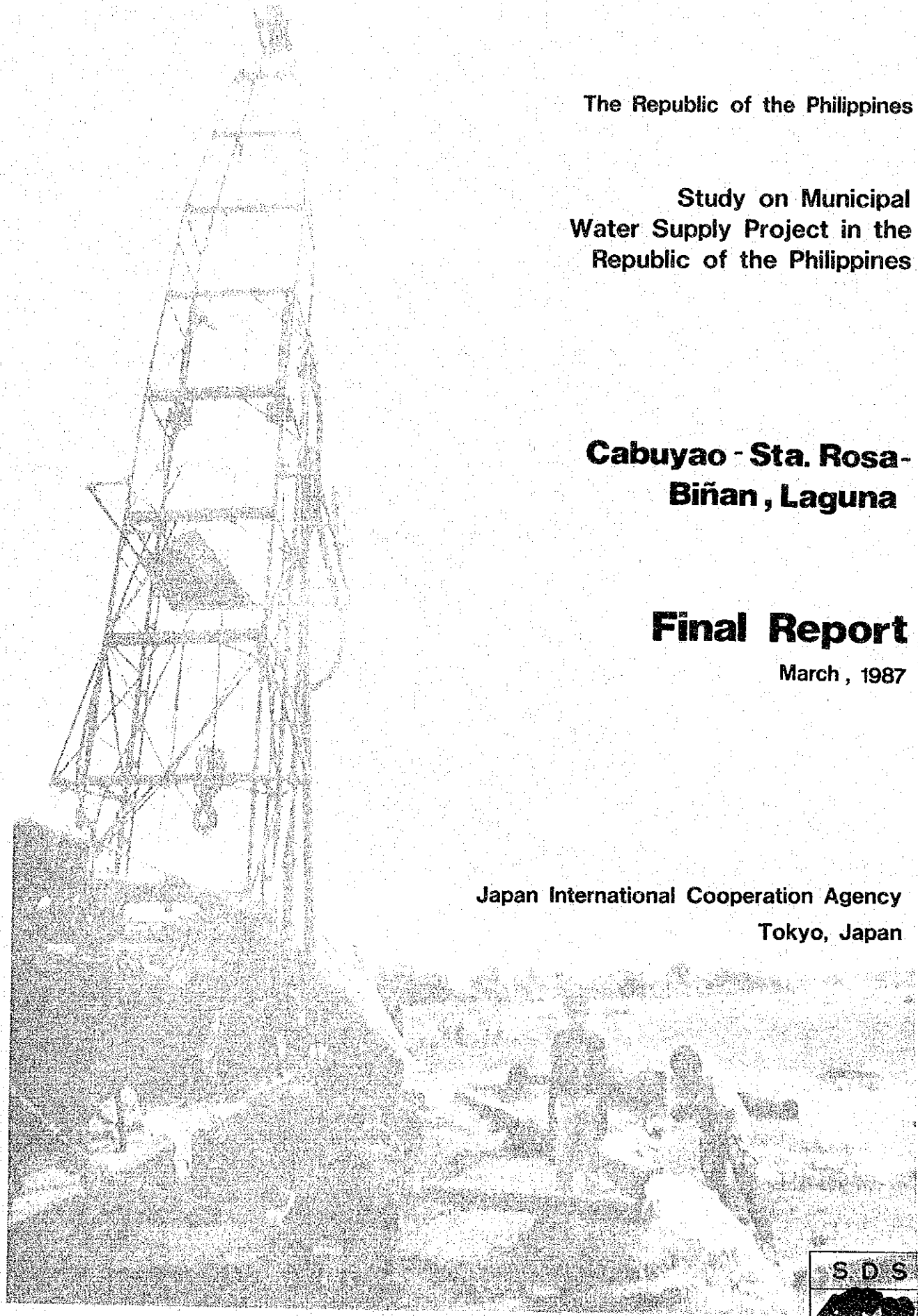


The Republic of the Philippines

Study on Municipal Water Supply Project in the Republic of the Philippines

Cabuyao - Sta. Rosa - Biñan, Laguna

Final Report

March, 1987

Japan International Cooperation Agency
Tokyo, Japan

THE REPUBLIC OF THE PHILIPPINES

STUDY
ON
MUNICIPAL WATER SUPPLY PROJECT
IN
THE REPUBLIC OF THE PHILIPPINES

CABUYAO-STA. ROSA-BIÑAN, LAGUNA

FINAL REPORT

MARCH, 1987

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN

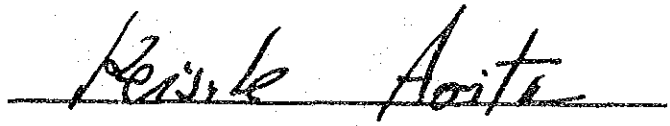
PREFACE

In response to the request of the Government of the Republic of the Philippines, the Japanese Government has decided to conduct a Master Plan and a Feasibility Study on Municipal Water Supply Project and entrusted the Study to the Japan International Cooperation Agency (JICA). JICA organized a study team headed by Mr. Toru Hayashi, Director, Nippon Jogesuido Sekkei Co., Ltd. to conduct the said study, from February 1986 to March 1987.

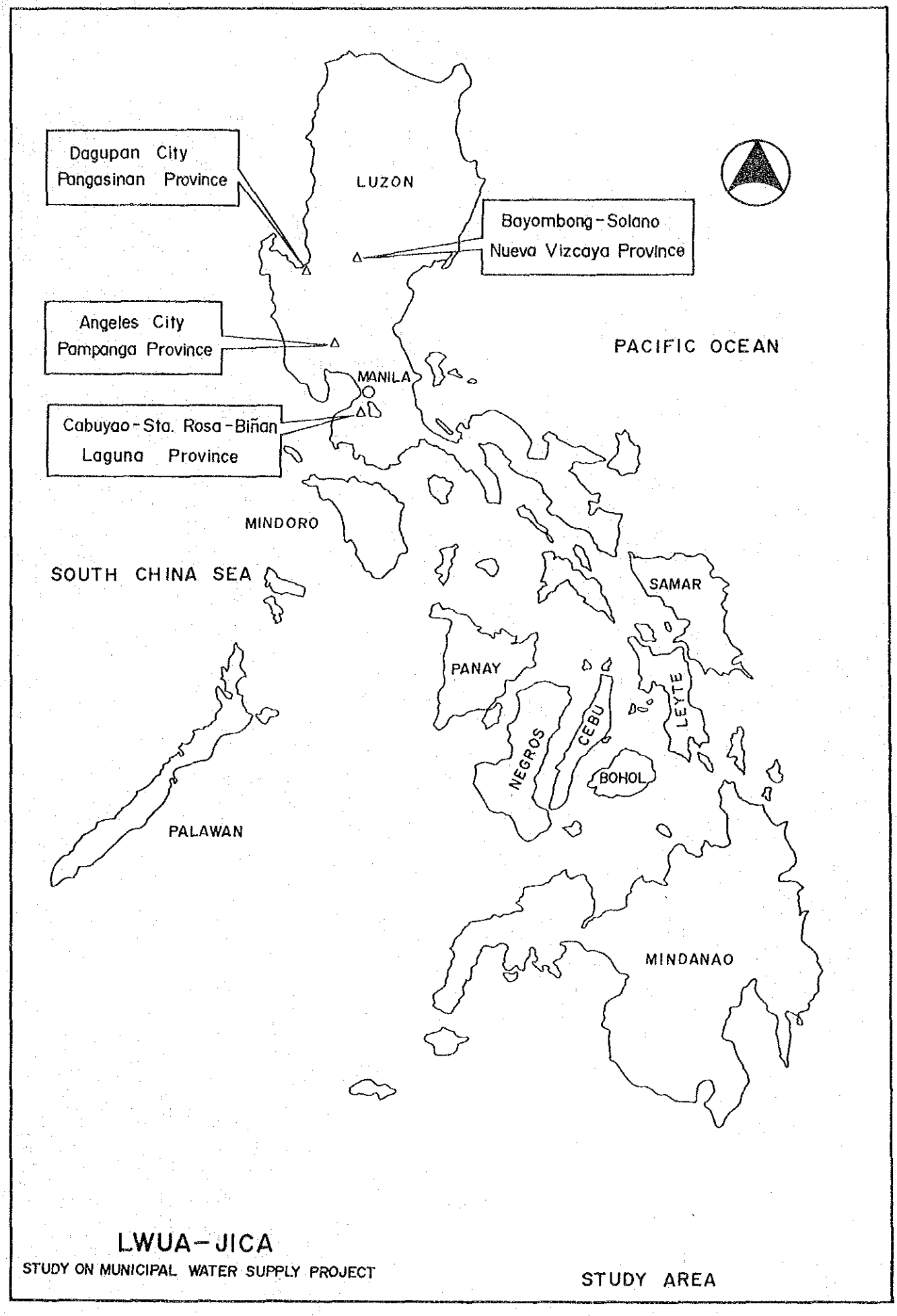
The team had discussions with the officials concerned of the Government of the Philippines and conducted a field survey in the Study Area and Metropolitan Manila. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries. I wish to express my deep appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

March, 1987



Keisuke ARITA
President
Japan International Cooperation Agency



LWUA – JICA

STUDY ON MUNICIPAL WATER SUPPLY PROJECT

STUDY AREA

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYMS

AC	-	Asbestos Cement
BPW	-	Bureau of Public Works (now MPWH)
BWP	-	Barangay Water Program
CCI	-	Centrifugal Cast Iron
CI	-	Cast Iron
CSBWS	-	Cabuyao-Sta. Rosa-Biñan Waterworks System
EIRR	-	Economic Internal Rate of Return
FIRR	-	Financial Internal Rate of Return
GI	-	Galvanized Iron
GOJ	-	Government of Japan
GOP	-	Government of the Republic of the Philippines
HH	-	Household
JICA	-	Japan International Cooperation Agency
LWUA	-	Local Water Utilities Administration
MERALCO	-	Manila Electric Company
MPWH	-	Ministry of Public Works and Highways
MWSS	-	Metropolitan Waterworks and Sewerage System
NCSO	-	National Census and Statistics Office
NEDA	-	National Economic and Development Authority
NIA	-	National Irrigation Administration
NPC	-	National Power Corporation
PE	-	Polyethylene
PLDT	-	Philippine Long Distance Telephone Company
PT&T	-	Philippine Telegraph and Telephone Corporation
PVC	-	Polyvinyl Chloride
RCPI	-	Radio Communication of the Philippines, Incorporated
RWDC	-	Rural Waterworks Development Corporation

ABBREVIATIONS

Units

cm	-centimeter
cm/sec	-centimeter per second
cu.m	-cubic meter
cu.m/conn.day	-cubic meter per connection per day
cu.m/day	-cubic meter per day
cu.m/day/km	-cubic meter per day per kilometer

Units

cu.m/month	-cubic meter per month
cu.m/sec	-cubic meter per second
FTU	-formazin turbidity unit
ha	-hectare
hr	-hour
kg/day	-kilogram per day
kg/sq.cm	-lilogram per square centimeter
km	-kilometer
KVA	-kilo volt ampere
kw	-kilo watt
KWH	-kilo watt hour
l/day	-liter per day
l/min	-liter per minute
l/min/m	-liter per minute per meter
l/sec	-liter per second
lpcd	-liter per capita per day
lps	-liter per second
mbgs	-meter below ground surface
mH	-meter in Height
micro-S/cm or micro-Siemens/cm	-micro Siemens per centimeter
mm/day	-millimeter per day
mm	-millimeter
MM	-man month
m	-meter
m/sec	-meter per second
MWH	-mega watt hour
mm/year	-millimeter per year
ohm-m	-ohm meter
pc or pcs	-piece(s)
pc/ha	-piece per hectare
p/ha	-person per hectare
sq.cm/sec	-square centimeter per second
sq.km	-square kilometer
sq.m/day	-square meter per day

CHAPTER 1
SUMMARY AND RECOMMENDATION

CHAPTER 1 SUMMARY AND RECOMMENDATION

1.1 GENERAL

This Chapter presents a summary of the results and analyses of the field surveys conducted in Cabuyao-Sta. Rosa-Biñan for the Project. The Short Term Development Plan and Long Term Development Plan with special emphasis on the water resources are also incorporated.

In the course of study, planning stages are considered as Phase I from 1986 to 1995 for the Short Term Development and Phase II from 1996 to 2010 for the Long Term Development period, respectively. The Phase I project period is further divided into two stages; Stage 1 from 1986 to 1990 and Stage 2 from 1991 to 1995, considering the practical implementation period for the required facilities.

With regard to the criteria and approach of technical and financial studies, the Methodology Manual being established and adopted by the Local Water Utilities Administration (hereinafter referred to as LWUA) was employed through the thorough review with data and information collected during the field surveys. Some deviations to the Methodology Manual, such as system pressure during the Phase I period, were made by cost considerations. Also adopted at the request of the LWUA was the terms and conditions for the financial analysis of the Project. Those which referred to the LWUA Methodology Manual are contained in APPENDIX of this report.

The fundamentals used for planning purpose and the study results are shown in TABLE 1.1.1.

1.2 FINDINGS AND PROJECTIONS

1.2.1 Study Area

The study area is composed of the Municipalities of Cabuyao, Sta. Rosa and Biñan, all located in the Province of Laguna. They are approximately 40 to 45 km from Metro Manila.

Cabuyao has land area of 4,292 ha. It is composed of 18 barangays, 15 of which are rural and 3 are urban. Sta. Rosa covers a total land

TABLE 1.1.1 SUMMARY OF PROPOSED PROJECT (Cabuyao-Sta. Rosa-Biñan)

Description	Present (1986)	Phase I		Phase II (2010)
		Stage 1 (1990)	Stage 2 (1995)	
A. Population				
1. Total Population	237,860	270,590	308,700	449,040
2. Pop. in Service Area	141,790	161,460	183,520	410,590
% of Total Pop.	60	60	59	91
3. Served Population	23,560	38,390	110,350	287,780
% of Pop. in Service Area	12	24	60	70
% of Total Pop.	6	14	36	64
B. Served Area (ha)	340	340	740	1,240
C. Water Demand (cu.m/day)				
1. Domestic (Daily Ave.)	3,487	4,567	14,125	43,739
2. Commercial (Daily Ave.)	75	920	3,704	17,495
3. Institutional (Daily Ave.)	22	377	501	1,276
4. Industrial (Daily Ave.)	134	150	150	150
5. Total Water Demand				
a) Daily Ave.	10,450	10,022	26,401	78,331
b) Daily Max.	-	12,500	33,000	94,000
c) Peak Hour	-	21,300	52,800	141,000
D. Number of Connection				
1. Domestic (Individual)	2,863	7,020	20,603	57,030
2. Domestic (Public Faucet)	-	-	-	-
3. Commercial	23	767	2,648	9,100
4. Institutional	16	82	94	168
5. Industiral	5	5	5	5
6. Total	2,907	7,874	23,350	66,303
E. Water Sources and Treatment				
1. Existing Facility	Spring	Spring	Spring	Spring
(capacity: cu.m/day)	9,300	9,300	9,300	9,300
	1 well	-	-	-
	1,350			
2. New Facility	-	1 well	4 wells	11 wells
(capacity: cu.m/day)		5,500	22,000	60,500
F. Transmission Facility	ϕ400 - ϕ100	ϕ250 - ϕ450	ϕ250	ϕ250 - ϕ700
	11,680m	3,500m	1,300m	12,200m
G. Distribution Facility				
1. Reservoir	1,350 cu.m	3,110 cu.m	-	2,530 cu.m
	x 1 unit	x 1 unit		x 1 unit
				12,430 cu.m
				x 1 unit
2. Main Pipeline	ϕ150 - ϕ250	ϕ250 - ϕ700	ϕ150 - ϕ500	ϕ150 - ϕ600
	26,500m	12,500m	9,300m	34,450m
3. Internal Network	ϕ50 - ϕ100	ϕ75 - ϕ100	ϕ75 - ϕ150	ϕ75 - ϕ150
	24,230m	4,160m	37,080m	67,280m
H. Number of Workers	31	33	81	141
I. Project Cost (Peso)				
1. Construction Cost				
a) Foreign Exchange	-	33,597,000	29,678,000	135,948,000
b) Local Currency	-	28,933,000	18,744,000	88,885,000
c) Total	-	62,530,000	48,422,000	224,833,000
2. O & M Cost (₱/annum)	879,566 1/	2,086,000	6,071,000	16,549,000
J. Ave. Family Income of Low Income Group (₱/month)	630	1,080	2,080	-
K. Water Rate (₱/cu.m; 0-10 cu.m)				
1. Domestic	1.0 (1/2")	3.25	6.75	-
2. Commercial	1.0 (1/2")	6.50	13.50	-
3. Institutional	1.0 (1/2")	3.25	6.75	-

1/ : 1985

area of 5,415 ha. It has 18 barangays, 15 of which are rural and 3 are urban. The Municipality of Biñan covers a total land area of 4,350 ha. It has 24 barangays, 9 of which are urban and 15 are rural. The present population (1986) of the three Municipalities is projected at 56,320, 79,330 and 102,210 for Cabuyao, Sta. Rosa and Biñan, respectively. The annual population increase rates of these Municipalities from 1975 to 1980 were reported to be between 4.41% to 6.19% by the 1980 National Census and Statistics Office (hereinafter referred to as NCSO) report.

In relation to the population growth rate of Laguna Province which was 3.90% from 1975 to 1980, the three Municipalities showed higher growth rates. This could be attributed to the proximity of the area to Metro Manila, industrialization, and accessibility to its adjoining municipalities and the availability of various social services and utilities.

Compared with the other municipalities of Laguna, the designated three Municipalities are among the most densely populated area.

Due to its proximity to Metro Manila, different industrial companies such as food processing, textile firms and chemical industry have been established in these areas, hence it is likely that the household income in the three Municipalities have increased.

Based on the increasing number of establishments, it is to be assumed that the areas once devoted to agriculture have gradually been reduced.

The three Municipalities have telegraph service provided by the Bureau of Telecommunications, and a telephone system owned by a private corporation. Electricity is supplied by the Manila Electric Company (hereinafter referred to as MERALCO).

1.2.2 Existing Water Supply and Sanitation Conditions

Approximately 90% of the total population in the 3 municipalities uses Level I water supply system. There are two Level III waterworks, the Cabuyao-Sta. Rosa-Biñan Waterworks System (hereinafter referred to as CSBWS) and the privately-owned Canlubang Water Supply System. The former is

managed by the Provincial Government. The service area is limited to the built-up areas with a total served population of 23,560, which include secondary users and borrowers (Cabuyao 5,820, Sta. Rosa 10,810 and Biñan 6,930). Total water consumption is estimated at about 4,000 cu.m/day.

A number of hand pumps is used, most of which are privately-owned. The existing Level III water system, likewise utilizes wells as supplementary water source. There exists no public Level II system.

The water sources for the CSBWS are the Matang-Tubig Spring in Cabuyao and two deep wells located in Biñan. The volume of spring water collected is approximately 100 l/sec. A chlorine storage bottle with a volume of 28 liters is installed and connected directly to the 200 mm diameter outlet pipe. The surrounding area of the spring box is fenced.

One of the pumping stations is not operating at present but is used as a standby pumping station. The other pumping station at the vicinity of the public market in Barangay San Vicente is being operated 8 hours a day.

The total length of the transmission line is 11.68 km which includes installed parallel pipes. The line is by gravity type with pipe diameters ranging from 150 to 400 mm (CCI). A concrete reservoir with a capacity of 1,350 cu.m is connected to the transmission line with a diameter of 200 mm and distribution pipes (ϕ250 mm) for the service of Cabuyao and Sta. Rosa. The distance from the spring box to the reservoir is approximately 7.1 km. The pipes in the first section are installed along the river bed without any protection.

There are two main distribution pipe lines. The total length of the distribution lines is approximately 51 km with diameters ranging from 50 mm to 250 mm.

There exists a total of 2,907 registered connections in the system. Approximately 85% of the total connections is metered. There is a total of 64 sluice valves and 54 hydrants in the system.

The result of water quality tests at the wells and taps indicated no significant problem.

The major works for operation and maintenance of the CSBWS are those for spring source, reservoir, and pumping stations. Deficiencies of the CSBWS facilities are mainly on water source and treatment, transmission and distribution facilities. Considerable improvements will be required for these facilities.

The water production in the system is estimated to be 9,750 cu.m/day. However, only 4,000 cu.m/day is being utilized in the service area.

Majority of the domestic connections have an average per capita water consumption of about 120 lpcd. Average unit consumption for commercial and institutional use is 1.1 and 1.4 cu.m/conn.day, respectively.

Unaccounted-for water is approximately 60% of the produced water due to leakage and wastage in the service area.

With reference to drainage and sewage disposal, open channels constitute the drainage system of the three municipalities. The drainage system of Biñan is inadequate with frequent flooding in some parts of the poblacion.

There exists no sewage collection system in the subject area. Sanitary sewage is disposed of at individual septic tanks, water sealed toilets or pit privies.

Garbage collection service is provided in the three municipalities. However, the service area is limited. Final disposal is by dumping on the open space. Mostly, garbage disposal is by burning/dumping in compost pits.

1.2.3 Population and Water Demand Projection

(1) Population Projection

The population was projected using the break-down method. The future provincial population was estimated with reference to the existing National Economic and Development Authority (hereinafter referred to as NEDA) projection. Then the projected provincial population, based on the assumed growth rates was broken down and distributed among the municipalities. The population in the urban and rural areas were likewise predicted. The population of each barangay in the urban and rural areas was projected based on historical data.

The 1980 population of 194,295 for the three Municipalities is projected to increase to about 449,040. TABLE 1.1.1 shows the projected population by design year.

(2) Population and Area to be served

The potential service area to be covered by the CSBWS in the future is determined based on the existing service area, population size and density by barangay, future development potential and topographical characteristics.

The table below shows the number of barangays to be covered in each Municipality by the short and long term development projects:

Municipality	Short Term	Long Term
Cabuyao	5	15
Sta. Rosa	11	15
Biñan	8	13
Total	24	43

The recommended population percentages to be served in each barangay of the three Municipalities for the years 1990, 1995 and 2010 are 20%, 60% and 70%, respectively. Thus, the population to be served for the years 1990, 1995 and 2010 will be 38,390, 110,350 and 287,780, respectively.

(3) Water Demand Projection

The future water consumption in the proposed service area for the years 1990, 1995 and 2010 was projected.

The estimated unit water consumption of each type of water consumer for each design year was based on the present water consumption. The increase rates for future figures are based on the LWUA Methodology Manual. The unit water consumption employed for the water demand projection is given below.

Consumer type		Design Year			
		1986	1990	1995	2010
Domestic	(lpcd)	110	119	128	152
Commercial	(cu.m/conn.day)	1.1	1.2	1.4	1.9
Institutional	(cu.m/conn.day)	3.8	4.5	5.3	7.5

The average daily water consumption covering all proposed areas for the design years are summarized as follows:

Item	1990	1995	2010
No. of Connections	7,874	23,350	60,411
Water Consumption (cu.m/day)	6,000	18,500	62,700

The percentages of the unaccounted-for water were assumed to be 40%, 30% and 20% in 1990, 1995 and 2010, respectively. The proposed percentages are based on the field survey. The demand variations for each design year are calculated using the LWUA Methodology Manual and are summarized as follows:

Unit: cu.m/day

Water Demand	1990	1995	2010
Daily average	10,000	26,400	78,300
Daily maximum	12,500	33,000	94,000
Peak hour	21,300	52,800	141,000

1.2.4 Water Resources

Water sources which can be tapped for the short and long term development of the water supply system were investigated and pumping tests undertaken. The test results were analyzed in as much as the use of groundwater is the major focus in the development of the water supply. It was found out that the wells studied can be constructed in the Laguna formation. For estimation purposes, the following well parameters are suggested:

Well Depth = 200 m (minimum)
Casing Diameter = 350 mm
Design Drawdown = 15 m
Expected Yield = Cabuyao 45 l/sec
Sta. Rosa 64 l/sec
Biñan 45 l/sec

With a total output of 40 l/sec the National Irrigation Administration (hereinafter referred to as NIA) wells and the untapped springs can be supplemental water sources. The existing spring may be used for future water supply. The ultimate solution for the long term development may be the Laguna de Bay. However, the required treatment of the water would be costly.

1.2.5 Analysis and Evaluation of Alternative

In the evaluation of alternatives, the recommended water sources, water demand, locations and other conditions are taken into account. The water supply system may be designed based on the source capacities and their locations. It is recommended that the existing NIA wells be used by project phase in addition to the new wells being developed in the Sta. Rosa area. The existing spring is also to be used. However, further study on aquifer conditions must be carried out so that more wells could be used. It would also be advisable to explore the possibility of water supply from the Metropolitan Waterworks and Sewerage System (hereinafter referred to as MWSS) to meet the requirements in 2010.

The alternative water supply systems covering the three Municipalities were studied using the result of alternative source study. One system covering the the three Municipalities is recommended in relation with the groundwater conditions.

Economic cost comparison on distribution alternatives was made considering a 12% per annum of the discount rate as instructed in the LWUA Methodology Manual.

1.2.6 Recommended Plan

The short term development plan was analyzed considering the selected long term development plan. The basis for planning the major facilities during Phase II is as follows:

(1) Source:

Major sources will be deep wells in Sta. Rosa area supplemented by the existing spring. The existing two wells will be abandoned.

(2) Treatment:

Provision of a constant flow chlorinator at the reservoir

(3) Transmission:

Improvement of pipe line installed along the bottom of the river from the existing spring to the reservoir. Installation of pipes from the new wells to the reservoir.

(4) Distribution:

New reservoir in Sta. Rosa (Phase I)
Expansion of existing reservoir (Phase II)
Expansion of the reservoir constructed in Phase I (Phase II)

(5) Electricity:

Power substation

The construction, operation and maintenance costs by phase are estimated at the 1986 price level in accordance with the implementation plan. The following is the summary of the costs.

(1) Construction cost (thousand pesos)

Phase I	Stage 1	:	62,530
	Stage 2	:	48,422
Phase II		:	224,833

(2) Operation and Maintenance cost (thousand pesos per annum)

Phase I	Stage 1	:	2,086
	Stage 2	:	6,071
Phase II		:	16,549

1.3 FINANCIAL ASPECTS

1.3.1 Financial Feasibility

The financial feasibility of the project was analyzed in line with the LWUA's guideline.

The balance sheet of revenue and expenditure shows substantial black since 1982. The water charge is the major source of the revenue and is presently collected on a basis of the flat rate for unmetered connections and the metered rate for metered connections. The present water rates for unmetered and metered are ₱14.0 per month and ₱10.0 per month for the first 10 cu.m, respectively.

According to the result of the market survey, it is observed that many respondents have willingness to connect the CSBWS in every income bracket.

The capital cost of the project is estimated to be ₱231.99 million of which 50% is presumed to be financed from the LWUA's regular loan, 45% from the LWUA's soft loan and remaining 5% from the Water District's equity participation, taking into account a 15% per annum of the escalation rate as instructed in the LWUA Methodology Manual. The future water tariff structure as shown below was developed assuming that:

(1) Minimum charge for the first 10 cu.m/month consumption must not exceed 5% of the monthly average family income of the low income group, and

(2) Increase of the minimum charge must be limited to within 60% of that in the previous year.

WATER TARIFF IN THE FUTURE

Period	Rate/ Unit	Consumption (cu.m) First 10	11-20	21-35	Above 35
1988	₱0.9	₱22.5	₱ 2.8	₱ 3.6	₱ 4.7
1989	1.3	32.5	4.1	5.2	6.8
1990	1.3	32.5	4.1	5.2	6.8
1991	1.9	47.5	5.9	7.6	10.0
1992	1.9	47.5	5.9	7.6	10.0
1993	2.4	60.0	7.5	9.6	12.6
1994	2.4	60.0	7.5	9.6	12.6
1995	2.7	67.5	8.4	10.8	14.2
1996	2.7	67.5	8.4	10.8	14.2
1997	3.5	87.5	10.9	14.0	18.4

Although the rapid increase of the water rate will be inevitable due to the present water rate at comparatively low level, the estimated Financial Internal Rate of Return (hereinafter referred to as FIRR) is 13.4%. Accordingly, the recommended project for the Short Term Development Plan will be financially feasible.

1.3.2 Economic Feasibility

The proposed improvement are expected to achieve considerable economic benefits to the respective Municipalities as a whole.

The economic analyses presented in CHAPTER 10 evaluate the effectiveness of the project in terms of socio-economic factors. The method adopted to give a synthetic measure of effectiveness is the Economic Internal Rate of Return (hereinafter referred to as EIRR). The benefits considered are the increase in land value, the economic value of water and health benefits. Results of the findings show that the EIRR is 12.3%.

1.4 ORGANIZATION AND MANAGEMENT

1.4.1 Existing Management System

The main root of problems regarding organization is institutional weakness. It is the shortcoming of human resources that gives rise to inadequate physical system and deficient water service.

For the CSBWS, good management and organization are wanting. There is a lack of a consistent policy on hiring, personnel performance evaluation, reward system or promotion. In other words, the lack of human resources development program. Training for personnel is not a regular program. As such the commercial and technical operations stand a lot of improvement.

1.4.2 Proposed Organization Structure

The Provincial Government of Laguna is interested in forming the three Municipalities into a Water District. This is being encouraged by the Japan International Cooperation Agency (hereinafter referred to as JICA) Study Team as experience from the last 13 years has proven that the water district structure is the best there is to manage water utility operations.

Using the LWUA Methodology Manual, the number of personnel needed for the CSBWS is 184 for the year 1995 and 626 for the year 2010. Although the formula presented in the LWUA Methodology Manual is based on statistical data, no evaluation has been indicated whether the figures derived from the formula are appropriate or not.

The JICA Study Team is proposing a new staffing guideline regarding the number of personnel based on the appropriate performance of individual work. This is intended to help management carry policy into effect efficiently within the limits assigned in order to attain the maximum performance at the minimum cost. In other words, all resources, particularly human resources, should be optimally utilized to realize the objectives of the Water District.

Based on this guideline the number of personnel needed to man the Cabuyao-Sta. Rosa-Biñan Water District, once formed, is 81 for 1995 and 141 for 2010.

Organization-wise, the JICA Study Team also proposes to divide the water district organization into two main branches or divisions; the administrative and commercial division and the engineering and technical division.

1.4.3 Other Recommendations

It is believed that the promotion of the water district concept should be more aggressively undertaken by the LWUA. Many municipalities are interested in forming its water system into a Water District if only the LWUA package of assistance is explained to them. Therefore, the LWUA should address itself to effective information measures to promote water district formation through grass-roots and media based information campaigns. All taken together, the LWUA's assistance is all aspects of water district operations; that is, technical, financial, institutional, training and public information will greatly enhance the water system's capability to provide adequate and efficient water service to its consuming public.

Another recommendation is in the area of water resources. Some areas in the Philippines have difficulties in finding adequate water sources, quality or quantity wise. In the near future, it may be necessary to amend further the Presidential Decree No.198 (hereinafter referred to as PD 198) to enable the LWUA to implement without much difficulty the "bulk water supply" concept. For areas close to Metro Manila, a "mutual interdependence" between the Metropolitan Waterworks and Sewerage System (hereinafter referred to as MWSS) and a water resource difficult water district may be made to solve such problems.

1.5 CONCLUSIONS

The Short Term and Long Term Development Plans were established for improvement and expansion of a existing CSBWS as presented herein. The proposed project in line with the Short Term Development Plan was verified technically and financially feasible. This project be urgently implemented, however serious consideration be given to the following matters for its effective implementation.

A surveillance system for deep wells be necessarily established to check the fluctuation of groundwater table which gives the basic information for selection of additional deep well sites. The review on water sources be comprehensively made taking into account the change in these deep wells, relation with deep wells for irrigation managed by the NIA and the development of the MWSS.

When implementing the project, the priority should be given to the spread of water meters, among others, which brings the increase in revenue and the decrease in wastage of water and results strengthening the management base of the Water District. For this purpose, it is noted that the cooperation of residents is inevitable, since the installation of house connections is left to their discretion even if the Water District installs water meters for them. Also, a incentive financing system with a low interest for such connection works be founded by either of the Water District, Municipality or the LWUA.

In relation to the above, it is recommended to repair all the not-functioning water meters or replace with new one during the early stage of the project implementation. The leakage detection survey on all the existing service connections shall be carried out at the same time. Through these activities, it is believed that the CSBWS will eventually regain the reasonable level of the unaccounted-for water.

The promulgation of the appropriate manner of water conservation to consuming public and the preventive maintenance program, especially periodical check up of water meters, are indispensable for sound operation of the CSBWS.

CHAPTER 2
GENERAL BACKGROUND

CHAPTER 2 GENERAL BACKGROUND

2.1 AUTHORIZATION

In response to the request of the Government of the Republic of the Philippines (hereinafter referred to as GOP), the Government of Japan (hereinafter referred to as GOJ) has decided to conduct the Study on the Municipal Water Supply Project in the Republic of the Philippines.

The JICA, the official agency responsible for the implementation of the technical cooperation programs of the GOJ, and the LWUA, the official agency responsible for the municipal water supply in the Republic of the Philippines, agreed on 23 October 1985 upon an Implementing Arrangement on the Technical Cooperation for the Study. The Study was started in the the middle of February 1986 and completed on March 1987.

2.2 BACKGROUND OF THE PROJECT

Many of the water supply facilities of the local cities and municipalities in the Philippines may not necessarily be in satisfactory condition due to rapid increase of population and deterioration of the facilities.

The LWUA is responsible for countryside waterworks development in cities and municipalities with a population of not less than 20,000. Its aim is the improvement of public health and sanitation, as well as the modernization of living.

This study was made on the area of four local cities and municipalities, among which are Cabuyao, Sta. Rosa and Binãn, Laguna. Despite the largeness in scale of these municipalities, the conditions of their water supply are extremely unsatisfactory. The GOP, therefore, with high priorities, requested the GOJ to cooperate in conducting a study on the improvement and development of the water supply system in these municipalities.

2.3 OBJECTIVE AND SCOPE OF WORK

The basic objective of this study is to assist the implementing agency (LWUA) in the preparation of the Long Term and Short Term Development Plans for the water supply project in Cabuyao, Sta. Rosa and Biñan, Laguna. The major elements of Scope of Work are as follows:

A. General

1. Review and evaluate all the data and previous studies directly relevant to the Study and conduct field investigations.
2. Conduct analysis mainly on general background, Study area, existing system facilities, population, water demand projection and water resources.
3. Examine and evaluate scheme to seek the most favorable plan for feasibility analysis.

B. Specific

1. Data collection, review and field investigations. Collect and review the existing data and information including topography, hydrogeology, meteorology, population, existing land use and city planning, socio-economy, water supply statistics and existing water supply facilities.
2. Conduct the following field investigations:
   - field reconnaissance and demand survey,
   - intake amount test of existing springs,
   - pumping test of existing well and test well drilling,
   - existing system hydraulic survey,
   - present unaccounted-for water survey, and
   - water quality survey.
3. Preparation of Long Term Development Plan (up to year 2010)
4. Preparation of Short Term Development Plan
5. Financial and Economic Study
6. Organizational and Managerial Study

CHAPTER 3
DESCRIPTION OF THE STUDY AREA

CHAPTER 3 DESCRIPTION OF THE STUDY AREA

3.1 GEOGRAPHICAL LOCATION AND PHYSICAL FEATURES

The study area comprises the Municipalities of Cabuyao, Sta. Rosa and Biñan, Laguna. FIGURE 3.1.1 shows the location of the three Municipalities.

Cabuyao, approximately 45 km south of Manila, is bounded on the east by the Laguna de Bay, on the west by the Cavite Province, on the north by Sta. Rosa and on the south by Calamba.

Sta. Rosa lies within 121°6' latitude and 14°19' longitude which is about 40 km south of Manila. It is bounded on the northwest by Biñan, on the south and southwest by Cabuyao, on the west by Silang, Cavite and on the northeast by the Laguna de Bay.

Biñan is about 40 km south of Manila. It lies within 121°5' latitude and 14°12' longitude. It is bounded on the north by San Pedro, on the south by Sta. Rosa, on the west by Carmona and Cavite, and on the east and north by the Laguna de Bay.

The three Municipalities are situated along the south transport corridor of Luzon and linked to Metro Manila and to the southern provinces by the old national highway, the Philippine National Railways south-line and the new Manila South Super Expressway. They are connected by good roads to the adjoining municipalities and by water transport along Laguna de Bay to the nearby lake coastal towns.

(1) Land Area and Topography

Cabuyao has a land area of 4,291 ha and more than 70% of the total land area consists of rolling narrow plains with the remaining portion situated on the western part with a few elevated areas. Thus, it is characterized as gently sloping to moderately rolling. The following is the slope classification:

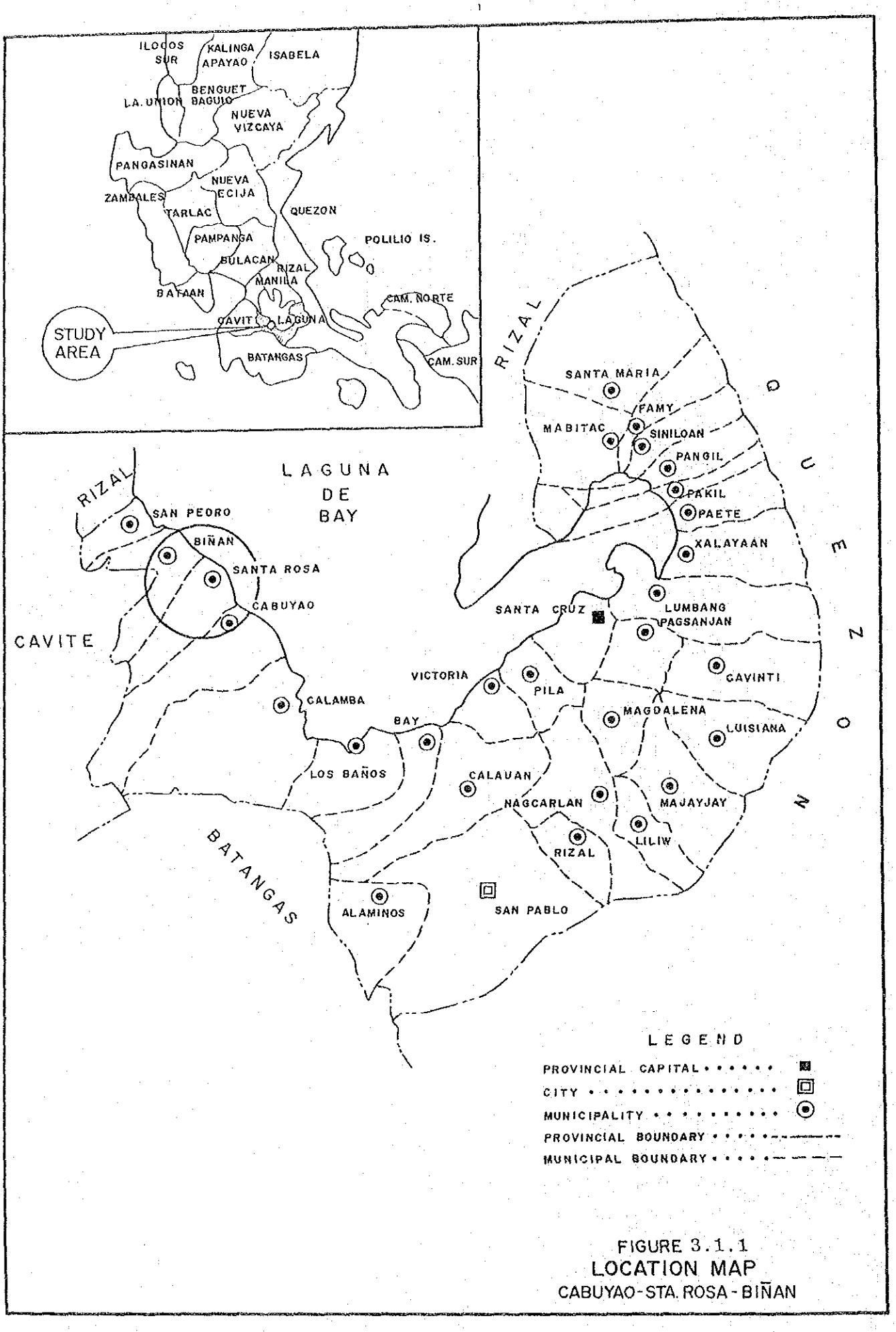


FIGURE 3.1.1
LOCATION MAP
CABUYAO-STA. ROSA-BIÑAN

TABLE 3.1.1 SLOPE CLASSIFICATION

Slope	Land Area (ha)	% to Total Area	Remarks
A. 6 - 2.5%	2,257.5814	53	Level to nearly level
B. 2.6 - 5.0%	1,715.9810	40	Very gently sloping
C. 5.1 - 10 %	318.0024	7	Gently sloping
TOTAL	4,291.5648	100	

Source: Bureau of Lands/Cadastral Survey of 1975.

The Municipality of Sta. Rosa covers a total land area of 5,415 ha. It is generally plain with 97.89% of its total land area having a slope of 0 to 2.5% which is level to nearly level. About 114 ha or 2.11% of the total land area is subject to erosion (southwestern tip of Barangay Sto. Domingo).

The Municipality of Biñan covers a total land area of 4,350 ha. It is generally plain with 85.33% of its total land area having a slope of 0 to 2.5%.

(2) Types of Soil

Cabuyao has six types of soil; the Lipa Loam which is concentrated in the western and southwestern portion, the Guadalupe Clay loam occupies the biggest area among the soils of the plains and comprises the undulating to level areas, the Quingua Fine Sandy Loam which is located along the river banks and shore, the Mountain Soil on the western portion, the Tagaytay Sandy loam on the westernmost tip near the boundary of Cabuyao and Cavite, and lastly, the Hydrosol located in Baclaran, a barangay near the short of Laguna de Bay. TABLE 3.1.2 shows the type of soils and land area.

TABLE 3.1.2 TYPES OF SOIL - CABUYAO

Soil Type	Land Area (ha)	% to Total Land Area
1. Lipa Loan	1,408.2505	32
2. Guadalupe Clay	1,768.1503	41
3. Quingua Fine Sandy Loam	728.1602	17
4. Tagaytay Sandy Loam	29.0	1
5. Mountain Soils	288.0025	7
6. Hydrosol	70.0013	2
TOTAL	4,291.5648	100

Sta. Rosa has four series of soil types, namely: Lipa series (68.39% of total land area); Carmona series (3.91%); Guadalupe series (23.38%); and Quingua series (4.32%). All four soil series are best suited for rice cultivation with the exception of the Guadalupe series, which is fit for sugarcane production.

Biñan has the same four series of soil types, namely: Lipa series (18.34%); Carmona series (59.24%); Guadalupe series (15.17%); and Quinga series (7.25%).

(3) Flood-Prone Areas

In Cabuyao, barangays along the lake including Bigaa, Butong, Marining, Gulod, Baclaran and part of Barangay Mamatid (about 327 ha or 8% of total land area) are flood-prone areas. A project on the Napindan Channel may provide measures to minimize flooding in the area.

Sta. Rosa has about 302 ha of flood plain zone located in the Barangays Sinalhan, Aplaya and Caingin, and in portions of Barangays Tagapo, Ibaba, Labas, Pook, Dila and Dita.

Low flood-prone areas of Biñan are located in Barangays Soro-Soro, Tubigan, Zapote, Bungahan, Mamplasan, Calabuso and in the lower portions of Barangays San Francisco, Biñan, Timbao, Loma and Langkiwa. Moderate seasonal flooding which takes about a week to few months to subside is observed in the barangays along the lakeshore such as Malaban, De la Paz, San Antonio, Canlalay and Platero.

3.2 ADMINISTRATIVE COMPOSITION AND LAND USE

Cabuyao is composed of 18 barangays which are generally agricultural. It has 15 rural barangays, of which 6 are located along the national highway, 6 on the lakeshore of Laguna de Bay and the remaining 3 on the western elevated portion. The three (3) urban barangays are located in the poblacion.

Sta. Rosa is composed of 18 barangays, 15 of which are rural and 3 are urban. Agricultural lands comprise more than half of the total land area. However, the area is slowly developing into industrial and commercial areas.

Biñan has 24 barangays, 9 of which are urban and 15 are rural.

TABLEs 3.2.1.A to 3.2.1.C show the barangay composition of Cabuyao, Sta. Rosa, and Biñan, respectively.

3.3 POPULATION AND LIVING CONDITIONS

The latest data available on the population and number of households was reported in 1980 through the NCSO census.

In the 1980 NCSO report, the total population of Cabuyao was 46,286, with a total number of households of 7,862, an average of 5.89 persons per household. The population had an annual increase of 4.86% from the 1975 population of 36,505.

Sta. Rosa had a total population of 64,325 in 1980, an annual increase of 6.19% over the 1975 population of 47,639. The households number is about 11,650 for an average of 5.52 persons per household.

Biñan had a total population of 83,684 in 1980, an annual increase of 4.41% from the 1975 population of 67,444. The total number of households was about 14,545 for a density of 5.75 persons per household.

In relation to the Laguna growth rate from 1975 to 1980 of 3.90%, the three municipalities showed higher growth rates. This could be attributed to the proximity of the area to Metro Manila, industrialization, and the accessibility to its adjoining municipalities and the availability of various social services and utilities.

The population for the three municipalities in 1986 was estimated to be 56,320, 79,330, and 102,210 for Cabuyao, Sta. Rosa and Biñan, respectively (Refer to CHAPTER 5).

In relation to other municipalities of Laguna, the population in the three municipalities rank among the biggest, including Sta. Cruz.

TABLEs 3.2.1.A to 3.2.1 C show the population and density in 1986 of Cabuyao, Sta. Rosa and Biñan, respectively.

Water-borne diseases occur particularly in the more densely populated areas of the municipality. Public health authorities recognize the correlation between the lack of safe water supply and sewerage facilities and the incidence of water-borne diseases.

TABLE 3.2.1.A BARANGAY COMPOSITION AND POPULATION, CABUYAO

Area	Barangay	Land Area (ha)	Population (1986)	Population Density (Persons/ ha)	Distance from Poblacion (km)
Urban (Poblacion)	1. Barangay I	70	2,410	86	-
	2. Barangay II		1,770		-
	3. Barangay III		1,830		-
	Sub-Total	70	6,010	86	
Rural	4. Baclaran	174	1,680	10	
	5. Banay-Banay	310	3,610	12	8
	6. Banlic	230	4,010	17	2
	7. Bigaa	209	4,860	23	4
	8. Butong	162	1,810	11	1.5
	9. Casile	318	740	2	3
	10. Diezmo	154	660	4	23
	11. Gulod	409	5,950	15	17
	12. Mamatid	260	5,570	21	3.5
	13. Marinig	392	6,620	17	6.5
	14. Niugan	353	4,480	13	1.5
	15. Pittland	291	530	2	1
	16. Pulo	491	3,780	8	18
	17. Sala	155	3,790	24	3
	18. San Isidro	314	2,220	7	0.5
	Sub-Total	4,222	50,310	12	3
	Total	4,292	56,320	13	

TABLE 3.2.1.B BARANGAY COMPOSITION AND POPULATION, STA. ROSA

Area	Barangay	Land Area (ha)		Popu-lation (1986)	Pop. Density (persons/ha)		Dist. from Pob. (km)
		Built-up	Total		Built-up	Gross	
Urban (Poblacion)	1. Barangay I	10	10	2,690	269	269	-
	2. Barangay II	12	18	4,790	399	266	-
	3. Barangay III	33	75	2,270	69	50	-
	Sub-Total	55	103	9,750	177	95	-
Rural	4. Aplaya	45	55	8,020	178	146	1.5
	5. Balibago	18	78	6,690	372	86	3
	6. Caiñgin	17	50	5,410	318	108	4
	7. Dila	23	179	2,660	116	15	5
	8. Dita	43	224	5,850	136	26	6
	9. Don Jose	27	829	2,020	75	2	15
	10. Ibaba	9	19	1,660	184	87	1
	11. Labas	36	80	3,350	93	42	3
	12. Macabling	17	198	4,000	235	20	4
	13. Malitlit	16	814	3,610	226	4	8
	14. Pook	15	133	5,530	369	42	2
	15. Pulong Sta. Cruz	25	1,343	3,970	159	3	7
	16. Sto. Domingo	14	873	860	61	1	20
	17. Sinalhan	31	105	7,720	249	74	3
	18. Tagapo	60	332	8,230	137	25	1
	Sub-Total	396	5,312	69,580	176	13	
Total		451	5,415	79,330	176	15	

TABLE 3.2.1.C BARANGAY COMPOSITION AND POPULATION, BINAN

Area	Barangay	Land Area (ha)		Popu-lation (1986)	Pop. Density (persons/ha)		Dist. from Pob. (km)
		Built-up	Total		Built-up	Gross	
Urban	1. Canlalay	40	263	9,300	233	35	1.5
	2. Casile	9	12	650	72	54	1.5
	3. De La Paz	45	216	17,410	387	81	2
	4. Malaban	40	121	18,260	457	151	2
	5. Poblacion	28	28	4,530	162	162	-
	6. San Antonio	57	139	15,760	276	113	2.5
	7. San Jose	7	15	4,770	681	318	1
	8. San Vicente	24	36	8,910	371	248	1.5
	9. Sto. Domingo	13	24	3,040	234	127	1
	Sub-Total	263	854	82,630	314	97	
Rural	10. Biñan	4	537	310	78	1	17
	11. Bungahan	3	91	260	87	3	8
	12. Calabuso	15	335	1,730	115	5	7
	13. Ganado	6	124	660	110	5	15
	14. Halang (San Francisco)	44	732	2,000	45	3	5.5
	15. Langkiwa	9	185	1,060	118	6	10.5
	16. Loma	6	115	950	158	8	13
	17. Malamig	3	398	130	43	0	16
	18. Mamplasan	7	268	1,340	191	5	21
	19. Platero	60	185	4,790	80	26	5.5
	20. San Anton (Sto. Niño)	7	88	1,370	196	16	2.5
	21. Soro-Soro	11	114	1,220	111	11	5
	22. Timbao	6	143	790	132	6	6
	23. Tubigan	88	81	2,560	29	32	2.5
	24. Zapote	3	100	410	137	4	4.5
	Sub-Total	192	3,496	19,580	102	6	
Total		455	4,350	102,210	225	23	

3.4 SOCIO-ECONOMIC CONDITIONS

3.4.1 Provincial and Municipal Revenue

(1) Laguna Province

The revenue of Laguna Province in 1981 was ₱29 million and in 1985 it became ₱47 million or increased by ₱18 million (62%) as shown below.

Year	Revenue	% of Increase from Previous Year
1981	₱29,390,987	
1982	33,562,949	14%
1983	37,630,433	12%
1984	40,020,046	6%
1985	47,041,339	18%

(2) Municipalities

The revenue of the three Municipalities is derived from real property tax, business license tax, internal revenue allotment, collections from operations and other earnings which includes building permit fee, police clearance fee. The revenue and expenditure of the Municipalities for the last five years are shown in TABLE 3.4.1.

The revenue of the Municipalities has considerably increased in the last five years in view of the positive development such as introduction of factories and provision of housing units due to the locational advantage of these Municipalities within the urbanizing orbit of Metropolitan Manila area.

3.4.2 Family Income

The average monthly household income of the Municipalities is approximately 1,200 pesos based on the result of the market survey (Refer to CHAPTER 9 FINANCIAL ANALYSIS).

At present, different industrial companies such as food processing, textile, chemical industry, etc. are established in Cabuyao, Sta. Rosa and Biñan, so it is most likely that the household income of their population have considerably increased.

TABLE 3.4.1 REVENUE AND EXPENDITURE OF THE THREE MUNICIPALITIES

Municipality	Year	Revenue	Expenditure	Surplus(deficit)
Cabuyao	1981	₱ 2,494,017	₱ 2,547,652	(₱ 53,635)
	1982	3,845,960	4,271,122	(425,162)
	1983	4,115,106	4,153,513	(38,407)
	1984	4,552,112	6,614,739	(2,062,627)
	1985	5,360,898	5,360,527	371
Sta. Rosa	1981	₱ 2,545,394	₱ 2,514,450	₱ 30,944
	1982	3,122,613	2,896,189	226,424
	1983	3,327,780	3,162,423	165,357
	1984	4,010,070	3,953,059	57,011
	1985	4,524,129	4,148,567	375,562
Biñan	1981	₱ 2,281,303	₱ 2,212,341	₱ 68,962
	1982	2,547,615	2,157,600	390,015
	1983	3,020,117	2,542,154	477,963
	1984	3,397,939	3,106,819	291,120
	1985	3,918,683	3,576,048	342,635

3.4.3 Agriculture, Livestock Farming and Fisheries

Approximately 3,100 ha (70%), 4,800 ha (90%) and 3,400 ha (80%) of total land area are devoted to agriculture in Cabuyao, Sta. Rosa and Biñan, respectively. Major crops currently being produced consist mainly of food crops like paddy corn, sugarcane, root crops, vegetables and fruits.

Ducks and chickens are significantly raised in Cabuyao. On livestock, most common being raised are the carabaos, hogs, cows, horses, and goats. On fishing, approximately 10% of the total number of households in Cabuyao are engaged in fishing, which are mostly residents in the coastal barangays along Laguna de Bay. Sta. Rosa residents, also in Biñan, avail themselves of the fishing resources of Laguna de Bay (920 fishermen).

3.4.4 Commerce and Industry

Due to the proximity of the subject Municipalities to Metro Manila, there has been a marked increase in the number of industrial establishments. Some of these large industries are food processing, textile and garment manufacturing, and chemical plants. There are also a number of small-scale industries such as rice-milks, manufacturing of hollow blocks, sash making, woodcraft, metalcraft, jeep and tricycle body building. Likewise, the populace are also engaged in some home industries such as footwear manufacturing, embroidery, balut-making, hog/duck raising, and chicharon/cassava cake/fried corn preparation.

The various commercial establishments in these Municipalities are eateries, restaurants, beerhouse, tailoring shops, dress shops, beauty parlors, barbershops and banks. There are also wholesale/retail stores engaged in the sale of groceries, drugs, men/women/children's apparel, dry goods, hardwares and appliances.

3.4.5 Transportation and Communication

In the Municipalities major means of transportation are public utility buses and jeepneys, tricycles, and few private cars and jeepneys. Aside from the above-mentioned transportation modes, the residents also avail of the Philippine National Railways commuter train. The land transportation routes are provided for by the South Expressway, the Old National Highway, local road network and the railways.

Telegraph service in the Municipalities are provided for by Bureau of Telecommunications, in addition to some private telegraph companies. Telephone system is also provided for by privately-owned corporations. Mail service is provided solely by the Bureau of Post.

3.4.6 Power Supply

Electricity is supplied to the Municipalities by the MERALCO on a steady continuous current of 220 volts through the day.

It's power supply comes through the facilities of the National Power Corporation (hereinafter referred to as NPC). The current electric charges adopted by the MERALCO is given in APPENDIX 3.4.1.

About 85% of the total households in the subject area is provided for by electric power. The 15% households not benefited by the MERALCO's power supply still rely on kerosene, oil and other sources for lighting purposes.

3.5 MUNICIPAL DEVELOPMENT PLAN

The three subject Municipalities issued the Municipal Development Plan in 1979 for the year 1990. The analysis and evaluation of the established pattern of development and of existing land uses were the basis for the proposed land use.

The built-up areas as a whole has grown in size following the road network pattern. The growth of communities are notable within and adjacent to the poblacion. Land use for the poblacion in Cabuyao is shown in FIGURE 3.5.1. FIGUREs 3.5.2 to 3.5.5 present existing and future land use for Sta. Rosa and Biñan.

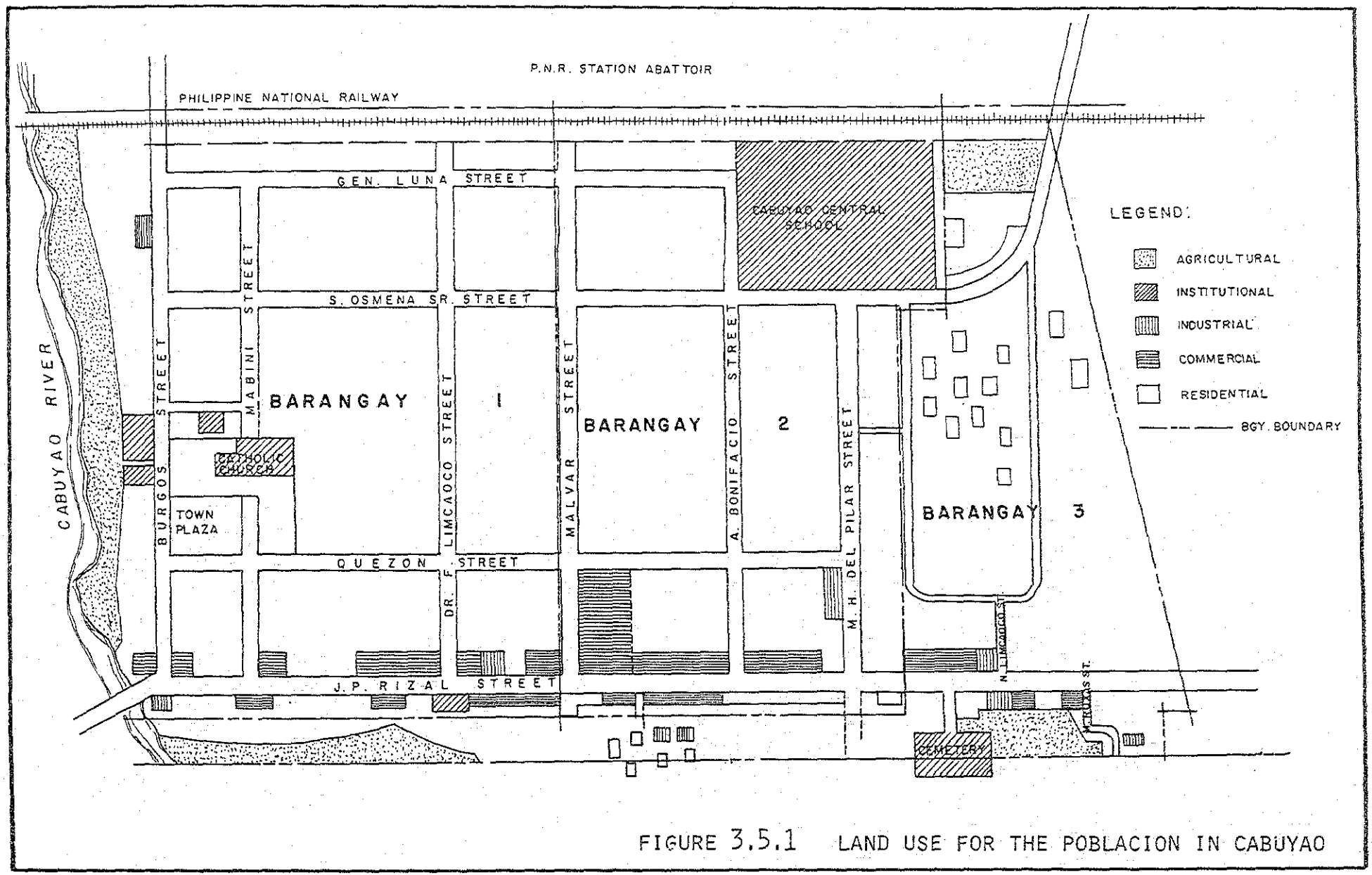


FIGURE 3.5.1 LAND USE FOR THE POBLACION IN CABUYAO

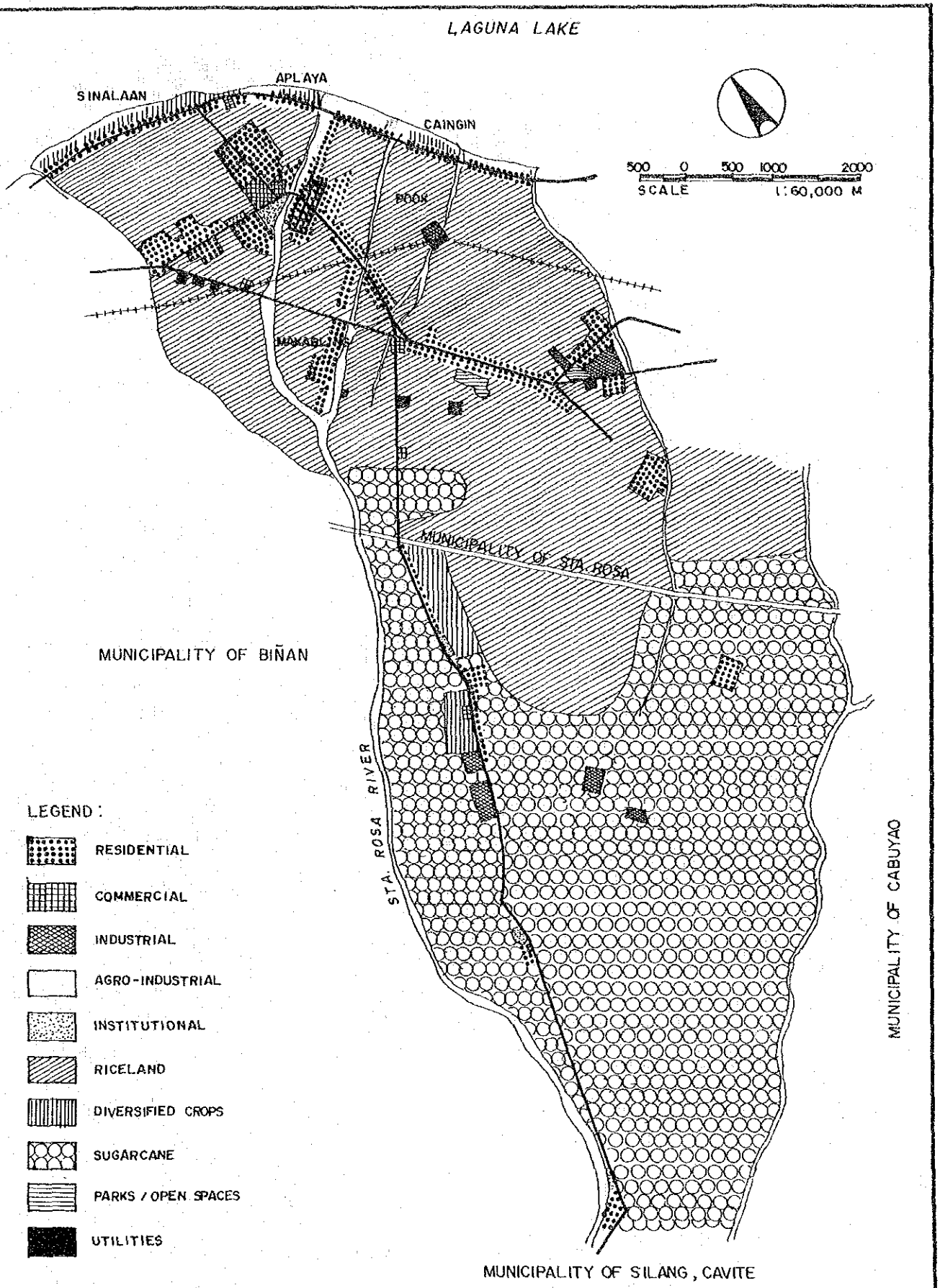


FIGURE 3.5.2

EXISTING LAND USE PLAN 1980

MUNICIPALITY OF STA. ROSA

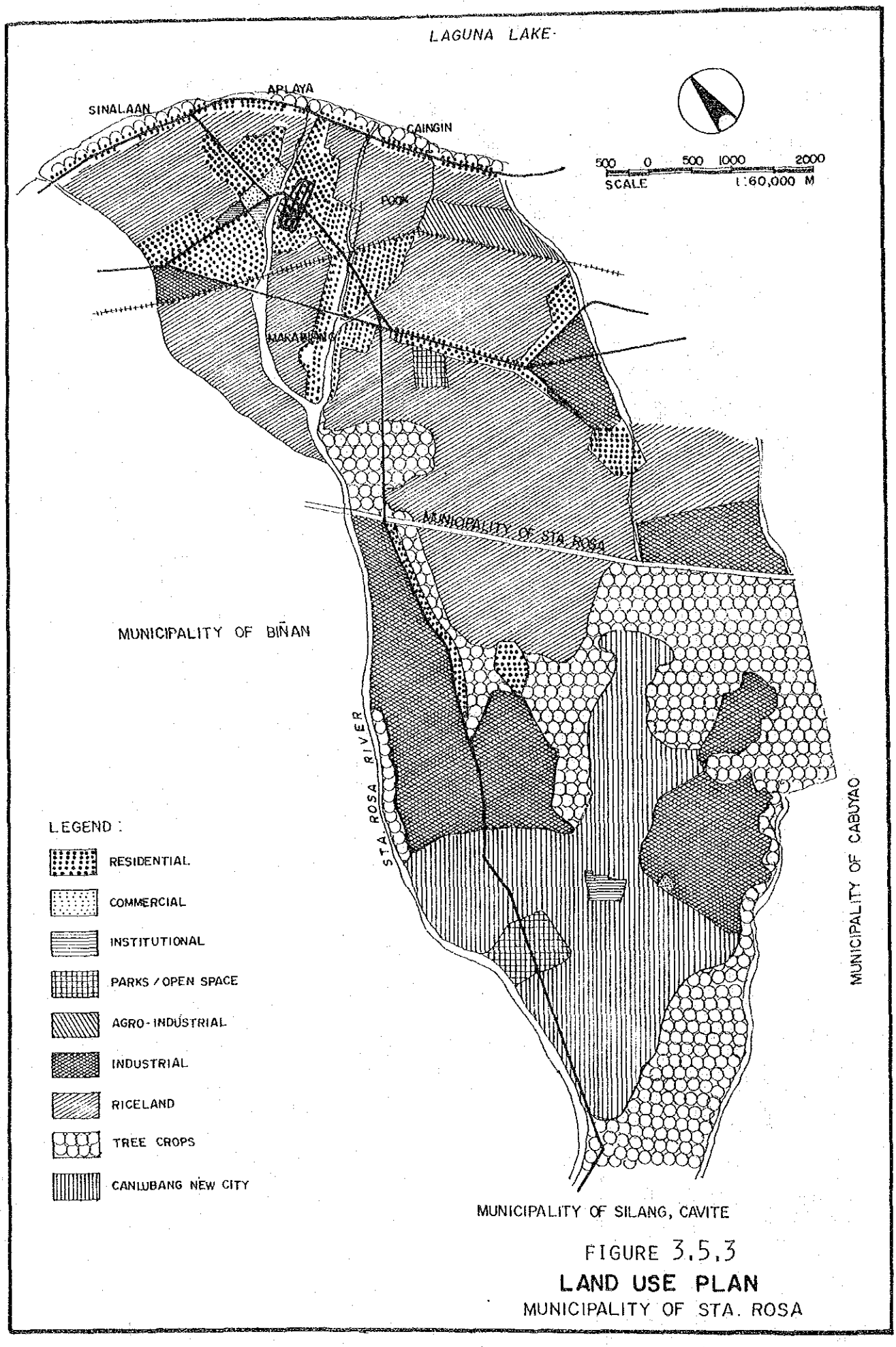


FIGURE 3.5.3
LAND USE PLAN
MUNICIPALITY OF STA. ROSA

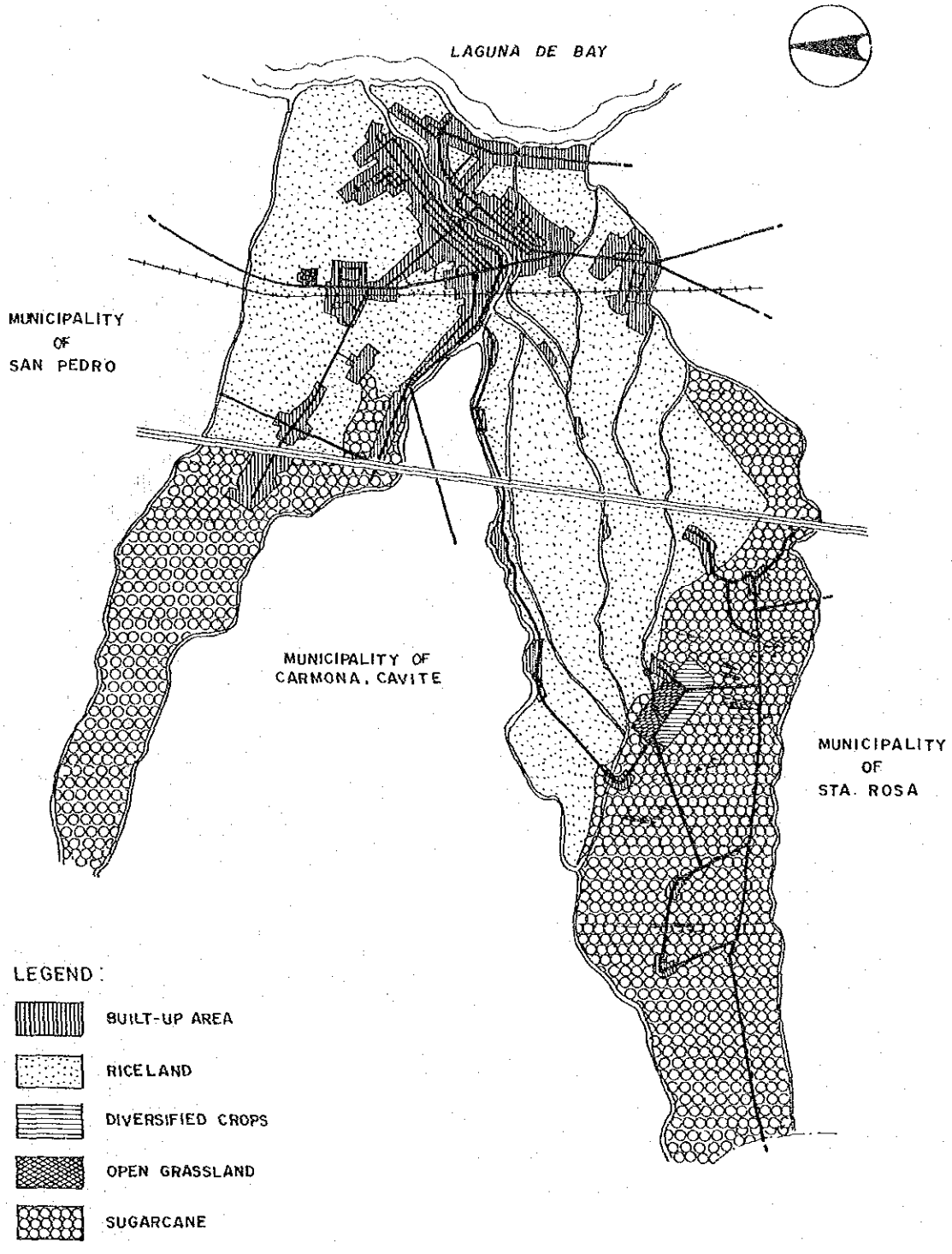


FIGURE 3.5.4

EXISTING LAND USE MAP 1979
MUNICIPALITY OF BIÑAN

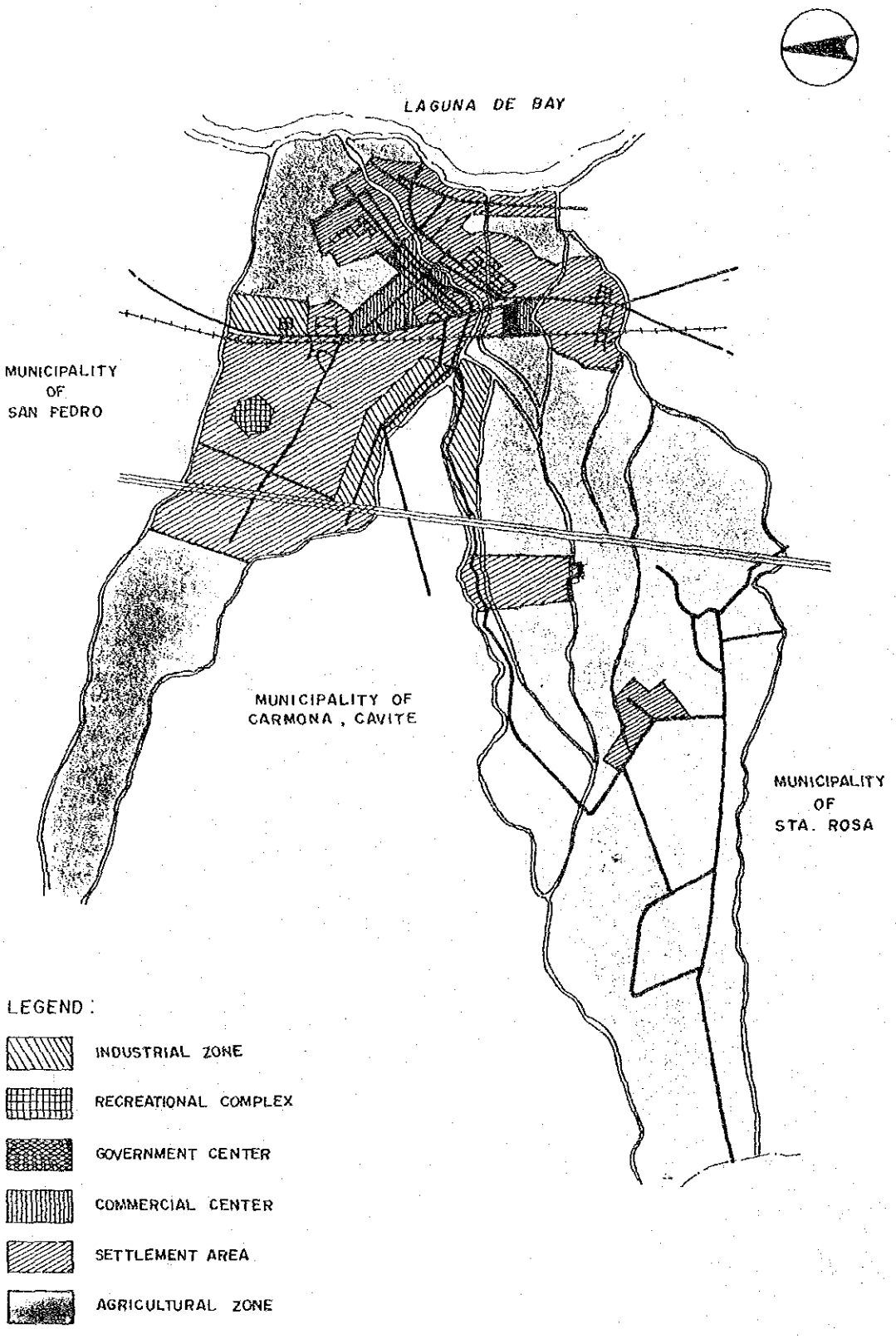


FIGURE 3.5.5

STRUCTURE MAP

MUNICIPALITY OF BIÑAN

CHAPTER 4
EXISTING WATER SUPPLY AND SANITATION CONDITIONS

CHAPTER 4 EXISTING WATER SUPPLY AND SANITATION CONDITIONS

4.1 PRESENT WATER SUPPLY IN THE STUDY AREA

The present water supply for the domestic and business users in the study area is provided by many point sources (Level I system), the CSBWS and Canlubang private water supply system.

The population and the number of households served by different water service levels are given by municipality in APPENDIX 4.1.1 to 4.1.3. Approximately 90% of the total population of municipalities use Level I water supply system. The sources are wells, springs and others.

The Canlubang private system serves Barangays Ganado anc Biñan. However, the latter barangay only enjoys the water supply at present (served population-60 persons).

The CSBWS of which water sources are Matang-Tubig Spring and a deep well in Biñan, is under the management of the Laguna Provincial Government. The existing service area is limited to the parts of built-up areas in the three Municipalities with a total served population of 23,560 which includes 20 to 50% secondary users/borrowers of direct population served based on the result of the interview. The served populations in Cabuyao, Sta. Rosa, and Biñan are 5,820, 10,810 and 6,930, respectively. The service area by the CSBWS is delineated in FIGURE 4.1.1. TABLE 4.1.1 shows served population and percentage by barangay. The total water consumption in the service area is estimated at 3,750 cu.m/day.

4.2 WATER SUPPLY FACILITIES BY DIFFERENT LEVEL OF SERVICES

4.2.1 Level I Water Supply System

A lot of hand pumps are used in the municipalities. Most of these are privately-owned. The existing Level III supply system, likewise utilizes pumps as supplementary water source. There exists no public Level II system in the study area.

1. BIÑAN

1. CANLALAY
2. CASILE
3. DE LA PAZ
4. MALABAN
5. POBLACION
6. SAN ANTONIO
7. SAN JOSE
8. SAN VICENTE
9. STO. DOMINGO
10. BIÑAN
11. BUNGAHAN
12. CALABUSO
13. GANADO
14. HALANG
15. LANGKIWA
16. LOMA
17. MALAMIG
18. MAMPLASAN
19. PLATERO
20. SAN ANTON
21. SORO-SORO
22. TIMBAO
23. TUBIGAN
24. ZAPOTE

2. STA. ROSA

1. KANLURAN
2. MALUSAK
3. MARKET AREA
4. APLAYA
5. BALIBAGO
6. CAINGIN
7. DILA
8. DITA
9. DON JOSE
10. IBABA
11. LABAS
12. MAKABLING
13. MALITLIT
14. POOK
15. PULONG STA. CRUZ
16. STO. DOMINGO
17. SINALHAN
18. TAGAPO

3. CABUYAO

1. BARANGAY I
2. BARANGAY II
3. BARANGAY III
4. BACLARAN
5. BANAY-BANAY
6. BANLIC
7. BIGAA
8. BUTONG
9. CASILE
10. DIEZMO
11. GULOD
12. MAMATID
13. MARINIG
14. NIUGAN
15. PITTLAND
16. PULO
17. SALA
18. SAN ISIDRO

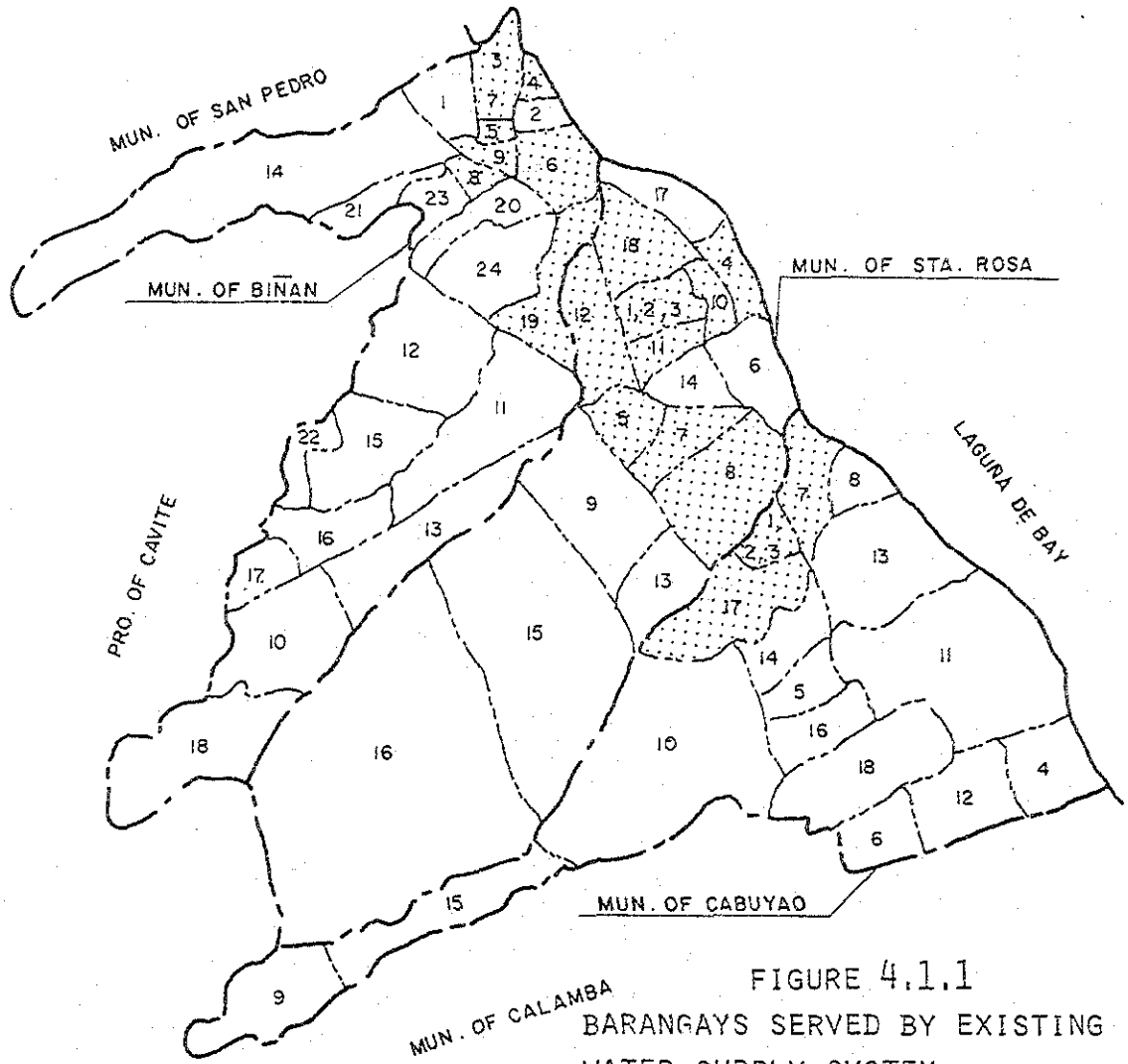


FIGURE 4.1.1
BARANGAYS SERVED BY EXISTING WATER SUPPLY SYSTEM

CABUYAO-STA. ROSA-BIÑAN

TABLE 4.1.1 PRESENT SERVED POPULATION AND PERCENTAGE

Barangay	Barangay Population	Served Population		Percentage	
		Primary	Total	Primary	Total
CABUYAO					
1. Barangay I	2,410	1,400	1,690	58.1	70.1
2. Barangay II	1,770	1,240	1,480	70.1	83.6
3. Barangay III	1,830	860	1,040	47.0	56.8
4. Bigan	4,860	640	770	13.2	15.8
5. Sala	3,790	700	840	18.5	22.2
Sub-Total	14,600	4,840	5,820	33.0	39.7
Municipality Total	56,320	4,840	5,820	8.6	10.3
STA. ROSA					
1. Apalaya	8.020	220	310	2.7	3.9
2. Balibogo	6,690	1,820	2,550	27.2	38.1
3. Barangay I	2,690	870	1,220	32.3	45.4
4. Barangay II	4,790	1,240	1,740	25.9	36.3
5. Barangay III	2,270	220	300	9.7	13.2
6. Dila	2,660	130	190	4.9	7.1
7. Dita	5,850	1,280	1,800	21.9	30.8
8. Ibaba	1,110	400	550	36.0	49.5
9. Labas	3,350	340	480	10.1	14.3
10. Macabling	4,000	80	120	2.0	3.0
11. Tagapo	8,230	1,110	1,550	13.5	18.5
Sub-Total	49,660	7,710	10,810	15.5	21.8
Municipality Total	79,330	7,710	10,810	9.7	13.6
BIÑAN					
1. De La Paz	17,410	160	230	0.9	1.3
2. Malaban	18,260	210	320	1.2	1.8
3. Platero	4,790	380	580	7.9	12.1
4. Poblacion	4,530	820	1,220	18.1	26.9
5. San Antonio	15,760	2,300	3,450	14.6	21.9
6. San Jose	4,770	370	550	7.8	11.5
7. San Vicente	8,910	250	380	6.4	9.7
8. Sto. Domingo	3,040	130	200	4.3	6.6
Sub-Total	77,470	4,620	6,930	6.0	8.9
Municipality Total	102,210	4,620	6,930	4.5	6.8
Served Barangay Total	141,730	17,170	23,560	12.1	16.6
3 Municipality Total	237,860	17,170	23,560	7.2	9.9

4.2.2 Level III System: Cabuyao-Sta. Rosa-Biñan Waterworks

(1) Source Facilities

The water sources for the CSBWS are the Matang-Tubig Spring, which was originally constructed in 1938, and two deep wells located in Biñan. The spring exists at the left bank of the Magunit River at an elevation of 170 m above the mean sea level in Barangay Casile in the Municipality of Cabuyao.

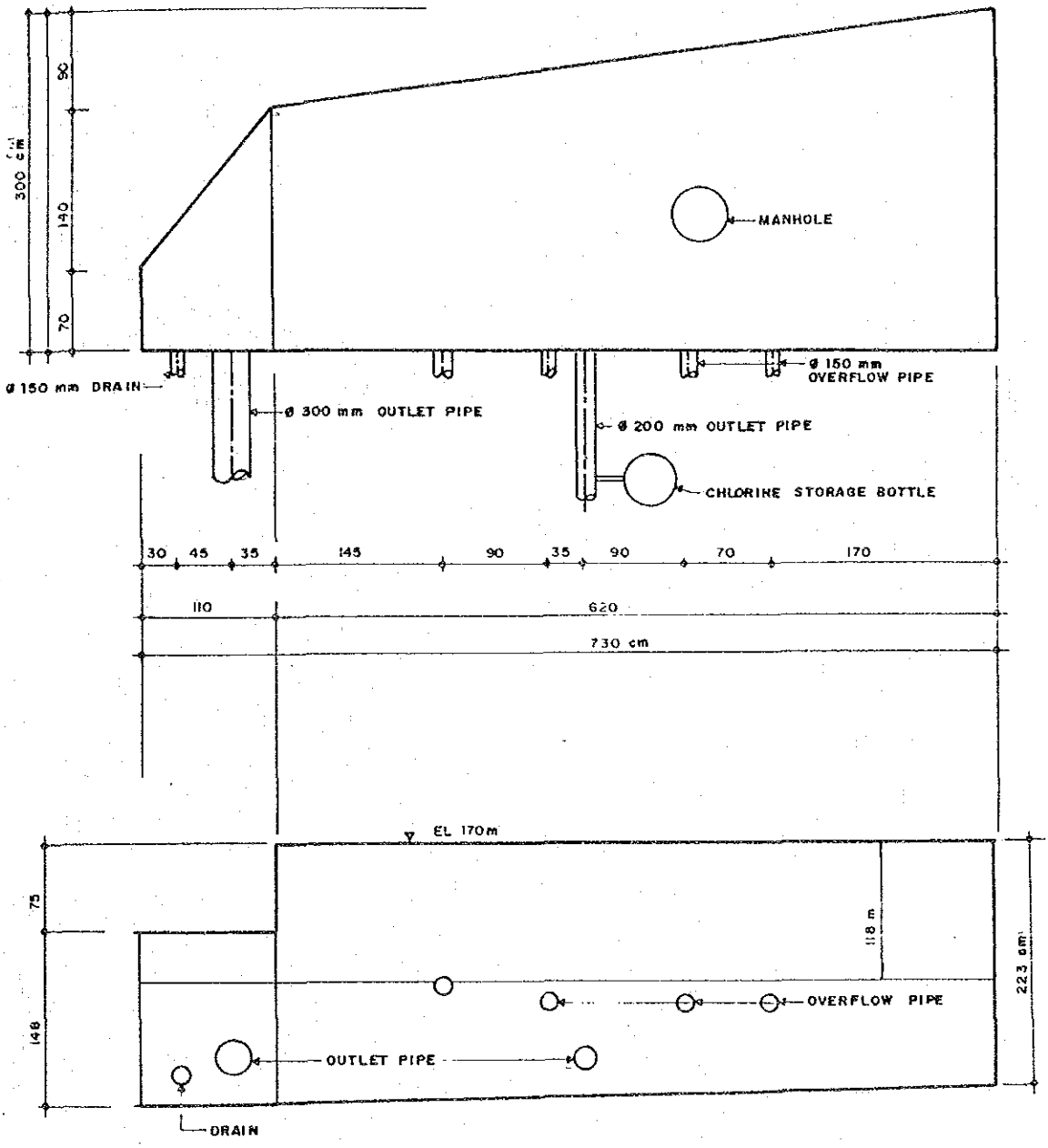
The spring box made of reinforced concrete with an approximate volume of 40 cu.m (see FIGURE 4.2.1) collects spring water. Two outlet pipes (CCI) with diameters of 200 mm and 300 mm are provided. In addition, there are four overflow pipes and one drain, all of which have a diameter of 150 mm. A chlorine storage bottle with a volume of 28 liters is installed and connected directly to the 200 mm diameter outlet pipe.

The depth of water in the box is observed to be about 1 m from the installed manhole and the collected water seems to flow out of the box freely. The structure and volume of the box are kept in good condition. The fences surround the spring box. Management of the facility is taken care of by the person employed by the CSBWS. The rough topographic surveys made in the spring area is shown in FIGUREs 4.2.2 and 4.2.3.

One of the supplementary pumping stations constructed in 1977 located in the Maremil Sub-Division, Barangay Platero is not operating at present. However, it is reserved as a standby pumping station since the pump is not operating efficiently for the water supply in the surrounding area.

Another pumping station constructed in 1965 (market side well) is located at the vicinity of the public market in Barangay San Vicente. The pump operates for 8 hours a day. TABLE 4.2.1 shows the pumping capacity and other information on the two existing pumping stations.

PLAN OF SPRING BOX



SECTION OF SPRING BOX

FIGURE 4.2.1

MATANG - TUBIG SPRING BOX

BARANGAY CASILE CABUYAO, LAGUNA

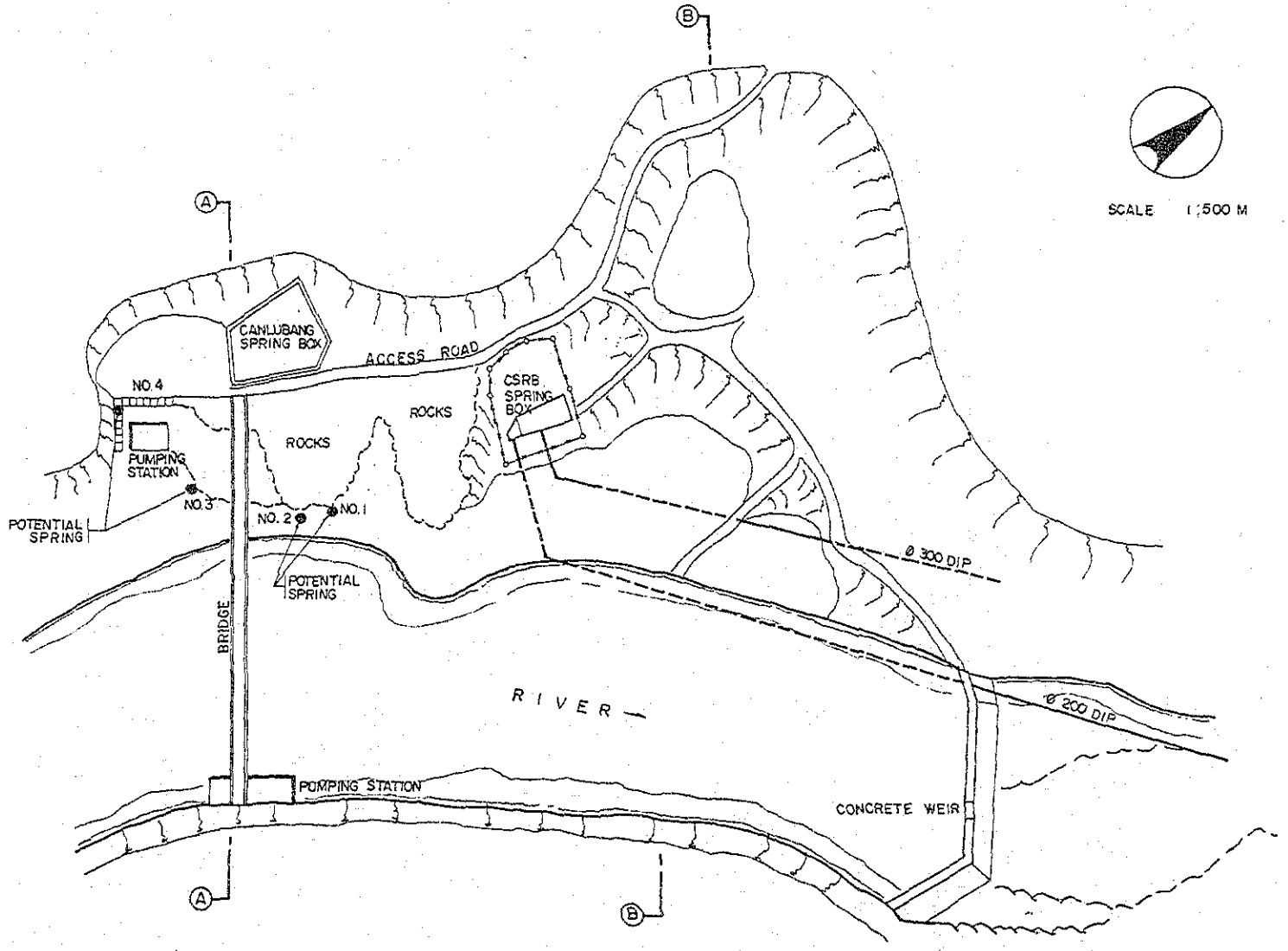
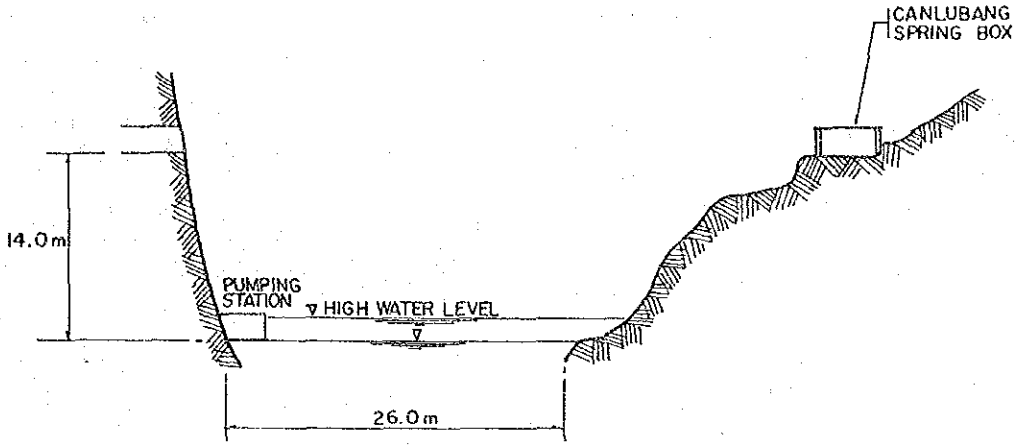


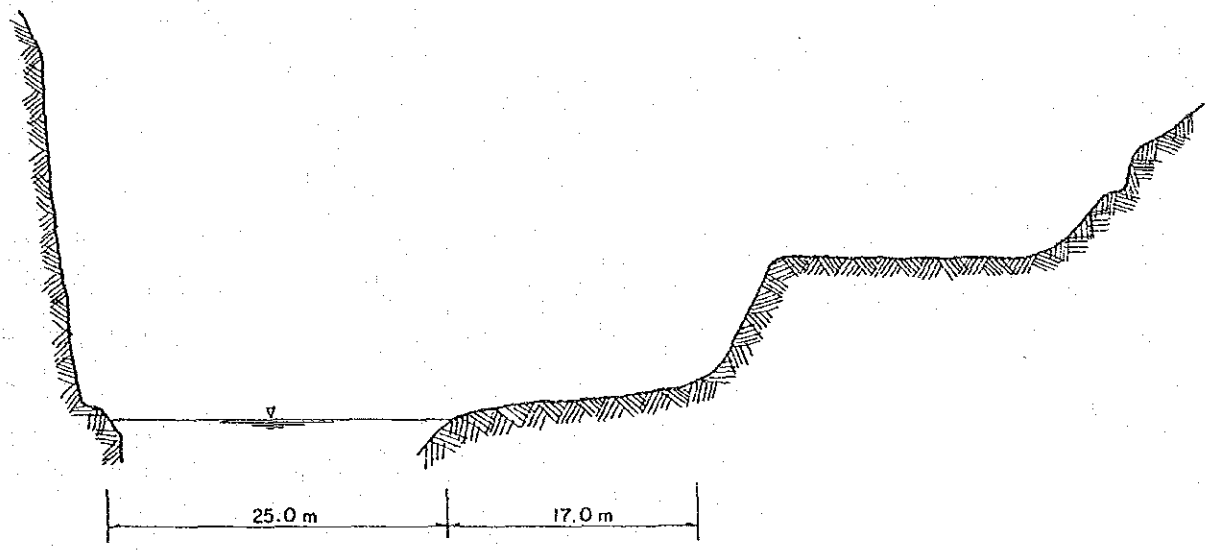
FIGURE 4.2.2

PLAN OF SPRING AREA

CABUYAO - STA. ROSA - BIÑAN



CROSS - SECTION A - A
SCALE 1 : 500



CROSS - SECTION B - B
SCALE 1 : 500

FIGURE 4.2.3

CROSS-SECTIONS OF SPRING AREA
CABUYAO - STA. ROSA - BIÑAN

TABLE 4.2.1 INFORMATION ON THE EXISTING PUMPING STATIONS

Pumping Station	Diameter of Casing Pipe (mm)	Well Depth (m)	Capacity of Pump (cu.m/day)	Motor (PS)	Constructed/Installed Year
Market side well	200	unknown	1,363	25	well = 1965 pump = 1978
New well	200	130	1,363	25	well = 1977 pump = 1977

(2) Transmission and Storage Facilities

The section of transmission line is regarded as that between the outlet of the spring and the existing reservoir with a total length of 11.68 km which includes pipes installed in parallel (See FIGURE 4.2.4).

The transmission line is the gravity type with pipe diameters ranging from 150 to 400 mm (CCI). A concrete-made reservoir is located in Barangay Pulong Sta. Cruz, Sta. Rosa which is connected to the transmission line with a diameter of 200 mm and distribution pipes (ϕ250 mm) for the service of Cabuyao and Sta. Rosa.

The transmission line with a diameter of 150 mm is connected directly to the distribution line for the supply to Biñan area. The distance from the spring box to the reservoir is approximately 7.1 km. The pipes in the first section are installed along the river bed of the Magunit River without any protection. When the pipes cross the river bank, the maximum earth cover is 8 m. The pipeline downstream of the river could not be observed since pipes are laid under ground along the roads.

There is no transmission line from the pumping stations in Biñan since the outlet pipes of the pumping stations are connected directly to the distribution system.

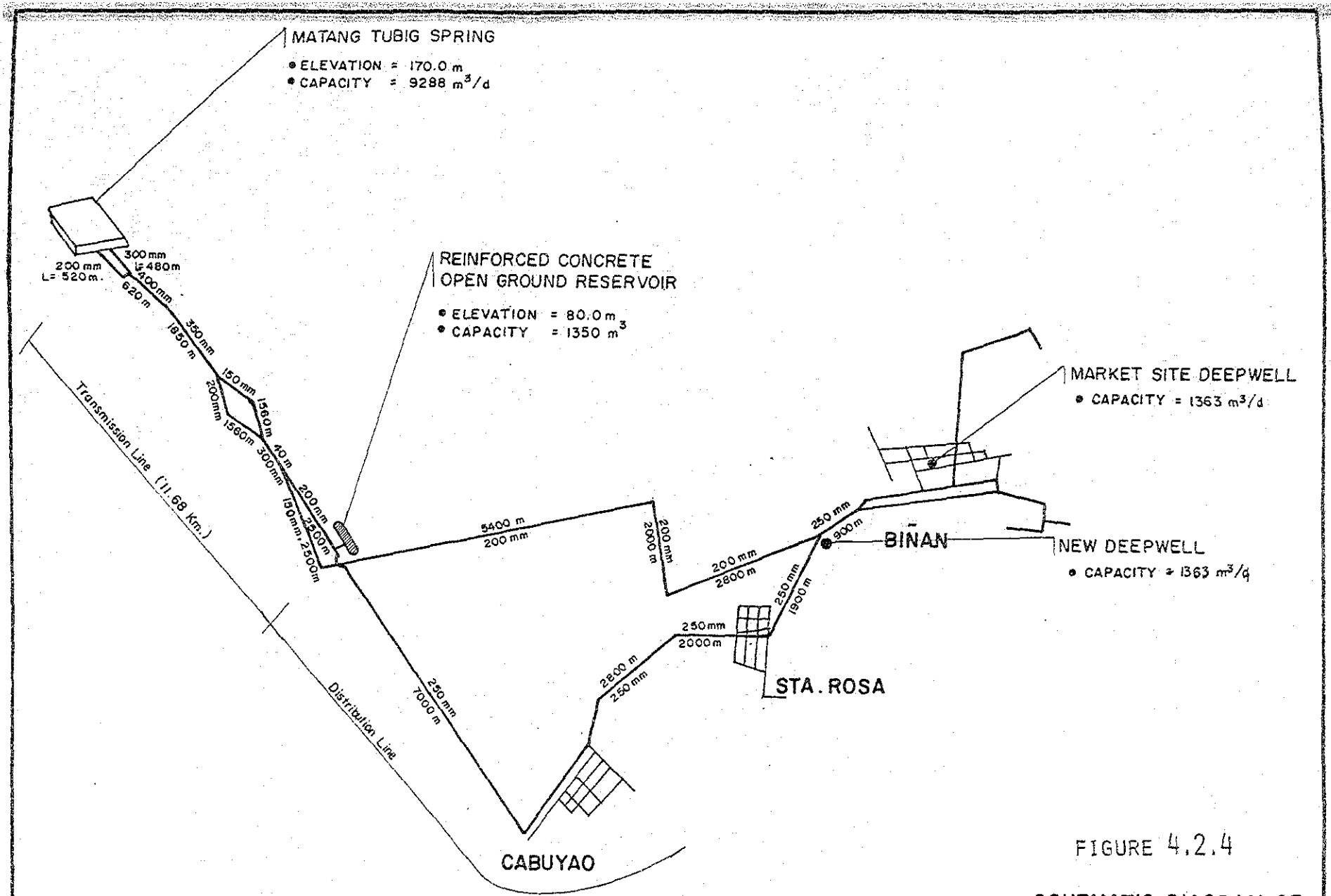


FIGURE 4.2.4

SCHEMATIC DIAGRAM OF EXISTING SYSTEM

CABUYAO - STA. ROSA - BIÑAN

Data on the transmission pipes are summarized in TABLE 4.2.2.

TABLE 4.2.2 BINAN TRANSMISSION PIPES

Pipe Diameter (mm)	Length (m)	Material
400	670	CCI
350	1,850	CCI
300	520	CCI
200	4,580	CCI
100	4,060	CCI
Total	11,680	

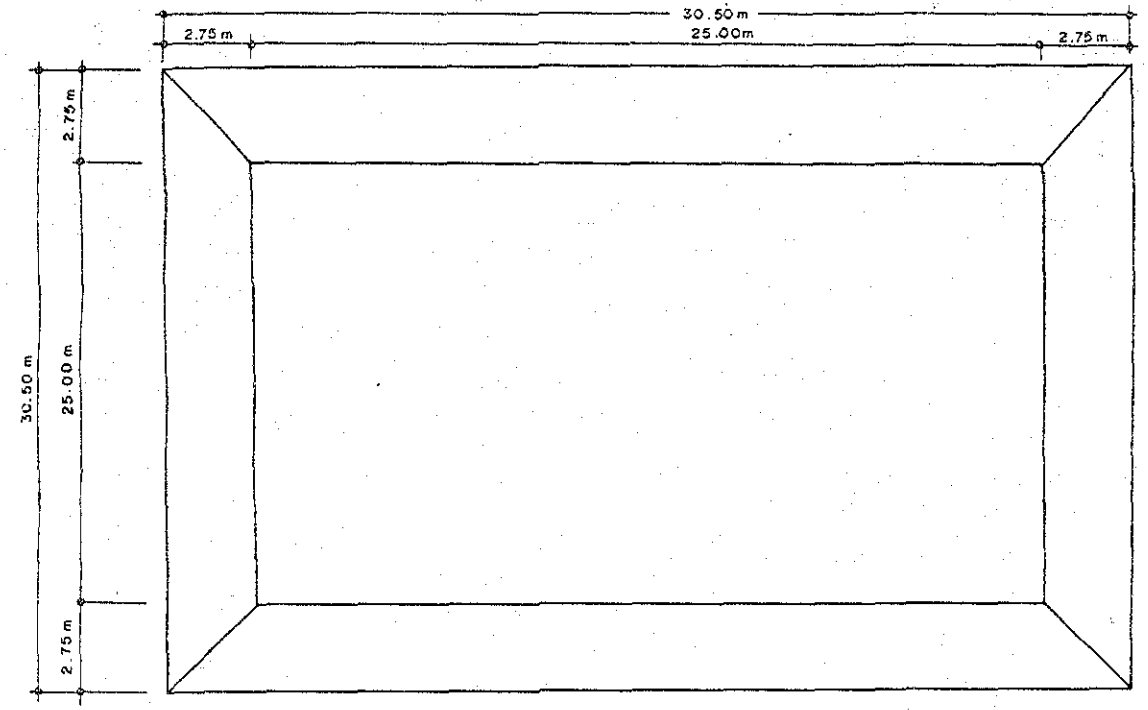
The reservoir mentioned above is the only existing storage facility in the CSBWS constructed in 1938. The reservoir is made of reinforced concrete and an open grand elevated type with a capacity of 1,350 cu.m. The designed water level for overflow is about 80 m above the mean sea level.

The sketch of the facility is given in FIGURE 4.2.5. Although fences are provided to surround the site, the reservoir is exposed to pollution like ashes and clay particles because of its location in the sugar cane land and since it is uncovered.

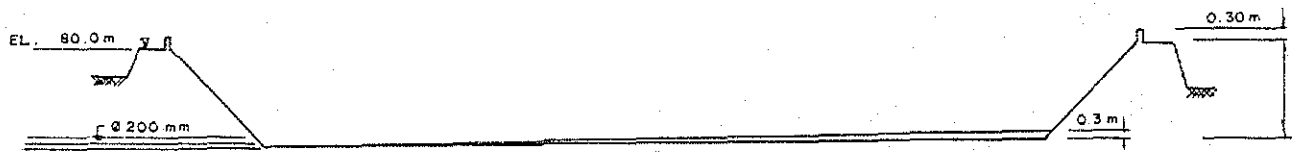
The "C" value, which is a factor in the "Hazen Williams' Formula," was analyzed using the obtained water pressure and flow rate at two selected points along the Cabuyao-Sta. Rosa line.

The "C" value was computed at about 140, which is a very high figure, considering the pipes were installed about 50 years ago. The inside of the pipes seems to be kept in good condition due to water quality. The non-existence of accessories such as air/gate valves and the straight alignment of the pipeline between the points may likewise account for the present pipe condition.

The obtained figure, however, may not be employed for the distribution lines in the network because of different conditions associated with the alignment of pipelines. The survey result was attached in APPENDIX 4.2.1.



TOP VIEW



ELEVATION

FIGURE 4.2.5

REINFORCED CONCRETE
OPENGROUND RESERVOIR

BGY. DON JOSE, STA. ROSA

(3) Distribution Facilities

1) Distribution Pipelines

The existing distribution system in the study area comprises two main pipelines (See FIGURE 4.2.4).

One pipeline is provided for the Cabuyao and Sta. Rosa service areas. It has a diameter of 250 mm (CCI) and runs from the reservoir to Sta. Rosa. The other pipeline with a diameter of 200 mm (CCI) from the vicinity of the reservoir goes directly to Biñan. These two main distribution lines meet near the boundary between Sta. Rosa and Biñan on the national highway. After the junction of the two main pipelines, another ϕ250 mm pipeline is installed to serve Biñan.

The total length of the distribution lines is approximately 51 km with diameters ranging from 50 mm to 250 mm.

Pipes with diameters over 75 mm are CCI, while pipes with diameters of 50 mm are GI. Information on the distribution lines are summarized in TABLE 4.2.3.

TABLE 4.2.3 DISTRIBUTION PIPES

Pipe Diameter (mm)	Pipe Length (m)	Composition in Length (%)	Type of Pipe	Constructed Year
ϕ 250	14,700	29	CCI	1938
ϕ 200	10,200	20	CCI	1958
ϕ 150	1,600	3	CCI	1938
ϕ 100	23,500	46	CCI	1952
ϕ 75	310	1	CCI	-
ϕ 50	420	1	GI	1970
Total	50,730	100		

The distribution status of water pressure through the day was analyzed with reference to the two water sources. The water supply in the three major service areas is discussed with the test results supported by flow rates measured at some points of the transmission/distribution lines during the field survey. The measurement was done covering 36 points on August 11 to 14, 1986. Using the sample records on the minimum and the maximum figures through the day, the contour lines of water pressure were prepared based on those taken at 7:00 A.M. and 1:00 A.M. (for details, refer to APPENDIX 4.2.2).

The topography of the study area is gentle in general with a slope of less than 1% from west toward east. There are two major transmission systems; the Cabuyao-Sta. Rosa line (ϕ250 mm, CCI), with a reservoir, and the Biñan line (ϕ200 mm, CCI).

The flow rate of the Cabuyao-Sta. Rosa line is controlled by means of the gate valve in the premise of the reservoir according to the following schedule and practices.

a) from 8:00 P.M. to 4:00 A.M. : Valve is closed up to 50%.

b) from 4:00 A.M. to 8:00 P.M. : Valve is open completely.

A pumping station is operated for 8 hours a day, a total water production of which is in accordance with the following schedule for supplementing purposes in the Biñan area.

Operating hours: 6:30 - 9:30
10:30 - 13:00
17:30 - 20:00

The water service in the Cabuyao and Sta. Rosa areas is characterized by a comparatively higher water pressure during nighttime from 8:00 P.M. to 4:00 A.M., and quite low pressure during daytime. The water pressure in Biñan area is low throughout the day except in a limited area in the vicinity of the pumping station when the pump is being operated. In general, the water pressure in the core areas of the Municipalities and the remote area from the main pipeline is

rather low (See FIGUREs 4.2.6.A and 4.2.6.B).

Cabuyao Area

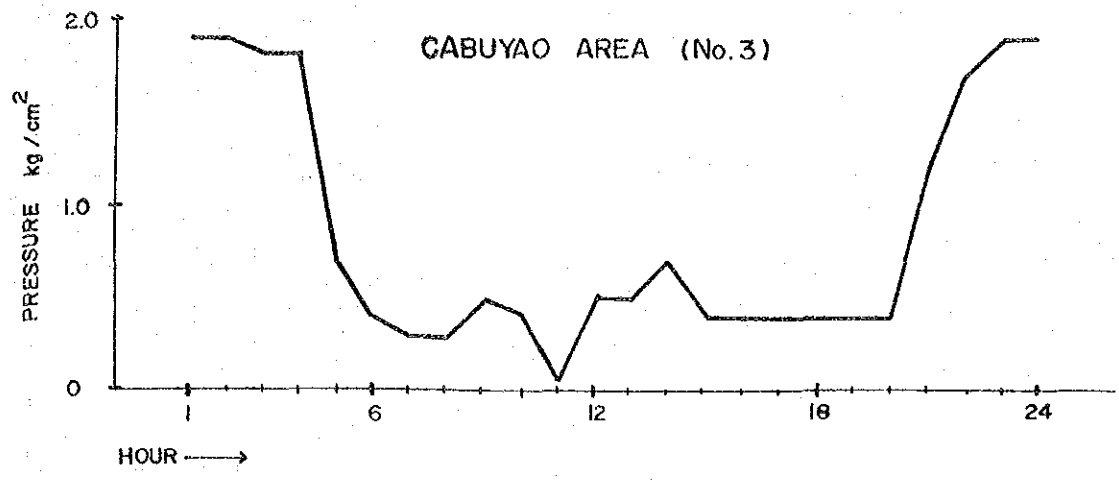
The water pressure in the Cabuyao area is concluded to be in a comparatively favorable level in a total system; more than 1.5 kg/sq.cm in the nighttime and a 0.5 kg/sq.cm in the daytime except in remote areas from the main pipes with 0.1 kg/sq.cm. This may be due to the limited service area in the Municipality and the timely arrangement of distribution amount at the reservoir. To upgrade the water service in the area, the installation of a larger diameter of pipes as well as augmentation of distribution network in the above-mentioned remote area will be required.

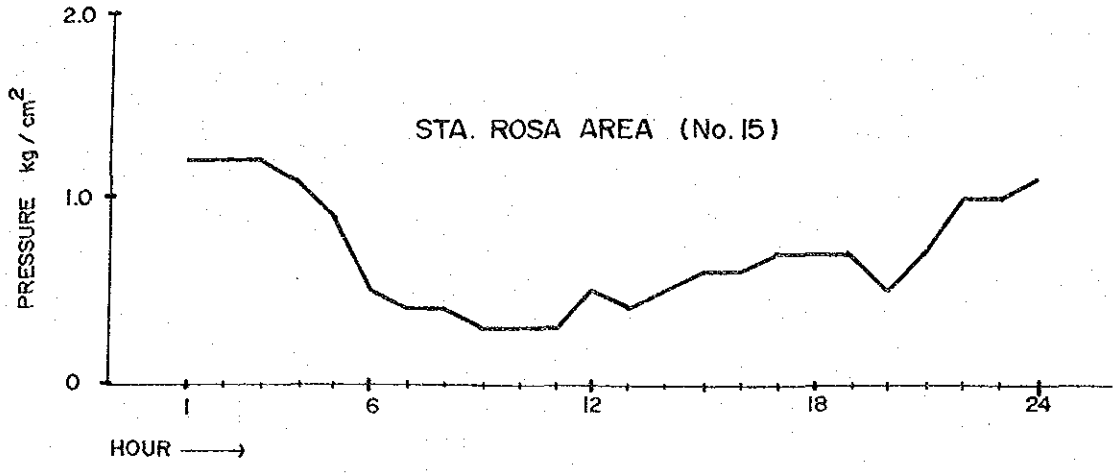
Sta. Rosa Area

The water pressure in the service area during nighttime is more than 0.5 kg/sq.cm, while in the daytime it is 0.1 kg/sq.cm in the maximum, and less than 0.1 kg/sq.cm in most of the area. The water supply in the Sta. Rosa area is provided by the Cabuyao-Sta. Rosa line and the Biñan line. Large amount of water distributed through the Cabuyao area to Sta. Rosa (Cabuyao-Sta. Rosa line) is principally consumed in Barangays Dita and Dila. The water pressure during daytime in the core area of Sta. Rosa seems to be affected by the above-mentioned supply status. In addition, deficiency of the distribution network, especially associated with pipe diameter, is one of the major reasons for this situation.

Biñan Area

The water pressure throughout the day in the study area is the lowest among those in the three Municipalities. The water pressure in the daytime is as low as 0.1 kg/sq.cm throughout the area, although 0.5 kg/sq.cm is recorded in a limited area during the operation of the pump. A higher water pressure in the transmission line will be a requisite to meet the required level of water supply.





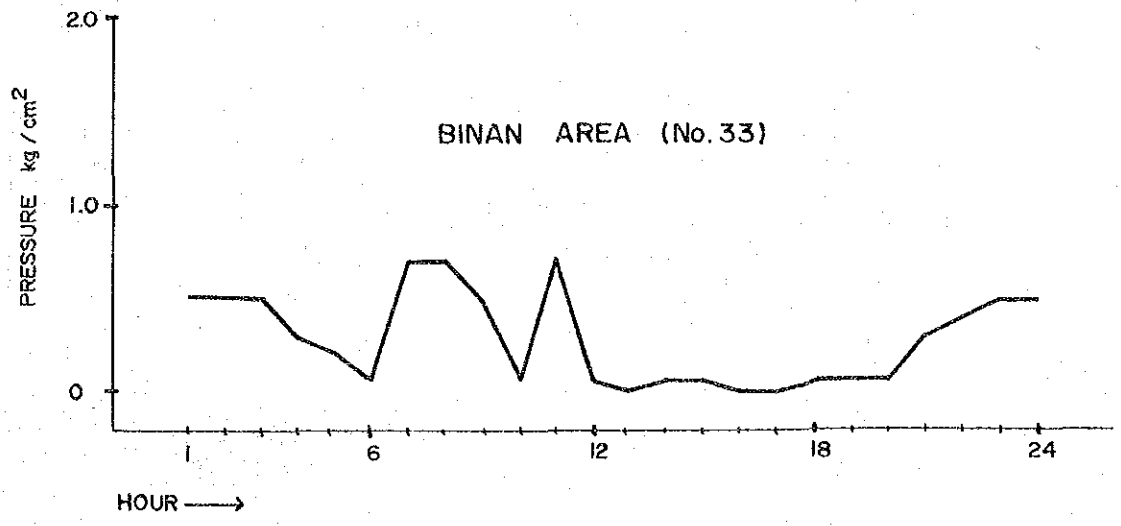
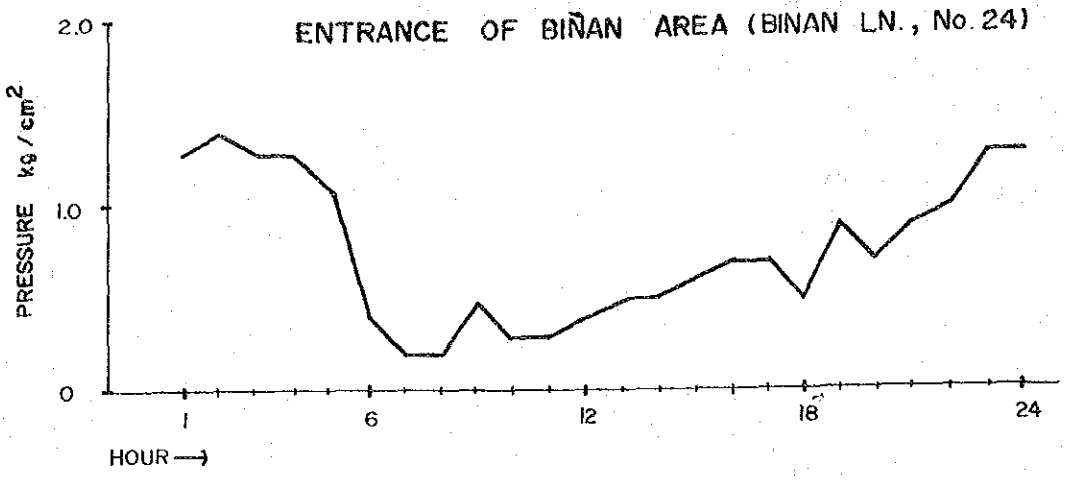


FIGURE 4.2.6.A DAILY VARIATION OF WATER PRESSURE IN THE CORE AREAS OF THE THREE MUNICIPALITIES



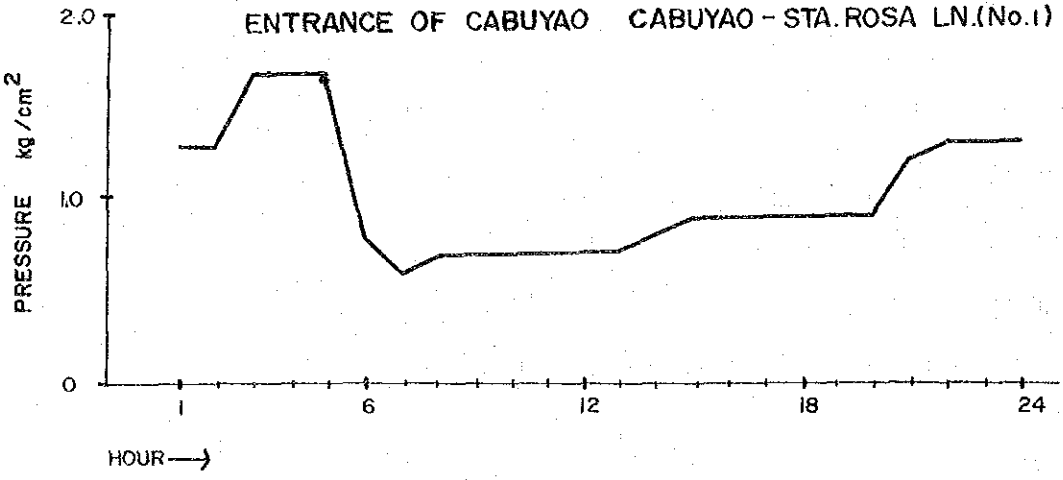


FIGURE 4.2.6.B DAILY VARIATION OF WATER PRESSURE AT THE ENTRANCE OF CABUYAO AND BIÑAN

2) Service Connections

The registered connections were categorized into metered and flat rate (unmetered and not-functioning meter) by consumer type. Number of connections by barangay covering the three Municipalities is summarized below (Details are given in TABLE 4.2.4).

As of June, 1986 there is a total of 2,907 connections. Approximately 85% or 2,416 connections have functioning meters. Non-metered connections are less than 10% of the total connections. Most of the connections in Cabuyao and Sta. Rosa area are metered, while about 70% of the total connections are metered in Biñan area. As to the composition of connections or consumer type, about 90% are domestic connections. Only 23 connections were categorized as commercial ones. The number of connections for institutional and industrial use is also minor. The collected charges for the month of June, 1986 is given in APPENDIX 4.2.3. The total amount collected is approximately ₱88,900, 90% of which is from metered concessionaires and the same percentage is from domestic consumers.

3) Valves and Hydrants

There are a total of 164 sluice valves in the distribution system excluding those used in the pumping stations. (See TABLE 4.2.5). The size of these valves ranges from 75 mm to 250 mm.

A total of 54 hydrants provided with ϕ75 mm riser pipe exists in the distribution system.

TABLE 4.2.4 NUMBER OF CONNECTIONS BY WATER CONSUMER TYPE BY BARANGAY
: METERED, NONFUNCTIONING METER AND WITHOUT METER

Municipality	Barangay	Metered					Flat Rate												Grand Total
							Domestic			Commercial			Institutional			Total			
		Domestic	Commer.	Insti.	Indust.	Sub-Total	w/ meter	no meter	sub-T	w/ meter	no meter	sub-T	w/ meter	no meter	sub-T	w/ meter	no meter	Total	
Cabuyao	1 Barangay I	203	-	-	-	203	29	2	31	1	1	2	2	1	3	32	4	36	239
	2 Barangay II	178	3	2	-	183	28	-	28	-	-	-	-	-	-	28	-	28	211
	3 Barangay III	130	-	-	-	130	14	-	14	-	-	-	-	-	-	14	-	14	144
	4 Bigaa	99	-	-	-	99	8	-	8	-	-	-	-	-	-	8	-	8	107
	5 Sala	109	1	1	-	111	7	1	8	-	-	-	1	-	1	8	1	9	120
	Sub-Total	719	4	3	-	726	86	3	89	1	1	2	3	1	4	90	5	95	821
Sta. Rosa	1 Aplaya	32	-	-	-	32	5	-	5	-	-	-	-	-	-	5	-	5	37
	2 Balibago	278	1	-	1	280	24	1	25	1	-	1	-	-	-	25	1	26	306
	3 Barangay I	126	1	-	-	127	15	4	19	-	-	-	-	-	-	15	4	19	146
	4 Barangay II	191	-	1	-	192	13	3	16	-	-	-	-	-	-	13	3	16	208
	5 Barangay III	32	-	-	-	32	4	-	4	-	1	1	-	-	-	4	1	5	37
	6 Dila	19	-	-	-	21	3	-	3	-	-	-	-	-	-	3	-	3	24
	7 Dita	202	1	-	1	204	11	1	12	-	-	-	1	-	1	12	1	13	217
	8 Ibaba	64	-	-	-	64	1	1	2	-	-	-	-	-	-	1	1	2	66
	9 Labas	52	-	-	-	52	5	-	5	-	-	-	-	-	-	5	-	5	57
	10 Macabling	13	-	-	1	14	1	-	1	-	-	-	-	-	-	1	-	1	15
	11 Tagapo	179	-	3	-	182	4	2	6	-	-	-	-	-	-	4	2	6	188
	Sub-Total	1,188	3	4	5	1,200	86	12	98	1	1	2	1	-	1	88	13	101	1,301
Biñan	1 De La Paz	14	-	-	-	14	1	10	12	-	-	-	-	-	-	2	10	12	26
	2 Malaban	8	-	-	-	8	3	24	27	-	-	-	-	1	1	7	25	28	36
	3 Platero	57	-	-	-	57	7	-	7	-	-	-	-	-	-	7	-	7	64
	4 Poblacion	64	6	-	-	70	8	64	72	1	4	5	2	1	3	11	69	80	150
	5 San Antonio	263	1	-	-	264	49	71	120	-	-	-	-	-	-	49	71	120	384
	6 San Jose	31	-	-	-	31	2	28	30	-	-	-	-	-	-	2	28	30	61
	7 San Vicente	38	-	-	-	38	-	4	4	-	-	-	-	-	-	-	4	4	42
	8 Sto. Domingo	8	-	-	-	8	-	14	14	-	-	-	-	-	-	-	14	14	22
	Sub-Total	483	7	-	-	490	71	215	286	1	4	5	2	2	4	74	231	295	785
	Total	2,390	14	7	5	2,416	243	230	473	3	6	9	6	3	9	252	239	491	2,907

Note: There is no industrial connection without or with non-functioning meter.
Data is for the month of June, 1986.

TABLE 4.2.5 NUMBER OF SLUICE VALVES BY SIZE

Diameter	Cabuyao	Sta. Rosa	Biñan	Total
250	-	1	2	3
200	-	1	2	3
150	-	4	-	4
100	13	12	27	54
75	-	2	-	2
Total	13	20	31	64

4.2.3 Operation and Maintenance

The major works for the operation and maintenance of the CSBWS are those for spring source, reservoir, and pumping stations. In addition, the supervision of the distribution facilities is essential for management of the CSBWS. The Provincial Government is responsible for these works.

The present organization consists of the following staff members.

Production and Maintenance Foreman	1
Mechanical Engineer	1
Waterworks Supervisor	1
Plumber Foreman	1
Plant Operator	3
Plumbers	6
Utility Worker	1

Chlorination at the outlet pipe (ϕ200 mm) of the spring box is carried out everyday. Five hundred (500) grams of chlorine powder is mixed with 28 liters of water for one day use and injected directly into the pipe by gravity.

The cleaning of the reservoir is undertaken once a week and one kilogram of chlorine is provided after the work for disinfection. A routine work at the reservoir is conducted by an operator to store water during nighttime to meet the peak demand of Cabuyao and Sta. Rosa. The

maintenance works for repair of the pumps at the existing pumping stations in Biñan, and service pipes and accessories are conducted as required.

4.2.4 Deficiencies of the Existing Water Supply System

Through the field inspection of the facilities of the CSBWS, the following were observed:

(1) Water Source and Treatment Facilities

The structure of the spring box seems to be adequate. However, because of its location on the slope of the valley, it is exposed to the danger of soil collapse from the upper part of the valley. During the rainy season, appropriate measures must be taken as required.

Chlorination provided in one of the outlet pipes at the spring box is not effective as confirmed during the field examination. It is therefore recommended that chlorine be added before the distribution of water. Appropriate amount should also be taken into consideration.

The operating pumping station is located in the market area and therefore easily accessible by the people. Maintenance of the facilities should be done taking into account such conditions.

The span from the spring up-to about 150 m downstream, the pipes with a diameter of 300 mm are installed covered with soil along the slope of the bank. Another pipe (ø200 mm) is partially exposed, and installed along the bottom of the river, although some countermeasures are provided like a concrete encasement. There is no apprehension to the potential damage in this span.

The span of more than 150 m downstream from the spring, the two pipelines are installed without any rule in their alignment since the pipes were constructed in different years. There are some areas along the bank which have collapsed. The pipes in this area are exposed to damage as experienced during the typhoon season in 1985. The section between those points, 150 m downstream of the spring and about 500 m downstream of the

spring, needs adequate countermeasures although there is a difficulty to its access.

On the other hand, at least the section between the spring and reservoir area seems to be in quite good condition in terms of the flow capacity of the pipes.

(2) Distribution Facilities

The water pressure, especially during the daytime is low except in some areas in Cabuyao. There are some reasons associated with this problem. Inspection visit revealed the following:

- o The diameter of the distribution pipes in the service areas is not sufficient and some pipes are already deteriorated having been used for more than 40 years.
- o Additional service connections were constructed without considering hydraulic restriction.
- o Inadequate temporary measures are provided to stop leakage (rubber strap) of service pipes.

Immediate provision of meters, especially in Sta. Rosa and Biñan is essential for sound management of the CSBWS. Supervision of existing meters is likewise recommended.

Most of the hydrants observed are inadequate for emergency use. Hydrant valves are either non-existent or damaged.

The existing reservoir with a storage capacity of 1,350 cu.m, half of which is constructed below the ground surface, is located in the sugar cane land. A common pipe with a diameter of 200 mm is used as inlet and outlet pipe. The storage and distribution of water are made by operating the gate valve. It was noticed that there are a lot of cracks on the wall of the reservoir, although the surface of which is covered with concrete mortar with a thickness of 2 cm.

4.3 WATER PRODUCTION

The water sources at present for the CSBWS are the Matang-Tubig Spring and a deep well with pumping facilities located near the market in Biñan.

The discharge rates of the spring during the dry and rainy seasons were measured using an ultrasonic flow meter on April 16 and August 5, 1986. TABLE 4.3.1 shows the measurement results. The discharge amount through the year is almost constant with less than 10% difference between the two seasons. However, the intake amount for the design should be approximately 9,300 cu.m/day, for the dry season.

TABLE 4.3.1 DISCHARGE RATE OF THE SPRING IN THE TWO SEASONS

Unit: cu.m/day

Composition	Dry Season	Rainy Season
Outlet with ϕ300 pipe	6,826	7,128
Outlet with ϕ200 pipe	2,462	2,880
Total	9,288	10,008
	≒ 9,300	≒ 10,000

It was found that there are four potential spring outlets at the slope of the valley in the vicinity of the existing spring box and the total amount was measured using the drum-can (April 16 and July 28, 1986).

The total amount is constant through the year with an approximate figure of 3,300 cu.m/day (the measurement result of spring discharge rate is given in APPENDIX 4.3.1).

The pump as a supplementary source has a capacity of 1,363 cu.m/day and is being operated for 8 hours a day. The volume of the water supplied from the well is estimated at 450 cu.m/day.

The total production for design purposes is concluded to be approximately 9,750 cu.m/day.